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Organizational Transformation and Managing Innovation in the Fourth Industrial Revolution

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As a key part of the fourth industrial revolution, technology companies have become the most valuable companies in the world in terms of market capitalization. Surprisingly, however, these companies have been overlooked by studies of gender diversity in corporate governance even though their highly distinctive features may cause major differences in gender diversity with respect to companies in other sectors. The goal of this chapter is therefore to provide the first characterization of gender diversity in the corporate governance of large technology companies—specifically those with the highest market value—and explore the relationship between gender diversity and business performance. To achieve this goal, descriptive statistical analysis is used. Data correspond to the period 2005 to 2017. The findings confirm the under-representation of women on the boards of directors of 162 publicly listed companies. The findings also show that the most profitable companies are those that have the greatest female representation on their boards of directors.

This chapter aims to clarify the role of social networking sites (SNSs) such as Facebook, Twitter, and LinkedIn in building the reputation of enterprises. SNSs have a vast potential in the digital environment to build reputation and thus a long-term competitive advantage for companies. The chapter opts for a literature review with which to discuss the difficulties and possibilities companies have in building reputation through SNSs. The SNSs used in companies are marketing-centered. Engagement is promoted only with customers, and is short-term and centered on results instead of being long-term and centered on competitive advantage and promoting engagement with different stakeholders. This issue is not dependent on the size of the company. Instead, it is dependent on understanding the concept of reputation from a strategic point of view, with companies adapting their management to their own particularities and to the different possibilities offered by SNSs.

One of the most significant changes in the last decade in the business environment has been caused by the development of information technologies and the internet. The internal structure and organization of companies has changed to evolve towards a digital environment influenced by internet business models and digital marketing (DM) techniques. This chapter develops a systematic literature review with the objective of identifying the key players in the business environment with respect to the new business models and digital marketing techniques applied to them, to improve the benefits they bring to the company. The results of the research identify and define the main actors of the electronic commerce (EC) ecosystem, as well as their typologies and the main techniques of DM used in this field of research. The results of the exploratory study can be used for future research in this field and to reinforce the reference bibliography in this area of research.

This chapter studies how FinTech is transforming traditional financial institutions (FIs). This chapter achieves the four related goals. First, it discusses the current stage of FinTech development in different areas such as crowdfunding, payment, blockchain, and cryptocurrency. Second, it examines how each FinTech development affects traditional FIs, in both positive and negative ways. Third, it explores how FIs are currently managing FinTech innovations. It also suggests ways through which these institutions could best utilize FinTech to better serve their customers and eventually optimize the overall financial system. Finally, following the book's focus on man's role at the center of technology advancement, this chapter discusses whether FIs' customers' needs are still placed at the center of FIs' incentives to adapt new technology, and if not, how can we focus back to the people that the financial system ultimately serves.

The arrival of collaborative contexts to the global economic stage is a latent reality which threatens to change the traditional production models' operation. Likewise, concepts such as Industry 3.0 or even 4.0 refer to the possibility of providing customers and users with unimaginable possibilities compared to the industrial manufacturing inherited from the past centuries. Within this environment, the fabrication laboratories (FabLabs) emerge. In this chapter, the authors approach an exploratory perspective in order to make known the FabLab movement origin and further worldwide development with the intention to highlight their characteristics and the main difficulties they face nowadays. The growing importance that the FabLabs have achieved despite their novelty justifies the precise study of their characteristics according to the importance related to the strong expansion of these laboratories in this decade and its contribution to a major revolution in the collaborative environments associated with the digital manufacturing.

In the fourth industrial revolution, one of the major driving force is cloud computing which helps in integration of cloud concepts in manufacturing sectors. Most of the high-end factories have started to adopt industrial automation by incorporating smart manufacturing technologies by incorporating cloud technologies, artificial intelligence, internet of things, big data analytics, cyber physical systems, and

also identified that there is not a causality relationship between research and development with economic growth and unemployment rate. Therefore, it is recommended that emerging economies should take necessary actions to increase research and development investment to have higher amount of export. Hence, it can be possible for these countries to minimize the negative effects of current account deficit. In addition to this issue, it can also be seen that making research and development investment plays a key role to improve the economic performance of these countries.

Section 3
Innovation in Training and Education

How do we wish to structure the universities of tomorrow? There is probably no single response to this question, but it is possible to make a contribution from the work psychology perspective that offers ways and mean to achieve higher quality in university teaching. The aim of this chapter is to describe various educational innovation activities, based on models and applications developed in the field of human resources, that make it possible to meet the needs and challenges that universities will have to face in the immediate future. The proposed activities arise from personal and career development assessments and place the student at the center of the process, since the commitment of universities is to develop student potential as far as possible in order to ensure that in their professional lives former students have the knowledge and competencies required of them by society.

The objective of the chapter is to describe the main competences to be developed in digital natives at the postgraduate level, based on the characteristics generated by information and communication technologies in the context of the fourth industrial revolution. From this perspective, individual knowledge, experience, initiative, and creativity are recognized as the unlimited resource of organizations and countries, so the talent of the people is the basis of the competitiveness and survival of organizations of any type. Three axes of training at the graduate level are identified: social competences, global competitions of investigation and innovation, and digital competitions with base in the inverted learning and gamification.

This chapter analyzes the formative aspects, trends, and initiatives that some faculties and schools are developing as an experimental part of a new educational ecosystem. It´s proposed to reflect on journalism, fundamentally, as a scientific discipline, whose teaching is endorsed and justified in the universities of world prestige where the realization of applied research of journalistic models with emerging technologies through medialabs is promoted. All this without prejudice to ethical principles, the use and contrast of sources, quality in writing and illustrations, created and produced in digital platforms and multimedia.

Preface

INTRODUCTION

One of the areas of much debate at the 2016 World Economic Forum (WEF), which brought together 2,500 political, social and business leaders from 99 countries under the banner "Mastering the Fourth Industrial Revolution", was the need to identify new identifying traits of this incipient Industrial Revolution and the resulting methods of adapting our world to the same. As for the first area, the exploration and pooling of attendees and the powerful organizations that they represent uncovers certain global trends (Davos Economic Forum, 2016).

First, there is the consolidation of a new period of economic development with structural and personality changes that suggests a new Industrial Revolution in the era of humanity that succeeds the three previous ones: the first is based on water and the value of the production forces; the second is driven by electricity and the division of work, and the third is based on automation, electronics and the information and communication technologies (ICT). Then we have this Fourth Industrial Revolution (4IR) which is dominated by Interconnectivity, Artificial Intelligence and Talent.

On the other hand, never in the history of humanity has there been such uncertainty while at the same time, so many opportunities, and, all of this, at an unheard of speed. This constant velocity of changes demands an ongoing ability to adapt to the same, an agility of society and of its organizations which until now, was unknown. Thus, the vision of the future, proactivity and initiative play a leading role and resources and the ability to intensely and permanently innovate in all areas are essential in determining the competitiveness and sustainability of the territories.

So, this is a panorama in which a hybrid economic development model is recommended, that is, one that requires the participation of all involved agents and that implies collaboration between the public and private.

Third, the WEF has declared the intent to convert this 4IR into a *Revolution of values*: man, more than ever in the center of it all. In short, to determine how to place the economic growth facilitated by the digital technologies at the service of the people.

The prior set of trends leads to this need to manage society and its organizations, based on a diversity approach, given that it is the facilitator of innovation and global enrichment. This is a contrasted reality in which organizations, both non- and for profit alike, reinforce their performance thanks to the diversity of talents of their personnel. From this argument we may infer that, not only is there a need for a greater fight against gender inequality in the labor market, but for female leadership to emerge as a new pillar of both incipient organizations and already consolidated ones.

Finally, the implementation of this new scenario reveals that the majority of the current work positions did not exist only ten years ago and that 65% of the children currently studying in primary school will eventually work in professions that do not exist today. This urges us, therefore, to consider new educational models in schools so that these children, as well as the other involved agents (including governments, businesses and other organizations) may participate. One of the fundamental characteristics of the current labor markets is an orientation towards competencies, as well as towards knowledge, in order to take on these permanent and rapid changes in the world that we have previously mentioned. But this also leads to a process of almost constant renovation in the competencies demanded of employees by their organizations: thus, it is anticipated that in 2020, one third of the current or recent competencies will not be considered essential. And this change in competencies is directed in large part towards the so-called *soft skills*, that is, social competencies such as complex problem resolution, critical thinking, creativity, personnel management, emotional intelligence or coordination.

CHALLENGE

The onset of the 4IR is occurring at the perfect time to address, rapidly but with the due tranquility needed for intense reflection, the challenge of how to effectively and efficiently tackle the needed adaptation to handle these global and structural changes. This is required by the world of public and private organizations, for profit –including companies, of course- or non-profit, given that they are already situated in the onset of this revolution.

The research community, in collaboration, more than ever, with the numerous actors affected by this situation, is one of the key bases of this extensive work of exploration and surveying, diagnostics, strategy planning and selection of the best strategies, and their implementation.

Therefore, this set of contributions made by recognised researchers from diverse countries attempts to create value by offering keys, models and scientific experiences that allow us to guide this process of change in the spheres of the excellent management of the organizations and their transformation, as well as those of innovation in the area of the social challenges and university education. In this way, they reach the source of the analysis of the trends previously mentioned by the WEF, in search of solutions for the considerable problems that arise.

For this reason, the synthesis of the area of study of this book is that of innovation for the management of organizations at the gateway of the 4IR, a path that should be known by all readers: if this information that the reader shall convert into knowledge is unknown, the necessary connection of all types of organizations and other agents with the new scenario shall not take place. This may endanger its survival.

Ultimately, an organization cannot adapt to these changes in its environment if it is unaware of them, is only partially aware of them, or, even worse, views them in a biased manner as a result of unqualified opinions. These last two circumstances occur frequently due to the information overload occurring over the multiple channels, especially the Internet: social networks, newsletters, blogs, forums, chats, work networks, virtual communities, etc.

To prevent this information bias, which is of a high strategic value, this work, allows the organization managers– and remaining recipients- to gain a comprehensive perspective of the major identifying traits of this new Industrial revolution and of the approach to the resulting challenges for organizations from all sectors.

For this, there is the need for a publication on this subject matter and inclusive content for managers at all levels, from all types of organizations (public and private, for profit and non-profit) and of all economic sectors; university professors (graduate and post-graduate) and of higher level courses of high school education too; researchers in the economic, business, territorial management, entrepreneurial, innovation management, sociology, applied ICT, public sector management, civic ethics, education, Corporate Social Responsibility –CSR-, and financing, among others; university students (graduates and post-graduates); libraries (university, high school, public); Entrepreneurs, especially those focused on the creation of innovative companies of small and medium sizes (example: Technology-Based Companies or Start-ups); directors of public management at local, national and supra-national levels; Social stakeholders in environmental or social areas, or those related to educational, financial or defenders of socially responsible behavior in organizations; companies or other organizations that apply CSR; policy makers in need of updating their political approach.

This work has been divided into three sections. The first, *New Management of Organizations*, includes the topic of excellence in the management of organizations and in managing your transformation to the 4RI gateway. In addition, it analyses how the ICT affect work methods, the economy and society. It offers methodology to measure organizational resilience. And it explores gender diversity in the large technological companies and its relationship with business performance. The role of the social networks in company reputation is described. The main agents of the e-commerce ecosystem are identified as well as the most noteworthy digital marketing techniques for this field. It examines how the FinTech are revolutionizing the traditional financial sector. The FabLab movement is described on a global level, revealing its unlimited possibilities for digital production in all organization types. A decision making model for SMEs is designed based on their integration in the cloud. And finally, a comparative is offered for the current first order technologies that may be interlinked: High Performance Computing, Big Data and Cloud Computing.

Section 2, *Need to Innovate to Overcome Social Challenges*, considers the challenge of ICT at the service of human development: Social and environmental digital innovation. For this, we begin by defining and describing Digital Social Innovation (DSI) and go on to detail the barriers that hinder its development in the form of good practices in DSI. The impact of the so-called *Organizations of Social Entrepreneurship* on economic, social and overall social performance of organizations is examined. A new model, the Quadruple Helix, is developed based on ethics and the CSR 2.0, intended for emerging countries. And the section ends by exploring the reasons behind the need for emerging countries to redouble their investments in R&D.

The final section, *Innovation in Training and Education*, examines educational innovation in the form of new university education methodologies oriented towards the formation of a new employee profile as needed now and in the future by organizations. For this, we close with the presentation of new trends in university education, focusing on the creation of educational ecosystems, the use of emerging technologies and education in the area of ethical values.

This structure has been formalized in the following chapters, the content of this book:

- **Chapter 1:** Doing More With Less: The Impact of New Technologies on Labor Markets, Economy, and Society
- **Chapter 2:** Measurement of the Staff Resilience of the Technological Institute Lázaro Cárdenas
- **Chapter 3:** Gender Diversity in the Senior Management of Large Technology Companies
- **Chapter 4:** The Benefits of Social Networking Sites in Building Reputation for Enterprises

- **Chapter 5:** Digital Marketing Strategies Based on the E-Business Model: Literature Review and Future Directions
- **Chapter 6:** FinTech and Its Disruption to Financial Institutions
- **Chapter 7:** The FabLab Movement: Democratization of Digital Manufacturing
- **Chapter 8:** Integrating SMEs Through Cloud: An Industrial Revolution
- **Chapter 9:** High Performance Computing, Big Data, and Cloud Computing: The Perfect De Facto Trio or Converging Technological Mantras?
- **Chapter 10:** Digital Social Innovation: Fundamentals and Framework of Action
- **Chapter 11:** Organizations of Social Entrepreneurship in Croatia: Entrepreneurial Orientation in the Context of Performance
- **Chapter 12:** Managing Social Innovation through CSR 2.0 and the Quadruple Helix: A Socially Inclusive Business Strategy for the Industry 4.0
- **Chapter 13:** Evaluating the Role of Research and Development and Technology Investments on Economic Development of E7 Countries
- **Chapter 14:** Educational Innovation Techniques Based on Assessment and Development of Student Potential
- **Chapter 15:** The Reconfiguration of Human Capital in Organizations: The Relevant Competences in the Digital Natives in the Postgraduate Level
- **Chapter 16:** Evolution and Trends in Teaching and Learning of Cyberjournalism

FINAL THOUGHTS

This book offers a panoramic view of new behaviors and trends that should be implemented in all types of organizations in response to the onset of the 4IR. The value created includes not only each of the topics addressed, vertexes of this multi-faceted reality in which we are beginning to live, but also attempts to discover connections existing between them, so as to offer an overall perception of the depth of the transformation that this revolution represents even with respect to recent times.

The future is here. This affirmation, widely accepted, along with the need for today's organizations to orient their actions towards this *future* which is now the *present*, and even to proactively anticipate it, should urge all political, social and economic agents to urgently begin this clearly structured adaptation process. The management of the transformation should be proposed as a permanent collaboration between the diverse actors that are involved and the search for global solutions given that these are also global challenges.

REFERENCES

Davos Economic Forum. (2016). *El futuro del empleo. ManpowerGroup. Business & Talent Paper #1.* Retrieved June 13, 2016, from https://drive.google.com/file/d/0BwktW2X_nhxqeGxUc0plTkxRdTg/view

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Section 1

New Management of Organizations

Chapter 1
Doing More With Less:
The Impact of New Technologies on Labor Markets, Economy, and Society

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ABSTRACT

Technological advances and novel applications in areas such as industrial robots (eventually personal robotics), artificial intelligence, big data, 3D printing, the internet of things, biotechnology, blockchain, and others have revived the debate on how the development and implementation of technological innovations may displace labor. These technologies are allowing the innovation of products, services, and business models at unprecedented speed, in the same way they are putting at risk both qualified and unqualified jobs and occupations. Most of the specialized literature dealing with the issue of technology and labor comes from the economics discipline, but it is pertinent to discuss how this translates into the managerial, organizational, and strategic principles framed for the fourth industrial revolution.

INTRODUCTION

The impact of technology and innovation on labor markets has been a recurring theme of study for economist and social scientists since the Luddite movement in England when it opposed the integration of the spinning jenny to yarn production, however the impact of modern technologies is beyond jobs, it also reaches into business models and the organization structure itself. Keynes (1930) in the short essay Economic Possibilities for our Grandchildren, mentioned how the increases in efficiency in the different production processes would result in the replacement of labor by capital, thus creating technological unemployment.

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Technology is allowing businesses to create more value using less resources, startups that turn eventually into "unicorns" or corporations that reach valuations of billions of dollars that employ people in the dozens or maybe hundreds versus the corporate behemoths of past times that employed people by the hundreds of thousands. Nowadays companies large and small can leverage key resources, outsource processes or automate as necessary to remain competitive and profitable.

Steijn (2017) attests that contemporary society is currently reaping the benefits of decades of investment and cumulative innovation in information technology and telecommunications. Technological advances and novel applications in areas such as industrial robots (eventually personal robotics), artificial intelligence, big data, 3D printing, the IoT, biotechnology, blockchain and others, have revived the debate on how the development and implementation of technological innovations may displace labor (Silva & Lima, 2017).

These technologies are allowing the innovation of products, services and business models at unprecedented speed, in the same way they are putting at risk both qualified and unqualified jobs and occupations (Manyika et al., 2013; Ford, 2015; Pratt, 2015 Sachs, 2015). Additionally, the emergence of what has been called digital economy, gig economy, economy on demand or collaborative economy has demonstrated a major shift in human resources management. The growth of digital platforms and peer-to-peer marketplaces (eg AirBnB, Amazon Flex, Amazon Mechanical Turk, Cabify, Deliveroo, Etsy, Lyft, Rappi, TaskRabbit, Uber, etc.) brings great advantages in efficiency in the use of resources and flexibility in working time, but it also raises questions if whether this model is considered decent work, whether it provides income stability and raises questions on the issue of social security benefits for workers under these new business models (OECD, 2016; ILO, 2016a; ILO, 2016b).

Brynjolfsson and McAfee (2014) argued that modern society has reached a second machine age. The first age automated muscular work freeing labor from the agricultural sector, leading to the manufacturing and service sectors that employ the bulk of the population. The second machine age would automate complex work and tasks, which until recently, was the exclusive domain of humans.

There are several factors that can influence the labor market, among these, the relative supply of skilled and unskilled labor, market liberalization, offshoring and outsourcing of production, globalization and global value chains, the decrease in the participation of workers in unions, changes in fiscal policy, among other aspects (Autor, 2015). However, in the most recent literature, the impact of ICT takes center stage.

This chapter aims to discuss how the creation and diffusion innovations are transforming business models, creating new products and services, empowering consumers, streamlining value chains and changing the organizational structure of corporations big and small, startups, even local and national governments.

SCHUMPETERIAN CREATIVE DESTRUCTION

Decades of cumulative public and private investment in the development of technologies like mainframes, transistors, processors, the internet, GPS[1], voice and facial recognition, material science and sensors, to name some, have permitted the incubation and development and commercialization of incremental and disruptive innovations (then products and services) that are shaping contemporary society.

In the 1990s the focus of attention shifted towards the impact of ICT. Aronowitz and Di Fazio (1995) and Rifkin (1995) presented a grim scenario for workers in the face of changes brought by the diminishing costs and the rapid diffusion of the aforementioned technologies. However, Handel (2003) rebutted these authors arguing that efficiencies were introduced by technology's diminishing prices allowing consumers to increase their demand for other goods and services, thus balancing those losses in certain sectors of the economy but changing the type of labor demanded.

This observation on ICT has supported the Skill-Biased Technological Change (SBTC) hypothesis. The hypothesis assumes that the implementation of ICT and the use of computers in various tasks displaces the less skilled labor while generating a greater demand for workers with better skills and competencies (Bell, 1996; Autor, Katz & Kruger, 1998; Bresnahan, Brynjolfsson & Hitt, 2002; Author, Levy & Murnane, 2003).

Autor, Levy and Murnane (2001) studied the effects the use of computers introduced in the labor market had in the United States between 1970 and 1998, particularly highlighting an increase in the demand for labor with a tertiary education starting in the 1980s. They emphasized the difference between certain easy to automate tasks (routine and programmable) versus tasks considered difficult to automate like driving an automobile or a truck. However, recent innovations have demonstrated that the world is on the verge of autonomous vehicles with minimal or no human intervention to operate (Bertoncello & Wee, 2015). Goos and Manning (2003) contributed to the discussion showing evidence of a market polarization in the United Kingdom where middle-skilled jobs are being lost due to the implementation of modern technologies.

It is usual to assume that technological progress only displaces workers with lower qualifications. However, after the Great Recession (2008-2009) in the United States, there has been a recovery in the economy that has not reintroduced the jobs lost in the contraction period (*jobless recovery*) but also certain jobs considered not at risk of substitution, due to their high cognitive component have increased their probabilities of automation (Jaimovich & Siu, 2012; Susskind & Susskind, 2015; Beaudry, Green & Sand, 2016).

In the seminal work of Frey and Osborne (2013) a model is presented that calculated the probability of certain jobs to be automated. This model showed that 47% of occupations in the United States are at risk of automation in the next two decades. This study was replicated for Germany by Bonin, Gregory, and Zierahn (2015) and similar results were found, 42% of the occupations had a probability greater than 0.7 of being automated. In the case of Japan, David (2017) using a methodology called "Random Forest Algorithm" estimated 55% of jobs likely to be carried out by computers in the coming years.

Although these predictions may seem daunting, a review of the methodology used by Frey and Osborne in the United States presented a lower probability of automation of occupations from 0.38 to 0.09 (Arntz, Gregory & Zierahn 2017).

Novel approaches are still in the making in order to capitalize the opportunities presented by the current digital transformation of society. A seminal work by El Sawy and Pereira (2013) introduced the VISOR model for digital business. VISOR is an acronym that stands for "Value proposition," "Interface," "Service platform," "Organizing model" and "Revenue model". On the same direction, Ismail, Malone, and Van Geest (2014) presented the concept of Exponential Organization (ExO), meaning an organization that achieves rapid growth while using agile approaches and a combination of internal and external factors that the authors identified as being used by successful fast growing companies. Both approaches imply the digitalization and automation of processes and a non-traditional operational stance.

One of the most salient observations made by Malone and Van Geest (2014) is that for a typical Fortune 500 company the time to reach a valuation of a billion dollars averaged 20 years, Google reached that milestone in 8 years, Facebook in 6, Tesla in 5, Uber in almost 3 years, WhatsApp, Snapchat and Oculus Rift in around 2 years. These examples illustrate how modern corporations can create vast amounts of value by using available technologies in a disruptive manner, but also creating agile workflows and organizational structures that allow flexibility in a fast moving business environment.

While information grows exponentially, organizations tend to evolve in a linear manner, thus becoming target of visionary entrepreneurs and investors that identify opportunities brought by the combination of innovations ready to disrupt industries, sectors and markets.

Taking into account that automation and business models based on collaboration are becoming a prevalent form of production and creation of value, it is very useful to consider the possible scenarios that the implementation of new technologies may bring to organizations large and small, for profit and non-profit, in order to identify opportunities and mitigate potential risks. The debate on the effects of technology in labor markets and consequently in organizational, managerial and operational practices is not over, thus it is pertinent and timely for the interested sectors (managers, investors, government, unions, academia) to balance the potential gains and losses associated with a highly automated future. On one hand, the creation of new ventures, services, products and industries and the cost rationalization achieved by organizations that leverage radical innovations in their favor; on the other hand, the probability of high unemployment rates, increase in crime, greater inequality and propensity to political and social risk.

A NOVEL CONCEPT FOR A NEW REALITY

Industry 4.0 is a trending topic in all discussions regarding near-future perspectives. Jazdi (2014) suggests that the concept first appeared in Germany in 2011, and was unveiled to the general public by the Association of German Manufacturers of Production Machines and Equipment (Verband Deutscher Maschinen- und Anlagenbau, VDMA) at the Hannover Fair 2013. This organization wanted to symbolize the entry of world industry into its fourth revolution, combining three technological innovations (automation, the IoT and artificial intelligence), by creating innovative business models and going beyond product and process innovation.

In this regard, Liao, Deschamps, Loures, and Ramos (2017) state that several European governments have adapted the concept under different names: Platform Industrie 4.0 in Germany, the "Industrie du Futur" initiative in France, the "Made Different - Factories of the Future" program in Belgium, the "Piano Industria 4.0" cluster in Italy. But not only in Europe, the scope of programs aimed at bringing together this concept has multiplied: 10-year "Made in China 2025" plan in China, "Japan Revitalization Strategy" program in Japan, "Manufacturing Innovation 3.0" roadmap in Korea. In the United States, the Obama administration announced in 2011 the creation of the "Advanced Manufacturing Partnership" (AMP 2.0).

However, according to Rüßmann et al. (2015) and Wan, Cai, and Zhou (2015), Industry 4.0 cannot be reduced to its technical dimension. All of its technological components are available: IoT, factory virtualization, collaborative robots (cobots), connected and intelligent machines, cyber production systems, autonomous guided vehicles (AGV), 3D printers, blockchain, among others. Likewise, Schwab (2016) attests these trends are arising from a blending of physical, biological and digital worlds, which are both transforming and being transformed by society. Just as the widespread use of the three previous revolutions had in the past revolutionized society, this will also occur with the new wave of technological convergence.

Separate organizations have set in motion prototypes to test this approach. Nonetheless, few have really exploited the full potential to understand, implement and utilize the new models (Baldassarre, Ricciardi

& Campo, 2017). Industry 4.0 represents a much more global transformation and companies are only at the dawn of it. Drath and Horch (2014) point out the Internet took off in 2000 while its constituent technologies (email, search engine, etc.) had already existed for several years. At that moment, the boom represented a radical economic and social change. According to some authors this phenomenon would apply as well for Industry 4.0.

INDUSTRY 4.0: THE CHALLENGE TO A TRADITIONAL STRATEGY

Through Industry 4.0, the entire model of how strategy is formulated and monitored should be rethought, from the fundamentals of how value is created to the economic rationale influencing profitability and efficiency for a productive sector (Erol, Schumacher, & Sihn, 2016; Lasi, Fettke, Kemper, Feld, & Hoffmann, 2014; Porter & Heppelmann, 2015). Additionally, Pollard, Chuo, and Lee (2016) attest that manufacturing needs to transform from a logic of mass production to that of mass customization, depending on the understanding of the conditions in their sector. Assembly lines are no longer built based on the effects of scale and volume, but on flexible and localized production close to demand.

This reality implies "just-in-time" manufacturing and there is no longer an inventory to carry, marking a dynamic adaptation to what the market needs. Wang, Wan, Zhang, and Zhang (2016) suggest companies organized around this concept might be more predictive, self-correcting and produce more efficiently from the beginning, since they could better prioritize the use of resources and do not place the product at the heart of its logic. Finally, Bauer, Hämmerle, Schlund, and Vocke (2015) mention these enterprises pass from a rigid organization of labor, inherited from Taylorism, to a flexible organization, with a greater attractiveness to employees and suppliers. It potentially represents a complete change of economic logic.

Today, operations are still organized in a variety of sectors to implement a cost efficiency that depends on the volume of manufactured products: the higher the volume produced, the lower the cost incurred. As a result, many industries have been preoccupied for decades with optimizing production costs, and not so much on optimizing the capital required. This industrial paradigm is now questioned (De Sousa Jabbour, Jabbour, Godinho Filho, & Roubaud, 2018). In a context of volatility, uncertainty, constraints and ambiguity, and of increasing diversity of customers and their expectations, the investments needed to produce at the lowest cost have created a vicious cycle leading to a lack of flexibility or under-utilization of industrial infrastructure (Arnold, Kiel, & Voigt, 2016; Burmeister, Lüttgens & Piller, 2015; Stahel, 2016).

According to Gilchrist (2016), Industry 4.0 allows for an increase in the return on capital invested, due to the fact that "operational cost/inefficiency savings in most industries only requires Industrial Internet savings of 1% to make significant gains" (p. 4). Firstly, because it uses the physical asset to the maximum of its possibilities, reducing the complexity that is carried by the programming component of a robot or machine. In this regard, the launching costs of new products are significantly reduced and less disruptive to the rest of a company's portfolio. Additionally, Lee, Bagheri, and Kao (2015) adduce that Industry 4.0 minimizes downtime with predictive maintenance. These technologies reduce waste and quality problems while adjusting to production variances and self-correct defects. Therefore, they are better used, as they allow to locate assets close to end customers (including less transport, intermediate components and an efficient use of logistics), while eliminating decoupling stock.

Furthermore, Industry 4.0 technologies might be cheaper when compared to those of the previous generation (Almada-Lobo, 2016; Kagermann, 2015). Indeed, the performance of a cobot is optimized and reduces the marginal cost when compared to a conventional robot; the price of sensors has decreased dramatically; radio-frequency identification and connectivity solutions are easier to use and not as pricey as their equivalent in a Kanban system, among others. In this regard, Schlechtendahl, Keinert, Kretschmer, Lechler, and Verl (2015) argue that digital endurance considers the integration and distinctive features of ICT, which leads to a better interaction from the legacy systems that exist in companies. Thus, the additional cost of investing in new equipment and software will be offset by the better use of the entire network infrastructure.

ALL ELSE DOES NOT REMAIN EQUAL

The transition from the traditional plant to the Industry 4.0 prototype can be based on some fundamental ideas that are transforming the way a factory is set up (Blanchet, Rinn, Von Thaden, & De Thieulloy, 2014).

Better connectivity flows, which will improve the ability to launch new products quickly by drastically reducing the production development time that will have been carried out virtually upstream (Lee, Bagheri & Kao, 2015). According to Synnes and Welo (2016), Industry 4.0 will also upgrade the operations of the plant by giving the management team a new way of controlling and intervening in the way processes and operations should transform, considering any new market demand.

Automation of operations, via autonomous guided vehicles or cobots, which will enable savings in logistics costs. However, according to Wollschlaeger, Sauter, and Jasperneite (2017), the challenge is not to automate, but to increase the resilience and responsiveness of the system as a whole, and to reduce the size of all inventories and stocks, which impact directly in the profitability of the organization. This transformation will allow a production line to perform tasks impossible to achieve exclusively by a human team, as the combination of flows and parts will greatly increase because of demand customization.

Smart robots and machines represent an important lever. Zheng et al. (2018) argue that these standalone machines no longer need operators to control them. They can self-correct themselves considering the diagnostics they continuously run and can perform autonomously their duties interconnected at night, for example. They allow for a much better time of use. Therefore, the employee who is in charge of their supervision has a very different approach to the problems to be solved from correcting to stabilizing (Wang, 2016).

In addition, cyber-physical systems will enable a real control layer for the plant and its suppliers, allowing for mass personalization and the re-adaptation of the production plan to a variation of the demand or a need for activity. Jazdi (2014) attests it is also what makes it possible to pass from a logic "push" (one makes to store), which incites to make discounts to sell the products, to a logic "pull" (one makes on order). This puts into question planning, logistics, piloting practices, among others, that will be transformed for the better in the medium term (Biao, Zhao, Wan, Hong & Jian, 2016).

Admittedly, the staff required to run the plant is reduced by about half, but such a plant puts the human being at the center of this new model (Kagermann, 2015). Human transformation and the impact on skills and qualification is very significant. However, Windelband (2017) argues the factory of the future will give a place to all levels of qualifications and not only to high or low qualifications. Industry 4.0's solutions are accessible to all. The skills to control a cobot are much simpler than programming an industrial robot and require far fewer dexterity.

On the other hand, research by Autor (2015), Gabriel and Pessl (2016) and Maynard (2015) consider an additional element regarding professional development: the evolution of "actionable empathy", that is to say, the relationship among every internal client, the understanding of the needs, how problems are resolved in a collaborative way, and the abolition of the repetitive, routine characteristics of any job description. Hereof, new professions will appear: system integration, cyber-security, big data, virtual reality in the form of local or distant skills, among others.

LABOR FORCE OF TOMORROW: HUMANS OR ROBOTS?

One of the most sensitive issues concerning the fourth industrial revolution is that of its impact in terms of jobs: the amount of work destroyed or transformed by digitizing and automating will or will not be offset by the creation of activities related to the benefits of this digitization. In fact, Lorenz, Rüßmann, Strack, Lueth and Bolle (2015) suggest the number of new jobs involved in Industry 4.0 is high, while the impact in terms of reducing the amount of work in the factories of the future with respect to current factories might potentially be important. Likewise, Schwab (2016) affirms that technology can drive social progress. As long as societies understand the full nature of the opportunities and challenges that lie ahead, the author envisions a future with better circumstances for employees and independent workers.

However, it is not volumes or the effect of scale or the labor cost factor that will create value, but the personalization and integration of the product and service offering and, economically, the optimization of capital when considering additional investments (Lee, Kao & Yang, 2014). These new levers of value creation represent a considerable potential for new activities and jobs.

For a long time, the debate related to automation was solved by a simple calculation: by bringing a higher yield, it allowed to lower the costs and thus to increase the volumes by the demand (the effect of scale), compensating for the decline in human activity required to produce the unit (Simonis, Gloy & Gries, 2016). This is the mechanism of Fordism. With the Taylorization of the factory, the specialization of tasks and the standardization of production, Ford´s Model T was only available in one version and one color: no wonder Ford reduced manufacturing time from 12 to 1.5 hours (Murrin, Johnson, McPherson, Fahs, & Gerstle, 2011).

Normally, this phenomenon should have resulted in a 90% jobs reduction. However, research by Turi, Mocan, Ivascu, Goncalves, and Maistor (2015) illustrate that as vehicles became much cheaper, they were accessible to a much wider range of customers. This demand pulled volumes, which grew much faster than productivity and actually generated jobs in much greater quantity than the decline brought about by the unit decline. This transformative mechanism and the increase of purchasing power were the cornerstone of the Thirties, and has more recently been used in many emerging countries, including China (Rodrik, 2014).

Where are the big industrial nations now? According to Noble (2017), volumes were able to offset the increase in productivity during successive waves of automation. However, industrial productivity has no longer turned into increased volumes, but in cost reduction, via a scale effect which allowed the development of services through better purchasing power of customers. At the same time, the productivity of industrial countries has also allowed the industrial development of emerging countries through a transfer of work to these countries (Decreuse & Maarek, 2015).

Additionally, the pervasive implementation of Enterprise Resource Planning (ERP) software in large and small companies is an aspect that affect the organizational structure of business (Morton &

Hu, 2008). It can streamline processes and eliminate tasks deemed not necessary for the operation. In addition, technology has enabled workers to operate remotely which has significant effects on how companies organize.

Bosua, Kurnia, Gloet, and Moza (2017) attest that distant work, telework, remote working are schemes that could reduce overhead and contribute to the work life balance of the workforce by reducing commuting times. Telework has many supporters and critics, on the positive side, distant working is seen as an alternative to the traditional 9 to 5 work flow thus liberating the productivity of the working beyond this time frame. On the other side of the story, Marica (2018) mentions distance may hinder collaboration efforts, some tasks require that the team working on them is physically present to solve any challenge. Some companies are not ready to take this significant step towards distance work due to lack of minimum technical requirements (connectivity, information security, the deployment of Virtual Private Networks VPN, secure servers, etc.), poor internal policies, corporate culture and work flow design.

Gough (2017) argues that the pervasive use of the Internet as a growing marketplace and a tool for trade could displace large number of people currently working in the retail sector, downplaying the role of the physical store and moving the workload to the development of digital content to become more attractive to consumers and increase satisfaction of delivery, that is, the logistics chain. This preference for e-Commerce should hint managers and investors to consider management and operative innovations that benefit from these market trends.

TECHNOPHOBES OR TECHNO-IGNORANTS?

Inglehart (2016) attests that since the past industrial revolution began, the decrease in industrial employment had been offset by outsourcing to services, productivity increases and low competitiveness in certain industries. However, it is not possible to rely on these aspects anymore. According to the International Labor Organization (ILO, 2017), in the last 15 years, European Union industry has lost 5 million jobs and reduced its share from 35% to 24% of total employment in the area.

The shortage of job opportunities is already having visible effects that are hitting the world's middle class first and foremost, namely the increase in inequalities. The World Economic Forum (2018) estimates a net loss of more than 5.1 million jobs from 2015 to 2020, especially in the Administrative job family. Hirsch-Kreinsen, Weyer, and Wilkesmann (2016) attest this situation has propelled a pessimistic view of the future of work and, more broadly, of human societies, where forced inactivity would be the lot of a majority of the population, and that an overqualified minority would reap the full benefits of the digital economy.

Each industrial revolution was accompanied by catastrophic impacts on employment because each time, many trades have disappeared, while others have appeared. Schwab (2016) states there is an intimate dynamic between technology and society, implying the 4th industrial revolution could be a bloody one with massive casualties, if businesses, governments and society in their core don't learn to master it. Yet, the job balance of each industrial revolution has been largely positive every time. In this regard, Hirsch-Kreinsen (2016) considers that like all industrial revolutions before it, Industry 4.0 has a considerable potential for value creation, which will come from new activities. But these value creation mechanisms are fundamentally different in nature from those prevailing in previous industrial revolutions.

An alarming trend found is the decline of the labor share in the GDP of most countries. Karabarbounis and Neiman (2013) found that wages have stagnated as productivity has increased in advanced economies since the 1980s. For Latin American countries, this trend is more worrisome given the inequality of these economies (Figure 1).

Accounting and Total Factor Productivity, 1990-2016. (Adjusted Version) May 2017. Averages from the following countries: Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Jamaica, Mexico, Peru, Dominican Republic, Saint Lucia, Trinidad and Tobago, Uruguay and Venezuela.

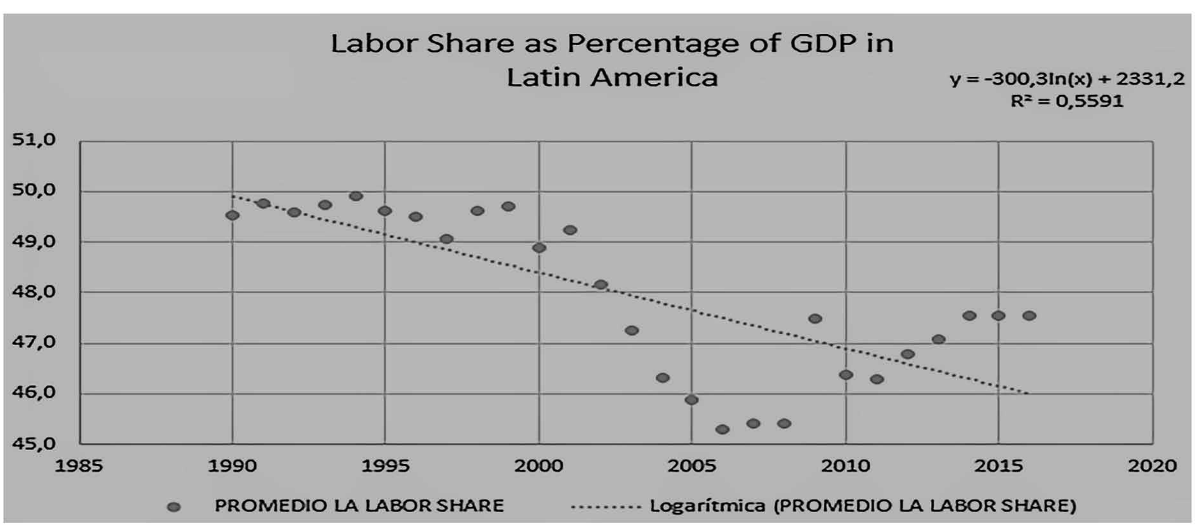
Industry 4.0 will allow local manufacturing of products with optimized industrial assets and relatively little labor. The very significant productivity in hours brought by these technologies. Davies (2015) affirms this will probably not result in lower prices by playing the effect of scale, as was the case in previous industrial revolutions. As it has been seen, the challenge now is to increase flexibility, customization, quality, but not to play on prices and volumes. The question is how to recreate activity and employment in this new situation. Probably via mechanisms very different from those the world has known until now. (Gorecky, Schmitt, Loskyll & Zühlke, 2014).

CONCLUSION

The rapid diffusion of technologies that reduce the need of labor and create efficiencies in business processes pose as a great opportunity for whole societies, entrepreneurs and investors. If automation, the implementation of IoT devices, the development of apps and other innovations become the dominant form of production and value creation, then organizations can achieve more with less. Companies that implement these technologies successfully, would run lean operations, outsource tasks to specialized agents and create more value leveraging less resources or even sharing resources.

Innovation is allowing the creation and destruction of industries, segments and markets. Both radical innovations and incremental innovations are challenging the landscape and assumptions of managers

Figure 1. Share of total labor compensation in GDP in Latin America
Source: Authors, with data from The Conference Board Total Economy Database ™ Growth



and investors. There is no sector or industry that has been spared from this wave of change. ICT have upended several industries and their respective business models.

The broad impacts of the Fourth Industrial Revolution on business and society are still in the making, as with any other significant change, there are many unknowns and unintended consequences to confront. May this be an invitation to all the interested stakeholders (academia, corporations, unions, government organizations) to ponder and consider both benefits and risks that modern technologies present.

The impact and consequences of the “digital economy”, also known as the “On-Demand economy” or “sharing economy” are still in the making. One thing is certain, these platforms are challenging traditional business models and provide efficiencies in the use of valuable resources, labor flexibility and lower entry barriers to jobs, but also they are questioned if these arrangements are considered decent work in the International Labor Organization (ILO) framework.

The projected effects that innovation and automation could generate in businesses are to be studied profoundly in order to mitigate possible negative effects of these forces and to take advantage of the opportunities that the fourth industrial revolution bring to contemporary businesses. The nature, breadth and reach of these effects should be the aim of further research in this field.

The approach to this subject matter must not be dominated by the economics discipline but a broad, multidisciplinary approach (computer science, sociology, psychology, political science, among others) is suggested to understand the variety of approaches, frameworks and insights that different disciplines bring to the table. The impact of the subject matter on business and society exceeds the economics discipline and the discussion can be enriched by methods and findings from these combinations of knowledge.

There is an assumption that tasks that require less formal education are the most automatable. However, recent reports showed that high-skill sectors such as finance, legal or even journalism have automated some of their operations in which complex algorithms are involved in decision making for purchasing or selling securities at high speed, doing legal research and writing news stories.

Work is a concept that goes beyond economics and the implication of it reaches deeply in the social fabric. In most jurisdictions, work is an activity that takes half of our waking life time (8 hours in average), thus providing not only salaries, but meaning, status and purpose to life. If this significant amount of time is suddenly “lost”, what would be the time passing activity in the coming future? The question is, are we inventing ourselves out of jobs?

The Economist published in its technology blog Babbage an apocryphal conversation between Henry Ford II and the union leader Walter Reuther while they were inspecting a car production plant recently automated. “Walter, how are you going to get those robots to pay your union dues,” said Ford mockingly. The union leader responded ingeniously, “Henry, how are you going to get them to buy your cars?”

These structural changes in conjunction with the rapid diffusion and implementation of the innovations mentioned in this document and the formulation of business models based in the gig economy are a complex challenge for managers, investors, the public and society at large.

Taking into account that the business models based on collaboration platforms, artificial intelligence, big data are becoming the “new frontier” and a pervasive form of value creation, it is useful to consider all the possible scenarios that these changes bring to societies and markets.

The consideration of ‘what-ifs’ and the tentative downsides of these changes is part of the due diligence that managers, investors, academia, unions and public institutions must ponder in order to prevent undesirable outcomes such as unemployment, crime or greater inequality and to propose solutions to these unintended effects.

REFERENCES

Almada-Lobo, F. (2016). The Industry 4.0 revolution and the future of manufacturing execution systems (MES). *Journal of Innovation Management*, *3*(4), 16–21.

Arnold, C., Kiel, D., & Voigt, K. I. (2016). How the industrial internet of things changes business models in different manufacturing industries. *International Journal of Innovation Management*, *20*(08), 1640015. doi:10.1142/S1363919616400156

Arntz, M., Gregory, T., & Zierahn, U. (2017). *Revisiting the Risk of Automation.* ZEW. Retrieved from https://goo.gl/Es1JqM

Aronowitz, S., & DiFazio, W. (1995). *Jobless Future: Sci-Tech and the Dogma of Work*. University of Minnesota Press.

Autor, D. (2015). Why Are There Still So Many Jobs? The History and Future of Workplace Automation. *The Journal of Economic Perspectives*, *29*(3), 3–30. doi:10.1257/jep.29.3.3

Autor, D., Katz, L., & Krueger, A. (1998). Computing Inequality: Have Computers Changed the Labor Market? *The Quarterly Journal of Economics*, *113*(4), 1169–1213. doi:10.1162/003355398555874

Autor, D., Levy, F., & Murnane, R. (2003). The Skill Content of Recent Technological Change: An Empirical Exploration. *The Quarterly Journal of Economics*, *118*(4), 1279–1333. doi:10.1162/003355303322552801

Baldassarre, F., Ricciardi, F., & Campo, R. (2017). The Advent of Industry 4.0 in Manufacturing Industry: Literature Review and Growth Opportunities. In *DIEM: Dubrovnik International Economic Meeting* (Vol. 3, No. 1, pp. 632-643). Sveučilište u Dubrovniku.

Bauer, W., Hämmerle, M., Schlund, S., & Vocke, C. (2015). Transforming to a hyper-connected society and economy–towards an “Industry 4.0”. *Procedia Manufacturing*, *3*, 417–424. doi:10.1016/j.promfg.2015.07.200

Beaudry, P., Green, D.A., & Sand, B.M. (2016). The great reversal in the demand for skill and cognitive tasks. *Journal of Labor Economics, 34*(1). DOI: doi:10.1086/682347

Bell, B. (1996). *Skill-Biased Technological Change and Wages: Evidence from a Longitudinal Data Set*. Oxford, UK: Nuffield College. Retrieved from https://goo.gl/qGXJCM

Bertoncello, M., & Wee, D. (2015). *Ten ways autonomous driving could redefine the automotive world*. McKinsey & Co.

Biao, W. A. N. G., Zhao, J. Y., Wan, Z. G., Hong, L. I., & Jian, M. A. (2016). Lean Intelligent Production System and Value Stream Practice. *DEStech Transactions on Economics, Business and Management*.

Blanchet, M., Rinn, T., & Dujin, A. (2016). The Industrie 4.0 transition quantified. *Roland Berger Strategy Consultants GmbH. München.* Retrieved from: https://www.rolandberger.com/en/Publications/pub_the_industrie_4_0_transition_quantified.html

Blanchet, M., Rinn, T., Von Thaden, G., & De Thieulloy, G. (2014). Industry 4.0: The new industrial revolution - How Europe will succeed. *Roland Berger Strategy Consultants GmbH. München.* Retrieved from: http://www. rolandberger. com/media/pdf/Roland_Berger_TAB_Industry_4_0_2014 0403. pdf

Bonin, H., Gregory, T., & Zierahn, U. (2015). Übertragung der Studie von Frey/Osborne (2013) auf Deutschland. *ZEW Kurzexpertise*, No. 57. Retrieved from https://goo.gl/cuCx3G

Bosua, R., Kurnia, S., Gloet, M., & Moza, A. (2017). Telework Impact on Productivity and Well-Being. *Social Inclusion and Usability of ICT-Enabled Services*, 201.

Bresnahan, T., Brynjolfsson, E., & Hitt, L. (2002). Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-Level Evidence. *The Quarterly Journal of Economics, MIT Press*, *117*(1), 339–376. doi:10.1162/003355302753399526

Brynjolfsson, E., & McAfee, A. (2014). *The second machine age. Work, progress, and prosperity in a time of brilliant technologies*. New York: W.W. Norton & Company.

Burmeister, C., Lüttgens, D., & Piller, F. T. (2015). Business Model Innovation for Industrie 4.0. *Why the Industrial Internet Mandates a New Perspective on Innovation.*, *0*, 1–31.

David, B. (2017). Computer technology and probable job destructions in Japan: An evaluation. *Journal of the Japanese and International Economies*, *43*, 77–87. doi:10.1016/j.jjie.2017.01.001

Davies, R. (2015). Industry 4.0. Digitalisation for productivity and growth. *European Parliamentary Research Service, Briefing*.

De Sousa Jabbour, A. B. L., Jabbour, C. J. C., Godinho Filho, M., & Roubaud, D. (2018). Industry 4.0 and the circular economy: A proposed research agenda and original roadmap for sustainable operations. *Annals of Operations Research*, 1–14.

Decreuse, B., & Maarek, P. (2015). FDI and the labor share in developing countries: A theory and some evidence. *Annals of Economics and Statistics. Annales d'Economie et de Statistique*, (119/120), 289–319. doi:10.15609/annaeconstat2009.119-120.289

Drath, R., & Horch, A. (2014). Industrie 4.0: Hit or hype? *IEEE Industrial Electronics Magazine*, *8*(2), 56–58. doi:10.1109/MIE.2014.2312079

El-Rabbany, A. (2002). *Introduction to GPS: the global positioning system*. Artech house.

El Wawy, O. A., & Pereira, F. (2013). *Business Modelling in the Dynamic Digital Space An Ecosystem Approach*. Kindle Edition. doi:10.1007/978-3-642-31765-1

Erol, S., Schumacher, A., & Sihn, W. (2016). Strategic guidance towards Industry 4.0–a three-stage process model. *International conference on competitive manufacturing*.

Ford, M. (2015). *Rise of the Robots: Technology and the Threat of a Jobless Future*. Kindle Edition.

Frey, C. B., & Osborne, M. (2013). *The Future of Employment: How Susceptible are jobs to Computerisation?* Retrieved from https://goo.gl/UvLsSg

Gabriel, M., & Pessl, E. (2016). Industry 4.0 and sustainability impacts: Critical discussion of sustainability aspects with a special focus on future of work and ecological consequences. *Annals of the Faculty of Engineering Hunedoara*, *14*(2), 131.

Gilchrist, A. (2016). *Industry 4.0: the industrial internet of things.* A press.

Goos, M., & Manning, A. (2003). *Lousy and Lovely Jobs: the Rising Polarization of Work in Britain*. Centre for Economic Performance.

Gorecky, D., Schmitt, M., Loskyll, M., & Zühlke, D. (2014). Human-machine-interaction in the industry 4.0 era. In *Industrial Informatics (INDIN), 2014 12th IEEE International Conference on* (pp. 289-294). IEEE.

Gough, J. (2017). Measuring the Impact of the Internet on Retailing. *World Economy*, *18*(4), 211–236.

Handel, M. J. (2003). *Implications of Information Technology for Employment, Skills and Wages: A Review of Recent Research.* SRI International. Retrieved from https://goo.gl/EcSRz7

Hirsch-Kreinsen, H. (2016). Digitization of industrial work: development paths and prospects/Digitalisierung industrieller Arbeit: Entwicklungspfade und Perspektiven. *Journal for Labour Market Research*, *49*(1), 1–14. doi:10.100712651-016-0200-6

Hirsch-Kreinsen, H., Weyer, J., & Wilkesmann, J. D. M. (2016). *"Industry 4.0" as Promising Technology: Emergence, Semantics and Ambivalent Character*. Universitätsbibliothek Dortmund. Retrieved from: https://www.wiwi.tu-dortmund.de/wiwi/de/forschung/gebiete/fphirschkreinsen/forschung/soz_arbeitspapiere/AP-SOZ-48.pdf

ILO. (2016a). *The rise of the "just-in-time workforce": On-demand work, crowdwork and labour protection in the "gig economy"*. Conditions of work and employment Series No. 71. Retrieved from https://goo.gl/RQrykV

ILO. (2016b). *Income security in the on-demand economy: Findings and policy lessons from a survey of crowdworkers.* Conditions of work and employment Series No. 74. Retrieved from https://goo.gl/o1YPt4

ILO. (2017). *Employment in industry (% of total employment).* ILOSTAT database. Retrieved from: https://data.worldbank.org/indicator/SL.IND.EMPL.ZS

Inglehart, R. (2016). Inequality and Modernization: Why Equality Is Likely to Make a Comeback. *Foreign Affairs*, *95*, 2.

Ismail, S., Malone, M. S., & Van Geest, Y. (2014). *Exponential Organizations: Why new organizations are ten times better, faster, and cheaper than yours (and what to do about it)*. Kindle Edition.

Jaimovich, N., & Siu, H. E. (2012). *The trend is the cycle: Job polarization and jobless recoveries.* NBER Working Paper No. 18334. Retrieved from https://goo.gl/vuwCKP

Jazdi, N. (2014). Cyber physical systems in the context of Industry 4.0. In *Automation, Quality and Testing, Robotics, 2014 IEEE International Conference* (pp. 1-4). IEEE.

Kagermann, H. (2015). Change through digitization—Value creation in the age of Industry 4.0. In *Management of permanent change* (pp. 23–45). Wiesbaden, Germany: Springer Gabler. doi:10.1007/978-3-658-05014-6_2

Karabarbounis, L., & Neiman, B. (2013). *The Global Decline of the Labor Share*. NBER Working Paper No. 19136. DOI: doi:10.3386/w19136

Keynes, J. M. (1963). *Essays in Persuasion*. New York: W.W. Norton & Co.

Lasi, H., Fettke, P., Kemper, H. G., Feld, T., & Hoffmann, M. (2014). Industry 4.0. *Business & Information Systems Engineering*, *6*(4), 239–242. doi:10.100712599-014-0334-4

Lee, J., Bagheri, B., & Kao, H. A. (2015). A cyber-physical systems architecture for industry 4.0-based manufacturing systems. *Manufacturing Letters*, *3*, 18–23. doi:10.1016/j.mfglet.2014.12.001

Lee, J., Kao, H. A., & Yang, S. (2014). Service innovation and smart analytics for industry 4.0 and big data environment. *Procedia Cirp*, *16*, 3–8. doi:10.1016/j.procir.2014.02.001

Liao, Y., Deschamps, F., Loures, E. D. F. R., & Ramos, L. F. P. (2017). Past, present and future of Industry 4.0-a systematic literature review and research agenda proposal. *International Journal of Production Research*, *55*(12), 3609–3629. doi:10.1080/00207543.2017.1308576

Lorenz, M., Rüßmann, M., Strack, R., Lueth, K. L., & Bolle, M. (2015). *Man and machine in Industry 4.0: How will technology transform the industrial workforce through 2025*. The Boston Consulting Group. Retrieved from: https://www. bcgperspectives. com/content/articles/technology-business-transformationengineered-products-infrastructure-man-machine-industry-4

Manyika, J., Chui, M., Bughin, J., Dobbs, R., Bisson, P., & Marrs, A. (2013). *Disruptive technologies: Advances that will transform life, business and the global economy.* McKinsey Global Institute. Retrieved from https://goo.gl/qPTLV7

Marica, M. E. (2018). Hoeworking/teleworking. Atypical forms of employment: between usefulness and precariousness. *Juridical Tribune/Tribuna Juridica, 8*(1).

Maynard, A. D. (2015). Navigating the fourth industrial revolution. *Nature Nanotechnology*, *10*(12), 1005–1006. doi:10.1038/nnano.2015.286 PMID:26632281

Morton, N. A., & Hu, Q. (2008). Implications of the fit between organizational structure and ERP: A structural contingency theory perspective. *International Journal of Information Management*, *28*(5), 391–402. doi:10.1016/j.ijinfomgt.2008.01.008

Murrin, J. M., Johnson, P. E., McPherson, J. M., Fahs, A., & Gerstle, G. (2011). *Liberty, equality, power: a history of the American people*. Cengage Learning.

Noble, D. (2017). *Forces of production: A social history of industrial automation*. Routledge.

OECD. (2016). *New forms of work in the digital economy.* OECD Digital Economy Papers No. 260. Retrieved from https://goo.gl/v35PgF

Pollard, D., Chuo, S., & Lee, B. (2016). Strategies for mass customization. *Journal of Business & Economics Research (Online)*, *14*(3), 101.

Porter, M. E., & Heppelmann, J. E. (2015). How smart, connected products are transforming companies. *Harvard Business Review*, *93*(10), 96–114.

Pratt, G. A. (2015). Is a Cambrian Explosion Coming for Robotics? *The Journal of Economic Perspectives*, *29*(3), 51–60. doi:10.1257/jep.29.3.51

Qin, J., Liu, Y., & Grosvenor, R. (2016). A categorical framework of manufacturing for industry 4.0 and beyond. *Procedia Cirp*, *52*, 173–178. doi:10.1016/j.procir.2016.08.005

Rifkin, J. (1995). *The End of Work. The decline of the Global Labor Force and the Dawn of the Post-Market Era*. Tarcher/Putnam.

Rodrik, D. (2014). The past, present, and future of economic growth. *Challenge*, *57*(3), 5–39. doi:10.2753/0577-5132570301

Rüßmann, M., Lorenz, M., Gerbert, P., Waldner, M., Justus, J., Engel, P., & Harnisch, M. (2015). Industry 4.0: The future of productivity and growth in manufacturing industries. Boston Consulting Group, 9.

Sachs, J. D., Benzell, S. G., & LaGarda, G. (2015). *Robots: Curse of blessing? A basic framework*. NBER Working Paper 21091. DOI: doi:10.3386/w21091

Schlechtendahl, J., Keinert, M., Kretschmer, F., Lechler, A., & Verl, A. (2015). Making existing production systems Industry 4.0-ready. *Production Engineering*, *9*(1), 143–148. doi:10.100711740-014-0586-3

Schwab, K. (2016). The 4th industrial revolution. In *World Economic Forum*. New York: Crown Business.

Silva, H. C., & Lima, F. (2017). Technology, employment and skills: A look into job duration. *Research Policy*, *46*(8), 1519–1530. doi:10.1016/j.respol.2017.07.007

Simonis, K., Gloy, Y. S., & Gries, T. (2016, July). INDUSTRIE 4.0-Automation in weft knitting technology. *IOP Conference Series. Materials Science and Engineering*, *141*(1), 012014. doi:10.1088/1757-899X/141/1/012014

Stahel, W. R. (2016). The circular economy. *NATNews*, *531*(7595), 435. PMID:27008952

Steijn, B. (2017). ICT, organisations and labour in the information society. In *The Future of Work in Europe* (pp. 45–62). Routledge.

Susskind, R., & Susskind, D. (2015). *The Future of Professions How technology will transform the work of human experts*. Kindle Edition.

Synnes, E. L., & Welo, T. (2016). Bridging the Gap between High and Low-volume Production through Enhancement of Integrative Capabilities. *Procedia Manufacturing*, *5*, 26–40. doi:10.1016/j.promfg.2016.08.006

Turi, A., Mocan, M., Ivascu, L., Goncalves, G., & Maistor, S. (2015, May). From Fordism to Lean management: Main shifts in automotive industry evolution within the last century. In *MakeLearn International Scientific Conference on Management of Knowledge and Learning* (pp. 25-27). Academic Press.

Wan, J., Cai, H., & Zhou, K. (2015, January). Industrie 4.0: enabling technologies. In *2014 International Conference on Intelligent Computing and Internet of Things (ICIT)*, (pp. 135-140). IEEE. 10.1109/ICAIOT.2015.7111555

Wang, K. (2016). Intelligent predictive maintenance (IPdM) system–Industry 4.0 scenario. *WIT Transactions on Engineering Sciences*, *113*, 259–268.

Wang, S., Wan, J., Zhang, D., Li, D., & Zhang, C. (2016). Towards smart factory for industry 4.0: A self-organized multi-agent system with big data based feedback and coordination. *Computer Networks*, *101*, 158–168. doi:10.1016/j.comnet.2015.12.017

Windelband, L. (2017). Work Requirements and Qualifications in Maintenance 4.0. In *Advances in Ergonomic Design of Systems, Products and Processes* (pp. 89–102). Berlin: Springer. doi:10.1007/978-3-662-53305-5_6

Wollschlaeger, M., Sauter, T., & Jasperneite, J. (2017). The future of industrial communication: Automation networks in the era of the internet of things and industry 4.0. *IEEE Industrial Electronics Magazine*, *11*(1), 17–27. doi:10.1109/MIE.2017.2649104

Zheng, P., Sang, Z., Zhong, R. Y., Liu, Y., Liu, C., Mubarok, K., ... Xu, X. (2018). Smart manufacturing systems for Industry 4.0: Conceptual framework, scenarios, and future perspectives. *Frontiers of Mechanical Engineering*, 1–14.

KEY TERMS AND DEFINITIONS

Automation: Technique of making a process or machinery to operate automatically with little or no human intervention.

Cobot: A robot created to have interactions with humans in working environments. They are also known as a co-robots or collaborative robots.

Fourth Industrial Revolution: The as the fusion of cyber-physical systems. The fourth industrial revolution builds from the third industrial revolution (electronics and information systems) and amplify the impact, scope, reach, and speed of disruption in almost all human aspects, such as production, distribution (logistics), management, governance, among others.

Industry 4.0: Refers to the potential gains of the fusion of cyber-physical systems. See Fourth Industrial Revolution.

Information and Communication Technologies (ICT): An extension of the information technologies (IT), which refers to the means used to support any information system. Additionally, it refers to all the elements associated to hardware and software, and in the ICT includes the integration of all the communication technologies as the telephones, computer networks and audio-visual systems.

Skill-Biased Technological Change: Hypothesis that refers to the way technology and innovations tend to affect low skilled workers' incomes vis-a-vis skilled ones.

Strategy: Refers to the way to obtain a competitive advantage.

Technological Unemployment: Refers to the loss of jobs caused by the deployment of innovations in work processes. See Automation.

ENDNOTE

[1] According to El-Rabbany (2002), a Global Positioning System is "a satellite-based navigation system [...] that provides continuous positioning and timing information, anywhere in the world under any weather conditions" (p. 1).

Chapter 2
Measurement of the Staff Resilience of the Technological Institute Lázaro Cárdenas

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ABSTRACT

The objective of this chapter is to show the importance and measurement of the resilience of the personnel of the Technological Institute of Lázaro Cárdenas Michoacán in scale of Resilience Mexican (RESI-M). An analytical review is made about resilience, with emphasis on central aspects such as its origin, definition, and the factors that determine the application of resilience, indicators, and disruptive situations. The models that establish different authors, classified in size and factors of resilience, follow different patterns according to sex, age, and schooling. A group of 100 top-level teachers was evaluated. The authors conclude that the level of resilience in women and men is significant.

INTRODUCTION

The objective of this chapter is to review the concept of resilience, its importance and measurement, emphasizing its definition, the disruptive situations, the factors and models established by different authors. These ARE classified into dimensions, factors, or characteristics, taking into account sex, age, and schooling, which determine resilience and the impact it has on the development of organizations. To achieve the objective of the research, a population of 113 higher education level, professors AT from the Technological Institute of Lázaro Cárdenas, Michoacán, using the RESI-M scale, developing a descriptive and transversal research. The instrument consists of 43 items, divided into five factors, the

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reliability of the instrument was measured by obtaining the Cronbach's Alpha, and a KMO test performs to validate the application of the factorial analysis, to obtain the feasibility of measuring resilience. In conclusion, in spite of the adverse situations, such as divorce, economic crisis and work environment, the individual overcomes and there is a significant difference between men and women, it shows which the factor has the greatest impact.

CONCEPTUAL THEORETICAL BACKGROUND

The term resilience comes from the Latin of the word "*resilio*", which means to go back, to jump and to rebound (Kotliarenco, Cáceres and Fontenecilla, 1997). Resilience is the resistance of a body, or the ability of a material to regain its original shape after summited to pressure. This concept comes from the area of physics and chemistry and civil engineering. It subsequently was adapted to different disciplines:

1. In the social sciences and in the pedagogical area, it is considered as the capacity that communities or populations can have to face difficulties and be strengthened.
2. In the health sciences, studying clinically the relationship of stress in therapeutic processes.
3. In ecology, in the recovery of an ecosystem and in climatological disasters, but above all to indicate the capacity for recovery.
4. In administrative sciences (Atehortúa 2002, p.49) shows organizational survival speaking in terms of flexibility and adaptability at the group and individual levels.
5. In the business field, this solves the problems of the globalized market. These disruptive situations can be in finances, production, sales and quality, among others. Business resilience is the ability of organizations to face moments of adversity and adapt quickly to changes and finally relates the resilience of people with business.

DEFINITION

The concept of resilience links through adversity, since this is the reason why the human being develops the process of facing, overcoming and transforming it, in an opportunity that leads him to submit it and such process is called resilience. Table 1 describes different definitions.

ECLECTIC DEFINITION

Resilience is a dynamic and multidimensional process that results in positive adaptation in contexts of great adversity. It is the human capacity to face, overcame, and be strengthen or transformed by experiences of adversity, achieving a condition that gives people the ability to overcome adversity and, in addition, build on them. The ability to succeed, to live and develop positively, in a socially acceptable way, despite fatigue or adversity, which usually involve a serious risk of negative outcome, that is, it is a spring from which, having received a blow, they have could surpass it (Grotberg, 2001; Luthar, 2000; Suárez, 2004; Bronfenbrenner, 1979; Cyrulnik, 2001; Masten, 2007).

Table 1. Definitions of resilience

Author	Definition
Bronfenbrenner (1979)	In the ecological insertion, it systematizes the contribution of the model of bio ecological development, which takes into account the multiple influences of the environment on the development of the individual in the course of his life.
Rutter and Rutter (1992).	Resilience is characterized as a set of social and intra-psychic processes that make it possible to have a healthy life in an insane environment.
Rutter (1993)	Resilience is the capacity of people to develop psychologically healthy and be successful despite the adverse situations they face and threaten their integrity.
Salgado (2005)	The concept of resilience is important in the promotion of development.
Osborn (1994)	Generic concept that refers to a wide range of risk factors and the results of competency. Resilience can be the product of a conjunction between environmental work factors, such as temperament and a type of cognitive ability that children have when they are very young.
Vanistendael (1994)	The author defines resilience distinguishing two components: resistance to destruction, that is, the ability to protect one's integrity under pressure; On the other hand, beyond resistance, the ability to build a positive vital behaviorism despite difficult circumstances is the ability of a person or social system to adequately deal with difficulties in a socially acceptable way.
Staudinger, Marsiske and Baltes (1993).	Resilience is dynamic, emergent and changing in relation to specific circumstances and challenges, it is applied to situations that may not be maintained over time or transfer to other circumstances or challenges.
Grotberg (1996).	The human capacity to face, overcome, emerge strengthened and even transformed by the experiences of adversity (p. 3).
Grotberg, (1998).	It is the capacity of the human being to face the adversities of life, overcome them and be positively transformed by them.
Luthar, Cicchetti and Becker (2000)	Dynamic process that embraces positive adaptation within significant adversity.
Cyrulnik (2001)	A misfortune is never wonderful. Resilience is an icy and black mud, a painful scar that forces us to choose: submit or overcome. Resilience defines the spring of those who, having received a blow, have been able to surpass it. Oxymoron describes the intimate world of those wounded victors.
Grotberg (2001)	The human capacity to face, overcome, and be strengthened or transformed by experiences of adversity.
Suárez (2004)	A human condition that leaves people the ability to overcome adversity and, in addition, build on them. Resilience is a dynamic process that results in positive adaptation, even in contexts of great adversity (p.10).
Masten (2007).	Resilience is a dynamic and multidimensional construct that refers to the ability of personal systems to cope or recover successfully from adverse situations. In this way, resilience can function as a self-regulating mechanism, which can protect personal systems from negative consequences in difficult stages of life, explicitly recognizing that adaptation is inherently multilevel.
Connor and Davidson (2003)	Clarified resilience in the characteristics that identify people capable of facing adversity; define it as the set of qualities, resources or strengths that favor individuals to progress successfully facing adversity.
RAE (2017)	Adaptation capacity of a living being in front of a disturbing agent or adverse state or situation.

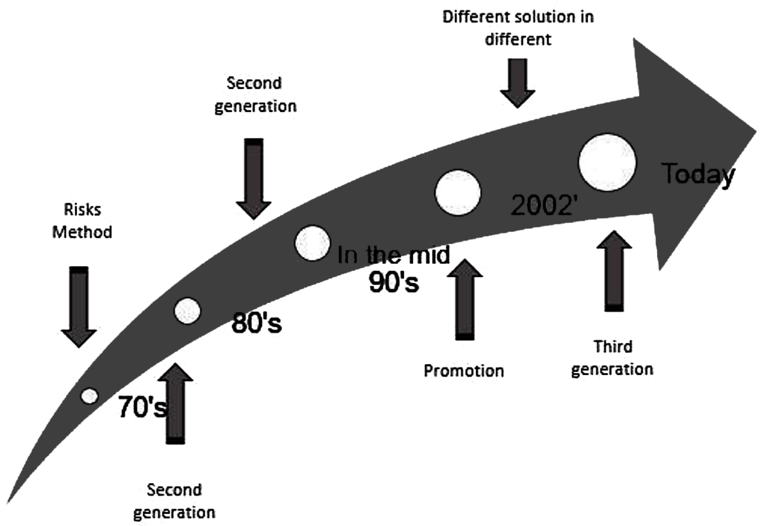
Source: Own elaboration based on the authors cited (2016)

RESILIENCE TIMELINE

As a summary, the evolution that resilience has had describes, as well as the generations, as described in Figure 1.

For three generations, the concept of resilience developed. The first was in the early 70's focused on discovering the protective factors (Kaplan 1999). This study bases on Werner (1992). Other authors who started with the dynamic notion of resilience were Rutter (1991), in Infante (1997, p10). In conclusion,

Figure 1. Evolution of resilience
Source: Own elaboration based on Suárez, Barna, Kotliarenco & Munist (2009)



this generation states that resilience is a set of personal characteristics: Empathy, affectivity, autonomy, humor and competence.

The second generation where resilience defines it as a dynamic process, the influences of the environment and the individual interact in a reciprocal relationship that allows people to adapt to think about adversities. The authors of this generation are Luthar and Cushing (1999), Kaplan, (1999), Masten (2001) and Bernard (1999). These researchers establish a transactional ecological model, and this generation point out the process that leads people out of adversity. The processes can be intrapsychic, social and relational. In this generation, the work of Grotberg (1996, p.3) stands out for establishing resilience factors, divided into internal strengths such as: I am or I can; and external strengths, external support received; I have, social skills and conflict resolution acquired, and I can.

The third generation, a holistic model of resilience is developed. It is an innovative proposal in personal or social resources. One of the tendencies is to integrate and harmonize different models in new operative models, as in Kumpfer (1999), can be observed in a summarized way in Table 2.

The generations described in the timeline explain in Table 3 and Table 4 their respective contributions according to the evolution from the definitions are from the work of Becoña (2006) and Villalba (2004).

DIMENSIONS OF RESILIENCE

The different authors classify the resilience in dimensions. The following section describes some of them.

1. Vanistendael (1997) proposes five dimensions of resilience, as shown in figure 2.
    a. **Existence of Informal Social Networks:** The person has friends, participates in activities with them and does so with pleasure; In general, he has good relations.

Table 2. Development of resilience in three generations

Generation	Author/Year	Definition	Focus
First	Gamerzy and Masten (1986)	Ability to return to the patterns of adaptation and competence that characterize the individual before the stressful period.	Characteristic
	Lösel, Blieserener and Koferl (1989)	Effective confrontation of circumstances and life events severely stressful and cumulative.	Characteristic
Second	Rutter (1993)	Resilience characterizes as a set of social and intra-psychic processes that make it possible to have a healthy life, living in an insane environment. These processes would take place over time, giving fortunate combinations between the child's attributes and their family, social and cultural environment.	Process
	Osborn (1994)	The generic concept of resilie2nce refers to a wide range of risk factors and the results of competition. It can be the product of a conjugation between environmental factors. For example, temperament and a type of cognitive ability those children have when they are very young.	Process
	Luthar and Cushing (1999)	As a dynamic process where the influences of the environment and the individual interact in a reciprocal relationship that allows the person to adapt despite adversity.	Process
Third	Luthar, Cicchetti and Becker (2000)	Resilience is a dynamic evolutionary process that implies a positive personal and social adaptation of the individual despite exposure to very significant risks, (p. 543).	Process
	Masten (2001)	Resilience is a habitual response and means a healthy adjustment to adversity (...) characterized by good results despite the threats to adapt to development.	Process
	Manciaux, Vanistendael. Lecomte, and Cyrulink (2003)	Resilience is the ability of a person or a group to develop, to continue projecting into the future despite the presence of destabilizing events, despite the presence of difficult or traumatic life conditions that are sometimes serious.	Process
	Luthar, (2006); Luthar, Cicchetti and Becker, (2000).	It is defined as a dynamic but evolutionary process that implies an adaptation of the individual better than would be expected, given the adverse circumstances	Process
	Liietz and Strength (2011)	Resilience is not just a process that is limited to applying individual development. It is the ability to use strengths to overcome risk and maintain family functioning.	Process

Source: Own elaboration base don Kumpfer (1999)

Table 3. Generational differences of the concept of resilience

80's First Generation	90's Second Generation	2000 Current Generation
Capacity	**Process**	**Paradigm**
What distinguishes those individuals who adapt despite the predictions of risk. Emphasis on human capacity Human interpretation Post-hoc interpretation (posterior)	What is the dynamics between factors that allows a positive adaptation? Emphasis on promotion Search for protective factors Emphasis on the process Emphasis on the social context	What is the framework that explains that the resilient response is not the exception to the norm, but the usual one. Emphasis on the change of look. Emphasis on the development of application models
It "is" resilient	Is "being" resilient and it "learns"	It "builds" resilience

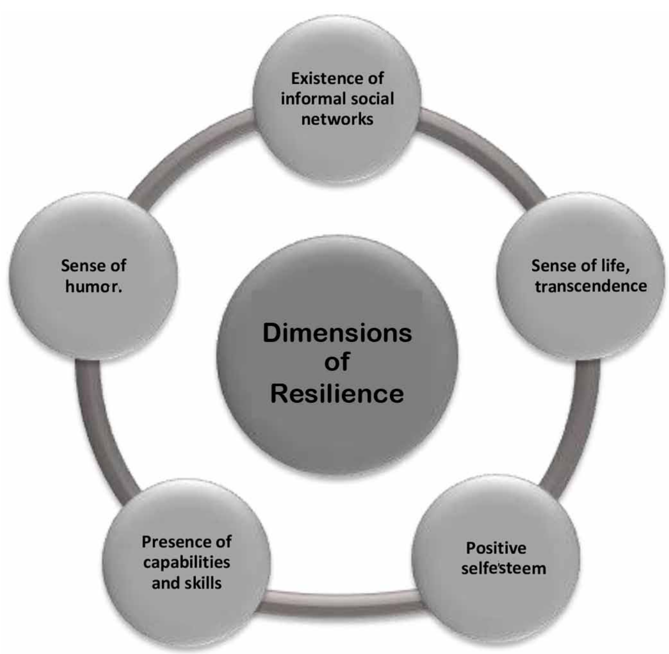
Source: Own elaboration based on authors cited (2016)

Table 4. Schools and main contributions

School	Authors	Perspective	Focus	Definition (Contributions)
Angloamerican	Rutter Michael Luthar Suniya Grotberg Edith.	It focused on a contextual conception of resilience, highlighting the interaction that exists between the person, their environment and the different ways that lead them to face adversity.	The person is nourished by the influences and relationships that he establishes with the environments and contexts to develop an adaptation process.	Resilience is a dynamic, diachronic and a process. The risk and protection factors based on the context. Resilience promoted between the person and their environment. The circumstantial resilience to the fact of being human. Resilience fermented.
European	Cyrulnik Boris Losel Frederick Vanistendael Stefan Manciaux Michel.	This school characterized by giving greater emphasis to the intervention with the person, who is at risk, the professionals with whom they relate and the culture to which they belong, to make changes in the environment and to the empowerment of protection factors and mechanisms.	The person as protagonist to develop a process of adaptation, development and promotion and interaction with their socialization environments.	Resilience is a diachronic and synchronic process between the person and their environment. Resilience is circumstantial to the fact of the human being. Resilience fostered by figures who act as "resilience tutors" Resilience is a generating capacity for human development.
Latinoamerican	Melillo Aldo Suárez Ojeda Elbio Kotliarenco.	This acquires a community dimension. On the one hand, it established that the person builds resilience within the community, and on the other hand. It pointed out that resilience is part of a collective process that originates socially.	The community is the one that originates a process of resilience that later influences the individual.	Resilience is an individual and collective process. Resilience promoted from the community. Resilience fostered at a group and community level has a multiplying effect.

Source: Own elaboration based on Becoña (2006) and Villalba (2004)

Figure 2. Dimensions of resilience
Source: Own elaboration based on Vanistendael (1997)



b. **Sense of Life, Transcendence:** The person shows ability to discover a meaning and coherence in life.
c. **Positive Self-Esteem:** The person values himself, trusts in his abilities and shows initiative to undertake actions or relationships with other people because he feels valuable and worthy of attention.
d. **Presence of Aptitudes and Skills:** He is able to develop his skills and trust them.
e. **Sense of Humor:** The person is able to judge, laugh, enjoy positive emotions and enjoy their experiences.

2. Davidson (2012) proposes six dimensions. In affective neuroscience is related to educational research on the work of teachers, their life and their effectiveness, the following dimensions are identified.
   a. **Resilience:** How slowly or quickly he or she recovers from adversity.
   b. **Attitude:** For how long is he or she able to stay in a positive emotion.
   c. **Social Intuition:** How well it gives him or her to capture the social cues of the people around him or her.
   d. **Awareness of Oneself:** How well he or she perceives bodily sensations that reflect emotions.
   e. **Sensitivity of the Context:** How well he or she is able to regulate your emotional responses to take into account the context in which he or she finds himself or herself
   f. **Attention:** How sharp and clear his or her ability to focus on something is.

Within the dimensions of resilience are emphasized the characteristics that allow people to overcome adversity or disruptive situations. Among them: ability, adaptability, and low susceptibility, effective confrontation, ability, and competence, resistance to destruction, positive life behaviors, special temperament and cognitive abilities.

Characteristics to Develop Resilience

Based on Saavedra (2005) there are protective factors in the different areas of development of a resilient person that allow them to overcome adversity. They described below:

1. **Personal Factors:** It is the highest intellectual level in the verbal and mathematical area, willingness to social approach, positive sense of humor and a balance in the biological state.
2. **Cognitive and Affective Characteristics:** Greater empathy; Greater self-esteem; Greater motivation to achieve; Greater feeling of self-sufficiency; Less tendency to feelings of hopelessness; Greater autonomy and independence; Confrontation skills characterized by orientation towards tasks; Greater activity aimed at solving problems and better economic management; Less tendency to avoid problems and less tendency to fatalism in difficult situations.
3. **Cognitive and Affective Factors:** They are empathy, an optimal self-esteem, the motivation of achievement, the feeling of self-sufficiency and the confidence that the problems solved.
4. **Psychosocial Factors:** A pleasant family atmosphere, mothers who support their children, open communication, a stable family structure, good relationships with peers, social support (emotional, material, informative, delivery of values).

According to Mrazek and Mrazek (1987) cited by Palomar and Gómez (2010) there are 12 skills that distinguish a resilient person.

Distinctive Resilience Skills

According to Mrazek and Mrazek (1987) cited by Palomar and Gómez (2010) there are 12 skills that distinguish a resilient person.

1. **Rapid Response to Danger:** The ability to recognize situations that put the subject at risk.
2. **Early Maturity:** Development of the capacity to take charge of oneself.
3. **Affective Untying:** It is the separation of intense feelings about oneself.
4. **Information Search:** It refers to the concern to learn everything related to the environment.
5. **Obtaining and Using Relationships That Help Subsist:** The ability to create relationships that benefit the person at critical moments.
6. **Positive Projective Anticipation:** It refers to the ability to imagine a better future to the present.
7. **Decision to Take Risks:** It is the ability to take personal responsibility when decisions made even if the decision has some kind of risk.
8. The conviction of being loved and believe that someone can be loved by others.
9. **Idealization of the Rival:** The person identifies with some opposing characteristic.
10. **Cognitive Reconstruction of Pain:** The ability to identify negative events in the way that is most acceptable.
11. **Altruism:** It refers to the pleasure of helping others.
12. **Optimism and Hope:** The willingness to take positively the things that could happen in the future.

Disruptive Situations

Disruptive is a term *disruptif* of French origin and in English is disruptive, used to name that which produces a sudden break or a decisive change. Individuals have disruptive behaviors, or behaviors that are disruptive, that is, behavior that is characterized by being bad manners, insolence, lack of cooperation, disrespectful, disobedient, aggressive, provocative, impulsive. This behavior observed in different environments. That is, in those unexpected circumstances, disruptive events, that generate devastating situations and that originate moments of crisis

In the disruption, three basic elements are considered: (i) a source that causes the disruption, (ii) a disruptive event that causes a disturbance with negative effects for the organization, and (iii) a consequence that is consolidated as the alteration of the normal operating conditions, as mentioned by Sanchis and Poler (2014, p.47).

Laverde and Rivera (2017, p.5) state that Rivera (2010, pp. 590-613) there is no consensus on its meaning. On the contrary, different typologies proposed to describe the turbulence, such as hostility, uncertainty, munificence, dynamism (Terreberry, 1968, Ansoff, 1993, Dess and Beard, 1984, D´aveni, 1994). Hu, Li, and Holloway (2008) explain that organizations consist of external resources such as suppliers, manufacturers and customers. In the case of inmates such as human, material, financial, technical or technological, they are interconnected, working to provide products or services to end customers. Based on this definition, for them a disruptive event is a situation that will lead to the partial loss of resources, which can cause a significant impact on the economy, so that the organization needs to start again with the necessary work to recover.

Sheffi and Rice (2005) state that any significant disruption has consequences on the performance of the organization, whether measured in sales, production level, benefits, customer service or other relevant metrics. They also classify the disruptions into random, such as natural disasters, accidents and intentions such as terrorism or sabotage.

MODELS OF RESILIENCE

In a first attempt to identify, classify and order the risk and protection factors, Grotberg (2003);-Henderson and Milstein (2003) and Vanistendael and Lecomte (2002), have developed the models recognized to date.

The Model of Interactive Sources in Resilience

This model classifies the resilient characteristics of people into three pillars Grotberg (2003), as shown in Figure 3.

- **I have:** They are characteristic aspects of resilience linked to those conditions that surround people, such as formal supports school, social and informal as a family, or groups of equals.
- **I am:** These are characteristic aspects associated with some personal abilities, such as social competence, autonomy or self-esteem.
- **I Can:** These aspects relate to some interpersonal skills and abilities such as the capacity for introspection, initiative and independence.

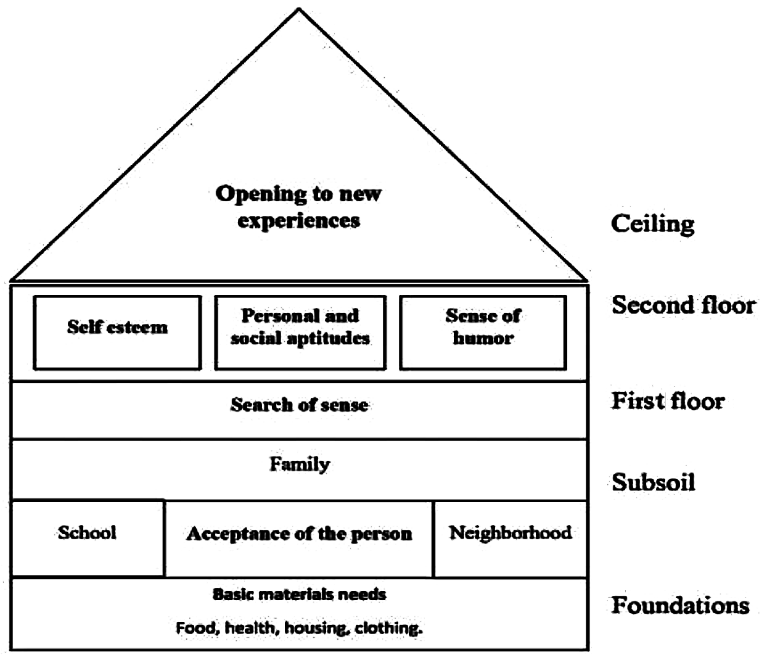
Resilience Building Model or Resilience House

Vanistendael and Lecomte (2002), take the model of a house with different rooms representing different domains, which intervene in the development of resilience in the different stages of development. It is a qualitative model, which originally began as a communication tool comprehensively presents the key elements of resilience, as shown in Figure 4, these are:

- **Floor:** It represents the basic needs and elementary health care. These foundations linked to the feelings of acceptance and fundamental esteem. As well as with informal social support networks such as family and friends.
- **Low Level:** It is associated with the ability to discover what the meaning of each person's life is.
- **First Floor:** It is where self-esteem, skills and competences found, as well as a sense of humor.
- **Attic:** Here are the experiences discovered and constitutes the opening to experience.

Figure 3. Interactive sources model
Source: Grotberg (2003)

Figure 4. House of resilience
Source: Vanistendael and Lecomte (2002, p. 175)



Therefore, the house of resilience is not like something absolute. The different authors declare that each person can build, adapt or repair it according to their needs. Each room of the house must communicate with the others representing the interrelation between each of the domains (Vanistendael and Lecomte, 2002).

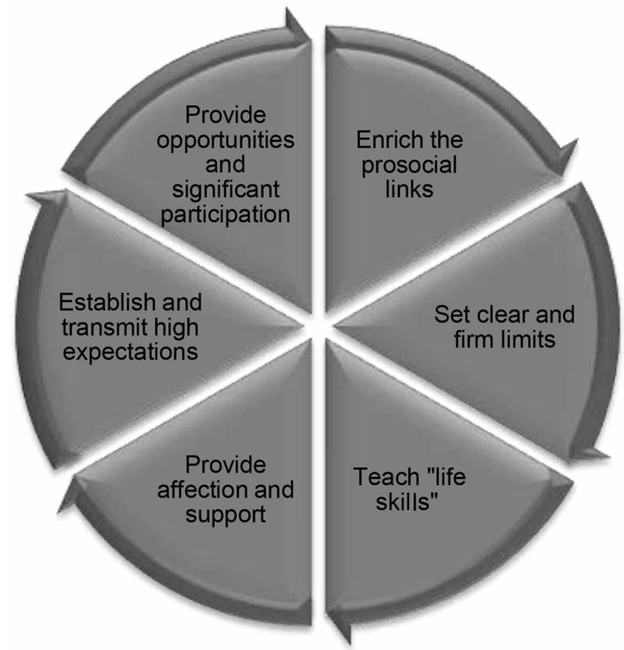
Model of the Wheel of Resilience

The wheel of resilience is a tool that consists of a central circle where personal characteristics written and around which are added the various strengths, achievements, skills and support networks with which the individual has. Building resilience in the environment in this area, the wheel is a resource that allows identifying risk and protection factors and vulnerability factors and this allows planning strategies to promote positive development in adverse situations. To mitigate the risk factors in the environment (Henderson & Milstein, 2003), as shown in Figure 5.

Model of Davidson

Within the dimensions of resilience are emphasized the characteristics that allow people to overcome adversity or disruptive situations. Among them: ability, adaptability, and low susceptibility, effective confrontation, ability, and competence, resistance to destruction, positive life behaviors, special temperament and cognitive abilities. It is important to consider the relationship of educational research on teachers' work, their lives and their effectiveness, Davidson (2012) proposes six dimensions: Resilience, Attitude, Social Intuition, Awareness of Oneself, Sensitivity of the Context, and Attention.

Figure 5. Wheel of resilience
Source: Henderson and Milstein (2003)



Factors of Resilience on Scale (RESI-M)

1. **Strength and Self-Confidence:** It is to believe in yourself and in your own abilities and abilities, is to recognize that you have yourself and recognize your own strengths. Strength is tolerance to negative situations and the strengthening of the effects of stress; refers to the set of positive expectations about oneself or more specifically about one's actions, is having or developing the ability to accept or cope with events despite the stress they bring, is to understand that life has meaning.
2. **Social Competence:** The ability or ability of the human being to interact successfully with his environment and achieve the satisfaction of their needs. It is to understand that life has meaning and evaluate their own contributions and exert a certain influence on their peers; taken into account, it is a quality very related to the health, emotional adjustment and well-being of the individual. Establish interpersonal relationships with people who provide support and trust and allow personal development, individuals must seek, be flexible to adapt to new situations.
3. **Family Support:** It is the time that family members share, the strength and loyalty that exists between them.
4. **Social Support:** It refers to the links between the individual and a defined set of people, with whom the exchange of communication, solidarity and trust is feasible.
5. **Personal Structure:** It is the ability of people to promote their well-being, behaving and acting according to what they want or have decided to do with their life. In addition, they are the rules and activities that people carry out, that make it easier for them to have organization and order in their life.

RISK AND PROTECTION FACTORS

When we talk about resilience, it means talking about protective and risk factors, how they influence, since they facilitate the protection of individuals who find themselves in adverse situations. Risk factors defined as those social, economic or biological conditions, behaviors or environments that are associated with the increase of susceptibility. It is worth mentioning that, based on resilience, there are certain processes and / or mechanisms that absorb and moderate stress that counteract risk. Based on the observations, Masten and Gamerzy (1985) grouped some variables that, according to their observations, operate as protective factors, as shown in Figure 6.

Considering positive compensating factors that are associated with adaptation to adversity that allow us to develop resilience.

Above all, for the human being to develop resilience in Table 5, the protection and compensation factors associated with resilience described.

Albee (1985) cited by Morón, Pérez and Pedrero (2017) relates the risk and protection factors in the promotion of resilience and establishes an equation, as can be seen in figure 7.

The Albee equation (1985) relates the psychosocial development is the result of the sum of the risk factors and the protective factors. By promoting protection factors, the empowerment of people promoted. This facilitates the experience of mastery, power and control of the person over their own life, promoting learning, the development and strengthening of coping skills and personal competencies, as well as the resources of the context, the social support networks, its competence and validity (Costa and López 2006).

According to Luthar, Cicchetti and Becker (2000) Manciaux (2004), resilience summarized in four major categories, as shown in figure 8.

EMPIRICAL REVIEW

- González and Valdez (2013) represent different factors in order, with different ages. Children and adolescents, classifying these factors in internal and external. When applying the instrument, it found that in women, it gave a higher percentage compared to men and age has an impact. Promote

Figure 6. Protective factors
Source: Own elaboration based on Masten and Gamerzy (1985)

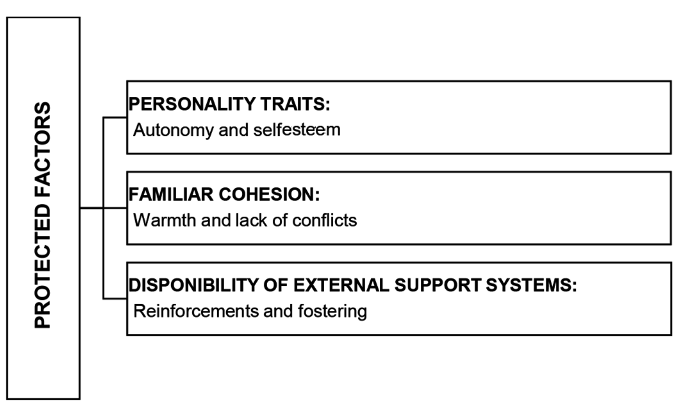


Table 5. Protection and compensation factors

Characteristics	Description
Of the human being	Good cognitive abilities, problem solving and executive functioning. Sociability and ability to adapt to the social environment. Ability to create and maintain social relationships. Self-esteem and self-efficacy. Characteristics valued by society (human talent, attractiveness). Positive outlook on life, hope and optimism. View. Ability to make sense of life. Empathy capacity.
Family members	Stable family environment. Harmonious relationship between parents. Feeling loved and cared for. Appropriate educational parental style. Establishment of norms and limits. Positive relationships with the extended family. Parents involved in the education of their children. Good educational level of parents. Religious affiliation. Socioeconomic status.
From the community	Safe neighborhood. Low levels of violence. Clean environment. Comfortable houses. Access to cultural, recreational or library centers.
School	Competent teachers. Support structure suitable for students with special educational needs. Extensive resources (musical, sports). High degree of employability for adults and adolescents. Health coverage. Access to emergency services (police, firefighters). Lying systems, other supports.
Social and cultural	Support policies for (children, women). Policies to prevent violence.

Source: Own elaboration based on Becoña (2006), Brooks and Goldstein (2004) and O 'Dougherty,-Masten and Narayan (2013).

healthy habits and mental health at different ages. In this work, a 32-item instrument used with an Alpha of Cronbach's of 0.890, with internal factors that measure the ability to solve problems and external factors such as having family support or significant people, altruistic, pro-social behavior. A sample taken composed of 607 participants divided into four age groups.

- Validity of the scale of resilience of Connor-Davidson (10 items) in a population of non-institutionalized elderly (Serrano, Garrido, Notario, Bartolome, Solera, and Martínez, 2012). The Spanish version of the CD-RISC-17 showed good psychometric properties and therefore can be used as a 25-item instrument, with an Alpha of Cronbach's 0.79 with a sample of 168, dimensions of: personal control, social competence are handled and personal. To measure the resilience in the population of non-institutionalized elderly, taking into account the sex age, level of study, marital status, level of savings, own housing. The data of the study seems more appropriate a version in Spanish of the CD-RISC of 17 items distributed in three dimensions, shows acceptable psychometric properties and correlates with social support, perception of stress, depression and mental component of quality of life.

Figure 7. Albee equation
Source: Albee (1985)

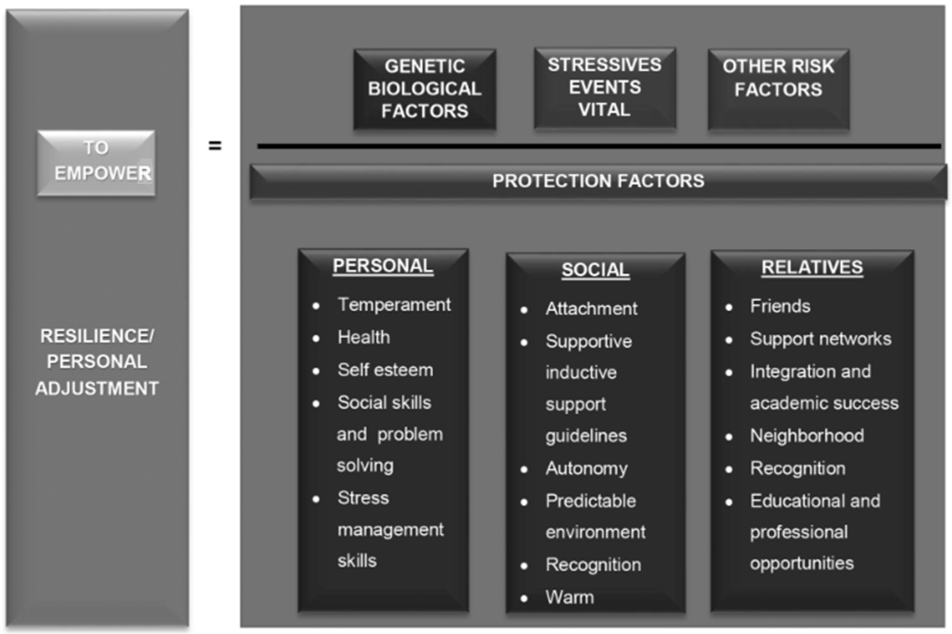
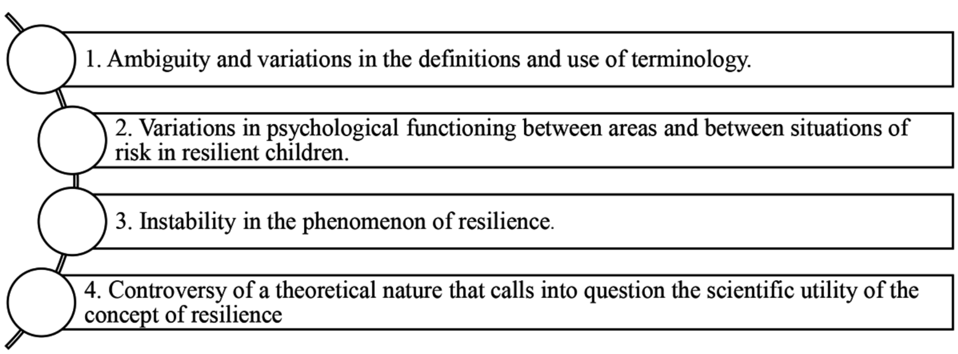


Figure 8. Resilience categories
Source: Luthar, Cicchetti and Becker (2000) and Manciaux (2004



- Resilience. Conceptualization and research in Argentina (Losada and Latour, 2013). The measurement of business resilience in the model of the eight stages of a disruption of Sheffi and Rice (2005) is of vital importance for companies to adopt a proactive attitude. In this way, are always ready to give a quick response, effective and efficient before a disruption and minimize the negative effects on the performance of the company, and of the individuals themselves.
- Measurement of Business Resilience before Disruptive Events. A Review of the State of the Art (Sanchis and Poler, 2011). The measurement of business residency must include components such as the company's adaptive capacity, vulnerability, the probability of occurrence of a disruptive

event, the time and level of recovery, the competitive position of the organization, the commitment and responsibility of the chain of supply, and the cost of redundancy, among others. It is necessary to define the metrics to assess the resilience that must be coherent for those who make decisions in organizations, as well as directly relevant to the general objectives of the organization. It is important to include components such as the company's adaptive capacity, vulnerability, the probability of occurrence of a disruptive event, the time and level of recovery, the competitive position of the organization and the individuals themselves.

- Development of a scale for measuring resilience with Mexicans (Resi-M) Palomar and Gómez (2010). Resilience is not one-dimensional; people have or do not have the possession of multiple skills in various degrees that help individuals to cope with adverse situations. Some overcome adversity, but come out strengthened from it. These people called resilient. At an individual level, it is very important to consider behaviors such as setting goals, being motivated, being committed, having self-control, being responsible, making decisions, facing problems objectively and peacefully, having a locus of internal control and a sense of life, as well as be optimistic; These are very powerful tools to face situations. In addition, the individuals themselves must develop skills and strategies to face adverse situations. A 43-item instrument and an Alpha de Cronbach .89 developed, a sample of 217 people, age range was from 18 to 25 years. Considering five factors: 1) Strength and self-confidence, 2) Social competence, 3) Family support, 4) Social support and 5) Structure, likewise sex and age considered.
- Resilience: Is it possible to measure and influence it? Monroy and Palacios (2011). The term resilience is a Castilianization of the English word resilience or resiliency, originally used in thermodynamics. In the biological sciences defined as the ability of an ecosystem or an organism to return to stability when suffering an alteration. In psychosocial research, consider risk factors, their own, protective, vulnerability and family. Resilience is a combination of personal and contextual factors, and is related to other terms such as: protective, risk and vulnerability factors, which describe the predisposing elements of the subject, the personal character and those of the environment that influence healthy behavior or contextual of the concept of resilience
- Measurement of the resilient characteristics, a comparative study in people between 15 and 65 years old (Saavedra and Villalta, 2008). The measurement of resilience, considers the factors, in subjects of different age groups and of both sexes, through the SV-RES test, in a Chilean sample, during the second semester of 2007. The instrument, Scale SV-RES (CHILE), developed by Saavedra and Villalta, consists of 60 items, divided into 12 factors; with Cronbachh's alpha is 0.96. The resilient characteristics measured in people between 15 and 65 years old. The results are that there is no statistically significant difference between the resilience levels of women and men; however, a different resilient profile described between both genders. Similarly, the levels of resilience are not directly associated with the age groups, since similar results obtained in the different stages of life.
- Disruption: The starting point of resilience or business failure (Reflections from engineering) (Laverde and Rivera, 2017). The resilience of an organization could have positive and significant effects both for the workers themselves and at the global organizational level. Work carried out in the field of occupational prevention, and it emphasized that resilience relates to the well-being of workers. In addition to the relationships with occupational health, it related to work performance,

which is why it is necessary to promote occupational health. It is important to emphasize that intervention at the individual, organizational and global levels is necessary, thus managing to overcome adverse events.

- The phenomenon of resilience in welfare and work performance (González Piedra, 2013). Consider the psychosocial risks and the results of health and performance does not require great costs. Looking for that the workers will be able in a relaxed environment, improve their skills and their vision to the labor demands, increasing the satisfaction and the motivation, to carry the difficulties or challenges that their positions require, so resilience is useful in the prevention of occupational risks. There is a relationship between occupational health and work performance, it is necessary to prevent psychosocial labor risks so that workers can overcome the different difficulties with success.
- Study of the sources of resilience: perception of risk factors and protection against different stressful events (Mikulic, Crespi, Cassullo, Fernandez, Caruso, Labandal, and Kohan Cortada, 2008). In many researches, the protective character that the support and acceptance of significant others has in the face of adversity is recognized, contributing also to the increase of self-esteem and psychological well-being. The Structured Interview used to evaluate Risk Factors, Protection and Resilient Potential (ERA, Mikulic, Crespi, 2003). This instrument allows the evaluation of risk and protection factors, through nine dimensions that include levels of personal, family and social analysis.

Personal factors such as optimism, patience, active position in the face of difficulties, religious beliefs, self-esteem and willpower identified as positive characteristics that favor coping with risk. The factors of vulnerability, the presence of negative personality characteristics such as anxiety, impulsivity, poor self-control, emotional instability, among others. The characteristics and conditions, personal and contextual, that operate as a source of protection, in situations independently of the nature of the adverse event, it is relevant to assess in each situation the effectiveness and functionality of the resources and factors, it is important to revalue the resilient potential of each person facing adversity.

CONTEXT AND PROBLEMATIZATION

The Lázaro Cárdenas Technological Institute (ITLAC) was born due to the lack of a Higher Level Studies Center in Lázaro Cárdenas Michoacán de Ocampo. A group of enthusiastic people decided to join and form the Pro-Foundation Board of the Higher Studies Center of Lázaro Cárdenas for the creation of this unit, since it was very expensive for parents to move their children to other cities. Currently the National Technological Institute of Mexico is the maximum house of studies in this city, which has 30 years of service.

Since its foundation, on October 13, 1987, it had only two careers, to which new academic offers added. Today there are study plans for eight different careers: six engineering and two bachelor's degrees, in addition to being able to perform a mastery The Institute has values, mission, vision and quality policy, as well as the certifications in ISO 9001: 2008 / NMX-CC-9001-IMNC-2008, SCS and SGA. The Institute has a teaching staff of 113 teachers, (50) full-time, (4) three-quarters of time, (8) part-time and (51) per subject.

In this article we seek knowledge and approximations of the factors related to the measurement of resilience. This process occurs when the individual exposed to adversity, with great efforts to contain it and end up orienting themselves positively despite suffering aggressions throughout the development process, they themselves face disruptive situations such as being part of a floating population, insecurity, work environment, working conditions, illness, divorce.

WORK HYPOTHESIS

Ho: The level of resilience affects the professional development of the teachers of the Technological Institute of Lázaro Cárdenas.

RESEARCH METHODS

Type of Research

Transverse Descriptive Research

We worked with a population of 113 teachers and 100 surveys recovered, so the sample is one hundred teachers, which processed in the software SPSS 20 obtaining an average of 3.03 and a standard deviation of 0.009.

Research Design

The design of this research focuses on how to obtain information to perform the analysis and determine the main findings and conclude. For the design of the survey, existing instruments used as a basis, which were used to measure the resilience of the staff of the Technological Institute of Lázaro Cárdenas. For the correct design of the measurement instrument, the objective of the investigation taken as a basis. We consider it of the utmost importance that linking the objectives with the questions of the survey allows us to obtain more clear and precise information, as well as facilitating the analysis.

Population and Sample

The population of this study is composed of 113 teachers from the National Institute of Mexico Lázaro Cárdenas in Michoacán de Ocampo.

Sample: The present investigation applied the surveys to all the personnel, but one hundred 100 were recovered. This is how the sample of 100 ITLAC teachers is established, later the information collection was carried out, of which a total of 100 were received instruments in a confidential manner with complete answers, information with which the analysis was carried out in the SPSS software, which allows obtaining the Cronbach's Alpha, from tests based on classical test theory. That is, it is a procedure used to calculate the reliability and validity of instruments.

Research Instrument

The instrument applied is the Mexican Resilience Scale (Resi-M) that consists of 43 items, classified into five factors: 1) Strength and self-confidence, 2) Social Competence, 3) Family support, a) Social support and 5) Structure. It validates with the Alpha of Cronbach's 0.942. For the development of the investigation, in order to measure the resilience to the personnel of the technological institute of Lázaro Cárdenas, the instrument applied to 100 workers.

Concentration of Information

Once the appropriate research design was completed and finished, the measurement instrument (RESI-M) applied; the next step was to collect the necessary data to measure the variables of the study. To achieve the information concentration, a data dump made, obtained from the surveys in the software SPSS version 20, to perform the analysis of data obtained, and then proceed with the corresponding statistical calculations.

Coding and Interpretation of Results

The information processed in SPSS software version 20, after which the analysis of the obtained data performed. The analysis of quantitative data carried out by means of graphs, percentages and statistical calculations; enriched by a qualitative part of the information obtained.

ANALYSIS OF THE RESULTS

Sex

Regarding gender, there are more men teachers than women teachers, as shown in Table 6.

The Figure 9 shows the gender of the ITLAC teaching staff, 66% male and 34%.

Age

In age, the bulk of the teaching staff is between 30 and 50 years old, as shown in table 7, 18% between 30 and 40 years, 27% of staff between 41 and 45 years, 24% between 46 and 60 years, 23% 51 and 60 years. You can say that the staff is young.

Table 6. Sex of the ITLAC teaching staff

	Female	**Male**
Sex	*34%*	*66%*

Source: Own elaboration 2017

Figure 9. Sex of the teaching personnel of the ITLAC
Source: Own elaboration 2017

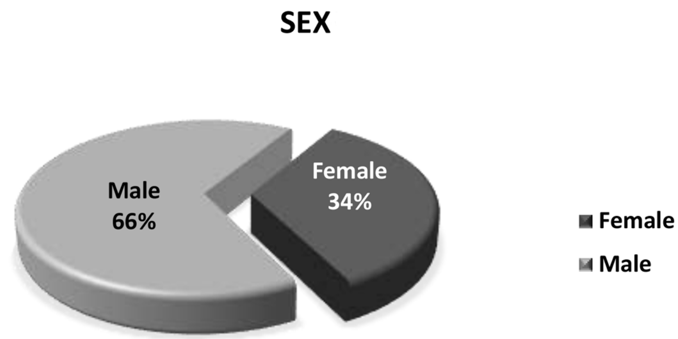


Table 7. Age of the ITLAC teaching staff

Age	Less than 30 years	30-40 years	41-45 years	46-50 years	51-60 years	60 or more
	1%	17%	26%	22%	26%	8%

Source: Own elaboration 2017

Civil Status

Table 8 shows the civil status of the teachers of the institute.

Scholarship

In the schooling of teachers, there is a high percentage (73%) with a degree, (23%) with a master's degree and (4%) teachers with a doctorate, as shown in Table 9.

Figure 10 shows the schooling of the staff.

Table 8. Schooling of the ITLAC staff

Married		Divorced		Singles		Single mother	Widow
F	M	F	M	F	M	F	F
20	58	7	6	3	2	3	1

Source: Own elaboration 2017

Table 9. Schooling of the ITLAC staff

Scholarship	Bachelor	Master degree	PhD degree
	73%	23%	4%

Source: Own elaboration 2017

Figure 10. Schooling of the ITLAC teaching staff
Source: Own elaboration 2017

The schooling at the beginning of work and currently of the ITLAC teachers in Table 10 describes the comparison.

The training during 2016 of the ITLAC teachers in Table 11 describes the comparison.

Plaza-Time

In Figure 11 shows the type of place-time of the teaching staff of the Technological Institute of Lázaro Cárdenas.

The 40% have a full-time position, 4% have a three-quarter time, 6% have a part-time position, and 50% are part-time and subject-based.

Figure 12 describes that 55% of the personnel does not know the concept of resilience.

Table 10. Comparative data of schooling of the ITLAC teaching staff

Scholarship	**Initial**	**Bachelor**	**Specialty**	**Master**	**Doctorate**
		91%	0.769%	3.077%	1%
	Currently	**Bachelor**	**Specialty**	**Master**	**Doctorate**
		73%	0.769%	23%	4%

Source: Own elaboration 2017

Table 11. Training of the ITLAC teaching staff

Training	**Courses taken**		
	1-2	3-4	5 or more
	43%	26%	26%

Source: Own elaboration 2017

Figure 11. Description of place-time of the ITLAC teaching staff
Source: Own elaboration 2017

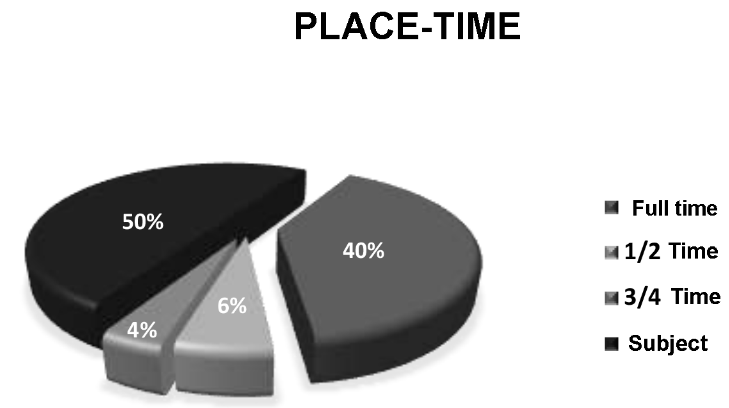
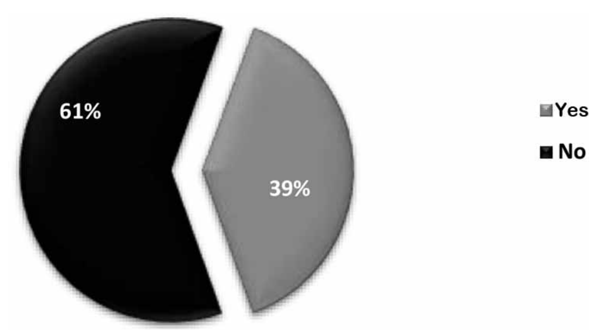


Figure 12. Knowledge of the concept of staff resilience
Source: Own elaboration 2017



Once the factor analysis is done, the KMO index is used to compare the magnitudes of the partial correlation coefficients, so that the smaller the value, the greater the value of the partial correlation coefficients ij (p) r.

The Table 12 describes the weighting by Kaiser-Meyer-Olkin for a Factor Analysis.

In practice, there are other tests to perform the factorial analysis, but for the purposes of this study, the KMO used.

Based on the Kaiser-Meyer-Olkin weighting evaluation, the results described in Table 13.

Table 12. Kaiser-Meyer-Olkin weighting

Káiser-Meyer-Olkin (KMO)	
KMO ≥ 0.75	Good
KMO ≥ 0.5	Acceptable
KMO < 0.5	Unacceptable

Source: Own elaboration 2017

Table 13. Kaiser-Meyer-Olkin weighting

Factor	Káiser-Meyer-Olkin	Items	Weighting
1. Strength and self-confidence	KMO ≥ 0.50	17	Acceptable
	KMO ≥ 0.75	2	Good
2. Social competence	KMO ≥ 0.50	17	Acceptable
	KMO ≥ 0.75	2	Good
3. Family support	KMO ≥ 0.55	5	Acceptable
	KMO ≥ 0-75	3	Good
4. Structure	KMO ≥ 0.55	1	Unacceptable
	KMO ≥ 0.75	4	Acceptable

Source: Own elaboration 2017

Based on the Kaiser-Meyer-Olkin weighting, observes that the factor 1, 2, 3 does not have any inconvenience, only the factor 5 Structure, a question is unacceptable. It is considered for future measurements the question will be modified.

For factor 1. Strength and self-confidence, the factorial load is described in table 14, the measurement of resilience is 62%, and it is a moderate percentage.

For the factor 2 social competence, the factorial load described in table 15, the level of resilience is 55% is below the percentage.

For the factor 3. Family Support, the factorial load is described in table 16, the level of resilience is 73% is acceptable.

Factor 4. Social support, the factorial load described in table 17; the level of resilience is 73% is acceptable.

In factor 5. Structure 55%, the factor load described in table 18; the level of resilience is very low.

CONCLUSION

To measure resilience it is necessary to consider different factors and characteristics of the individual that influence the development of the institution, career accreditation, professional development, postgraduate studies, as well as offering external services that generate an economic benefit that benefits to the institution. The approach is multidisciplinary resilience. It occurs in the processes that live individually or in groups that go through crisis, including families, integrated after an adversity, as well as the contributions of different perspectives or sciences that allow analyzing and describing the impact of the factors, the context in the different ecological, social, and health, organizational, educational and business environments.

The objective of the research carried out in the measurement of the resilience of the staff of the Technological Institute of Lázaro Cárdenas and performing the analysis of the level of resilience.

The test of the hypothesis validated with the results obtained, for the factor 1. Strength and self-confidence, the level of resilience is 62%, it is a low percentage. This reflects that there is not enough self-confidence, and solve their problems and take control of their life, there is a degree of uncertainty.

Table 14. Factor load of factor 1

FACTOR 1 STRENGTH AND SELF-CONFIDENCE (ITEMS 1-19)		
Original instrument	**Item**	**Factor load**
D-RISC	1. What has happened to me in the past makes me feel confident to face new challenges	.669
D-RISC	2. I know where to look for help	.636
D-RISC	3. I am a strong person	.622
D-RISC	4. I know very well what I want	.706
D-RISC	5. I have control over my life	.538
D-RISC	6. I like challenges	.667
D-RISC	7. I strive to achieve my goals	.749
D-RISC	8. I am proud of my achievements	.630
RSA	9. I know I have skills	.763
RSA	10. Believing in myself helps me overcome difficult moments	.691
RSA	11. I think I will succeed	.733
RSA	12. I know how to achieve my goals	.739
RSA	13. Whatever happens, I will always find a solution	.506
RSA	14. My future looks good	.573
RSA	15. I know that I can solve my personal problems	.637
RSA	16. I am satisfied with myself	.722
RSA	17. I have realistic plans for the future	.653
RSA	18. I trust my decisions	.660
RSA	19. When I'm not well, I know that better times will come	.624

Source: Own elaboration (2016) from the data obtained in the field research and processed in SPSS software

Table 15. Factor load of factor 2

FACTOR 2 SOCIAL COMPETENCE (ITEMS 20-27)		
Original instrument	**Item**	**Factorial load**
RSA	20. feel comfortable with other people	.455
RSA	21. It is easier for me to establish contact with new people	.639
RSA	22. It is easier for me to make new friends	.664
RSA	23. It's easy for me to have a good conversation topic	.688
RSA	24. I easily adapt to new situations	.655
RSA	25. It's easy for me to make other people laugh	.451
RSA	26. I enjoy being with other people	.491
RSA	27. I know how to start a conversation	.399

Source: Own elaboration (2016) from the data obtained in the field research and processed in SPSS software

Table 16. Factor loading factor 3

FACTOR 3. FAMILY SUPPORT (ITEMS 28-33)		
Original instrument	**Item**	**Factorial load**
RSA	28. I have a good relationship with my family	.700
RSA	29. I enjoy being with my family	.787
RSA	30. In our family we are loyal to each other	.798
RSA	31. In our family, we enjoy doing activities together.	.746
RSA	32. Even in difficult times, our family has an optimistic attitude towards the future.	.687
RSA	33. In our family, we agree in relation to what we consider important in life.	.676
RSA	28. I have a good relationship with my family	.700
RSA	29. I enjoy being with my family	.787

Source: Own elaboration (2016) from the data obtained in the field research and processed in SPSS software.

Table 17. Factor load of factor 4

FACTOR 4 SOCIAL SUPPORT (ITEMS 34-38)		
Original instrument	**Items**	**Factorial load**
RSA	34. I have some friends / family who really care about me	.722
RSA	35. I have some friends / family who support me	.733
RSA	36. I always have someone who can help me when I need it	.804
RSA	37. I have some friends / family who encourage me	.755
RSA	38. I have some friends / family who value my abilities	.636

Source: Own elaboration (2016) from the data obtained in the field research and processed in SPSS software.

Table 18. Factor loading of factor 5

FACTOR 5 STRUCTURE (ITEMS 39-42)		
Original instrument	**Items**	**Factorial load**
RSA	39. Rules and routine make my life easier	.469
RSA	40. I keep my routine even in difficult times	.545
RSA	41. I prefer to plan my activities	.607
RSA	42. I work better when I have goals	.608
RSA	43. I'm good at organizing my time	.535

Source: Own elaboration (2016) from the data obtained in the field research and processed in SPSS software.

In factor 2 social competence, with a level of resilience of 55% is low, this reflects the behavior of interpersonal relationships, coexistence and communication of personnel. The factor 3 family support and 4, social support the level of resilience is 73% is acceptable and reflects a good family relationship and support from friends, significant people, recognition of family and friends.

In factor 5 structure the level of resilience is 55%, it is very low, this reflects problems with the achievement of objectives, goals, organization of time, that is, and there are no aspirations or motivation to make decisions to overcome set goals. In addition, this reflects with the statistics; with only 4% have a doctorate, 13% with a master's degree and 82% with a bachelor's degree. Resilience in women is higher than in men.

The findings are that the instruments applied in the different researches carried out based on instruments with different numbers of items, applied to different ages, in different contexts. The instrument (RESI-M) developed by Palomar and Gómez (2010) with a high degree of reliability for the measurement of resilience and for establishing strategies to develop individual and group resilience, in search of achieving better results in the Institution.

REFERENCES

Albee, G. (1985). The argument for primary prevention. *The Journal of Primary Prevention*, *5*(4), 213–219. doi:10.1007/BF01324537 PMID:24277528

Ansoff, R. (1993). Finfing a home for a psychology of volition. *Theory ogy,* (3), 323-336.

Atehortúa, M. (2002). Resiliencia: Otra perspectiva de las experiencias sociales y personales dentro de la empresa. *Estudios Gerenciales.*, *18*(82), 47–55.

Becoña, E. (2006). Resiliencia: Definición, características y utilidad del concepto. *Revista de Psicopatología y Psicología Clínica*, *11*, 125–146.

Bernard, B. (1999). Applications of resilience: possibilities and promise. In M. Glantz & J. Johnson (Eds.), *Resilience and Development: positive life adaptations* (pp. 269–277). Plenum Publishers.

Bronfenbrenner, U. (1979). *Ecology of human development*. Boston: Harvard University Press.

Brooks, R. B., Goldstein, S., & Bueno, B. (2004). *El poder de la resiliencia: cómo lograr el equilibrio, la seguridad y la fuerza interior necesarios para vivir en paz*. Paidós.

Connor, K. M., & Davidson, J. R. (2003). *Development of a new resilience scale*: The Connor - Davidson Resilience Scale (CD-RISC). *Depression and Anxiety*, *18*(2), 76–82. doi:10.1002/da.10113 PMID:12964174

Costa, M., & López, M. (2006). *Manual para la vida Psicológica. Dar Poder Vivir. Más allá del counseling*. Madrid: Pirámide.

Cyrulnik, B. (2001). *La maravilla del dolor*. Barcelona: Granica.

D'aveni, R. (1994). *Hypercompetition. Managing the dynamics of strategic maneuvering*. New York: Free Press.

Davidson, R. (Ed.). (2012). The psychobiology of consciousness. Springer Science and Business Media.

Dess, G. G., & Beard, D. (1984). Dimensions of organizational task environment. *Administrative Science Quarterly, 29.*

Friborg, O., Hjemdal, O., Rosenvinge, J. H., & Martinussen, M. (2001). A new rating scale for adult resilience: What are the central protective resources behind healthy adjustment? *International Journal of Methods in Psychiatric Research*, *12*(2), 65–76. doi:10.1002/mpr.143 PMID:12830300

Gamerzy, N., & Masten, A. S. (1986). Stress, competence and resilience: Common frontiers for therapist and psychologist. *Behavior Therapy*, *17*(5), 500–521. doi:10.1016/S0005-7894(86)80091-0

González, A. López, F. N., & Valdez, M. J. (2013). Resiliencia: Diferencias por edad en hombres y mujeres mexicanos. *Acta de Investigación Psicológica - Psychological Research Records, 3*(1), 941-956.

González, P. E. (2013). *Fenómeno de la Resiliencia en el Bienestar y el Rendimiento Laboral (Máster en Prevención de Riesgos Laborales)*. Universidad Oviedo.

Grotberg, E. (1996). *Guía de promoción de la resiliencia in los niños para fortalecer el espíritu humano. Holanda: La Haya*. Fundación Bernard van Leer.

Grotberg, E. (1998). I Am, I Have, I Can: What Families Worldwide Taught Us about Resilience. *Reaching Today's Youth. The Community Circle of Caring Journal*, *2*(3), 36–39.

Grotberg, E. (2001). *Nuevas tendencias en resiliencia. Resiliencia: Descubriendo las propias fortalezas*. Buenos Aires: Paidos.

Grotberg, E. (2003). Resiliencia, descubriendo las propias fortalezas. *Recuperado el*, *3*(5), 11.

Henderson, N., & Milstein, M. M. (2003). *Resiliencia en la escuela*. Buenos Aires: Paidós.

Hu, Y., Li, J., & Holloway, L. E. (2008). *Towards modeling of resilience dynamics in manufacturing enterprises: Literature review and problem formulation*. Automation Science and Engineering.

Infante, F. (1997). *Acciones específicas que los jóvenes y los agentes de salud toman para promover la resiliencia en los primeros. Tesis para postular al título de Psicóloga de la Universidad Diego Portales*. Santiago de Chile.

Kaplan, H. P. (1999). Toward an understanding of resilience. A critical review of definitions and models. In M.D. Glantz & J. L. Johnson (Eds.), Resilience and development. Positive life adaptations. Kluwer Academic/Plenum Press.

Kotliarenco, M. A., Cáceres, I., & Fontecilla, M. (1997). *Estado del arte en resiliencia*. Washington, DC: Organización Panamericana de la salud.

Kumpfer, K. L. (1999). Factors and processes contributing to resilience: The resilience framework. In M. D. Glantz & J. L. Johnson (Eds.), *Resilience and development. Positive life adaptations. Nueva* (pp. 179–224). Kluwer Academic/Plenum Press.

Laverde, V. G., & Rivera, R. H. (2017). La disrupción: El punto de partida de la resiliencia o del fracaso empresarial (Reflexiones desde ingeniería). *Espacios*, *38*(7), 5.

Liietz, C., & Strength, M. (2011). Stories of successful reunification: A narrative study of family resilience in child welfare. *Families in Society*, *92*(2), 203–210. doi:10.1606/1044-3894.4102

Losada, A. V., & Latour, M. I. (2013). Resilience. Conceptualization and research in Argentina. *Revista Latinoamericana De Ciencia Psicológica*, *4*(2), 84–97.

Lösel, F., Bliesener, T., & Koferl, P. (1989). *On the concept of invulnerability: Evaluation and first results of the Bielefeld project. In Children and risk: Assessment, longitudinal research, and intervention* (pp. 186–219). New York: Walther de Gruyter.

Luthar, S., & Cushing, G. (1999). The construct of resilience: Implications for interventions and social policy. *Development and Psychopathology*, *26*(2), 353–372.

Luthar, S. S. (2006). *Resilience in development: A synthesis of research across five decades*. Academic Press.

Luthar, S. S., Cicchetti, D., & Becker, B. (2000). The construct of resilience: A critical evaluation and guidelines for future work. *Child Development*, *71*(3), 543–562. doi:10.1111/1467-8624.00164 PMID:10953923

Luthar, S. S., Cicchetti, D. E., & Becker, B. (2000). The construct of resilience: A critical evaluation and guidelines for future work. *Child Development*, *71*(3), 543–562. doi:10.1111/1467-8624.00164 PMID:10953923

Manciaux, M. (2004). *La resiliencia: resistir y rehacerse*. Barcelona: Gedisa.

Manciaux, M., Vanistendael, S., Lecomte, J., & Cyrulnik, B. (2003). La resiliencia: estado de la cuestión. In *La resiliencia: Resistir y rehacerse* (pp. 17–27). Barcelona: Gedisa.

Masten, A. S. (2001). Resilience come of age: Reflections on the past and outlooks for the next generation of researchers. In M. Glantz & J. Johnson (Eds.), *Resilience and Development: positive life adaptations, Nueva York* (pp. 281–296). Plenum Publishers.

Masten, A. S. (2007). Resilience in developing systems: Progress and promise as the fourth wave rises. *Development and Psychopathology*, *19*(3), 921–930. doi:10.1017/S0954579407000442 PMID:17705908

Masten, A. S., & Garmezy, N. (1985). Risk, vulnerability, and protective factors in developmental psychopathology. Advances in Clinical Child Psychology, (8), 1-52. doi:10.1007/978-1-4613-9820-2_1

Melillo, A., Suárez, O., & Rodríguez, D. (2004). *Resiliencia y subjetividad. Los ciclos de la vida*. Buenos Aires: Paidós.

Mikulic, I. M., Crespi, M., Cassullo, G. L., Fernández, G. L., Caruso, A., García, L. L., … Sosa, P. (2008). Estudio de las Fuentes de Resiliencia: Percepción de Factores de Riesgo y Protección Ante Distintos Sucesos Estresantes. *XV Jornadas de Investigación y Cuarto Encuentro de Investigadores en Psicología del Mercosur.* Facultad de Psicología - Universidad de Buenos Aires, Buenos Aires, UBACyT.

Monroy, C. B., & Palacios, C. L. (2011). Resiliencia: ¿Es posible medirla e influir en ella? *Salud Mental, 34*(3), 237-246. Recuperado en 02 de agosto de 2017, de http://www.scielo.org.mx/scielo.php?script=sci_arttextandpid=S0185-33252011000300007andlng=esandtlng=es

Moreno, J. B., González, J. L., & Garrosa, E. (2001). Desgaste profesional (burnout), personalidad y salud percibida. In J. Buendía & F. Ramos (Eds.), *Empleo, estrés y salud* (pp. 59–83). Madrid: Pirámide.

Morón, J. A., Pérez, M. P., & Pedrero, P. G. (2016). *Educación para la salud y prevención de riesgos psicosociales: En adolescentes y jóvenes*. Madrid: Narcea S. A. Ediciones.

Mrazek, P. J., & Mrazek, D. (1987). Resilience in children at high risk for psychological disorder. *Journal of Pediatric Psychology*, *12*(3), 3–23. PMID:3572675

O' Dougherty Wright, M., Masten, A. S., & Narayan, A. J. (2013). Resilience processes in development: Four waves of research on positive adaptation in the context of adversity. In M. Gauvain & M. Cole (Eds.), *Handbook of resilience in children* (pp. 15–37). New York: Springer.

Osborn, A. (1994). *Resiliencia y estrategias de intervención*. Ginebra: BICE.

Palomar, L. J., & Gómez, Valdez, G. N. (2010). Desarrollo De Una Escala De Medición De La Resiliencia Con Mexicanos (Resi-M) Construction of A Measurement Scale of Resilience in Mexicans (Resi-M). *Interdisciplinaria*, *27*(1), 7–22.

Real Academia Española. (2017). *Diccionario de la lengua española* [Dictionary of the Spanish Language] (24th ed.). Madrid, Spain: Author.

Rivera, R. H. (2010). Cambio estratégico para entornos Turbulentos. *Facultad de Ciencias económicas. Investigación y Reflexión*, *18*(1), 87–117.

Rutter, M. (1991). *Resilience: Some conceptual considerations*. Trabajo presentado en Initiatives Conferences on Fostering Resilience, Washington, DC.

Rutter, M. (1993). Resilience: Some conceptual considerations. *The Journal of Adolescent Health*, *14*(8), 626–631. doi:10.1016/1054-139X(93)90196-V PMID:8130234

Rutter, M., & Rutter, M. (1992). *Developing Minds: Challenge and Continuity across the Life Span*. London: Penguin Books.

Saavedra, E. (2005). Resiliencia: La historia de Ana y Luis. Liberabit. *Revista de Psicología*, *11*, 91–101.

Saavedra, G. E., & Villalta, P. M. (2008). Measurement of the resilient characteristics, a comparative study in people between 15 and 65 years old. *Liberabit. Revista de Psicología*, *14*, 31–40.

Salgado, A. C. (2005). Métodos para medir la resiliencia: Una alternativa Peruana [Methods of measurement of resilience: A Peruvian alternative]. *Liberalit*. *Revista de Psicología*, *11*, 41–48.

Sanchis, R., & Poler, R. (2014). Enterprise resilience assessment: a categorization framework of disruptions. *Dirección y organización, 54*, 45-53.

Serrano, P. D., Garrido, A. M., Notario, P. B., Bartolomé, G. R., Solera, M. M., & Martínez, V. V. (2012). Validez de la escala de resiliencia de Connor-Davidson (10 ítems) en una población de mayores no institucionalizados. *Enfermeria Clinica*, *23*(1), 14–21.

Sheffi, Y., & Rice, J. B. Jr. (2005). A supply chain view of the resilient enterprise. *MIT Sloan Management Review*, *47*(1), 41.

Staudinger, U. M., Marsiske, M., & Baltes, P. B. (1993). Resilience and levels of reserve capacity in later adulthood: Perspectives from life-span theory. *Development and Psychopathology, 5*(4), 541-566. doi 101017/S0954579400006155

Suárez, N. (2004). *Resiliencia, tendencias y perspectivas*. Unla.

Suárez, O. N., Barna, R., Kotliarenco, M., & Munist, M. (2009). *Resiliencia: proyectos e investigaciones*. Universidad Nacional de Lanús. Colección Salud Comunitaria.

Terreberry, S. (1968). The Evolution of Organizational environments. *Administrative Science Quarterly*, *12*(4), 590–613. doi:10.2307/2391535

Vanistendael, S. (1994). *Cómo crecer superando los percances. Resiliencia: capitalizar las fuerzas del individuo*. Ginebra: BICE.

Vanistendael, S. (1997). *Resiliencia. In Conferencia presentada en el Seminario: Los aportes del concepto de resiliencia en los programas de intervención psicosocial*. Santiago, Chile: Pontificia Universidad Católica de Chile.

Vanistendael, S., & Lecomte, J. (2002). *La felicidad es posible. Despertar en niños maltratados la confianza en sí mismos: construir la resiliencia*. Barcelona: Gedisa.

Villalba, Q. C. (2004). *El concepto de resiliencia. Aplicaciones en la intervención social*. Sevilla: Universidad Pablo de Olvide.

Werner, E. E., & Smith, R. S. (1992). *Vulnerable but invincible. A study of resilient children*. New York: Cornell University Press.

KEY TERMS AND DEFINITIONS

Disruptive Behavior: Refers to antisocial behavior of persons characterized by a very marked break with respect to behavior patterns and accepted general or social values, which may threaten harmony and even the survival of people through hostile and provocative actions that encourage the disorganization of interpersonal and group activities.

Factor: Element, circumstance, influence, which contributes to produce a result.

Lazaro Cardenas: A municipality and city locations in the South coast of the State of Michoacán, Mexico.

Measurement: Action to measure. Measure those results from this action.

Protection: Action to protect or prevent a person or a thing from receiving damage or from reaching something that produces it. Help for a person or a thing to be in good condition.

Organizational Resilience: It is the ability of an organization to anticipate, prepare, respond, and adapt to exponential change and sudden interruptions to survive and thrive. It goes beyond risk management, towards a more holistic vision of health and business success.

Resilience: In psychology, the ability of a person to overcome traumatic circumstances such as the death of a loved one, an accident, etc.

Risk: Possibility of a mishap or misfortune, of someone or something suffering harm or damage. Situation in which that possibility can occur.

Scale: Proportional system used to indicate the correspondence between the size of an object on a plane and its actual size.

Staff: Set of people who form a body or study team, information, or advice in a company or organization.

Technological Institute: Technological or polytechnic institute, or even polytechnic school, is a high-level educational institution specialized in the teaching and learning of technologies.

Chapter 3
Gender Diversity in the Senior Management of Large Technology Companies

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ABSTRACT

As a key part of the fourth industrial revolution, technology companies have become the most valuable companies in the world in terms of market capitalization. Surprisingly, however, these companies have been overlooked by studies of gender diversity in corporate governance even though their highly distinctive features may cause major differences in gender diversity with respect to companies in other sectors. The goal of this chapter is therefore to provide the first characterization of gender diversity in the corporate governance of large technology companies—specifically those with the highest market value—and explore the relationship between gender diversity and business performance. To achieve this goal, descriptive statistical analysis is used. Data correspond to the period 2005 to 2017. The findings confirm the under-representation of women on the boards of directors of 162 publicly listed companies. The findings also show that the most profitable companies are those that have the greatest female representation on their boards of directors.

INTRODUCTION

The issue of gender[1] in business is highly topical. This issue is subject to interpretation and, on occasion, biased approaches that often prove controversial. The interest that this issue has elicited from policymakers reflects the firm belief that boards of directors that have greater diversity are more effective and that

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women are under-represented on these boards of directors. These factors explain the recent tendency to implement actions that promote gender diversity in corporate management. Between 2008 and 2015, 32 countries implemented 42 policies to foster board diversity (Adams, 2016).

Such issues have also been addressed by scholars. Particularly during the last decade, many studies have investigated various facets of the relationship between the representation of women on companies' boards of directors and these companies' financial performance (Terjesen, Couto, & Francisco, 2016) and market image (Al-Shaer & Zaman, 2016), as well as the impact of this representation on decision making (Nielsen & Huse, 2010). However, this literature contains certain gaps. For example, there is a lack of consensus on the role of gender diversity in corporate governance (Isidro & Sobral, 2015). Furthermore, studies have generally focused on large companies, particularly publicly listed companies. This choice of focus results from two factors: the applicability of certain standards and guidelines, especially regarding the proportion of minorities that must be represented on the boards of these companies; and the greater data availability, which enables the analysis of performance, profitability, and financial structure.

It is much less common for studies to examine the issue of gender in senior management from a sector perspective. Sector analyses of the digital economy or the collaborative economy are practically nonexistent. The lack of such research is particularly relevant in today's context, which is characterized by the hyperconnectivity and technological revolution that define the so-called Fourth Industrial Revolution and that exert unprecedented effects on society (Cheong & Lee, 2017).

Consequently, this study focuses on the business sector that contributes the most to shaping the digital economy and that, in a sense, acts as a catalyst for the development of a new digital society, which is replacing the industrial society that dates back to the 19th century. Specifically, this study focuses on large companies, in terms of market capitalization, in the global technology sector. One example of the importance of this sector is the fact that the five largest companies in the world by market capitalization—Apple Inc., Alphabet Inc., Microsoft Corporation, Amazon Inc, and Facebook Inc. (Bloomberg L.P., 2018)—are all technology companies. This list reflects a radical change with respect to the previous decade, when the world's largest companies were banks, oil companies, and retailers.

Technology companies have a number of features that make analyzing female representation in this thriving business sector particularly interesting. These companies are characterized by a high proportion of employees with a background in technology, linked to qualifications or studies in STEM (Science, Technology, Engineering, and Mathematics) subjects. Traditionally, these subjects have been numerically dominated by men (Glass, Sassler, Levitte, & Michelmore, 2013). A priori, this dominance would suggest some selection bias in the senior management of these companies. In addition, the new business models that are adopted in the digital economy differ considerably from traditional models in terms of management and governance. Such differences relate to the profile of entrepreneurs, founders, and partners as well as the profile of customers. These new business models, coupled with the crucial role of technological and business development skills, call for professionals with a broad range of training and experience and, at the same time, a forward-looking and visionary mindset. Technology companies' governance structures are also notoriously flat, and personal leadership takes precedence over hierarchical leadership, with a predominance of young entrepreneurs as opposed to the generally older managers in traditional companies. Finally, technology companies are a magnet for professional talent because of their status and the high salaries they offer. This perspective of analysis of talent has also been considered in the technology sector (Foust-Cummings, Sabattini, & Carter, 2008) under the premise that, in these companies, maximizing talent regardless of gender can reduce gender barriers.

Against this backdrop, the goal of this study is to analyze female representation in the governance of large technology companies and its possible effects on the performance of these companies. Specifically, this study characterizes gender diversity in the senior management of large technology companies, also assessing how it has evolved over time, and explores the possible relationship between gender diversity and business performance. To the best of the authors' knowledge, this is the first study of gender for this sector. To conduct this study, the authors used Bloomberg L.P. (2018) to gather data on the gender diversity of the senior management of the 162 technology companies with the highest market capitalization worldwide as of February 15, 2018. The authors adopted Bloomberg L.P.'s (2018) classification of large companies by market capitalization. These data were supplemented with financial data gathered from the Osiris database (Bureau van Dijk, 2018). The data were gathered and analyzed for the period 2005 to 2017. After drawing the sample, the authors performed descriptive and numerical statistical analyses using measures such as the arithmetic mean, standard deviation, minimum, maximum, and percentiles. These results yield two principal findings. First, women are under-represented on the boards of directors of the analyzed companies. On average, women account for only 11.13% of board members. Second, the most profitable companies are those with the greatest gender diversity. The most significant differences in terms of profitability arise between companies that have no female board members and companies that have at least one female board member.

This chapter has five sections. Following this introduction, the second section reviews the gender literature that examines a range of facets of the role of women in corporate boards of directors. The third section describes the data sources that were used to gather the data for the empirical study and the method that was used to analyze these data. The fourth section presents the results of the analysis. The fifth section provides conclusions based on the study's findings.

THEORETICAL BACKGROUND

It may be hypothesized that gender diversity affects corporate governance and company performance. In the broadest sense, greater diversity in organizations, whether it is in terms of race, age, or gender, may lead to different perceptions of business performance and creativity. Similarly, more diverse groups of workers can arguably develop more innovative solutions to problems given the range of views that are elicited and discussed (Robinson & Dechant, 1997). However, this effect would contradict the hypothesis of equality. The hypothesis therefore requires thorough analysis.

In reference to corporate governance, Carter, Simkins and Simpson (2003) draw upon agency theory (Fama & Jensen, 1983) to argue that gender diversity increases the independence of the board of directors because people of different gender, ethnicity, or culture are able to question things that directors from a similar background would not. Other arguments provide several additional reasons why gender diversity is a determinant of the effectiveness of boards of directors (Adams & Ferreira, 2009). First, gender diversity allows the company to benefit from the greater stock of talent provided by its directors. Second, women's participation in the board of directors differs from that of men. For example, women contribute to improving attendance at meetings and are more likely to join monitoring committees. Harjoto, Laksmana and Lee (2015) argue that gender diversity increases the board's ability to recognize the needs and interests of different stakeholders, all of which affects corporate social responsibility because more diverse groups have different knowledge bases, experiences, and social perspectives. Nielsen and Huse (2010), however, note that the impact of women on the board's decision capabilities depends on the type of task, with a positive impact on strategic tasks. It is also important to consider not only women's presence on the board of directors but also the need for a critical mass of female board members. A minimum of three female directors is needed to enhance the contribution of the board of directors in terms of organizational innovation (Torchia, Calabró, & Huse, 2011).

A rich literature discusses the differences between men and women. These differences influence the behavior of the board of directors when it has female members. Notably, leadership style varies across genders (Nielsen & Huse, 2010), as reflected by the characteristics that are embodied more by men than by women (e.g., confidence, ambition, aggression, and independence) and the characteristics that are embodied more by women than by men (e.g., concern for the well-being of others, affection, helpfulness, and friendliness). There are also gender differences in terms of attitudes toward risk. Women are more risk-averse than men are (Bernasek & Shwiff, 2001). Finally, women behave differently from men with respect to debt: Women are less likely to seek external financing (Byoun, Chang, & Kim, 2016). Other such differences also exist.

After presenting these arguments, it is important to reflect on the empirical evidence regarding the influence of gender-diverse corporate governance on business performance. Findings in this area vary, with scholars reporting positive, negative, and neutral effects (Isidro & Sobral, 2015). Examples of studies that have failed to find a causal relationship between gender diversity in corporate governance and business performance include the study by Carter, D'Souza, Simkins and Simpson (2010). To explain their results, they note the likelihood that the increased company value due to gender diversity in the board of directors could be obscured by issues such as conflict or exclusion. They also argue that this relationship may be contingent. In other words, the relationship may depend on the circumstances and period under analysis. Similar results have since been reported by Yeh and Trejos (2015) and Marinova, Plantenga and Remery (2016).

Notable studies that have found a negative relationship include the study by Adams & Ferreira (2009), who report that more diverse boards are associated with more poorly performing companies in terms of *Tobin's Q ratio* and return on assets (*ROA*). They explain their findings by arguing that gender diversity only increases value when additional monitoring would increase company value. Gulamhussen and Santa (2015) report that the participation of women in boards of directors of large banks in OECD countries exerts a positive influence on profitability and a negative influence on risk.

Nevertheless, a greater number of studies have shown the existence of a positive relationship. Notable examples include Carter et al.'s (2003) study, which showed the positive influence of the presence of women or minorities on company value creation. Similar findings have been reported by Rodríguez-Domínguez, García-Sánchez and Gallego-Álvarez (2012) for companies in the energy and petrol sector, Liu, Wei and Xie (2014) for Chinese listed companies, García-Meca, García-Sánchez and Martínez-Ferrero (2015) for the banking sector, and Terjesen et al. (2016) for a sample of companies from 47 countries. Finally, Post and Byron (2015) conducted a meta-analysis of 140 studies of a range of contexts, finding evidence that female representation on boards of directors is important for increasing profitability.

In the technology sector, gender differences are gaping (Cohoon, 2011). Certain studies have corroborated these gender differences, particularly for the case of US technology companies (Ashcraft, Mclain, & Eger, 2016). These differences may owe to the traditionally lower enrolment rate of women in university STEM programs (Glass et al., 2013) or the lack of active gender policies among high-technology companies (Williams, 2014) or problems that women face in achieving promotions (Simard, Henderson, Gilmartin, Schiebinger, & Whitney, 2008). Thus, technology companies also seem to have a glass ceiling (Fernández & Campero, 2012).

METHOD AND DATA SOURCES

Description and Analysis of the Sample

To select the sample, the authors selected the largest publicly listed technology companies in the world in terms of market capitalization in USD over the full study period, subject to data availability. To select these companies, the classification provided by Bloomberg L.P. (2018) was used. This classification identifies small, medium-sized, and large enterprises according to their market value or capitalization. Restricting the selection to companies in the technology sector, the authors selected all large companies, as per the classification on Bloomberg L.P. (2018). The next step consisted of searching for and gathering all gender variables provided by Bloomberg L.P. (2018) for these companies. Of the 173 companies that were initially selected, gender data were available for 163 companies for the period 2005 to 2017.

Once these data had been collected, the authors supplemented the data with financial data gathered from the Osiris database (Bureau van Dijk, 2018). A series of measures were collected for this study. These measures correspond to some of the primary indicators used to explain company performance. These measures are also some of the most commonly used in studies of corporate governance. The activities of one of the sampled companies included financial activities, so the data format for this company differed from the format for all other companies in the sample. This discrepancy would have prevented data comparability across the sample. Therefore, this company was eliminated from the sample. The financial variables were expressed in different currencies depending on each company's country of origin. All values were therefore converted into USD. To convert the values to USD, for each year, the official exchange rate for each currency as reported by the World Bank (2018) was used.

This procedure yielded data on 162 companies. According to their classification in Bloomberg L.P. (2018), each company belonged to one of three industries: technology hardware and equipment (42 companies), software and services (91 companies), or semiconductors and semiconductor equipment (29 companies). This sample had several notable characteristics. First, the companies were based in 19 countries across America, Europe, and Asia-Pacific. Africa was the only continent that was not represented by the sample. Also, several companies were headquartered in Bermuda (three companies) or the Cayman Islands (seven companies) for tax reasons. Second, more than half of the companies in the sample (83 companies) were from the US. The countries with the second and third highest representation were Japan and China. Table 1 shows the number of companies by country and region, reflecting the hegemony of the US and Europe's low representation. At the time of analysis, 18 of the 162 analyzed companies had a market capitalization of more than 100 billion USD (14 of these were US companies), and 17 had a market capitalization of 50 to 100 billion USD.

The variables that were used in this study can be broadly classified in two categories: gender variables and financial variables. The variables can be described as follows:

1. Gender variables gathered from Bloomberg L.P. (2018):
    a. **Wom_Board:** Number of women on the board of directors.
    b. **%Wom_Board:** Percentage of female board members.
    c. **Wom_Exe:** Number of women executives.
    d. **%Wom_Exe:** Percentage of female executives.
    e. **Wom_Chair:** Female president. Dichotomous variable that takes the value 1 if the president is a woman and 0 otherwise. The use of this variable and the following variable is important

Table 1. Distribution of companies in the sample by country and region

America		Europe		Asia-Pacific	
Bermuda	3	Germany	4	China	9
Brazil	1	Spain	1	South Korea	7
Canada	3	Finland	1	India	4
Cayman Islands	7	France	3	Israel	1
US	83	Ireland	2	Japan	20
		Netherlands	3	Taiwan	5
		United Kingdom	2		
		Sweden	1		
		Switzerland	2		
Total	97		19		46
Percentage	60%		12%		28%

Source: Compiled by the authors using information from Bureau van Dijk (2018)

because there is evidence that the gender of the president and CEO affects the contribution of female directors to the decision-making process of the board of directors (Torchia et al., 2011).

f. **Wom_CEO:** Female CEO. Dichotomous variable that takes the value 1 if the CEO is a woman and 0 otherwise.

g. **Wom_Board_1:** Dichotomous variable that takes the value 1 if the board of directors has at least one member who is a woman and 0 otherwise.

2. Financial variables gathered from Bureau van Dijk (2018):

   a. **ROA (%):** Return on assets, calculated as the ratio of ordinary income before tax to total assets.

   b. **Tobin's Q ratio:** Calculated as the ratio of total market value to total asset book value.

   c. **ROE (%):** Return on equity, calculated as the ratio of ordinary income before tax to shareholders' equity.

These three variables were included in the analysis because they are some of the most commonly used business performance measures in studies of gender diversity in corporate governance (Adams & Ferreira, 2009; Isidro & Sobral, 2015; Rodríguez-Ruiz, Rodríguez-Duarte, & Gómez-Martínez, 2016). As reported by Carter et al. (2010), the *ROA* indicates the ability of the company to generate profit using its assets, valued at their historical cost. *Tobin's Q ratio* provides a measure of the wealth of shareholders and creditors. This indicator partly depends on the market value of the company. Therefore, its use in the study of listed companies is essential because it offers a market valuation of the investment opportunities provided by the company (Carter et al., 2010). The *ROE* indicates how well shareholders' equity is used to generate profit (Rodríguez-Ruiz et al., 2016).

Although these three variables are key variables in the literature, other measures are also useful for explaining a company's situation. Therefore, this study used three additional ratios (*Cash*, *Solv*, and *Gear*). The first variable, *Cash*, captures the cash flow of the company. The financial community considers cash flow the primary indicator of the financial health of the company (Llorente & Amador, 2010). Cash flow refers to the inflows and outflows of cash in the company's accounts. Because of the lag between income/expenses and receipts/payments, it is important to go beyond profit to study the company's ability to finance the business and meet short-term debt obligations.

- **Cash (thousand USD):** Cash flow.
- **Solv (%):** Solvency ratio, calculated as the ratio of shareholders' equity to total assets.
- **Gear (%):** Gearing ratio, calculated as the ratio of noncurrent liabilities and loans to shareholders' equity.

One of the pillars of business risk is financial risk, which is closely linked to the company's ability to generate liquid assets (Llorente & Amador, 2010). It is therefore important to analyze the company's solvency, which offers a measure of the stability of the company and its ability to meet its short- and long-term obligations. Therefore, to provide an overview of each company's solvency, the proportion of assets that are financed by shareholders' equity (*Solv*) was included in the study. An indicator of the company's leverage (*Gear*) was also used. This indicator was included not only because of the importance of debt as a determinant of business performance (Pamburai, Chamisa, Abdulla, & Smith, 2015) but also because of the notable differences between men and women in terms of their attitudes toward risk (Bernasek & Shwiff, 2001) and company debt (Hernández-Nicolás, Martín-Ugedo, & Mínguez-Vera, 2015). The gearing ratio is the ratio of the company's most important sources of external financing, such as long-term liabilities and short-term loans, to shareholders' equity.

Finally, the following four variables, some of which have frequently been used in the corporate governance literature, were included in the analysis to provide an indication of the size and characteristics of the firms in the sample:

- **Board:** Number of members of the board of directors.
- **Tot_Ass (thousand USD):** Total assets.
- **Sls (thousand USD):** Sales.
- **R&D (thousand USD):** R&D spending.

Method

This study is based on descriptive and numerical statistical analysis whose goal is to process and extract useful information from the data (Newbold, Carlson, & Thorne, 2007). To conduct the analysis, several types of measures were used: measures of central tendency, measures of variability, minimum and maximum values, and percentiles. For the measures of central tendency, the arithmetic mean was used. The arithmetic mean provides numerical information about a standard observation. A measure of variability (i.e., the standard deviation) was used to measure the dispersion of observations around the arithmetic mean. The goal of this measure was to complement the description provided by the mean.

These measures were used provide an overview of the primary characteristics of large technology firms in terms of gender diversity in the senior management and business performance. The purpose was also to explore the relationship between the two variables, thereby addressing the research goal. First, the mean, standard deviation, minimum, maximum, and percentiles were calculated for the sample (Table 2) and for each industry within the sample (Table 3). The next step was to provide a more exhaustive description of female representation in the senior management of the analyzed companies over the last

Table 2. Descriptive statistics for the sample (162 companies)

Variables	Obs	Arithmetic Mean	Standard Deviation	Minimum	Maximum	25th percentile	50th percentile	75th percentile
Wom_Board	1017	1.1327	1.2106	0	6	0	1	2
%Wom_Board	1569	11.1318	10.7495	0	100	0	10	18.18
Wom_Exe	1254	1.0685	3.0059	0	47	0	1	1
%Wom_Exe	1254	9.5992	12.2184	0	80	0	4.44	16.66
Wom_Chair	1426	0.0147	0.1204	0	1	0	0	0
Wom_CEO	1441	0.0194	0.1380	0	1	0	0	0
Wom_Board_1	1181	0.6680	0.4711	0	1	0	1	1
ROA	1837	9.6742	12.5494	-96.92	97.36	4	10	16
Tobin's Q ratio	1614	2.2180	2.0992	0.012	24.295	1	2	3
ROE	1790	18.3394	50.4252	-866.31	631.48	9	18	29
Cash	1854	1692157	4331432	-3779252	63900000	92389	509457.5	1409849
Solv	1835	53.1297	22.97137	-55	96	39	55	71
Gear	1307	69.5550	94.2873	0	913	17	44	86
Board	1577	9.5890	2.636831	3	27	8	9	11
Tot_Ass	1839	14100000	30400000	114	375000000	1325981	4828337	13200000
Sls	1870	9939253	24800000	1	272000000	680578	2822593	8278141
R&D	1507	892246.4	1745702	0	16600000	48224	303200	894856

Source: Compiled by the authors using outputs from Stata 11. Obs (observations).

three years (Table 4). This period was used not only because it depicts the current situation but also because data were available for all companies for these years. Finally, Table 5 shows the arithmetic means of the financial variables for samples under different gender-based criteria. The goal was to identify possible relationships between these variables and gender characteristics.

RESULTS OF THE ANALYSIS

The results of the analysis described in the previous section are presented in this section, accompanied by a brief discussion.

Table 2 shows the values for the aforementioned statistics for the whole sample. The data in Table 2 show that women are substantially under-represented on the boards of directors of the sampled companies. On average, the boards of directors have just one member who is a woman (1.1327), yet the average number of members per board is approximately 10 (9.5890). Similarly, the average percentage of women on these boards of directors is only 11.13%. For 75% of the observations for this indicator, the percentage of female board members is less than 18.18%. The highest number of female members on any board of directors is 6, while the largest board has 27 members. The average percentage of female executives to total executives at the company is also very low (9.59%).

Table 3. Descriptive statistics by industry

Variables	Obs	Arithmetic Mean	Standard Deviation	Minimum	Maximum	25th percentile	50th percentile	75th percentile
Technology Hardware and Equipment (42 Companies)								
Wom_Board	224	0.9553	1.2045	0	5	0	1	2
%Wom_Board	424	8.7606	11.4413	0	100	0	7.14	14.29
Wom_Exe	347	1.6051	5.4345	0	47	0	1	1
%Wom_Exe	347	7.4412	10.7674	0	50	0	1.408	11.111
Wom_Chair	389	0.0179	0.1331	0	1	0	0	0
Wom_CEO	394	0.0279	0.1649	0	1	0	0	0
Wom_Board_1	260	0.5807	0.4943	0	1	0	1	1
ROA	485	8.6371	10.6251	-61	45	4	9	13
Tobin's Q ratio	430	1.5627	1.3325	0	10	1	1	2
ROE	472	15.375	38.7205	-678	185	8	16	24
Cash	486	2583686	6639082	-2245939	63900000	16192	511173.5	2425000
Solv	484	53.9524	21.3584	-21	96	41	55	69
Gear	424	55.1816	66.5332	0	542	15	35.5	74
Semiconductors and Semiconductor Equipment (29 Companies)								
Wom_Board	193	1.1761	1.3189	0	6	0	1	2
%Wom_Board	322	10.6796	10.8636	0	44.444	0	10	16.67
Wom_Exe	238	0.5882	0.9494	0	5	0	1	1
%Wom_Exe	238	6.9168	10.3276	0	40	0	0	14.286
Wom_Chair	284	0.0070	0.0837	0	1	0	0	0
Wom_CEO	284	0.0140	0.1180	0	1	0	0	0
Wom_Board_1	232	0.6896	0.4636	0	1	0	0	1
ROA	351	8.2877	12.6705	-97	38	3	10	15
Tobin's Q ratio	327	1.8929	1.7525	0	24	1	2	2
ROE	342	11.0438	34.7574	-253	125	5	16	24
Cash	351	1411319	2268680	-3779252	17200000	266710	771290	1579908
Solv	350	60.12	22.2815	-55	92	48	63	77
Gear	232	61.3146	91.378	0	811	12.5	35.5	76.5
Software and Services (91 Companies)								
Wom_Board	600	1.185	1.1717	0	6	0	1	2
%Wom_Board	823	12.53028	10.1010	0	45.454	0	11.111	20
Wom_Exe	669	0.961136	1.0432	0	5	0	1	2
%Wom_Exe	669	11.67277	13.1472	0	80	0	11.111	20
Wom_Chair	753	0.0159363	0.1253	0	1	0	0	0
Wom_CEO	763	0.017038	0.1294	0	1	0	0	0
Wom_Board_1	689	0.6937591	0.4612	0	1	0	1	1
ROA	1001	10.6603	13.3007	-96	97	5	10	17
Tobin's Q ratio	857	2.6849	2.4425	0	24	1	2	3
ROE	976	22.3288	58.9778	-866	631	11	20	34
Cash	1017	1363043	3299609	-3383778	30000000	103505	412015	1187786
Solv	1001	50.2867	23.4215	-51	96	35	51	69
Gear	651	81.8556	108.187	0	913	21	52	101

Source: Compiled by the authors using outputs from Stata 11. Obs (observations).

Analysis of the financial data shows that, on average, the sampled firms have a *ROA* of 9.67%. For 75% of the observations for this indicator, the *ROA* is less than 16%. On average, the market value of the sampled firms is more than twice the historical cost of total assets (*Tobin's Q ratio* = 2.21). The average *ROE* is 18.33%, although the highest *ROE* is 631.18%. In general, cash flow is positive and is greater than 92.389 million USD. On average, 53.12% of the assets are financed by shareholders' equity. On average, noncurrent liabilities and financial debt account for around 70% of shareholders' equity. Average total assets are 14.10 billion USD, with high dispersion, reflecting a high degree of heterogeneity. Average sales are 9.94 billion USD. Finally, the majority of firms invest more than 48.22 million USD in R&D.

Table 3 complements this analysis by showing the statistics for each industry. The gender indicators show that, although women are under-represented on the boards of directors of companies in all three industries, the technology hardware and equipment industry presents the worst data. On average, only 8.76% of the board members of companies in this industry are women. This percentage is slightly higher for the semiconductors and semiconductor equipment industry (10.67%). The best data are for the software and services industry (12.53%). Similarly, the companies in the software and services industry also have the highest proportion of female executives (11.67%) and the best financial performance in terms of *ROA* (average of 10.66% versus 8.63% for the technology hardware and equipment industry and 8.28% for the semiconductors and semiconductor equipment industry), *Tobin's Q ratio* (average of 2.68 versus 1.89 for the semiconductors and semiconductor equipment industry and 1.56 for the technology hardware and equipment industry), and *ROE* (average of 22.32% versus 15.37% for the technology hardware and equipment industry and 11.04% for the semiconductors and semiconductor equipment industry). Differences also arise for leverage (*Gear*), not only in terms of average values for the gearing ratio (software and services: 81.85%; semiconductors and semiconductor equipment: 61.31%; technology hardware and equipment: 55.18%) but also in terms of the percentiles and maximum values. In all cases, the software and services industry had the highest values.

Table 4 provides a more complete picture of female representation on the boards of the sampled companies. Table 4 shows the number of companies that meet certain criteria in relation to the gender variables at the sector and industry levels for the period 2005 to 2017. To ensure clarity, an explanation of each of these criteria is provided as the corresponding results are presented. First, the number of companies whose boards of directors had no female members reduced year on year (see Criterion 1). Specifically, in 2015, 52% of the companies in the sample (84 companies) had at least one female member on the board of directors (versus 48% of companies with boards of directors formed entirely of men). In 2017, this percentage had increased to 76% (123 companies). Although the number of companies with at least one female board member increased year on year in all industries, there were considerable differences across different industries. Specifically, the largest increase over the period occurred in the software and services industry, where the percentage increased by 29 percentage points. Thus, in 2017, 85% of software and services companies had at least one female board member. In the semiconductors and semiconductor equipment industry the percentage increased by 24 percentage points to 79%. The technology hardware and equipment industry lagged behind, with an increased from 40% in 2015 to 55% in 2017.

Criteria 2 and 3 refer to the number of companies with at least two or three female board members, respectively. The results show a sharp drop in practically all cases with respect to Criterion 1. The largest drop is in the semiconductors and semiconductor equipment industry. In general, these drops grew year on year in terms of both the difference between the number of companies that met Criteria 1 and 2 and the difference between the number of companies that met Criteria 2 and 3. This result reflects the

Table 4. Number and proportion of companies by criterion (2015–2017)

Criteria	162 companies	Technology hardware and equipment (42 companies)	Semiconductors and semiconductor equipment (29 companies)	Software and services (91 companies)
2015				
(1) Wom_Board >= 1	84 (52%)	17 (40%)	16 (55%)	51 (56%)
(2) Wom_Board >= 2	56 (35%)	14 (33%)	9 (31%)	33 (36%)
(3) Wom_Board >= 3	25 (15%)	7 (17%)	2 (7%)	16 (18%)
(4) Wom_Chair =1	3 (2%)	2 (5%)	1 (3%)	0
(5) Wom_CEO =1	6 (4%)	3 (7%)	1 (3%)	2 (2%)
(6) %Wom_Board >= Mean	94 (58%)	23 (55%)	19 (66%)	49 (54%)
(7) %Wom_Board >= 25%	35 (22%)	10 (24%)	4 (14%)	21 (23%)
(8) %Wom_Board >= 50%	7 (4%)	1 (2%)	0	6 (7%)
2016				
(1) Wom_Board >= 1	112 (69%)	24 (57%)	20 (69%)	68 (75%)
(2) Wom_Board >= 2	71 (44%)	15 (36%)	12 (41%)	44 (48%)
(3) Wom_Board >= 3	37 (23%)	7 (17%)	5 (17%)	25 (27%)
(4) Wom_Chair =1	4 (2%)	2 (5%)	0	2 (2%)
(5) Wom_CEO =1	5 (3%)	2 (5%)	1 (3%)	2 (2%)
(6) %Wom_Board >= Mean	85 (52%)	23 (55%)	17 (59%)	51 (56%)
(7) %Wom_Board >= 25%	46 (28%)	10 (24%)	6 (21%)	30 (33%)
(8) %Wom_Board >= 50%	6 (4%)	1 (2%)	0	5 (5%)
2017				
(1) Wom_Board >= 1	123 (76%)	23 (55%)	23 (79%)	77 (85%)
(2) Wom_Board >= 2	77 (48%)	16 (38%)	13 (45%)	48 (53%)
(3) Wom_Board >= 3	39 (24%)	7 (17%)	4 (14%)	28 (31%)
(4) Wom_Chair =1	4 (2%)	2 (5%)	0	2 (2%)
(5) Wom_CEO =1	5 (3%)	2 (5%)	1 (3%)	2 (2%)
(6) %Wom_Board >= Mean	85 (52%)	23 (55%)	18 (62%)	51 (56%)
(7) %Wom_Board >= 25%	45 (28%)	10 (24%)	5 (17%)	30 (33%)
(8) %Wom_Board >= 50%	6 (4%)	1 (2%)	0	5 (5%)

Source: Compiled by the authors using outputs from Stata 11. For Criterion 6, the values for a given industry were calculated using the arithmetic mean for that industry.

fact that, in virtually no case (across the sample as a whole or in each separate industry), the number of companies with at least two female board members exceeds 50%. The exception is the software and services industry for the year 2017 (53%). This is also the only industry for which, also for 2017, the percentage of companies with at least three female board members is greater than 30%.

These conclusions are particularly relevant given that the average number of members on the board of directors of the sampled firms is approximately 10 and that for 75% of the observations for this indicator, the number of board members is at least 8 (see Table 2; arithmetic mean and 25th percentile of the

Table 5. Arithmetic mean of financial variables by gender-based criterion

Criteria	*ROA*	*Tobin's Q ratio*	*ROE*	*Cash*	*Solv*	*Gear*
(1)Wom_Board = 0	6.2090	2.1465	8.4581	919266.3	54.5884	76.4190
(2)Wom_Board >= 1	10.3787	2.2416	20.3205	1854605	52.8313	68.2424
(3)Wom_Board >= 2	10.9324	2.2693	20.7440	1943327	54.4431	60.9365
(4)Wom_Board >= 3	11.2140	2.2321	20.3336	1723444	56.1857	57.517
(5)%Wom_Board < Mean	9.2742	2.0099	17.0364	1548598	55.4090	69.4424
(6)%Wom_Board >= Mean	10.0214	2.4416	19.5197	1815558	51.1269	69.6692
(7)Wom_Chair =0	10.0146	2.1714	20.2591	2048004	53.59059	68.1869
(8)Wom_Chair =1	12.6	1.8421	48.33333	107935.2	31.4	243
(9)Wom_CEO =0	10.24693	2.1767	20.7305	2039595	53.8751	67.8006
(10)Wom_CEO =1	6.538462	1.92	21.28	1550279	33.4615	208.4444

Source: Compiled by the authors using outputs from Stata 11.

measure *Board*). Therefore, although a high proportion of the boards of the sampled companies have at least eight members, the number of companies with at least three female board members was just 25 in 2015 (15%), 37 in 2016 (23%), and 39 in 2017 (24%). These findings are supported by Criteria 6, 7, and 8, which relate to the number of companies with a proportion of female board members that is greater than the sample mean, 25th percentile, and median, respectively. Thus, the results show that, in general, more than half of the companies across the sample and in each separate industry have a percentage of female board members that is greater than the mean. In very few companies, however, do women account for at least 25% of all board members (22% of companies in 2015 and 28% of companies in 2016 and 2017). In even fewer companies do women account for at least 50% of the board members (only 4% of companies in 2015 and virtually the same percentage in 2016 and 2017).

Finally, Criteria 4 and 5 refer to the number of companies where the president and the CEO, respectively, are women. The data are more stable for these criteria than for any other criteria. Only minor changes are observed over time, and very few companies meet these criteria. Specifically, in 2017, in only 4 out of the 162 analyzed companies (2%) was the president a woman. Two of these companies are from the technology hardware and equipment industry and two are from the software and services industry. In 2017, only 5 out of the 162 sampled companies (3%) had female CEOs.

Next, the data in Table 5 were used to examine the possible relationship between female representation in the senior management of the sampled companies and the performance of these companies. Table 5 shows the mean of each financial variable calculated for different gender-based criteria. For Criteria 1 through 4, the data show that as the minimum number of female board members increases, so does the average profitability of the firms (in terms of both *ROA* and *ROE*) and the market value (*Tobin's Q ratio*). This finding reflects the need to reach a critical mass of female board members so that their contribution becomes apparent. The reason is that majorities exert a greater influence than minorities, which are more easily marginalized (Torchia et al., 2011). Notably, the largest increase in these measures occurs in cases where the composition of the board changes from consisting solely of men to including at least one female member (i.e., from Criterion 1 to Criterion 2).

The remaining means also indicate the existence of a positive association between the presence of women in the company's senior management and the generation of positive cash flows. This finding is implied by the variation in the average of the cash flow measure (*Cash*), which is more than twice as large in companies that have at least one female board member than in companies whose boards of directors comprise only men. Although the mean solvency indicator (*Solv*) is lower for Criterion 2 than for Criterion 1, it increases as the minimum number of women on the board of directors increases from one to three. Notably, the mean leverage ratio (*Gear*) decreases when there is at least one woman on the board of directors (from 76.41% to 68.24%). This ratio continues to decrease, albeit to a lesser degree, when the minimum number of female board members increases from two to three.

Similarly, Criteria 5 and 6 also reveal differences in the averages of practically all financial indicators. Specifically, Criteria 5 and 6 refer to companies for which the percentage of female board members is less than the sample mean (Criterion 5) and companies for which the percentage of female board members is greater than or equal to the mean (Criterion 6). The results highlight notable differences between the companies in each of the two cases. Companies for which the percentage of female board members is greater than or equal to the sample mean are more profitable (in terms of *ROA* and *ROE*), have higher values for *Tobin's Q ratio*, and generate greater positive cash flows.

The remaining criteria reveal considerable differences between companies depending on whether the president is male or female (Criteria 7 and 8, respectively) and between companies depending on whether the CEO is male or female (Criteria 9 and 10, respectively). On average, the most profitable companies have a female president. This is particularly true in the case of the *ROE*, which is more than twice the *ROE* for companies with a male president. Companies whose president or CEO is male have higher market values and generate greater positive cash flows. If the president or CEO is a woman, the company has a lower percentage of assets that are financed by shareholders' equity and, therefore, greater leverage. Both of these variations are substantial.

The findings presented herein show the clear gender differences in the corporate governance of leading technology companies, based on inadequate female representation. On average, women account for 11.13% of board members. Although the number of companies with at least one female board member has an increasing trend, the number of companies that have at least two or three female board members is substantially lower, particularly considering that the average number of board members is approximately 10.

It is also noteworthy that the gender data vary by industry. Software and services has made the best progress in terms of female representation in the senior management. These findings are particularly important given that the data highlight the differences in the performance of companies depending on the female representation on the corporate board. Companies with female board members are more profitable than companies whose boards of directors comprise only men. These findings are consistent with most of the related literature, which emphasizes the need to have women on the board of directors to improve company performance (Carter et al., 2003; Liu et al., 2014; Post & Byron, 2015; Terjesen et al., 2016).

CONCLUSION

The importance of encouraging gender-diverse boards of directors is supported by numerous arguments and studies. Much has yet to be done, however, not only because of the conflicting findings regarding the potential influence of gender diversity on company performance, but also because certain types of companies have received less attention and because the literature contains few sector analyses. Studies of gender in relation to the digital economy sector are scarce, despite the major impact of this sector on the economy and society and despite its unique characteristics, which make analyzing female representation in senior management positions in this sector particularly interesting. In response, this study's goal was to provide a characterization of gender diversity in corporate governance and examine its potential effects on several financial variables. To achieve this goal, descriptive statistical analysis of the 162 largest technology companies in the world in terms of market capitalization was conducted for the period 2005 to 2017.

The primary conclusions, which are based on the results of the analysis, allude to scarce female representation on the board of directors and in the senior management. Second, the software and services industry has the fewest companies with no female board members. Companies in this sector have made the most progress in recent years in terms of female representation on the board of directors.

A notable finding is that the most profitable companies are those with female board members and female presidents. This finding reflects the sizeable task faced by the sampled firms to achieve gender equality in their senior management. This conclusion also applies to numerous other areas and represents an ethical, social, and economic challenge for institutions and society as a whole.

Finally, this study has certain limitations. These limitations fundamentally relate to the fact that the study presents an initial descriptive analysis and does not explore causal relationships between variables using sound econometric methods. This study could be extended by applying more rigorous analyses and by broadening the scope to other samples of interest.

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REFERENCES

Adams, R. B. (2016). Women on boards: The superheroes of tomorrow? *The Leadership Quarterly*, *27*(3), 371–386. doi:10.1016/j.leaqua.2015.11.001

Adams, R. B., & Ferreira, D. (2009). Women in the boardroom and their impact on governance and performance. *Journal of Financial Economics*, *94*(2), 291–309. doi:10.1016/j.jfineco.2008.10.007

Al-Shaer, H., & Zaman, M. (2016). Board gender diversity and sustainability reporting quality. *Journal of Contemporary Accounting and Economics*, *12*(3), 210–222. doi:10.1016/j.jcae.2016.09.001

Ashcraft, C., Mclain, B., & Eger, E. (2016). *Women in Tech: the Facts*. Retrieved from https://www.ncwit.org/sites/default/files/resources/ncwit_women-in-it_2016-full-report_final-web06012016.pdf

Bernasek, A., & Shwiff, S. (2001). Gender, risk, and retirement. *Journal of Economic Issues*, *35*(2), 345–356. doi:10.1080/00213624.2001.11506368

Bloomberg, L. P. (2018). *Bloomberg Professional Services* [computer software]. Madrid: Universidad CEU San Pablo.

Bureau van Dijk. (2018). Osiris [Data file]. Available from: https://www.bvdinfo.com/en-gb/our-products/data/international/osiris

Byoun, S., Chang, K., & Kim, Y. S. (2016). Does corporate board diversity affect corporate payout policy? *Asia-Pacific Journal of Financial Studies*, *45*(1), 48–101. doi:10.1111/ajfs.12119

Carter, D. A., D'Souza, F., Simkins, B. J., & Simpson, W. G. (2010). The gender and ethnic diversity of US boards and board committees and firm financial performance. *Corporate Governance*, *18*(5), 396–414. doi:10.1111/j.1467-8683.2010.00809.x

Carter, D. A., Simkins, B. J., & Simpson, W. G. (2003). Corporate governance, board diversity, and firm value. *Financial Review*, *38*(1), 33–53. doi:10.1111/1540-6288.00034

Cheong, H., & Lee, H. (2017). Technology and policy strategies in the era of CPS (cyber physical system) and automated driving. *Procedia Computer Science*, *122*, 102–105. doi:10.1016/j.procs.2017.11.347

Cohoon, J. M. (2011). Which Gender Differences Matter for High Tech Entrepreneurship? *Open Source Business Resource*. Retrieved July 1, 2017, from https://ssrn.com/abstract=2577124

Fama, E., & Jensen, M. (1983). Separation of Ownership and Control. *The Journal of Law & Economics*, *26*(2), 301–325. doi:10.1086/467037

Fernández, R. M., & Campero, S. (2012). *Gender Sorting and the Glass Ceiling in High Tech.* MIT Sloan Research Paper No. 4989-12. Retrieved July 1, 2017, from https://ssrn.com/abstract=2067102

Foust-Cummings, H., Sabattini, L., & Carter, N. (2008). *Women in technology: Maximizing talent, minimizing barriers*. Retrieved from http://www.catalyst.org/system/files/Women_in_Technology_Maximizing_Talent_Minimizing_Barriers.pdf

García-Meca, E., García-Sánchez, I., & Martínez-Ferrero, J. (2015). Board diversity and its effects on bank performance: An international analysis. *Journal of Banking & Finance*, *53*, 202–214. doi:10.1016/j.jbankfin.2014.12.002

Glass, J. L., Sassler, S., Levitte, Y., & Michelmore, K. M. (2013). What's so special about STEM? A comparison of women's retention in STEM and professional occupations. *Social Forces*, *92*(2), 723–756. doi:10.1093fot092 PMID:25554713

Gulamhussen, M. A., & Santa, S. F. (2015). Female directors in bank boardrooms and their influence on performance and risk-taking. *Global Finance Journal*, *28*, 10–23. doi:10.1016/j.gfj.2015.11.002

Harjoto, M., Laksmana, I., & Lee, R. (2015). Board diversity and corporate social responsibility. *Journal of Business Ethics*, *132*(4), 641–660. doi:10.100710551-014-2343-0

Hernández-Nicolás, C. M., Martín-Ugedo, J. F., & Mínguez-Vera, A. (2015). The influence of gender on financial decisions: Evidence from small start-up firms in Spain. *E+M. Ekonomie a Management*, *18*(4), 93–107. doi:10.15240/tul/001/2015-4-007

Isidro, H., & Sobral, M. (2015). The effects of women on corporate boards on firm value, financial performance, and ethical and social compliance. *Journal of Business Ethics*, *132*(1), 1–19. doi:10.100710551-014-2302-9

Liu, Y., Wei, Z., & Xie, F. (2014). Do women directors improve firm performance in China? *Journal of Corporate Finance*, *28*, 169–184. doi:10.1016/j.jcorpfin.2013.11.016

Llorente, J. I., & Amador, S. (2010). *Análisis de estados económicos-financieros*. Madrid: Centro de Estudios Financieros.

Marinova, J., Plantenga, J., & Remery, C. (2016). Gender diversity and firm performance: Evidence from Dutch and Danish boardrooms. *International Journal of Human Resource Management*, *27*(15), 1777–1790. doi:10.1080/09585192.2015.1079229

Newbold, P., Carlson, W. L., & Thorne, B. (2007). *Statistics for business and economics*. London: Pearson Education, Inc.

Nielsen, S., & Huse, M. (2010). The contribution of women on boards of directors: Going beyond the surface. *Corporate Governance*, *18*(2), 136–148. doi:10.1111/j.1467-8683.2010.00784.x

Pamburai, H. H., Chamisa, E., Abdulla, C., & Smith, C. (2015). An analysis of corporate governance and company performance: A South African perspective. *South African Journal of Accounting Research*, *29*(2), 115–131. doi:10.1080/10291954.2015.1006482

Post, C., & Byron, K. (2015). Women on boards and firm financial performance: A meta-analysis. *Academy of Management Journal*, *58*(5), 1546–1571. doi:10.5465/amj.2013.0319

Robinson, G., & Dechant, K. (1997). Building a business case for diversity. *The Academy of Management Executive*, *11*(3), 21–31. Retrieved from https://www.jstor.org/stable/4165408?seq=1#page_scan_tab_contents

Rodríguez-Domínguez, L., García-Sánchez, I., & Gallego-Álvarez, I. (2012). Explanatory factors of the relationship between gender diversity and corporate performance. *European Journal of Law and Economics*, *33*(3), 603–620. doi:10.100710657-010-9144-4

Rodríguez-Ruiz, Ó., Rodríguez-Duarte, A., & Gómez-Martínez, L. (2016). Does a balanced gender ratio improve performance? The case of Spanish banks (1999-2010). *Personnel Review*, *45*(1), 103–120. doi:10.1108/PR-07-2014-0143

Simard, C., Henderson, A. D., Gilmartin, S., Schiebinger, L., & Whitney, T. (2008). *Climbing the technical ladder: Obstacles and solutions for mid-level women in technology*. Retrieved from http://anitaborg.org/wp-content/uploads/2013/12/Climbing_the_ Technical_Ladder.pdf

Terjesen, S., Couto, E. B., & Francisco, P. M. (2016). Does the presence of independent and female directors impact firm performance? A multi-country study of board diversity. *The Journal of Management and Governance*, *20*(3), 447–483. doi:10.100710997-014-9307-8

The World Bank Group. (2018). World Development Indicators [Data file]. Retrieved from http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators

Torchia, M., Calabrò, A., & Huse, M. (2011). Women Directors on Corporate Boards: From Tokenism to Critical Mass. *Journal of Business Ethics*, *102*(2), 299–317. doi:10.100710551-011-0815-z

Williams, J. C. (2014). *Hacking tech's diversity program*. Retrieved from https://hbr.org/2014/10/hacking-techs-diversity-problem

Yeh, C. M., & Trejos, B. (2015). The influence of governance on tourism firm performance. *Current Issues in Tourism*, *18*(4), 299–314. doi:10.1080/13683500.2013.820258

KEY TERMS AND DEFINITIONS

Business Performance: A wide range of indicators that can focus on profitability, growth, or social performance of companies.

Gender Diversity: Usually measurable by the proportions of male and female in companies or institutions. In this work, gender diversity focuses on the percentage and number of women on boards of big technological companies. In the broadest sense, diversity in organizations can be in terms of race, age, or gender.

ROA: Return on assets, calculated as the ratio of ordinary income before tax to total assets.

ROE: Return on equity, calculated as the ratio of ordinary income before tax to shareholders' equity.

Solvency Ratio: Calculated as the ratio of shareholders' equity to total assets.

Technology Companies: Those who are focused on products and services with a main technological component.

Tobin's Q Ratio: Calculated as the ratio of total market value to total asset book value.

ENDNOTE

[1] In this work the concept of gender is used in its differentiating aspect between women and men, following the approach of most of the specialized literature.

Chapter 4
The Benefits of Social Networking Sites in Building Reputation for Enterprises

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ABSTRACT

This chapter aims to clarify the role of social networking sites (SNSs) such as Facebook, Twitter, and LinkedIn in building the reputation of enterprises. SNSs have a vast potential in the digital environment to build reputation and thus a long-term competitive advantage for companies. The chapter opts for a literature review with which to discuss the difficulties and possibilities companies have in building reputation through SNSs. The SNSs used in companies are marketing-centered. Engagement is promoted only with customers, and is short-term and centered on results instead of being long-term and centered on competitive advantage and promoting engagement with different stakeholders. This issue is not dependent on the size of the company. Instead, it is dependent on understanding the concept of reputation from a strategic point of view, with companies adapting their management to their own particularities and to the different possibilities offered by SNSs.

INTRODUCTION

This paper addresses Social Networking Sites (SNSs) as part of a Social Media (SM) strategy in building reputation for companies. Considerable research has been done into Social Media practices (Karami & Naghibi, 2014), and, over the last few years, SNSs and SM in general have been gaining popularity among both scholars and companies (Dutot & Bergeron, 2016).

Social Media are forms of electronic communication through which users share information, ideas, personal messages and other content such as videos.

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SNSs are part of a firm's social media strategy (Chung, Tyan & Chung, 2017), and act as communication platforms, such as Facebook, LinkedIn, Instagram, etc. that allow, particularly, networking, as a way of establishing contacts for an organization to be known, and to listen and learn from others. Social networking sites present some different particularities from other social media channels such as webpages, blogs, wikis, etc. Social networking sites are "Web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system" (Boyd & Ellison, 2008:211). According to these authors, SNSs "enable users to articulate and make visible their social networks" (op. Cit.: 201), and allow individuals to engage with strangers.

Although the issue about reputation and social media has been addressed by professionals (e.g. books such as Azevedo, 2018; Tyler, 2016; Miller, 2015) more than academically (Dijkmans, Kerkhof & Beukeboom 2015; Pownall, 2015), however, the issue of managing reputation through SNSs in particular does not seem to have been sufficiently addressed. In this line, Zenelaj, Gambarov & Bilge (2016) confirm the importance of managing corporate reputation through the use of SNSs, finding it to have a significant effect on corporate reputation. Also, Rashid, Othman, Othman & Salleh (2016) argue that SNSs should be included in a firm's strategic planning as part of its effort to maintain long-term corporate reputation.

Given this context, the present work begins with a preview review of the literature found in Scopus, Google Scholar and WOS (Web of Science) database, using the keywords Reputation+SNSs, SNSs+Enterprises, and Enterprises+Reputation. All document considered relevant for this work are contained in WOS (although some of them were possible to find also in Scopus or Google Scholar). At any case, WOS is the most complete database due to the fact that it includes papers indexed in Science Citation Index, Arts & Humanities Citation Index, Emerging Sources Citation Index and Conference Proceedings, Book Citation Index among others (WOS, 2018).

The term of Social Networking Sites rather than Social Media was chosen since we consider all SNSs to be part of the Social Media strategy, but that the Social Media strategy includes other, broader, formats than just SNSs (Chung *et al*., 2017).

The term reputation has been considered as corporate reputation excluding documents related to personal reputation or other concepts as prominence, prestige or well-known. The term has been defined widely in the specific literature related to corporate issues (Podnar & Golob, 2017) and has to be understood as different from other terms as corporate celebrity, corporate image or corporate identity (Gardberg, 2017).

The term enterprise has been considered and also different synonyms such as business, firm, organization and corporation.

The first combination of keywords (Reputation+SNSs) yielded a total of sixteen documents that were framed within the areas of knowledge of communication, marketing in general, tourism marketing, and information and technology. For the SNSs+Enterprises and synonyms combinations, most of the documents focused on the marketing environment from a commercial perspective. The combination Enterprises and synonyms +Reputation yielded more documents, of which those which addressed communication strategically were taken into account. It was clear that the scope of reputation linked to SNSs, in particular, has received little attention, and is an area of study that calls for further investigation. Due to the fact that although SNSs can be considered as a particular part of Social Media, when "Social Networking Sites" is introduced as key word in databases, the most part of documents referred generally to Social Media, not to social networking sites as particular platforms, such as Facebook, LinkedIn, etc.

In this line, the present chapter will deal with explaining the following topics:

1. What is known about the use of SNSs and corporate reputation.
2. What recommendations can help companies to manage their reputation on SNSs.

STARTING POINT AND MAIN CONCEPTS

The position on the topic is that it is important to discuss how companies can use SNSs as part of their communications strategy to manage their reputation for long-term competitive advantage (Bång & Hell, 2015) as opposed to only paying attention to the short-term relationship between reputation and sales/ consumer engagement.

To discuss how companies can use SNSs as part of their communications strategy to manage their reputation, it is necessary to provide broad definitions and discussions of the concepts of corporate reputation, SNSs versus SM, and engagement, incorporating a specific literature review into the discussion to support the position on the topic.

Corporate Reputation

Corporate reputation is a relevant concept for all organizations, regardless of their size or the market in which they operate (Fombrun & van Riel, 2004; Khan & Digout, 2017). Although it is a concept that is defined very broadly, it is still confused with many approaches and terms such as identity and image (Podnar & Golob, 2017). According to Gardberg (2017), in twenty years there has been no evidence of corporate reputation being just a fashion, but instead there is indeed evidence that research on it has become a phenomenon in the field of business and society. Money, Saraeva, Garnelo-Gomez, Pain & Hillenbrand (2017) find the concept to be steadily growing in interest among researchers and practitioners.

Corporate reputation is a construct that develops gradually over the long term. It implies organizations making decisions that allow them to generate value through the management of their corporate identity (defining and specifying what they are), the image they project (Walker, 2010), and their corporate culture (the values that define them). It is also conditioned by the firm's relationship with its stakeholders and the evolution of their perceptions (Harvey, Morris & Müller Santos, 2017) in the online and offline environment.

Corporate reputation has been studied professionally and academically in the offline context, but there does not seem to have been any in-depth explanation of it within the online environment (Khan & Digout, 2017).

Corporate Reputation Is Unique

Each firm has its own unique corporate reputation, independently of its different dimensions (e.g. financial, social, labour, commercial, public among others) and environments in which it is constructed (online or offline).

In this sense, the debate about reputation as being a formative or reflective construct is resolved by understanding that, on the one hand, a firm's overall reputation responds to a formative construct (involving different dimensions that do not necessarily have to correlate with each other). On the other hand, each dimension of its reputation (financial, social, labour, commercial…) responds to a reflective approach. They comprise indicators that indeed are interdependent.

This debate is complicated by understanding that changes which occur in the dimensions directly affect the firm's overall reputation (for example, improvements in product quality influence reputation). But changes in corporate reputation are not immediately reflected in the dimensions (for example, good reputation does not directly improve product quality).

At this point, the perceptions of the organization's publics come into play. These publics receive different inputs from the firm (for example, product quality), and give added value to the firm which can help build its reputation.

In talking about online reputation, one should not understand this to be a reputation different from the offline one, but rather an environment in which the perceptions of different publics are dealt with through specific channels. Although there are firms that live exclusively in the online environment, one cannot speak only of online reputation since being on the Internet does not mean that all operations are digitized. Therefore, when speaking about online reputation we are not speaking of a different type of reputation, but of an integral subset of each firm's total corporate reputation (Khan & Digout, 2017).

Corporate Reputation Is Relative

Reputation is by nature a relative element. It is possible that a firm is favourably perceived for one of its dimensions and unfavourably for another (Khan & Digout, 2017), or that perceptions change from one environment to another (Walker, 2010). This does not mean that we are dealing with different reputations, but rather that reputation is a multidimensional construct which has to be explained in relation to other of the context's elements with which it maintains a strong dependence. It is therefore impossible to study reputation without taking into account the different contexts in which it is manifest (Khan & Digout, 2017).

Reputation must also be understood in a relative fashion because a firm's stakeholders form their perceptions about it by comparing it to something else. One of the main objects of comparison is competition (Walker, 2010), but it is also possible that the comparison is with past actions, with crisis situations, or with the firm's evolution inside and outside the online environment for example. Therefore, reputation is neither unipolar nor bipolar (Walker, 2010), but lies on a continuum between favourable and unfavourable depending on how it is managed in all of its dimensions and contexts in which it is projected.

Corporate Reputation Depends on the Stakeholders

Reputation depends cognitively on what the firm does, and affectively on its publics' experiences, relationships, and emotions (Khan & Digout, 2017).

A person's affective commitment to an organization may be based on such aspects as the symbol, colours, and fonts of its logo, its age, its country of origin, the behaviour of its CEO, etc. (Turk, Jin, Stewart, Kim & Hipple, 2012). Reputation is subject to the actions of all stakeholders who maintain online and offline contact with the organization, not just of the customers or consumers of its products. Dijkmans *et al.,* (2015:65) "emphasizes the importance for a company of not only engaging online with its customers, but not the least also with its non-customers". The organization's activities affect all its stakeholders, and they also have an effect on it. The stakeholders' different perceptions must be taken into account and managed individually (Walker, 2010; Harvey *et al.*, 2017). The formation of reputation therefore depends on the reactions of the different stakeholders (not only the clients) in the different environments (offline and online).

In the offline context, the signals that an organization's publics receive come largely by way of traditional communication channels, such as press releases, annual reports, etc. Digitization brings complexity to the formation of reputation because it adds numerous points of contact (Ji, Li, North & Liu, 2017). Stakeholders now rely on new sources of information online. User-generated content and word-of-mouth (WOM) (van Noort & Willemsen, 2012) are critical drivers of reputation that need to be monitored on SNSs (Rauschnabel, Kammerlander & Ivens, 2016).

Corporate Reputation Management Does Not Only Depend on Communication

Reputation is a strategic variable that is not only managed through communication, whether offline or online. According to the Reputation Institute (2014:1) "70% of companies depend on Corporate Communication/ Public Affairs to manage reputation. Unfortunately, this is where the issues begin." Researchers and professionals need to understand more systematically the concept of corporate reputation as part of an organization's overall strategy (Melewar, Nguyen, Alwi & Navare, 2017), not just as a result of communication strategy.

Again, according to the Reputation Institute (2014:2), reputation is an invaluable contribution for firms which have converted their stakeholders' perceptions into input for the development of their overall strategy, rather than only the output of how well they are doing their communication.

Social Media and SNSs

According to Baruah (2012) some of the most popular electronic forms of social media are social networking sites, blogs (including so-called microblogs), media-sharing sites, social bookmarking and selection sites, analysis sites, forums and effective worlds, and applications for mobile communications. SNSs have unleashed a revolution not just in marketing, but also in the communications industry (Saxton & Waters, 2014).

There are many kinds of SNSs that can enhance relationships between an organization and its stakeholders. Burgueño (2009) distinguishes them into categories according to target and issue, which is fundamental to take into account when choosing and managing SNSs according to an organization's intended target.

Depending on the use made of them, SNSs can be grouped into generalist, specialist, and professional. Generalist (or horizontal) social networks are characterized by not having a definite topic, and are aimed at a generic audience. They all share the same characteristics: creating a profile, a list of contacts, and sharing content. Examples are Facebook, Twitter, Google+, Identi.ca, and Instagram. Specialist (or vertical) social networks are platforms that are aimed at a specific sector. This type of platform makes it easier for users to find other people with similar tastes and hobbies. The specialist SNSs are very diverse, focusing on such sectors as sports, free time and leisure, video games (Wipley), music (Last.FM), motorcycling (Moterus), crochet (Ravelry), graphic artists (Domestika, Behance), pets (Unitedcats, Uniteddogs), and travel (Minube). Professional social networks focus on business and commercial activities. Their aim is for their users to establish relationships with people who share common professional interests. Examples are Viadeo, Xing, and LinkedIn.

Engagement and SNSs

According to Taylor & Kent (2014:384) "The term engagement is used regularly in the scholarly literature but rarely defined. Engagement is a part of dialogue and through engagement, organizations and publics can make decisions that create social capital. Engagement is both an orientation that influences interactions and the approach that guides the process of interactions between groups."

The concept takes centre stage in the digital environment in which social media engagement "is viewed as interactions with stakeholders and public via social media" (Taylor & Kent, 2014:386), with many authors in particular using it to describe communication via SNSs, in particular. Although engagement is explained in the Social Media context is much more evident in SNSs such as Facebook or Twitter (Taylor & Kent, 2014) due to the possibilities of Social Networking Sites to manage engagement according to its special characteristics such as possibility to construct a public or semi-public profile within a bounded system, articulate a list of other users with whom they share a connection, and view and traverse their list of connections and those made by others within the system (Boyd & Ellison, 2008). In this line, Panagiotopoulos, Shan, Barnett, Regan & McConnon (2015) define three aspects that determine the concept of social media engagement: the management of social interactions, the creation of content to interact with specific audiences, and the use of SNSs as channels to further develop that engagement.

Engagement is a multidimensional concept (Dijkmans *et al*., 2015:59) defined as "a combination of cognitive aspects (e.g., being interested in a company's activities), behavioural aspects (participation in the company's activities), and/or emotional aspects (feeling positive about a company's activities)".

Therefore, one can establish three dimensions within engagement: the behavioural or dialogic dimension (based on social interactions), the cognitive dimension comprising interest in the organization and its contents, and the emotional dimension based on feelings towards the firm.

The Dialogic Dimension

When we talk about engagement, the dialogic dimension (participation based on social interactions) seems sometimes to be confused with the possibility of obtaining some response from the public. Dialogue is impossible when only getting a response from the subject. It needs real interactivity and the subject's commitment in the communication.

The first question is therefore to understand what interactivity is. It is not the same as feedback. Interactivity begins where feedback ends, opening the door to real dialogue, but not guaranteeing it. One can say that getting the answer from the other is not interactive communication but only initiating it. Interactivity depends on three factors as described by Liu & Shrum (2002:54-55): "Active Control. Active control is characterized by voluntary and instrumental action that directly influences the controller's experience. Two-Way Communication. Two-way communication refers to the ability for reciprocal communication between firms and users and users and users. Synchronicity. Synchronicity refers to the degree to which users' input into a communication and the response they receive from the communication are simultaneous".

Dialogic communication must always be interactive, even if it is not always to the same degree. The degree will depend on the level of active control, multi-directionality, and synchrony. Dialogic communication also needs a level of commitment on the part of the subject. Tsai & Men (2013) extracted two forms of behaviour according to the public's commitment: reactive commitment (consuming information), and proactive commitment (contributing and generating value by showing interest and participating actively). It can thus be said that dialogue will occur when there is proactive commitment on the part of the subject at different levels: low (for example, giving a "like"), medium (making a comment), and high (sharing the content).

The Cognitive Dimension

The cognitive dimension is important in the definition of engagement, and is developed by way of the content presented through digital communication channels (García, Carrillo & Tato, 2017). On the one hand, it is vital to monitor the content generated by the firm itself. This content must respond to a series of indicators that will strengthen the firm's presence in the digital environment: transmit its identity and values, and reach everyone by working on resolving any problems of usability (García *et al.*, 2017). And on the other hand, social networks' focus on the users allows those users to play a relevant role in actively creating content (Men & Tsai, 2014).

Thus, Muntinga *et al.* (2011) proposed a classification of the forms of online participation into three levels: content consumption (mere passive recipients), contribution (adding something to another's content), and content creation (actively generating information). When there is a contribution or creation, it needs to be determined whether the content has a positive or a negative sense. According to Ji *et al.* (2017), researchers should go into some depth in the meaning of the comments, and relate that meaning to the organization's reputation.

The Emotional Dimension

The emotional dimension, "feeling positive about a firm's activities" (Dijkmans *et al*., 2015:59), is not only assessing whether the firm is friendly or whether the public's feelings towards it are positive. This dimension enters more deeply into the commitment that has to exist between the two. It has already been stated above that commitment is necessary for there to be effective dialogue. Explaining how engagement occurs is crucial to the development of engagement (Taylor & Kent, 2014).

According to Chung *et al.* (2017), commitment is possible when an individual accepts being influenced because firstly they hope to achieve a favourable reaction from another person or group, secondly they want to establish a satisfactory relationship with another person or group, and thirdly they find the result of the behaviour to be intrinsically gratifying and want to maintain it (internalization of the commitment).

Commitment based on getting specific rewards can be obtained using an SNS to purchase a product or for any other specific commercial relationship. Commitment based on the desire to become a member of a community can arise from participating in an action that involves some follow-up (for example, a contest). Internalization of the commitment can occur when the subject has a long-term compliance with the values the firm represents.

THE USE OF SNSs BY ENTERPRISES

Uses and Issues

In the following paragraphs, we shall refer to some of the uses of SNSs and their limits in supporting corporate reputation if they are only partially understood. Three propositions will be established with the aim of drawing attention to the reorientation necessary concerning some of these uses.

SNSs and Online Interaction

SNSs are particularly useful for maintaining commercial online engagement with current clients in order to increase sales (Nobre & Silva, 2014), and, above all, they can help improve those clients' engagement. Also, SNSs can help enterprises attract new consumers (Bång & Hell, 2015). Users seem to rely more on the opinions expressed in SNSs than on the information generated and shared by the companies themselves, and are thus more likely to be predisposed to test the companies' products. According to Nobre & Silva (2014:5), SNSs have "the ability to advertise to a particular consumer group, focusing messages that meet their specific needs and tastes (Deloitte, 2012)", which can facilitate the WOM process in online communications (Becker *et al.*, 2013), a process that may be critical for the survival of companies.

Proposition One: Research results show that SNSs can foster engagement with customers, but also allow the company to "tell a story" about its own identity (Burson-Marsteller, 2010) and create new messages as part of its corporate communications or public relations strategy among other channels of Social Media.

SNSs and Relationships With Stakeholders

The effectiveness of SNSs in developing personal relationships with the company "can result in connections between individuals that would not otherwise be made", and "these meetings are frequently between people who share some offline connection" (Boyd & Ellison, 2008:211) as is always common in the more accessible business contexts. Opening up to new stakeholders so as to foster networking entails adapting the firm's SNSs strategy to each of the different groups of stakeholders which the company must identify *a priori*. Not all SNSs refer to the same stakeholder profile (there are specifically professional networks, social networks…). Even within a given network, there are multiple groups that can be reached differently according to the firm's communications strategy. Therefore, the different SNSs allow a firm to implement such targeting without increasing the number of groups of stakeholders they need to address, but rather, on the contrary, to segment them so as to better address their different interests and concerns.

Proposition Two: Users are constantly arriving through SNSs, and it is important for the firm to discard the idea that only its consumers or people who share some offline connection are in contact with it through the SNSs: "Even if a user is not interacting with an unknown user, he/she might get invitations/requests from friends of a known friend. The friends of a friend are indirectly connected to the user" (Raj & Babu, 2017:1). SNSs relationships eliminate intermediaries and barriers, and facilitate the arrival of new stakeholders.

SNSs and Corporate Reputation Management

Although SNSs are very important platforms, affecting communication, innovation, and profitability by reducing costs and increasing revenue (Bughin & Chui, 2010), it is still an open question as to whether they represent a major online form of building a reputation (Raj & Babu, 2017). Managing corporate reputation through SNSs is an important issue to study, in particular, the potential that these sites represent for firms (Ji *et al.*2017). In general terms, building reputation requires "rethinking the strategy in social media to set where companies want to be and with what objective" (Costa-Sánchez & Fontela, 2016: 235).

Proposition Three: When considering reputation creation on SNSs, the first thing to understand is that firms do not have one online and another offline reputation. They only have a single corporate reputation that must be managed both in and out of network environments. Reputation management on SNSs thus becomes an opportunity for the company to create and add value by managing its reputation holistically.

DISCUSSION

In the following paragraphs, we shall discuss each of the propositions set out above with the aim of completing and redefining the SNSs strategy approach to managing corporate reputation to response our objectives.

What Is Known About the Use of SNSs and Corporate Reputation

In this part, it is explained some key points to reflect on the role of SNSs in reputation management: SNSs are not only for Commercial communication, but also for Strategic Communication, SNSs allow reaching new stakeholders, SNSs are able to add value to the corporate reputation strategy

SNSs for Commercial and Strategic Communication

Companies need corporate communication channels (not only commercial communication channels) that facilitate the fulfilment of their objectives and ensure contact with their stakeholders, not only clients.

Companies typically use horizontal SNSs such as Facebook and Twitter rather than vertical (professional) SNSs, few of them support their corporate strategies through those sites (Chigora, 2016), and even those that do usually approach the issue unsatisfactorily.

It is important to set up a social media strategy that includes SNSs, not only consider them for commercial online interactions. In this sense, gaining competitive advantages through SNSs should not be understood only as making it possible to save on resources, to generate traffic, or to gain a potential market (Narváez & Montalvo, 2014) through interaction among users. Users are not only consumers, so their interaction has to be seen in a wider sense as involving different stakeholders.

If SNSs constitute a good channel through which to engage stakeholders and thus build reputation, decisions have to be taken at the level of corporate strategy, not only marketing strategy. The firm's top managers have to be involved. In this sense, decisions to participate in a social media platform are strategic (Dutot & Bergeron, 2016:1165). This strategic decision has to be taken as an opportunity to redefine targets, business resources, and actions aimed at sustaining performance more proactively.

Firms are more dependent on the point of view of their owners than on that of the corporate strategy, and this becomes a new limitation. According to Institutional Theory (Willmott, 2014), owners and managers seem to be more concerned about watching their competitors' steps, and therefore doing something because the "other one" does it, rather than thinking about how to optimize their own investment in SNSs. In this line, Institutional Theory explains that the institutionally established posture (understood as generally accepted facts) is created and transformed by agents (firms) so that the beliefs and actions of other agents (other firms) are conditioned by that posture.

Although SNSs have become a tool with which companies can get to know their stakeholders (their customers in particular) whose needs and views they cannot ignore, many companies see these sites as relatively insignificant for communication due to the limited effect they have on most customers, and their bias towards personal rather than strategical corporate communications (Durkin, McGowan & McKeown, 2013). In sum, the most relevant barriers to companies using SNSs in their social media strategy are economic issues, staff training (due to unfamiliarity with technology in general, and to the time and expertise needed to engage stakeholders), lack of control, and mixing social activities with business outcomes, as well as a generalized attitude of managers against their strategic use.

Some firms usually do not use SNSs for business purposes but rather to socialize with friends, even though profiles on SNSs, which some firms maintain to a greater or lesser extent, have generated satisfactory dialogue and attitudes, as well as modernizing firms' resources (Lekhanya, 2013). They do not take advantage of the possibilities offered by SNSs to differentiate between their really interested customers from other users such as friends or acquaintances.

The fear of not controlling what happens on SNSs, in part because of not having the resources to monitor them, is another element the firm has to take into account. In this sense, companies find it easier to control their owners' personal profiles (for example) than their corporate profiles, which leads to confusion between what is personal and what is professional and makes it even more difficult to control what happens in relation to the company, thus complicating the relationship with the different stakeholders and the measurement of the results.

A specific budget is needed to manage SNSs strategically. Generally, most entrepreneurs state that they have no definite budget intended for building social networks through SNSs (Narváez & Montalvo, 2014). According to Stankovska, Josimovski & Edwards (2016:225), such a budget is necessary if SNSs are to be part of the firm's communications strategy. Those authors add that: "The correlation between companies' marketing budgets and the number of different online tools used show [sic] a significant trend, which is not the case for those with only SM channels." A budget is necessary not only for commercial communication through SNSs, but also for corporate communication.

Employing SNSs to build reputation requires having someone responsible for linking the SNS strategy with the corporate strategy (whether this is done internally or externally). In this sense, according to Stankovska *et al.* (2016), the number of social media channels used is associated significantly with the number of staff employed in departments related to this area.

Researchers found two marked tendencies. One is of companies that create their SNSs internally: "The owner of the company or some assistant who becomes the Community Manager or Social Media Manager" usually deals with them (Narváez & Montalvo, 2014:539). The other is of those who hire an outside agency, leaving them generally responsible for adding content, tracking questions or comments, uploading promotions, etc. A common risk when there is no one in charge and the management of SNSs is done outside the company is that external agencies only provide technical support (Narváez & Montalvo, 2014) which is often not enough, and may end up being a very poor decision for the implementation of a strategic approach in the use of SNSs.

SNSs and New Stakeholders

There is a need to reinforce research on the impact of SNSs on companies for them to better manage their stakeholder engagement. Not evaluating the effectiveness of SNSs is a problem related to “the lack of a strategic approach” (Garrido-Moreno & Lockett, 2016:177). A quantitative measure of effectiveness could show up any lack of expertise related to the benefits of creating dialogue with stakeholders. A qualitative approach would be in line with the possibility of actively listening to stakeholders, not just hearing their online conversations.

An interesting aspect related to the possibility of building reputation through SNSs is to also engage internal stakeholders. Internal stakeholders such as employees are critical if a firm is determined to manage its reputation. The current literature suggests that the information and resources that can be derived from a social network are dependent on the strength of the ties amongst the members of the workplace social network (Levin & Cross, 2004).

Establishing and maintaining appropriate contacts with stakeholders through SNSs is fundamental for the management of reputation. It demands the definition of a map of the firm’s groups of stakeholders (consumers, potential customers, employees, public institutions, suppliers…), and combining them with the possibilities provided by each type of SNS. It is also important to establish the level of relationship and active communication that is necessary with each of those groups. To this end, some variables can be taken into account that will help determine the relative importance of communication with each stakeholder group. For example, one might establish as general variables to help delimit the firm’s strategy each group’s importance for the organization, management, and economic interests of firms, and the capacity of each group to influence the opinions of the other stakeholder groups on the SNSs.

SNSs in the Corporate Reputation Strategy

To be successful in building reputation for all kinds of companies, two conditions must be met: reputation must be managed in different environments (including the digital one) and in the long term (because it is impossible only in the short term), and the engagement of stakeholders together with their reactions in those environments must be cultivated and observed so as to generate the necessary mutual trust.

Among the different requirements in SNSs, there is on the one hand the company’s desire of how it wishes to be known as expressed in its online strategy, and on the other the definition of strategic stakeholder groups. Reputation must be assessed in an overall sense, taking into account the various sources through which the company may voluntarily communicate, such as different types of SNSs. Moreover, it is necessary to take into consideration the influence of SNSs on the company’s stakeholders, and how the stakeholders later behave by feeding back to the company their positive or negative recognition. Positive recognition may be transformed in the long run into reputation as a competitive advantage.

Therefore, effective reputation management requires the attention, assessment, and management of communication with the different stakeholders, establishing relationships of engagement with each group. This is a key aspect that should be developed in the SNSs as it allows dialogic communication, understood as a conversation that is neither unidirectional, nor even bidirectional, but multidirectional.

Little by little, the use of SNSs is forcing organizations to innovate and reorganize strategically. For this reason, while there had not been many studies about reputation and SNSs in the past, they are now increasing in frequency (Raj & Babu, 2017; El Marrakchi, Bensaid & Bellafkih, 2016). However, attention by companies and scholars on the use of SNSs in building reputation has been focused on marketing objectives, but not on corporate ones (Musa *et al.*, 2016: 5). As pointed out by Dijkmans *et al.*, (2015), studies on SNSs typically do not focus on corporate reputation but on related concepts, such as consumer engagement, emotional appeal, and brand attitude, which themselves have positive effects on reputation.

For example, "brand attitude" has a stronger correlation with performance than "brand reputation and image" (Musa *et al.*, 2016). For this reason, companies are not paying enough attention to the process of creating online reputation, only to how the results of their behaviour are perceived in the digital environment.

According to Costa-Sánchez & Fontela (2016), it is possible to determine factors that influence corporate reputation, such as a proactive attitude, quality of information, consumer attitude, corporate presence, communication on SNSs, and dynamism on SNSs. However, measurement of how these factors influence long-term reputations on SNSs has been through the quantification of opinions about or evaluations of the company (Arroyo *et al.*, 2017). Nevertheless, El Marrakchi, Bellafkih, Bensaid (2015:1) have proposed new options in which "the system gives a scoring to a product or an entity's reputation, measured by parsing belonging opinions that are pouring in a community without asking any rating from its members". Little by little, these experiences in SNSs have been creating a theoretical "corpus", but a corpus which is still quite vague and imprecise.

What Recommendations Can Help Companies to Manage Reputation on SNSs

At this point, we shall discuss solutions and recommendations that have been put forward to deal with the issues, controversies, and problems presented in the preceding section.

The particular novelty brought by SNSs is that they encourage the feeling that the opinions other users have are more important than what the companies say about themselves (Ji *et al.*, 2017). The sum of these opinions becomes the company's letter of presentation, which is personal and public as well as difficult to control, and directly affects the level of reputation the firm will attain and, more importantly, the real opportunities it will have for its future. Thus, "the evaluations, reviews, ratings, and stars that users give are the metaphorical traffic lights that govern these new interactions at all levels. That is where the avenues of reputation interact" (Arroyo, Murillo & Val, 2017:4).

In a highly unstable environment, it cannot be presumed that setting up an SNS strategy will actually improve corporate reputation. It can be said, however, that if SNSs are included in the reputation management strategy then it is necessary to monitor and strengthen engagement with stakeholders. Neither can it be said that achieving a high level of engagement will necessarily result in obtaining a good reputation. But some recommendations can be made to resolve some of the problems detected in managing reputation through SNSs by enhancing engagement.

Recommendations for the Design of Commercial and Corporate Strategies

SNSs are a good channel through which to develop the company's message and its identity, behaviour, and values, providing valuable information and transparency in real time about corporate reality. This information and transparency should not be understood as only being related to products and services. SNSs can empower their users by transmitting their experiences or information in the community built around a company's identity (not only around its products) in the long term.

There are therefore two types of communication: commercial (relating to products and services) and corporate (relating to the organization as a whole). The two communication strategies allow possible benefits to be obtained through SNSs in terms of direct and indirect profitability. According to the Banesto (2013) report, the commercial communication strategy will mainly bring direct profitability through sales of the product or service. The corporate communication strategy will bring indirect or deferred profitability by strengthening both the short-term image and the long-term reputation.

Therefore, direct profitability can be obtained on SNSs through sales on the social network itself or by generating traffic to the firm's shops, whether online or physical. To generate traffic to the online shop, firms can use promotions or upload content related to products that have a link to the online shop associated with them.

However, there is a risk of overusing such incentives because community members may not actually participate in the community's activities (e.g., information exchange, communicating with other members and marketers), but merely obtain the incentives and leave. Thus, marketers should provide not only tangible incentives but also venues for social interaction and entertainment to promote the engagement (Taylor & Kent, 2014).

With regard to indirect or deferred profitability, it must be said that the greatest benefit obtained is mainly intangible in nature, and it is therefore recommendable to make use of these long-term strategies.

SNSs must transmit brand image using for instance, vertical SNSs that make it possible to differentiate and segment the public. They must convert the firm into a referent whether for the information and content posted on those sites or for their ability to respond to the firm's groups of stakeholders.

A firm's SNSs allow it to stay in contact with its publics beyond the time of purchase. Building a database and maintaining fluid communication will allow it to achieve a higher level of commitment.

The firm needs to monitor its real presence on its SNSs. To this end, it is important to familiarize itself with the tools made available by some SNSs such as Facebook, Twitter, and Instagram. There are also specialized external tools which can provide extra information.

Recommendations to Improve Engagement on SNSs

According to Durkin *et al.*, (2013), the relationship between companies and their stakeholders has two directions. One is that, when referring to sales, the action is "pushing" consumers, but the other is that, when referring to reputation, the action is "pulling" stakeholders so as to engage them. Today, the challenge for a company is to interact with its stakeholders transparently, and hence build reputation as a competitive advantage.

In general terms, SNSs can constitute a key resource for a firm, one that is of particular importance in maintaining engagement between it and its publics. Dijkmans *et al.*, (2015:59) state that: "Achieving a high level of engagement is viewed as desirable, because it may enhance a company's reputation and brand loyalty (Van Doorn *et al.*, 2010; Hollebeek, 2011)" According to those authors: "The relational consequences of engagement may include commitment, trust, stakeholders' emotional brand attachment and loyalty (Brodie *et al.*, 2013). These are of added value for companies", especially for those whose markets are highly competitive.

Achieving stakeholder engagement means working on three dimensions: dialogic, cognitive, and emotional issues that are extremely close to what SNSs are able to do on the Internet.

With respect to the dialogic dimension, SNSs can familiarize people with a company's online and offline activities. There are many expressions of online behaviour of engagement with a company that are based on experiencing interest, and on interacting, contributing, participating, etc. with the company. SNSs have this capacity, but the organization has to activate it. For example, a question put forward to generate debate can foster interactivity to engage in dialogue. Nonetheless, while interactivity must be guaranteed, what is important in generating value is that the public feels committed to the firm. For this, the dialogue must be effective, and not simply seek commitment just through actions that produce a one-off type of gratification.

With respect to the cognitive dimension, the organization has to work both on its own content that it posts to SNSs and on that generated by its stakeholders. In relation to content posted by the organization, García *et al.* (2017) suggest there is a need to prepare information that shows what the firm is like and what its values are (this should appear as its "Profile" on the SNSs). Neither should the translation of messages into other languages and accessibility of the content be neglected. In this line, according to Social Media Australia (2018), Facebook and Twitter have put considerable effort into improving accessibility since 2009. In relation to user-created content, the intention of the firm must be to reduce the consumption of content without participation, and increase the contribution and creation of content.

With respect to emotional aspects of engagement, SNSs can present an emotional dimension of the company while it is dealing directly with its different stakeholders, not just consumers (Dijkmans *et al.*, 2015). According to the broaden-and-build theory (Fredrickson, 2001), personal information accumulated while an individual is exposed to positive emotions lasts longer than temporary emotions. One can say therefore that users whose experiences through SNSs are positive extend their well-being to other aspects of their lives, and do not want to leave the SNSs. This connection can be achieved through such techniques as branded content (communication designed to transmit values and emotions, which, with a well-constructed discourse, generate a connection between the firm and the public). The goal is to generate affinity rather than to sell a product. One way of creating branded content is in storytelling. This consists of connecting with your audiences by means of a story with its own character and plot, appealing to the emotional side, and thus generating trust and fidelity.

In sum, engagement can be improved by being clear that, firstly, the messages must be adapted to the different stakeholder groups – a single message cannot connect with everyone. Secondly, the firm's publics must learn something useful to them, in particular, they have to be taught something that is not a waste of their time. If something does not work on SNSs, the firm can try to redirect it, but without spending undue time to wait for it to end up working. And thirdly, the firm must always take the public's perspective into account. An organization without empathy will not be able to reach people because it does not listen to them.

Recommendations for the Design of an Online Corporate Reputation Strategy

Corporate reputation is a real competitive advantage that is only possible in the long term, so that it has to be more a strategic possibility than a short-term operational advantage.

Companies are more accustomed to managing their short-term image than their long-term reputation (Bång & Hell, 2015). Reputation implies a certain control and constancy in the firm's implementation of its corporate strategies and its communications.

There are various reasons why SNSs are a very useful resource with which to include the long-term in firms' management of their reputation. Firstly, because of their nature, they are channels with great continuity in time (Nobre & Silva, 2014), unlike other media or tools such as the use of a mailing or advertising campaign which have a useful life that practically only covers the duration of the campaign that it was designed for, and at a much greater cost.

Secondly, they allow the content to always be alive from the firm's perspective (Michaelidou, Siamagka & Christodoulides, 2011).

Thirdly, SNSs allow a dynamism that helps to create and consolidate the firm's corporate personality (Costa-Sánchez & Fontela, 2016).

And fourthly, SNSs also significantly reinforce offline relationships with a firm's stakeholders (Boyd & Ellison, 2008). The capacity of SNSs to establish multidirectional dialogues in real time, capable of transcending the online environment itself, is a valuable currency of exchange in the generation of corporate reputation for companies.

Therefore, if the corporate reputation strategy is to be extended to the environment of SNSs, it would be advisable to include the SNS actions within a broader social media strategy that completes the offline communication strategy. The diversification of channels will allow the SNSs to be focused more on achieving engagement, and to work on the dialogic, cognitive, and emotional dimensions in order to listen actively to stakeholders.

Adopting an SNS corporate reputation management strategy will also require creating a crisis protocol to enable rapid response to any emergency situation. It is not the mistakes themselves that undermine reputation, but inappropriate ways of trying to resolve them.

FUTURE RESEARCH DIRECTIONS

This final section looks at some lines for further research that might prove fruitful for improving the theoretical framework concerning corporate reputation and SNSs for companies in general.

One suggested line of future research is to look at actual SNS practices in companies. This has not been examined adequately from a strategic point of view with the engagement of all the groups of stakeholders. Studies of SNS adoption and utilization by companies remain limited. Researchers have been focusing on customers, but not on other stakeholders (Dijkmans *et al.*, 2015).

According to Durkin *et al.*, (2013), another second line of research is to look at the challenges that arise in the processes of adopting SNSs, in particular those regarding the relationships with the company's stakeholders (not only its customers) and their implications for different types of companies. For example, due to their size, SMEs would seem to be more likely to engage in dialogue, although it is not clear that they do so not whether they take a strategic approach to this question.

A third line of future research that is worth exploring is the emphasis on personal contacts preferred by companies versus virtual contacts with their stakeholders. Given that companies see the quality of their personal contacts as particularly important, and that their use of virtual contacts through SNSs is focused more on friends and family than on stakeholders, it would be worthwhile to explore this gap so as to align efforts to achieve greater value and benefits.

The fourth possible line of research would be based on the great diversity of companies not only in the sectors in which they work, but also in terms of their size and organization. Therefore, it is important to recognize that reputation management, although possible for any company, will have to be adapted to particular realities. This calls for a precise and rigorous study of the different types of companies and their different approaches to the management of reputation on SNSs.

Finally, Taylor & Kent (2014:396) encourage researchers to explore engagement. There are shortcomings in the definition of the dimensions of engagement as a first step with which to start any discussion on ways to measure it. Other fields, such as education or business management, can provide additional components for that exploration. Researchers should study the places where engagement occurs, and those experiences in which engagement is broken so as to better understand the obstacles.

CONCLUSION

This work has provided a discussion of what corporate reputation really is, and how one can understand its management through SNSs. SNSs constitute a perfect context for companies when they want to develop appropriate online communications using a strategic approach that includes budgeting for the implementation of actions in the long term. This work has attempted to provide organizations with information to contribute to their continuing progress with SNSs in particular.

For any analysis of how SNSs are involved in the construction of corporate reputation, it is essential to realize how invaluable an intangible asset that reputation is. Also, it is important to understand the true meaning of what is usually called online reputation so as not to interpret it as being in any way really separate from a firm's offline reputation.

To address the role of SNSs in communication strategies, it is not enough to know when and where they exist and how they are used. Instead, one must understand their capacity to achieve engagement among other Social Media channels. In fact, engagement is particularly defined in the context of SNSs on platform such as Facebook or Twitter (Taylor and Kent, 2014).

Although there is no surety of engagement directly leading to the construction of corporate reputation, it will improve the use of SNSs as part of the long-term strategy for reputation management. Hence, while there is no obligation to include SNSs in a reputation management strategy, their use has benefits over the inclusion of other digital channels.

Monitoring engagement in a firm's SNSs translates firstly into seeing the best way to engage in a dialogue that requires real interactivity and an adequate level of commitment, secondly into participation in the creation of content, and thirdly into establishing emotional ties with the firm.

This chapter has shown how SNSs can be critical for organizations by also engaging with their stakeholders. Such engagement will enhance reputation in the long term.

Reputation building using SNSs is compatible with all the kinds of companies since it has been shown that their use has nothing to do with the size or type of the organization. Instead, they are useful for all organizations that have a solid sense of their corporate reality – a sense which translates into doing things well, and striving for recognition from key groups of stakeholders.

Finally, it should be noted that the reality of firms' presence on SNSs is still fairly unprofessional. There is a limited capacity to achieve engagement, a lack of strategy and planning in terms of the content posted to those sites, and little long-term strategic orientation.

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REFERENCES

Arroyo, L., Murillo, D., & Val, E. (2017). *Confiados y Confiables. La fabricación de la confianza en la era digital*. Barcelona: ESADE.

Azevedo, F. (2018). *Online Reputation Management: Secrets from a Pro Ethical Hacker*. Independently Published.

Banesto Foundation. (2013). *Observatorio sobre el uso de las redes sociales en las PYMEs españolas*. Retrieved from http://www.slideshare.net/cink/segundo-observatorio-sobre-el-uso-de-las-redes-sociales-en-las-pym-es-espanolas

Bång, A., & Hell, J. (2015). *Digital Marketing Strategy: Social Media and its Contribution to Competitiveness*. Retrieved from https://www.divaportal.org/smash/get/diva2:824959/FULLTEXT01.pdf

Baruah, T. D. (2012). Effectiveness of Social Media as a tool of communication & its potential for technology enabled connections: A micro-level study. *International Journal of Scientific & Research Publications*, *2*(5), 1–10.

Becker, K., Nobre, H., & Kanabar, V. (2013). Monitoring & protecting company & brand reputation on social networks: When sites are not enough. *Global Business & Economics Review*, *15*(2-3), 293–308. doi:10.1504/GBER.2013.053075

Boyd, D. M., & Ellison, N. B. (2008). Social Network Sites: Definition, History, & Scholarship. *Journal of Computer-Mediated Communication*, *13*(1), 210–230. doi:10.1111/j.1083-6101.2007.00393.x

Burgueño, P. (2009). *Clasificación de redes sociales.* Retrieved from http://www.pabloburgueno.com/2009/03/clasificacion-de-redes-sociales

Chigora, F. (2016). Social Media & Brand Equity: Reality for Small to Medium Enterprises in Zimbabwe Tourism Industry. *International Journal of Innovative Research and Development*, *5*(4).

Chung, N., Tyan, I., & Chung, H. C. (2017). Social support & commitment within Social Networking Site in Tourism Experience. *Sustainability*, *9*(11), 2102. doi:10.3390u9112102

Costa-Sánchez, C., & Fontela Baró, B. (2016). Public Relations and Social Media. Spanish companies proactivity in the audiovisual social networks. *Revista Internacional de Relaciones Públicas*, *6*(11), 235–254.

Dijkmans, C., Kerkhof, P., & Beukeboom, C. J. (2015). A stage to engage: Social Media use and corporate reputation. *Tourism Management*, *47*, 58–67. doi:10.1016/j.tourman.2014.09.005

Durkin, M., McGowan, P., & McKeown, N. (2013). Exploring Social Media adoption in Small to Medium-Sized Enterprises in Ireland. *Journal of Small Business and Enterprise Development*, *20*(4), 716–734. doi:10.1108/JSBED-08-2012-0094

Dutot, V., & Bergeron, F. (2016). From strategic orientation to Social Media orientation: Improving SMEs' performance on Social Media. *Journal of Small Business and Enterprise Development*, *23*(4), 1165–1190. doi:10.1108/JSBED-11-2015-0160

El Marrakchi, M., Bellafkih, M., & Bensaid, H. (2015). Towards reputation measurement in online social networks. In Intelligent Systems & Computer Vision (ISCV) (pp. 1-8). IEEE. doi:10.1109/ISACV.2015.7105540

El Marrakchi, M., Bensaid, H., & Bellafkih, M. (2016). Intelligent reputation scoring in social networks: Use case of brands of smartphones. In *Intelligent Systems: Theories & Applications (SITA), 2016 11th International Conference on* (pp. 1-6). IEEE.

Fombrun, C. J., & Van Riel, C. B. (2004). *Fame & fortune: How successful companies build winning reputations*. FT Press.

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden-&-build theory of positive emotions. *The American Psychologist*, *56*(3), 218–226. doi:10.1037/0003-066X.56.3.218 PMID:11315248

García, M., Carrillo-Durán, M. V., & Tato-Jiménez, J. L. (2017). Online corporate communications: Website usability & content. *Journal of Communication Management*, *21*(2), 140–154. doi:10.1108/JCOM-08-2016-0069

Gardberg, N. A. (2017). Corporate Reputation: Fashion, Fad, or Phenomenon? *Corporate Reputation Review*, *20*(3-4), 177–180. doi:10.105741299-017-0033-4

Garrido-Moreno, A., & Lockett, N. (2016). Social Media use in European hotels: Benefits and main challenges. *Tourism & Management Studies*, *12*(1), 172–179. doi:10.18089/tms.2016.12118

Harvey, W. S., Morris, T., & Müller Santos, M. (2017). Reputation and identity conflict in management consulting. *Human Relations*, *70*(1), 92–118. doi:10.1177/0018726716641747

Ji, Y. G., Li, C., North, M., & Liu, J. (2017). Staking reputation on stakeholders: How does stakeholders' Facebook engagement help or ruin a company's reputation? *Public Relations Review*, *43*(1), 201–210. doi:10.1016/j.pubrev.2016.12.004

Karami, S., & Naghibi, H. S. (2014). Social Media Marketing (SMM) Strategies for Small to Medium Enterprises (SMEs). *International Journal of Sales & Marketing Management Research & Development*, *4*(4), 11–20.

Khan, S., & Digout, J. (2018). The Corporate Reputation Reporting Framework (CRRF). *Corporate Reputation Review*, *21*(1), 22–36. doi:10.105741299-017-0041-4

Lekhanya, L. M. (2013). The Use of Social Media & Social Networks as the Promotional Tool for Rural Small, Medium & Micro Enterprises in KwaZulu-Natal. *International Journal of Scientific & Research Publications, 3*(7).

Levin, D. Z., & Cross, R. (2004). The strength of weak ties you can trust: The mediating role of trust in effective knowledge transfer. *Management Science*, *50*(11), 1477–1490. doi:10.1287/mnsc.1030.0136

Liu, Y., & Shrum, L. J. (2002). What is interactivity & is it always such a good thing? Implications of definition, person, & situation for the influence of interactivity on advertising effectiveness. *Journal of Advertising*, *31*(4), 53–64. doi:10.1080/00913367.2002.10673685

Marsteller, B. (2010). *Global Social Media Check Up White Paper*. Retrieved from https://www.slideshare.net/webconomia/burson-marsteller-2010-global-social-media-check-up-white-paper-3368506

Melewar, T. C., Nguyen, B., Alwi, S. S., & Navare, J. (2017). Guest Editors' Introduction: The State of the Art on Corporate Reputation: A Special Section. *International Studies of Management & Organization*, *47*(3), 217–219. doi:10.1080/00208825.2017.1318016

Men, L. R., & Tsai, W. H. S. (2015). Infusing Social Media with humanity: Corporate character, public engagement, & relational outcomes. *Public Relations Review*, *41*(3), 395–403.

Michaelidou, N., Siamagka, N. T., & Christodoulides, G. (2011). Usage, barriers & measurement of Social Media marketing: An exploratory investigation of small & medium B2B brands. *Industrial Marketing Management*, *40*(7), 1153–1159. doi:10.1016/j.indmarman.2011.09.009

Miller, R. (2015). *The Complete Guide To Online Reputation For Small & Local Business: Everything You Must Know About Managing Your Online Reputation*. MDM-Publishing.

Money, K., Saraeva, A., Garnelo-Gomez, I., Pain, S., & Hillenbrand, C. (2017). Corporate Reputation Past & Future: A Review & Integration of Existing Literature & a Framework for Future Research. *Corporate Reputation Review*, *20*(3-4), 193–211. doi:10.105741299-017-0034-3

Muntinga, D. G., Moorman, M., & Smit, E. G. (2011). Introducing COBRAs: Exploring motivations for brand-related social media use. *International Journal of Advertising*, *30*(1), 13–46. doi:10.2501/IJA-30-1-013-046

Musa, H., Rahim, N.A., Azmi, F. R., Shibghatullah, A S., & Othman, N.A. (2016). Social Media marketing & online small and medium enterprises performance: Perspective of Malaysian small & medium enterprises. *International Review of Management & Marketing*, *6*(7S).

Narváez, G. A., & Montalvo, E. (2014). Best Practice in the Use of Social Networks Marketing Strategy as in SMEs. *Procedia: Social and Behavioral Sciences*, *148*, 533–542. doi:10.1016/j.sbspro.2014.07.076

Nobre, H., & Silva, D. (2014). Social Network Marketing Strategy & SME Strategy Benefits. *Journal of Transnational Management*, *19*(2), 138–151. doi:10.1080/15475778.2014.904658

Panagiotopoulos, P., Shan, L. C., Barnett, J., Regan, Á., & McConnon, Á. (2015). A framework of social media engagement: Case studies with food & consumer organisations in the UK and Ireland. *International Journal of Information Management*, *35*(4), 394–402. doi:10.1016/j.ijinfomgt.2015.02.006

Podnar, K., & Golob, U. (2017). The Quest for the Corporate Reputation Definition: Lessons from the Interconnection Model of Identity, Image, & Reputation. *Corporate Reputation Review*, *20*(3-4), 186–192.

Pownall, C. (2015). *Managing Online Reputation: How to Protect Your Company on Social Media*. Springer.

Raj, E. D., & Babu, L. D. (2017). An enhanced trust prediction strategy for online social networks using probabilistic reputation features. *Neurocomputing*, *219*, 412–421. doi:10.1016/j.neucom.2016.09.036

Rashid, M. A. A., Othman, M. N. A., Othman, M. Z., & Salleh, K. (2016, July). Exploring Employees' Social Media Engagement & Corporate Reputation of a Malaysian Public Enterprise. *3rd European Conference on Social M di R h Media Research EM Normandie*, 332.

Rauschnabel, P. A., Kammerlander, N., & Ivens, B. S. (2016). Collaborative brand attacks in social media: Exploring the antecedents, characteristics, and consequences of a new form of brand crises. *Journal of Marketing Theory and Practice*, *24*(4), 381–410. doi:10.1080/10696679.2016.1205452

Reputation Institute. (2014). *Playing to Win in the Reputation Economy 2014. Annual Reputation Leaders Study*. Retrieved from https://www.reputationinstitute.com/research/reputation-leaders-study

Saxton, G. D., & Waters, R. D. (2014). What do stakeholders like on Facebook? Examining public reactions to nonprofit organizations' informational, promotional, and community-building messages. *Journal of Public Relations Research*, *26*(3), 280–299. doi:10.1080/1062726X.2014.908721

Stankovska, I., Josimovski, S., & Edwards, C. (2016). Digital channels diminish SME barriers: The case of the UK. *Economic Research-Ekonomska Istraživanja*, *29*(1), 217–232. doi:10.1080/1331677X.2016.1164926

Taylor, M., & Kent, M. L. (2014). Dialogic engagement: Clarifying foundational concepts. *Journal of Public Relations Research*, *26*(5), 384–398. doi:10.1080/1062726X.2014.956106

Turk, J. V., Jin, Y., Stewart, S., Kim, J., & Hipple, J. R. (2012). Examining the interplay of an organization's prior reputation, CEO's visibility, and immediate response to a crisis. *Public Relations Review*, *38*(4), 574–583.

Tyler. (2016). *Mechanics of Online Reputation Management: Repair and Control Your Name or Brand Reputation Online*. CreateSpace Independent Publishing Platform.

van Noort, G., & Willemsen, L. M. (2012). Online damage control: The effects of proactive versus reactive webcare interventions in consumer-generated and brand-generated platforms. *Journal of Interactive Marketing*, *26*(3), 131–140. doi:10.1016/j.intmar.2011.07.001

Walker, K. (2010). A systematic review of the corporate reputation literature: Definition, measurement, and theory. *Corporate Reputation Review*, *12*(4), 357–387. doi:10.1057/crr.2009.26

Web of Science. (2018). *Database Information*. Retrieved from https://apps.webofknowledge.com/select_databases.do?highlighted_tab=select_databases&product=UA&SID=F3LBJ8MFntCrg5hnKVH&last_prod=UA&cacheurl=no

Willmott, H. (2015). Why institutional theory cannot be critical. *Journal of Management Inquiry*, *24*(1), 105–111. doi:10.1177/1056492614545306

Zenelaj, B., Gambarov, V., & Bilge, F. A. (2016). Using Social Media Communication as a Marketing Strategy to Generate Corporate Reputation: A Study in the Telecommunication Industry. In *Central & Eastern Europe in the Changing Business Environment* (pp. 356–370). Prague: University of Economics.

ADDITIONAL READING

Barger, V., Peltier, J. W., & Schultz, D. E. (2016). Social media and consumer engagement: A review and research agenda. *Journal of Research in Interactive Marketing*, *10*(4), 268–287. doi:10.1108/JRIM-06-2016-0065

Carroll, C. E. (2017). Corporate Reputation and the News Media: The Origin Story. *Corporate Reputation Review*, *20*(3-4), 165–170. doi:10.105741299-017-0038-z

Ellison, N. B. (2007). Social network sites: Definition, history, and scholarship. *Journal of Computer-Mediated Communication*, *13*(1), 210–230. doi:10.1111/j.1083-6101.2007.00393.x

Excellence, C. *Centre for reputation leadership.* Retrieved from http://www.corporateexcellence.org/

Fuchs, C. (2017). Social media: A critical introduction. *Sage (Atlanta, Ga.)*.

Schultz, M. (2017). Corporate Reputation From Within. *Corporate Reputation Review*, *20*(3-4), 171–172. doi:10.105741299-017-0037-0

Schultz, M., Hatch, M. J., & Larsen, M. H. (Eds.). (2000). *The expressive organization: Linking identity, reputation, and the corporate brand: Linking identity, reputation, and the corporate brand*. OUP Oxford.

Tuten, T. L., & Solomon, M. R. (2017). Social media marketing. *Sage (Atlanta, Ga.)*.

KEY TERMS AND DEFINITIONS

Commercial Communication: Set of communication actions directed towards customers or potential consumers so as to improve the marketing objectives set for the firm's products or services.

Corporate Communication: Set of communication actions directed towards increasing the organization's value, taking into account all of its stakeholders.

Corporate Reputation Management: Set of strategic, not just tactical, decisions that allow organizations to generate value through the management of their corporate identity (what they are, and what they do), the image they project, and their corporate culture (the values that define them), and which are conditioned by their relationship with their stakeholders and the evolution of the stakeholders' perceptions.

SNSs (Social Networking Sites): Communication platforms that can act as a part of a social media strategy. SNSs are web-based services that allow individuals to construct a public or semi-public profile, and articulate a list of contacts with whom they share a connection.

SNSs Engagement: Combination of actions developed through SNSs that allow active dialogue with the firm's publics, applying strategies that promote interest, participation, positive feelings, and above all, the strongest possible commitment to the firm's activities.

Social Media: Forms of electronic communication through which users share information, ideas, personal messages, and other content such as videos.

Strategic Communication: Effort put into communication management to be carried out in the long term, so as to achieve the objectives set out in the business strategy.

Chapter 5
Digital Marketing Strategies Based on the E-Business Model:
Literature Review and Future Directions

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ABSTRACT

One of the most significant changes in the last decade in the business environment has been caused by the development of information technologies and the internet. The internal structure and organization of companies has changed to evolve towards a digital environment influenced by internet business models and digital marketing (DM) techniques. This chapter develops a systematic literature review with the objective of identifying the key players in the business environment with respect to the new business models and digital marketing techniques applied to them, to improve the benefits they bring to the company. The results of the research identify and define the main actors of the electronic commerce (EC) ecosystem, as well as their typologies and the main techniques of DM used in this field of research. The results of the exploratory study can be used for future research in this field and to reinforce the reference bibliography in this area of research.

INTRODUCTION

Different research conducted in the last decade, indicate that one of the most significant changes in the business environment has been the implementation of Digital Marketing (DM) social media marketing strategies to maximize the return on investment -Return on investment (ROI) - of these in Electronic Commerce (EC) and this fact has led many authors to talk and research about the new digital industry as the Industry 4.0. (Chaffey, 2012).

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As indicated by O'Reilly (2005), one of the factors that caused this transformation process was the so-called Bubble Point Com, which together with the development of information and communication technologies, built a speculative economic current on companies of technological base or startups and business on the Internet (Cohen et al., 2000; Järvinen, and Karjaluoto, 2015).

Therefore, we can affirm, following the works of Kaushik (2009) and Chaffey (2015) that innovation, new technologies and social networks have changed the way of doing business and the business model as we understood it until the last decade of the 20th century. It is important to point out that in the 60s and 70s the emphasis would already be on the value that for companies had to identify the interests and orientations of consumers in emerging market studies. Drucker, would explain his fundamental theory of Marketing focusing on customer orientation and segmentation as the keys to Marketing: "Marketing aims to know and understand the consumer so well that the product fits perfectly to their needs" (Arch, Woodside, Milner, 1992).

Based on these ideas, Godin (1995) would synthesize Drucker's conception of Marketing in its concept of "Permission Marketing", where Marketing would put aside aggressiveness for sale and intrusion and focus on getting the permission of consumers before proceeding with the sale process: "Consumers will only give permission to a company to communicate with them if they know what they are going to earn in return."

This philosophy of exchange and adaptation, anticipated by Drucker and developed by Godín (1995), would be the driving force for the DM thanks to the development of the Internet (O'Reilly, 2005, Chaffey, 2012).

In addition, this vision would be the starting point to the debate raised in the mid-1980s, in which after the Bubble Point Com, the use of traditional marketing techniques in this new business environment would be criticized, leading to the assimilation and approach of new DM techniques -also known as e-Marketing- suitable for sales in new digital environments (German et al., 2013).

In 1985, it would be when another important milestone took place in the formulation of the current DM paradigm, Relational Marketing. In 1990, the new social networks and the concept of social web burst among the websites with most Internet traffic, largely due to the relationship between brands and consumers (Chaffey, 2015). This fact would raise again the strategic model to develop to get customers through the use and development of digital strategies on the Internet (Celaya, 2011).

With the technological revolution in the late 20th century and early 21st -understood as a process of changes at the level of efficiency and productivity that affected both material changes as well as changes related to learning, management development and knowledge, the development of the DM would establish a new dimension in traditional Marketing and its application on the Internet (Águila, 2000; Lenskold, 2002; Kaushik, 2009; Chaffey, 2015).

The concepts and methodologies referring to the DM would be coined in the last decade of the 20th century, when the use of the Internet and sales through Electronic Commerce (EC) would be consolidated, supported by the irruption of the use of New Technologies (ICTs) in the business environment. Regarding the academic relevance of the DM, would occur in the first decade of the 21st century in which the authors would focus their interest in the new way of developing business on the Internet, methodologies and definitions of strategies, the optimization of DM techniques and the different types and modalities of use of these (Yao et al. 2013; Jayaram et al., 2015 and Zhang et al., 2016).

As we have already indicated, DM has promoted the birth of technology-based companies, startups, which, driven by innovation, would develop their business strategies based on the exploitation of DM and

EC strategies to achieve the viability of the business plan. Under this new paradigm, companies would begin to prioritize DM techniques over traditional marketing techniques in these digital environments in order to optimize ROI on the Internet (Yun-Cheol et al. 2016).

These updates based on innovation and data automation, have built a new ecosystem, an Industry 4.0 that is characterized by new business models, innovation in data acquisition strategies, process automation and development of new business models based on the Internet.

The objective of this research is to identify the main business models in EC, from a Industry 4.0 perspective, as well as the main digital marketing techniques developed by these models in this new technological ecosystem. The methodology carried out is a systematic review of literature on EC and DM to detect those key players in the development of the new economy or digital economy in these internet-based models.

THE IMPORTANCE OF DIGITAL STRATEGY FOR COMPANIES: THE NEW PERSPECTIVE OF THE INDUSTRY 4.0

The presence of the company on the Internet - as a tool for creating and maintaining stable relationships with the customer - has given rise to new forms of interaction between companies and consumers in a direct way through social networks (Chaffey, 2015).

As we have already pointed out, the Internet has fostered the development of new Marketing practices, which must be competitive on the Internet and be integrated into the organization's strategy. The strategy developed by the company must be geared to the achievement of objectives. If we look at the DM, these objectives could be, following the work of Kaushik (2009): attract visitors, convert them into buyers and finally get them to repeat the purchase and create a personalized and direct service with these buyers.

In short, the digital strategy, according to Chaffey (2012), would be to use all the electronic tools that would help the company formulate its global strategy, in order to improve operations, innovation and customer service (Mavridis and Symeonidis, 2015).

The importance of the Internet in the modern business strategy would be highlighted by Honeycutt and Herring (2009) when they would point out that: "The key question is not whether the Internet should be implemented, -the companies have no other option if they want to be competitive-, the key question is how to implement it.". This has led to a Digital Transformation in companies in the last decade. Moreover, this digital transformation is based on an Industry 4.0 focused on increasing interaction with users through new technologies, social networks and online platforms. The innovation based on this new Industry 4.0 is changing the rest of marketing strategies and processes in companies. These companies have no to change and digitized and automated their strategies in order to optimize the Industry 4.0 benefits to the maximum.

It is for this reason, as indicated in his work Chaffey (2015), that DM must be integrated with other traditional marketing activities, and must rely on different objectives and methodologies. A DM strategy would have similar characteristics in the objectives set by a traditional Marketing strategy (Zhuofan et al. 2015; Yun-Cheol et al. 2016).

Germán et al. (2014) would establish the following benefits for DM actions within a strategy approach: (i) Identify; Internet can be used as research in DM to discover new consumers, know what they want and what they need; (ii) Anticipate; Internet provides an additional channel for consumers to access information and make purchases and (iii) Satisfy, achieve consumer satisfaction through the electronic channel. It is necessary to design and modify factors such as UX or user experience and the usability of the 2.0 tools used to achieve the objectives set.

Following the investigations of Xu et al. (2016) and Saura, Palos-Sanchez and Cerda (2017), the objectives of the DM strategies should be the following: (i) provide a future line for the development of DM activities in the company; (ii) involve the external analysis of the organization, internal analysis and other sources of information to propose a strategy; (iii) define DM objectives that support the objectives of the Digital Marketing strategy; (iv) define different DM strategies to achieve the objectives set and create a competitive advantage; (v) include in the strategy indicators formulated in the Digital Marketing plan as the target audience, positioning and specification for the DM mix; (vi) help identify which strategies are not correct by relying on the traditional Marketing plan and (vii) specify how the resources of the organization will be used to achieve the proposed strategy in digital marketing and social networks.

In parallel, authors such as Ryan and Jones (2009) and Chaffey (2012) would indicate the following characteristics for a DM strategy: (i) be aligned with the business strategy and Marketing strategy; (ii) use measurable objectives for the development of the brand and the company with initiatives and priorities marked annually; (iii) be aware of the different types of consumers and have effective contact with them through the Internet; (iv) define value proposals that are effective in that channel; (v) specify the actions on-line and off-line in order to attract visitors to the company's website; (vi) support the consumer purchase process through the use of the Internet in combination with other channels and (vii) place the consumer purchase cycle to attract visitors to the corporate website, get conversions and build loyalty (Leeflang et al., 2014).

Table 1 presents the "5S of DM" model of Chaffey (2013) that indicates the benefits offered by the use of these strategies, from the point of view of an adaptation of the traditional Marketing techniques to new 2.0 environments.

However, technology through this new Industry 4.0 has facilitated the creation of value, which through the value chain is used to discover the possibilities of positioning products and services on the Internet (Saura and Palos-Sanchez, 2018). The understanding of the target market, can involve the development of DM techniques, such as the analysis of internal and external databases and user interaction records based on variables and indicators to understand how users interact with the brand in Internet (Moreno et al., 2015).

Table 1. Digital marketing benefits and descriptions

Digital Marketing Benefits	Items descriptions
Sell - Increase sales	Increase the sales increases the target audience and the distribution of products or services is facilitated.
Serve - Add value to the service	Add value to the product or service by offering additional information and online catalogues.
Speak - Increase communication	Approaching the customer creates two new communication channels, through interactions in social networks and through information acquisition methodologies such as online forms.
Save - Save on costs	Reduction in the cost of sending notifications to the customer thanks to services such as email.
Sizzle – Extending the brand	Extend the brand on the Internet get the proposal of new strategies and new experiences in the online channel.

To develop an effective DM strategy, the company must consider how to create and deliver value through the Internet. The first step would be to apply the strategic principles of Marketing to understand that the company itself would really be an entity that takes information from a variety of sources -both offline and online- with which it generates hypotheses about the customer (Águila et al., 2001).

This information must be constantly analyzed and updated and technologies such as DM provide a source of information that can be analyzed and used to obtain a competitive advantage in the new paradigm of Industry 4.0. Therefore, the information, the data and its processing and analysis are fundamental for the development of an online positioning strategy. Kotler (2006) would affirm that "the intelligent management of information and the use of interactions with the client, supported by technology is among the basic rules of electronic marketing for the new economy". In order to implement the information and data collected from activities in DM in the process of the online value chain of a company, we must define the term "value" first (Chaffey and Ling-Yee, 2011).

Consequently, we can point out that the value chain would be a strategic analysis tool that helps determine the foundations of a company's competitive advantage and, although its nature is offline, it must be developed through the DM techniques in the shares of the company on the Internet. The problem is that the value chain is undergoing a transformation, modifying the steps from production in an industry, to delivery to the customer, with the essential component of information and data measurement (Chaffey, 2015).

Companies no longer prioritize that the manufactured product has a perfect finish, but it is a priority that it arrives at the right time to the customer and meets their expectations, such as express product shipments after making a purchase at EC (Saura, Palos-Sanchez and Cerda, 2017). Consequently, the information that surrounds production, both in terms of external and internal agents, would be more important, and through its analysis, the keys to the competitive advantages of companies could be found on online channels. Properly managing this information in the era of Industry 4.0 would require permanent contact with suppliers, and at the same time, try to allow customers to access a company that will satisfy their needs with products that meet their expectations (Wilson and Pettijohn, 2008).

METHODOLOGY

For the development of this research, a systematic literature review has been carried out in which the main scientific databases have been consulted: Web of Sciences, Journal of Citation Report (JCR), SCOPUS as well as SciencesDirect, PubMed, PsyINFO and other databases of scientific category. Likewise, for the selection of the works that are the object of study in this investigation, queries have been made in the indicated databases with Boolean operators including the terms AND or OR and vice versa, taking into account the keywords in the title and in the summary of the works "Electronic Commerce" and "Digital Marketing" as well as "Digital Business Model" or "Electronic Business Model". This process has allowed us to identify the main journals that investigate this topic: Journal of Direct, Data and Digital Marketing Practice, Journal of Interactive Marketing, Journal of Advertising Research, Electronic Commerce Research and Applications and Journal of Digital & Social Media Marketing.

The research works resulting from these consultations have been selected by number of citations and references, as well as by the position of the journal that publishes it in the indicated rankings, based on those indexed in Quartile 1 and 2 within the Business and Management categories or directly related.

In order to carry out the methodological process, different queries were first made in databases that were then refined according to the objectives of the selected researches. Articles identified in databases with the terms “Electronic Commerce” “and” Digital Marketing “as well as” Digital Business Model “or” Electronic Business Model have pass through the following process:

- Items excluded after the analysis of titles and abstracts (n = 234)
- Inappropriate terms
- They were not conclusive
- Potentially eligible items (n = 140)
- Items excluded from the full article analysis (n = 121)
- Did not match the search terms
- They were not related to the research criteria
- Limited quality in the evaluation
- No description and specification of the terms
- Final Items included (n = 19)

This process has a resulting selection of 19 papers within the characteristics indicated above (Table 2).

The process of systematic review of literature will allow to obtain a solid vision about the ecosystem of digital marketing and electronic commerce from a global perspective attending to the main works, which have addressed this issue.

THE DIGITAL ENVIRONMENT

Electronic Commerce and Digital Marketing

The EC and the DM do not represent only a change in the media to establish commercial relationships, but rather they are configured as a paradigm that has changed the commercial and economic level. Both concepts have been established as a phenomenon that must be understood from social, accounting and business organization perspectives (Saura, Palos-Sanchez and Martin, 2018)

In contrast, according to Kotler (2006), in traditional Marketing, responses are based on the emotions and feelings of consumers, with powerful incentives and mass dissemination strategies. As for the DM’s objective, it would be to know the needs of the customers and provide them with a solution through the study of the actions carried out in 2.0 environments. The difference with traditional Marketing would be the importance that customers or users acquire in the method of applying their actions (Zhu et al., 2011).

After this analysis and the indications made by Kotler (2006), it is important to highlight that the DM is a methodology, evolution or typology of traditional Marketing adapted to the new Digital Era, for which the strategic and methodological bases serve those already developed by Traditional Marketing over the last decades (Järvinen, and Karjaluoto, 2015). Although it is evident that traditional marketing contributes to the DM with the rules and theoretical tactics to follow in the digital environment, we must highlight the importance for companies and the professional sector of EC in an increasingly globalized and digital world (Viana et al., 2008 and Verma et al. 2012).

As we have already pointed out, in the same way as the Internet, the evolution of EC would be based on the development of new technologies (Cohen et al., 2000). The foundations of the EC would begin

Table 2. Articles results of Systematic Literature Review

Authors	Research Title
Palos-Sanchez et al. (2018)	The influence of social networks on the development of recruitment actions that favor user interface design and conversions in mobile applications powered by linked data
Rodríguez et al. (2017)	Information classification on social networks. Content analysis of e-commerce companies on Twitter. Clasificación de información en redes sociales. Análisis de contenido en Twitter de empresas de comercio electrónico
Saura, Palos-Sánchez and Suárez (2017)	Understanding the Digital Marketing Environment with KPIs and Web Analytics.
Xu et al. (2016)	Effects of big data analytics and traditional marketing analytics on new product success: A knowledge fusion perspective.
Moreno et al. (2015)	A system to enrich marketing customers acquisition and retention campaigns using social media information.
Zhuofan et al. (2015)	Search Engine Marketing, Financing Ability and Firm Performance in E-commerce
Jayaram et al. (2015)	Effective use of marketing technology in Eastern Europe: Web analytics, social media, customer analytics, digital campaigns and mobile applications
Mavridis and Symeonidis (2015)	Identifying valid search engine ranking factors in a Web 2.0 and Web 3.0 context for building efficient SEO mechanisms.
Järvinen and Karjaluoto (2015)	The use of Web analytics for digital marketing performance measurement
Vásquez and Escamilla (2014)	Best Practice in the Use of Social Networks Marketing Strategy as in SMEs
Leeflang et al. (2014)	Challenges and solutions for marketing in a digital era
Verma, Stock and Mccarthy (2012)	Customer Preferences for Online, Social Media, and Mobile Innovations in the Hospitality Industry.
Nabout, Skiera and Stepanchuk (2012)	Return on Quality Improvements in Search Engine Marketing
Chaffey and Patron (2012).	From web analytics to digital marketing optimization: Increasing the commercial value of digital analytics
Kent et al. (2011)	Learning web analytics: A tool for strategic communication
Lee (2010)	Death of 'last click wins': Media attribution and the expanding use of media data
Boyd (2007)	Social network sites: Definition, history, and scholarship
O'Reilly (2005)	What is Web 2.0. Design Patterns and Business Models for the Next Generation of Software
Chaffey y Wood (2005).	Business Information Management. Improving Performance Using Information Systems. Business Information Management.

more than four decades ago through the electronic transmission of messages and information packages (Greene et al., 2003). The term of EC (EC-Electronic Commerce), would be born referring to an extension of the term coined as electronic data interchange (EDI-Electronic Data Interchange) whose main objective would be from the 1960s, the exchange of documentation between large companies (Nabout et al., 2012).

The EC as an object of study in itself, would be a recently created phenomenon linked to the emergence of the Internet as a network of networks, which has facilitated the commercial relations on the social, political and cultural. EC would not necessarily mean making sales through the Internet, in fact, the Anglo-Saxon terms of eCommerce or eBusiness would mark this difference, when the first would involve the sale, and the second, would refer to the notion of doing business through electronic means, without necessarily selling (Jayaram et al., 2015). The EC would be a model of doing business characterized by communication with companies, the organization and that would possess characteristics such as speed, comfort, instantaneity, ubiquity and interactivity (Cohen et al., 2000; Järvinen, and Karjaluoto, 2015).

In spite of gathering attractive communication possibilities for the advertiser, the Internet would never leave aside the rest of traditional media such as television, radio or the press. Compared to traditional media, the Internet, and specifically through the EC would present a series of advantages over other means of communication or promotion. Television advertising, for example, is of short duration and, nevertheless, the promotion of products and services on the Internet would be permanent and continuous. The EC would allow the potential consumer to analyze the information provided, as well as in printed media, but would have attractive differentials, such as moving images and sound (Yao et al. 2013; Zhang et al., 2016).

The EC through the DM offers interactivity with the consumer, a key aspect that no other means of communication would offer until then. In this way, the viewer or user, before the exposure of information and/or advertising, would not be a passive actor, would be an active actor to which companies would direct the message to organize the content that is advertised (Águila, 2000). The Internet would be considered as an option for immediate response to advertising given its interactive nature. The way to execute actions in this digital scenario would be the DM, through the different existing development techniques.

In traditional advertising, the viewer would be impacted by an advertisement with the aim of feeling the desire to obtain information about the product or service, and after understanding it, it allow to go to the physical headquarters to satisfy that need (Saito et al. 2008). However, in EC, we would talk about users who through a click can know the information and the characteristics of the product (Kaushik, 2009; Chaffey, 2015).

The Internet offers a new path for Direct Marketing as a sales channel, allowing greater precision when obtaining statistical data and giving the possibility of analyzing the results of transactions or purchases in real time. Through the Web Analytics (WA), we can obtain data on how many users visit a web page daily and how many make a purchase as well as the conversions obtained for each action. The new technologies, through the WA allows obtaining numerous data of the user or buyer, through small software programs such as cookies or logs files (Küster and Vila, 2003). In this way, the Internet allows communication to be personalized, that is, each individual receives a different message according to their preferences through the DM techniques (Leeflang et al., 2014; Mavridis and Symeonidis, 2015).

The use of Internet verifies that we are in a global community in which differences in schedule and geographical location do not matter, implying that business and commercial activity can be carried out instantly with anyone and anywhere in the world (Yao et al. 2013). As pointed out by Águila (2000), the new applications present in EC would help to reformulate the different alternatives to carry out commercial activities (Wang, Park, and Fesenmaier, 2012).

Therefore, it is clear that the EC is not only electronic purchase and sale of goods, information and services, but also include the use of Internet for activities before and after the sale, such as advertising, Marketing, DM, search for information, negotiation or collaboration of companies (Yun-Cheol et al., 2016; Zhuofan et al. 2015; Yun-Cheol et al. 2016).

To define the concept of EC, we look at Table 3 where we can check the definition of "Electronic Commerce" according to different authors.

The EC would make use of the data flows in an effective way and would be introduced in the companies in three phases: substitution of manual operations based on paper by electronic alternatives;

Table 3. Definitions of Electronic Commerce (EC)

Authors	Description
Regueira (2016)	Any form of commercial transaction (not just buy and sell) in which the parts interact electronically rather than by exchange or direct physical contact. We could also talk about electronic business, which is more general and reserve the term commerce for purchases and sales over the Internet.
Zhang et al. (2016)	Electronic Commerce (EC) where online transactions take place.
Kaushik (2012)	Any form of transaction or exchange of commercial information based on the transmission of data over communication networks such as the Internet. In this sense, the concept of EC not only includes the electronic purchase and sale of goods, information or services, but also the use of the Internet for activities before or after the sale.
Kent et al. (2011)	The development of economic activities through telecommunications networks.
Kucuk and Sandeep (2007)	EC is a general concept that encompasses any form of commercial or business transaction that is transmitted electronically using telecommunication networks and using as change currency the electronic money.

rethinking and simplification of information flows and the dynamic use of information. According to Chaffey (2015), these phases have given rise to two types of EC: Indirect and Direct. Their differences would be in the form of carrying out the operations and in the type of good, which is in the transaction.

Indirect EC would consist in acquiring tangible goods to be physically sent using traditional channels of distribution. On the other hand, the Direct EC would be for which the order, the payment and the shipment of the intangible goods and/or services would be produced online, such as the acquisition or purchase of computer programs or applications (Chaffey and Ling-Yee, 2011; Moreno et al., 2015).

Digital Marketing Tactics in the Electronic Commerce: Identifying the Key Strategies for Industry 4.0

Due to the early nature of the development of the Internet and new technologies, the use of Marketing in the 4.0 environment has meant that until a few years ago there was no academic research analyzing the DM. The review of the main research journals -Journals focused on the practices of the DM (Journal of Direct, Data and Digital Marketing Practice, Journal of Interactive Marketing, Journal of Advertising Research, Electronic Commerce Research and Applications and Journal of Digital & Social Media Marketing) would show that the main topics in which their research is published are the following categories: DM; EC; Social Media Marketing; practice in B2C and B2B; Email marketing; digital campaigns; Search Engine Marketing optimization (SEO and SEM); Web Analytics focused on Social Media and Digital Marketing; Mobile marketing and Video marketing.

The categories analyzed in the different research on the DM have their own sub-categories defined by the different concepts that each of them possesses which we could use in any strategy based on the Industry 4.0. Let's quickly identify each of these subcategories and definitions within the research conducted on the subject of DM (Chaffey and Ling-Yee, 2011; Jayaram et al., 2015)

The different investigations are based on the practice of the DM as a concept and strategy, focusing on the different actors involved in its practice. Most of them are related to Web Analytics, the definition of its link with the strategy of the companies and the main indicators to develop this activity efficiently, focusing on the development of methodologies and models to increase profitability of the DM at a global level (Nabout et al., 2012; Moreno et al., 2015).

Search Marketing: Search Engine Marketing (SEM) and Search Engine Optimization (SEO)

It is a subcategory within the DM, highly researched for its repercussion and its economic value for the company (Chaffey, 2015). There are numerous investigations focused on improving these techniques based on the user's purchasing behavior, traditional marketing techniques and the definition of Key Performance Indicators (KPI) or analytical variables that help to improve this ecosystem (Yun-Cheol et al., 2016; Zhuofan et al. 2015 and Yun-Cheol et al. 2016).

Electronic Commerce (E-Commerce)

The investigations show different analysis of the evolution of the sector in the last two decades, analyzing the behavior of the user and the number of sales on the Internet. The number of users on the Internet and its use is also a frequent research practice (Nabout et al., 2012; Leeflang et al., 2014; Rodríguez, B., Pérez-Bustamante and Saura, 2017).

Social Media Marketing and Social Networks

They are primarily based on the development of content by the user and the creation of models to interact with customers in this environment. Diverse investigations also indicate the importance of how to control in the business field this DM technique, with the aim of increasing the company's benefits and the brand value. Increase in recent years the use of new methodologies for the analysis of data such as Sentiment Analysis with Machine Learning, Textual Analysis with Artificial Intelligence or analysis techniques based on Big Data (Nabout et al., 2012; Leeflang et al., 2014).

Web Analytics: Quantitative and Qualitative Indicators

A category that receives a lot of research focused on understanding how the user interacts with the 2.0 ecosystem to determine the best practices and definitions of KPIs that help the company to determine which is the best action and which determines or has the highest percentage to get a sale on the Internet. These KPIs can be both qualitative and quantitative. We speak of qualitative web analytics KPIs when referring to the study of consumer behavior on a web page, the color tests to see how to call attention to visitors or the study of heat maps on the web itself (Moreno et al., 2015; Mavridis and Symeonidis, 2015).

Big Data for Digital Marketing and Electronic Commerce

Understanding shopper behavior is essential for business success. Big data is an essential component of the process, and provides information on trends, spikes in demands and customer preferences and also Big data has a significant role in making online payments easier and more secure. Consecuently, Big data tapps into the core user experience to develop measurable ways of identifying improvement in experience.

Types of Business Model in the Electronic Commerce

The type of agent that is involved in the terms of trade of goods and services in EC would distinguish different forms of relationships between companies, customers and organizations (Chaffey and Ling-Yee (2011; Chaffey, 2015; Zhang et al., 2016).

We could distinguish the following types of EC according to the agents involved: B2B, company-company relations; B2C, business-consumer relations; C2C, consumer-consumer relations; B2A and C2A, EC between companies or consumers and Public Administration; C2B, consumer-business relations and P2P EC, peer-to-peer relationships and among people of equal standing (Moreno et al., 2015). Table 4 shows the definitions of each of these areas.

In addition, it is interesting to note that there are different stages for each of the models and that they share all of them. As indicated by Chaffey (2016), the online shopping cycle that we are going to analyze when defining a DM strategy is one of the most effective tools that exist for designing advertising campaigns based on EC (Rayman-Bacchus and Molina, 2001)

As indicated by Kaushik (2009) and Chaffey and Ling-Yee (2011), the strategy of DM based on the purchase cycle would be valid for the online and offline ecosystem, but if we look at the online world exclusively, we should pay special attention to certain aspects that we will see next.

The evolution of the EC has generated changes in the traditional consumer purchase cycle. These changes have led to the birth of terms such as ROPO (Research Online, Purchase Offline) or what is the same, research online and buy offline, new stages in the consumer shopping cycle that would be born thanks to the development of DM techniques and EC evolution (Kotler, 2006).

Table 4. Acronyms of business models on the Internet and definitions

Electronic Business Model	Description
Business to Business (B2B)	It would be the purchase-sale of products and services between companies. These transactions would be those that would be carried out when the companies made orders, invoices, payments and in definitive, they related to their suppliers or corporate customers through the Internet.
Business to Consumer (B2C)	The market of sale of retail type or direct sale to the consumer in Internet or B2C, we could find a number of characteristics different from which we can observe in the traditional commerce. We could highlight from the B2C EC that the efficiency of the markets as one of their main characteristics, where the price would be set after the analysis of the volume of buyers and sellers, or the power of the consumers, who could use tools to buy and analyze what is the best product according to your wishes.
Consumer to Consumer (C2C)	This EC modality would be based on the realization of transactions between consumers and purchase-sale processes, in order to put in contact users interested in the purchase or sale of a certain product (Fleming et al., 2010). The type of EC C2C would encompass those transactions in which both the seller and the buyer would be final consumers and act through a platform for the exchange of goods or services.
Business/Consumer to Public Administration (B2A or C2A)	It is the type of EC that would appear between the companies and the Administration, and consists mainly of the fact that the companies would become suppliers of the administration.
Consumer to Business (C2B)	This type of trade would consist of a group of final consumers who would need the same or similar product, they would join and ask the company to offer the product based on the number of buyers. Although, it would be a slower purchasing process, since a certain number of buyers would have to be gathered.
Business to Employee (B2E)	A B2E portal would be a personalized combination of news, resources, applications and e-commerce options accessible from the desk of each member in a company and would become the main means where staff would perform their work. A B2E network could improve efficiency and change the culture of the organization.

On the other hand, as Saura, Palos-Sanchez and Debasa (2018) or Moreno et al. (2015) would indicate, the consumer purchase cycle would be the time line that takes place since a buyer is not aware of his need to purchase, until he ends up buying. The stages that would make up the online purchase cycle, described chronologically, would be the following, taking into account the investigations of Kaushik (2015) and Chaffey (2016).

First of all, the Discovery stage. In this phase, the user would have a need and would begin to browse through the Internet or to make inquiries in search engines, actions with which he would get answers or clarify his doubts. Thus, it is necessary to detect what would be the user's need to offer content adapted to that need at that moment of the purchase cycle. The digital analytics and the analysis of the user's actions in search engines or the web of the companies, as indicated by Kaushik (2009), would be key factors for a correct analysis (Okazaki and Hirose, 2009).

Second, the Consideration stage. In this second phase, the user would already be aware that he has a need and that the solution would be to make a purchase. On this occasion, companies should detect the different options available in the market to cover this need and offer it to the user or consumer.

Finally, the decision stage. According to Chaffey (2015) would be the last phase in which the user has already seen the best options offered by the market to cover their needs. Here, the company should create content that helps the user to choose the best option and thus to close the purchase cycle.

EXPLORATORY ANALYSIS

Following the development of the study on electronic commerce and digital marketing, the following key events have been identified for the development of e-commerce businesses based on DM techniques. These would be the following:

The Importance of Search Marketing and Big Data for Electronic Commerce

Search Engine Marketing or Search Marketing could be divided into two classes (i) organic or natural -SEO- and (ii) sponsored or paid -SEM (Nabout et al., 2012). The difference in visibility with Search Engine Marketing compared to other models of Internet advertising is that the user searches voluntarily for a service, product or information. The abbreviations SEO, as we have already indicated, refer to Search Engine Optimization and in order to have presence in the search engines and attract traffic, it is essential that our page be among the first results of the SERPs (Search Engine Results Pages), as was point out by Nabout et al. (2012) and Leeflang et al. (2014).

The objectives of the web positioning of e-commerce are not reduced to the improvement of positions for certain consultations, they must be measured in increased traffic and traffic converted into sales. Leeflang et al. (2014) explains the operation of the SEO technique in search engines attending to the opportunity they offer to start the purchase process attending to its different stages.

Regarding the second technique identified, SEM, we can say that it is a technique of realization of DM that seeks to promote websites by increasing their visibility in search engines in computers, televisions, mobile phones or tablets (Yao et al. 2013; Jayaram et al., 2015)

The organization that regulates these activities worldwide is the Search Engine Marketing Professional Organization (SEMPO) and its objectives are to promote and develop best practices for search engine optimization professionals and their development, as well as providing educational materials and information to consumers and members of the industry about best practices (Yun-Cheol et al. 2016).

The objective of the technique of SEM is to improve the visibility of a website in the search engine results, by not including the term organic, we refer to any form that favors the positioning in the first places of results for advertising in search engines. One of the main characteristics of SEM is the establishment of the different Keywords (KW) as the objective of the DM strategy. In different search engine management software, there would be different types of keyword matching. In this research, we will take as an example the online advertising management platform Google Ads (Saura, Palos-Sanchez and Cerda, 2018).

In this way, Big data allows insights into some of the most intricate reasons a customer may or may not complete a sale, all without needing to incorporate long, tedious surveys or conducting costly, in-depth focus group (Lee, 2016).

These digital strategies also apply to the payment and ordering processes talking about Digital Marketing, Ecommerce and Big Data. Most customers desire a convenient, digital, app-based experience for buying food from local restaurants and stores, but that experience can suffer if the app experience does not meet or exceed the quality of the physical experience. Big data provides insights on best practices for building a payments solution, while also identifying core markets (Saura, Palos-Sanchez and Cerda, 2018).

The Influence of Social Media Marketing and Social Networks on Electronic Commerce Models

With the development of Web 2.0 and the expansion of the Internet, the term “Social Media” acquires a new dimension in which the user has before him an open access channel with which to interact freely with other people (Mavridis and Symeonidis, 2015).

Barnes defines the concept of social network in 1954 as indicated in the Boyd investigation (2007). From that moment, it would be shown that man created relationships throughout his life with the aim of developing ties and connections that over time would remain in force or connected by other people. For Celaya (2010), social networks make it easier for users to meet a common need, goal or interest. Authors such as Wilson, Wiebe and Hoffmann (2005) point out that social networks generate a social environment that would share experiences and knowledge of each person regardless of any kind of borders.

Yun-Cheol et al. (2016) would point out that social networks would be characterized as places on the Internet where individuals would publish and share all types of information, both personal and professional, with third parties regardless of whether they are known or unknown. Boyd et al. (2010) would indicate that social networks would generate changes through the construction of empirical knowledge that comes from concessions with users with a common interest. Yun-Cheol et al. (2016) would complete this assessment by noting that they would allow social expansion through the Internet by providing contact to users.

Boyd et al. (2010) affirm that the success of social networks is characterized by its rapid growth due to the exponential increase in its use in addition to providing a new means of communication with other people who would relate people through different geographical regions. Following the work of Vazquez and Escamilla (2014), Social Media could be defined as those platforms, media and social networks through which we express, share, interact, discuss and ultimately, we are part of a community. These reasons would justify the presence of brands in media. Now the consumer would not look at the brand from afar because it would be in their everyday environment. In this way, when the brand is pronounced in Social Networks, it receives an immediate response from the users allowing the communication between the brand and the consumer to be reciprocal. Social media could be conceived as a category within online media, as an instrument of mass communication or as an instrument for the democratization of information.

One of the great benefits that companies get with Social Media Marketing is the fact that any company can generate, quickly and easily, a large amount of written content or video format and spread it to their customers, providing them with interesting information and of added value that helps them when deciding to buy a product or service. The budget is no longer so important, but to know how to effectively manage and use social media sites (Lin et al. 2014).

The approach of the SMM (Social Media Marketing) would be again the construction of an asset, a channel that once built will provide an economic benefit to the company in the form of attracting traffic to their website that becomes contacts and subsequently in clients. Once the users are linked around the community, it would be used as a platform to disseminate content and thus attract traffic to the website (Järvinen, and Karjaluoto, 2015).

On the one hand, the SMM has to create a sufficient number of followers, but on the other hand, it must build good relationships with relevant people in the business area of the company, opinion leaders or influencers. The term to monitor, according to Welling (2006) means to keep track of the actions that are carried out, the reactions they have caused and everything that would be commented on the company or brand in social media. With the data obtained it can be done an analysis and to study how to improve or correct errors to increase the effectiveness of actions in this medium (Wilson, 2004).

Web Analytics: Quantitative and Qualitative Indicators for Electronic Commerce

The quantitative analytical indicators are based on a measurable data. According to Avinash Kaushik (2009), considered one of the greatest specialists in the field of global web analytics and Digital Marketing Evangelist at Google, there are three basic types of results that we expect from quantitative data analysis: income (conversion), cost reduction (conversion) and increase customer satisfaction or customer loyalty (user) (Lee, 2010). These three objectives, especially the first two, are aimed at e-commerce (Chaffey, 2009). When considering the content strategy, the focus is on informing the user or potential customer to attract their attention and interest (Kaushik, 2009).

There are several ways to measure the behavior of users and optimize the service. One is to use qualitative analysis data (Wang et al. 2017) that identifies reasons related to why the user has performed an action on a web page. These metrics are the feedback that is linked to the quantitative indicators of Analytics. The web analytics are not user data, which are the information provided by the actions performed by users. We can divide the qualitative information into two groups, depending on how we get it: Direct, asking the users a direct way on a series of questions: surveys, discussion groups or focus and interviews with users or Indirect: do not ask directly to the user, but analyze the behavior and the answer to the appropriate questions A/B tests, usability studies or experts in heuristic analysis (Kaushik, 2009). The great challenge for all companies is in the effectively analysis of information to turn it into knowledge to get better conclusions about the behavior of users on a website.

Mobile First: Mobile Marketing

The mobile phone has become a key tool for communication between companies and consumers. The clients, following the IAB Europe report (2017), spend an average of 5 hours a day in front of the mobile phone. All this time is an opportunity for the DM to attract traffic to the EC stores in the world. It is a developing sector that is evolving with the passage of time. The number of mobile phones is doubled with respect to 2017 and the number of mobile applications downloaded (small software that define a specific function) by users who use Smartphones over the past few years has been increased. The total time dedicated to the digital world through mobile phones has grown by 53%, a percentage that has been driven mainly by the use of mobile apps (Zhuofan et al. 2015; Yun-Cheol et al. 2016).

CONCLUSION

As has been demonstrated throughout this investigation, the interest of researchers on EC and DM has highlighted the importance of this industry for researchers from the point of view of the analysis of the main digital techniques and the main models of business on the Internet.

Therefore, and following the assessments as those of Nabout et al. (2012) and Leeflang et al. (2014) we can highlight that EC has driven the marketing industry towards the DM due to the need for companies to apply their tactics to the new digital ecosystem.

The EC industry has become the engine of DM techniques such as Search Marketing, SMM, Email and others as the WA techniques to measure their impact. Although it has been shown that the EC is a sector influenced by the development of social networks, it is interesting to highlight the important role played by DM techniques in the sector.

With the exploratory analysis presented at the end of this study, we have shown that the EC has evolved solidly over the last decade. Likewise, the research carried out in recent years has highlighted the interest of researchers in the actions related to search marketing, both SEO and SEM techniques, the influence of electronic commerce on social media and vice versa, web analytics, qualitative and quantitative indicators and mobile marketing.

The limitations of this study are those related to the number of consulted references, as well as those related to the development of new technologies applied to this sector and the time period analyzed throughout the study. Researchers can use this work in future studies to increase the theoretical framework and to identify the main strategies of DM and EC according to the interest of researchers in the last decade.

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REFERENCES

Boyd, D., & Ellison, N. B. (2007). Social network sites: Definition, history, and scholarship. *Journal of Computer-Mediated Communication*, *13*(1), 210–230. doi:10.1111/j.1083-6101.2007.00393.x

Boyd, D., Golder, S., & Lotan, G. (2010). Tweet, tweet, retweet: Conversational aspects of retweeting on twitter. In *Proceedings of the 43rd Hawaii International Conference on Social Systems (HICSS)*. IEEE. 10.1109/HICSS.2010.412

Celaya, J. (2000, 2001, 2012). La empresa en la Web 2.0: el impacto de las redes sociales y las nuevas formas de comunicación on-line en la estrategia empresarial. Barcelona.

Chaffey, D., & Patron, M. (2012). From web analytics to digital marketing optimization: Increasing the commercial value of digital analytics. *Journal of Direct*. *Data and Digital Marketing Practice*, *14*(1), 30–45. doi:10.1057/dddmp.2012.20

Chaffey, D., & Wood, S. (2005). *Business Information Management. Improving Performance Using Information Systems*. Business Information Management.

Del Águila, R. (2000). *Comercio Electrónico y Estrategia Empresarial: Modelos de Negocio en Internet*. Daccach T., J. C.

Germann, F., Lilien, G., & Rangaswamy, A. (2013). Performance implications of deploying marketing analytics. *International Journal of Research in Marketing*, *30*(2), 114–128. doi:10.1016/j.ijresmar.2012.10.001

Godin, S. (1995). Emarketing: Reaping profits on the information highway. New York: Perigree Books.

Honeycutt, C., & Herring, S. C. (2009). Beyond microblogging: Conversation and collaboration via Twitter. *42nd Hawaii International Conference on System Sciences*, 1-10.

Järvinen, J., & Karjaluoto, H. (2015). The use of Web analytics for digital marketing performance measurement. *Industrial Marketing Management*, *50*, 117–127. doi:10.1016/j.indmarman.2015.04.009

Jayaram, J., Manrai, K., & Manrai, S. (2015). Effective use of marketing technology in Eastern Europe: Web analytics, social media, customer analytics, digital campaigns and mobile applications. *Journal of Economics, Finance and Administrative Science*, *20*(39), 118–132. doi:10.1016/j.jefas.2015.07.001

Kaushik, A. (2009). *Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity*. Academic Press.

Kent, M. L., Carr, B. J., Husted, R. A., & Pop, R. A. (2011). Learning web analytics: A tool for strategic communication. *Public Relations Review*, *37*(5), 536–543. doi:10.1016/j.pubrev.2011.09.011

Kotler, A. E. (2006). *Principles Of Marketing.* Academic Internet Publisher.

Kucuk, S., & Sandeep, K. (2007). An Analysis of Consumer Power on the Internet. *Technovation*, *27*(1-2), 47–56. doi:10.1016/j.technovation.2006.05.002

Lee, G. (2010). Death of 'last click wins': Media attribution and the expanding use of media data. *Journal of Direct*. *Data and Digital Marketing Practice*, *12*(1), 16–26. doi:10.1057/dddmp.2010.14

Leeflang, P., Verhoef, P., Dahsltröm, P., & Freundt, T. (2014). Challengues and solutions for marketing in a digital era. *European Management Journal*, *32*(1), 1–12. doi:10.1016/j.emj.2013.12.001

Lenskold, J. (2002). Marketing ROI: Playing to win. *Journal of Marketing Management*.

Lin, Y., Fang, C., & Hsu, C. (2014). Determining Uses and Gratifications for Mobile Phone Apps. *Lecture Notes in Electrical Engineering Future Information Technology*, 661-668. doi:10.1007/978-3-642-55038-6_103

Ling-Yee, L. (2011). Marketing metrics' usage: Its predictors and implications for customer relationship management. *Industrial Marketing Management*, *40*(1), 139–148. doi:10.1016/j.indmarman.2010.09.002

Mavridis, T., & Symeonidis, A. L. (2015). Identifying valid search engine ranking factors in a Web 2.0 and Web 3.0 context for building efficient SEO mechanisms. *Engineering Applications of Artificial Intelligence*, *41*, 75–91. doi:10.1016/j.engappai.2015.02.002

Moreno, J., Tejeda, A., Porcel, C., Fujita, H., & Viedma, E. (2015). A system to enrich marketing customers acquisition and retention campaigns using social media information. *Journal of Service Research*, *80*, 163–179. doi:10.1016/j.knosys.2014.12.033

Nabout, A., Skiera, B., & Stepanchuk, T. (2012). Return on Quality Improvements in Search Engine Marketing. *Journal of Interactive Marketing*, *26*(3), 141–154. doi:10.1016/j.intmar.2011.11.001

O'Reilly, T. (2005). *What is Web 2.0*. Madrid: Design Patterns and Bussiness Models for the Next Generation of Software.

Okazaki, S., & Hirose, M. (2009). Does gender affect media choice in travel information search? On the use of mobile Internet. *Tourism Management*, *30*(6), 794–804. doi:10.1016/j.tourman.2008.12.012

Palos-Sanchez, P. R., & Saura, J. R. (2018). The Effect of Internet Searches on Afforestation: The Case of a Green Search Engine. *Forest*, *9*(2), 51. doi:10.3390/f9020051

Palos-Sanchez, P. R., Saura, J. R., & Debasa, F. (2018). *The influence of social networks on the development of recruitment actions that favor user interface design and conversions in mobile applications powered by linked data*. Mobile Information Systems. doi:10.1155/2018/5047017

Rayman-Bacchus, L., & Molina, A. (2001). Internet-based tourism services: Business issues and trends. *Futures*, *33*(7), 589–605. doi:10.1016/S0016-3287(01)00003-9

Rodríguez, B., Pérez-Bustamante, D. & Saura, J.R. (2017). Information classification on social networks. Content analysis of e-commerce companies on Twitter. Clasificación de información en redes sociales. Análisis de contenido en Twitter de empresas de comercio electrónico. *Revista Espacios*, *38*(52).

Ryan, D., & Jones, C. (2009). *Understanding digital marketing: marketing strategies for engaging the digital generation*. Kogan Page.

Saito, K., Nakano, R., & Kimura, M. (2008). Prediction of information diffusion probabilities for independent cascade model. In *Knowledge-Based Intelligent Information and Engineering Systems* (pp. 67–75). Springer. doi:10.1007/978-3-540-85567-5_9

Saura, J. R., Palos-Sánchez, P., & Suárez, L. M. (2017). Understanding the Digital Marketing Environment with KPIs and Web Analytics. *Future Internet*, *9*(4), 76. doi:10.3390/fi9040076

Saura, J. R., Palos-Sanchez, P. R., & Rios-Martin, M. A. (2018). Attitudes to environmental factors in the tourism sector expressed in online comments: An exploratory study. *International Journal of Environmental Research and Public Health*, *15*(3), 553. doi:10.3390/ijerph15030553 PMID:29562724

Vásquez, G. A., & Escamilla, E. M. (2014). Best Practice in the Use of Social Networks Marketing Strategy as in SMEs. *Procedia: Social and Behavioral Sciences*, *148*, 533–542. doi:10.1016/j.sbspro.2014.07.076

Verma, R., Stock, D., & Mccarthy, L. (2012). Customer Preferences for Online, Social Media, and Mobile Innovations in the Hospitality Industry. *Cornell Hospitality Quarterly*, *53*(3), 183–186. doi:10.1177/1938965512445161

Viana, W., & Andrade, R. M. C. (2008). XMobile: A MB-UID environment for semiautomatic generation of adaptive applications for mobile devices. *Journal of Systems and Software*, *81*(3), 382–394. doi:10.1016/j.jss.2007.04.045

Wang, D., Park, S., & Fesenmaier, D. R. (2012). The role of smartphones in mediating the touristic experience. *Journal of Travel Research*, *51*(4), 371–387. doi:10.1177/0047287511426341

Wang, R., Kim, J., Xiao, A., & Jung, Y. J. (2017). Networked narratives on Humans of New York: A content analysis of social media engagement on Facebook. *Computers in Human Behavior*, *66*, 149–153. doi:10.1016/j.chb.2016.09.042

Welling, R., & White, L. (2006). Web site performance measurement: Promise and reality. *Managing Service Quality*, *16*(6), 654–670. doi:10.1108/09604520610711954

Wilson, R. D. (2004). Using web traffic analysis for customer acquisition and retention programs in marketing. *Services Marketing Quarterly*, *26*(2), 1–22. doi:10.1300/J396v26n02_01

Wilson, R. F., & Pettijohn, J. B. (2008). Affiliate management software: A premier. *Journal of Website Promotion*, *3*(1/2), 118–130. doi:10.1080/15533610802052894

Wilson, T., Wiebe, J., & Hoffmann, P. (2005). Recognizing contextual polarity in phrase-level sentiment analysis. *Proceedings of the conference on human language technology and empirical methods in natural language processing*. 10.3115/1220575.1220619

Xu, Z., Frankwick, G. L., & Ramirez, E. (2016). Effects of big data analytics and traditional marketing analytics on new product success: A knowledge fusion perspective. *Journal of Business Research*, *69*(5), 1562–1566. doi:10.1016/j.jbusres.2015.10.017

Yao, K., Zweig, G., Hwang, M.-Y., Shi, Y., & Yu, D. (2013). *Recurrent Neural Networks for Language Understanding*. Interspeech.

Zhang, K., Yun, X., Liang, J., Zhang, X.-y., Li, C., & Tian, B. (2016). Retweeting behavior prediction using probabilistic matrix factorization. *Computers and Communication (ISCC), IEEE Symposium on*, 1185–1192. 10.1109/ISCC.2016.7543897

Zhu, J., Xiong, F., Piao, D., Liu, Y., & Zhang, Y. (2011). Statistically modeling the effectiveness of disaster information in social media. *Global Humanitarian Technology Conference (GHTC)*, 431–436. 10.1109/GHTC.2011.48

Zhuofan, Y., Shib, Y., & Wang, B. (2015). Search Engine Marketing, Financing Ability and Firm Performance in E-commerce. *JMR, Journal of Marketing Research*, *55*, 1106–1112. doi:10.1016/j.procs.2015.07.078

Chapter 6
FinTech and Its Disruption to Financial Institutions

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ABSTRACT

This chapter studies how FinTech is transforming traditional financial institutions (FIs). This chapter achieves the four related goals. First, it discusses the current stage of FinTech development in different areas such as crowdfunding, payment, blockchain, and cryptocurrency. Second, it examines how each FinTech development affects traditional FIs, in both positive and negative ways. Third, it explores how FIs are currently managing FinTech innovations. It also suggests ways through which these institutions could best utilize FinTech to better serve their customers and eventually optimize the overall financial system. Finally, following the book's focus on man's role at the center of technology advancement, this chapter discusses whether FIs' customers' needs are still placed at the center of FIs' incentives to adapt new technology, and if not, how can we focus back to the people that the financial system ultimately serves.

INTRODUCTION

Financial Technology (FinTech) is defined as "a new financial industry that applies technology to improve financial activities" (Schueffel, 2016). This chapter studies how FinTech is transforming traditional financial institutions (FIs), including banks and investment companies such as mutual fund, hedge fund, venture capital firms (VCs) and private equity firms (PEs). This chapter achieves the four related goals. First, it discusses the current stage of FinTech development in various areas such as crowdfunding, payment, blockchain and cryptocurrency. Second, it examines how each FinTech development affects traditional FIs, in both positive and negative ways. Third, it explores how FIs are currently managing FinTech innovations. It also suggests ways through which these institutions could best utilize FinTech to serve their customers and eventually optimize the overall financial system. Finally, following the book's focus on man's role at the center of technology advancement, this chapter discusses whether customers' needs are still placed at the center of FIs' incentives to adopt new technology, and if not, how can we focus back to the people that the financial system ultimately serve.

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This chapter makes the following contributions. First, this chapter is one of the first studies to provide an overview of all three major areas—crowdfunding, payment, and blockchain—of FinTech development and their impacts on FIs. Second, it inspires critical thinking on the effects of technology on traditional industries and how traditional industries use technology to optimize their businesses. The discussion also focus on the effect of such transformation on man, discussing both economic and social impacts.

BACKGROUND

Economics of Financial Institutions

As the aim of the chapter is to examine the impacts of FinTech on the financial industry, we need to understand the economics of financial industry and institutions. Financial institutions (FIs) examined in this chapter include commercial banks, investment banks, and investment companies (e.g., mutual fund, hedge fund, VC, and PE). Table 1 discusses the main businesses for each of these FIs.

FIs perform the essential function of channeling funds from those with surplus of funds ("fund suppliers") to those with shortages of funds ("fund users") (Saunders, 2014). Because of the information asymmetry between the fund suppliers and fund users, the first important function of FIs, as financial intermediaries, is the *ex-ante screen of potential fund users and the ex-post monitoring of them*. Specifically, an FI collects suppliers' funds and invests in securities (e.g., stocks, bonds, derivatives) issued by fund users. This aggregation of funds mitigate the information problem in two ways. First, it provides greater incentive for an FI to hire employees with superior skills and training in monitoring. In this way, fund suppliers have appointed the FI as a delegated monitor to act on their behalf (Diamond, 1984). Second, the relative large size of the FI allows collection of information to be accomplished at a lower average cost (the economies of scale) (Saunders, 2014). This is a key function performed by all FIs—commercial banks in their loan decisions, investment bank when giving advice for M&A and IPOs, and investment companies picking portfolio for their clients.

A second function of FIs is to *provide liquidity and diversification for the fund suppliers, thus acting as asset transformers*. FIs purchase primary securities, such as bonds and stocks issued by funds users and finance these purchases by selling securities to fund suppliers in the form of deposits, shares of

Table 1. Business of each type of FIs

Financial Institutions	Main Businesses
Commercial banks	Take deposit and make loans
Investment banks	Advise corporate clients on the following: ● merger & acquisitions (M&As) ● securities underwriting, such as initial public offering (IPOs) and syndicated loans ● securities research, brokerage, and trading
Investment companies (also "investment funds") ● Pension funds & mutual funds ● Hedge funds ● VC ● PE	Pool financial resources of individuals and companies and invest those resources in diversified portfolios of assets ● Highly regulated to hold investment-grade securities ● Investment in high-risk securities and companies ● Investment in early-stage companies ● Normally invest in late-stage companies

Source: Saunders (2014)

mutual funds, and other securities. FIs reduce liquidity risks of fund suppliers by transferring the risk to their own balance sheets. For instance, commercial banks offer highly liquid deposit account to fund suppliers on the liability side of their balance sheets, while investing in less liquid bonds issued by fund users on the asset side of their balance sheets (Saunders, 2014).

The ability of FIs to provide the liquidity service is based upon diversification. FIs can exploit the law of large numbers in making their investment decisions—such as offering loans to various borrowers and investing in a large portfolio of stocks (mutual fund) or portfolio of companies (PEs and VCs)—whereas individual fund suppliers, because of their smaller wealth size, are constrained to holding relatively undiversified portfolios. As a result, diversification allows an FI to predict more accurately its expected return and risk on its investment portfolio so that it can credibly fulfill its promises to the suppliers of funds to provide highly liquid claims with little price risk. As long as an FI is large enough to gain from diversification and monitoring on the asset side of its balance sheet, its financial claims (its liabilities) are likely to be viewed as liquid and attractive to small fund suppliers—especially when compared to direct investments in the capital market.

FIs perform services that *improve the operation of the financial system as a whole and the well-being of the overall economy* in the following three ways. First, because deposits are a significant component of the money supply, which in turn directly impacts the rate of economic growth, commercial banks play a key role in the transmission of monetary policy from the central bank to the rest of the economy (Saunders, 2014). Second, FIs provide payment services that directly benefit the economy. Two important payment services are cheque-clearing and wire transfer services. Third, FIs provide time intermediation through intergenerational wealth transfers. The ability of savers to transfer wealth from their youth to old age as well as across generations is also of great importance to a country's social well-being.

Fintech Opportunities and Challenges for FIs

FinTech is defined as technology enabled financial solutions and financial services (Arner, Barberis, & Buckley, 2015; Chishti & Barberis, 2016; Schueffel, 2016). With the advancement of and the ever-improving nature of technology, FinTech is a very broad term. The most well-known FinTech application is in the area of payment, such as PayPal and Apple Pay. Other FinTech applications includes crowdfunding (alternative finance), blockchain and cryptocurrency, AI-based financial advising (robo-advising), the use of technology in the insurance industry (InsurTech), and the use of technology for regulation and compliance (RegTech). Table 2 lists these six most important categories of FinTech solutions and example of applications and platforms of each category.

Table 3 further shows the EY (2017)'s FinTech adoption rate by countries with the average adoption rate across all 20 surveyed markets being 33% (untabulated). The EY (2017) report identifies 17 distinct FinTech services and defines a regular FinTech user as an individual who has used two or more FinTech services in the last six months. The research is based on more than 22,000 online interviews in 20 markets and the adoption index is defined as the FinTech users as a percentage of the digitally active population.

In terms of FinTech's impact on FIs, a survey conducted by KPMG (2017a) examines factors that disrupt the financial industry. The survey result shows that FinTech is the biggest disruptor for FIs, with 57% respondents ranking it number one disruptor, ahead of growing global regulatory complexity (51%) and new business models (46%).

In a McKinsey white paper, Dietz *et al.* (2016) state that FinTech solutions in FIs mainly aim at (1) providing new ways to enhance the customer experience, (2) underpinning new payments or digital de-

Table 2. The FinTech ecosystem

Categories	Examples
1. Payment & Remittance	*PayPal, ApplePay, Fundbox, Taulia*
2. Crowdfunding (alternative finance)	*GoFundMe, Kiva, Indiegogo, Kickstarter, Lending Club, Prosper, Seedrs, CrowdCube, FundersClub*
3. Robo-advising	*Robinhood, Motif, Moneyfarm, Advizr*
4. Blockchain & Cryptocurrency	*Bitcoin, Ethereum, Ripple, Circle, R3*
5. Insurance Technology (InsurTech)	*Friendsurance, Kasko, Knip*
6. Regulation Technology (RegTech)	*iComply, Silverfinch, Quarule, ViClarity, Fortia*

Source: Author and EY (2017)

Table 3. FinTech adoption rate by countries

Rank & Countries	Adoption Rate	Rank & Countries	Adoption Rate	Rank & Countries	Adoption Rate	Rank & Countries	Adoption Rate
1. China	69%	6. Spain	37%	11. Hong Kong	32%	16. Ireland	26%
2. India	52%	7. Mexico	36%	12. S. Korea	32%	17. Singapore	23%
3. UK	42%	8. Germany	35%	13. Switzerland	30%	18. Canada	18%
4. Brazil	40%	9. S. Africa	35%	14. France	27%	19. Japan	14%
5. Australia	37%	10. USA	33%	15. Netherlands	27%	20. BE & LUX	13%

Source: EY (2017)

livery models, (3) making service delivery faster and more cost efficient, (4) responding to regulatory change, and (5) improving the efficiency of back-office functions. The authors find that 62% of FinTech companies aim to provide solutions for retail banking with only 11% focused on large corporate banking offerings. Payment is the most popular area and lending is the most lucrative area of banking by revenue. The authors also find that FinTech startups are focused on unbundling banks by offering one type of product or service within a bank's offering and concentrating on doing it well.

FIs' adoption of FinTech is first and foremost driven by customers' expectation and demand of personalized product, real time transaction, and transparency. These three trends are mostly driven by the changing consumer habits and the rising of millenniums. First, over the past 5 to 10 years, there has been a rapid shift in how consumers view financial services companies. This is driven by changing consumer needs where retail products can be tailor-made to them, a habit affected by Amazon, Uber, and Netflix. In addition, large tech players have done well in the context of applying data analytics, AI, and cognitive thinking to personalize the customer experience. In KPMG's (2017b) Top of Mind Survey, 29% of respondents expected increasing demand for personalization to be the most disruptive consumer behavior trend over the next two years. Second, driven by another reality where retail products can be ordered and delivered in the same day, customers of FIs' also want their financial transactions to occur in real time. This includes payment transaction, decisions on mortgages, insurance coverage, and other financial needs, which calls for technology to speed up financial services and decisions. Third, FIs' customers would like to have complex financial products explained to them in clear and relevant terms that make sense within their day-to-day lives. This requires technology to provide more transparency and education through easy-to-use applications for these customers.

The fast development of FinTech has forced traditional FIs to face a new reality—to thrive, FIs need to recognize their opportunities and challenges from FinTech. In the meanwhile, competitors are evolving too, who are not just FinTech companies, but also large tech giants such as Google and Amazon, retailors and other global companies that are looking for ways to improve the financial services their customers want.

In summary, the increasing pressures from both customers and organizational stakeholders, combined with a proliferation of technology options and competition from maturing FinTech companies and Tech giants, have moved FinTech to the top of the growth agenda for leading FIs. The rest of chapter discusses three main areas of FinTech – (1) payment, (2) crowdfunding, and (3) blockchain (including cryptocurrency) Discussion of each area will start with a detailed description of the area, with some examples of success stories, platforms, and solutions. Then the sections discuss in detail the impact of each area on traditional FIs, focusing on the opportunities and challenges it brings, and some existing ways that traditional FIs are coping with or taking advantage of FinTech.

FINTECH PAYMENT SOLUTION AND FINANCIAL INSTITUTIONS

The section examines Fintech-enabled online payment and transfer systems, both in retail sectors and for business-to-business transactions, as well as invoice finance, supply chain finance, and trade finance. The applications and solutions discussed here are based on non-blockchain FinTech platforms, whereas the blockchain solutions on payment, supply chain and trade finance are discussed in the next section.

Payment

Payment systems are at an economy's core as they have the purpose of settling transactions by transferring monetary value from one person or institution to another. In the retail payment market, the consumer and retail payments is the fastest-growing area in terms of innovation and adoption of new payment capabilities. Growth in e-commerce has both facilitated and encouraged the further development of digital payments. Mobile payments provides enormous opportunities for businesses as they enable real-time money transfer and payment from consumers to the companies, and thereby improving businesses' working capital management and cash positions.

Banks are still the biggest players in payments, followed by payments processed by tech giants such as PayPal, Apple Pay, Ali Pay, Samsung Pay, and traditional payment networks such as Visa and MasterCard.

Invoice Finance

Account receivables of a company are the outstanding invoices to be collected from its clients or customers. A traditional way for a company to manage its invoices is through a financial intermediary called "factor" that pays immediate cash payment to the company and takes its account receivable at a discount. However, traditional factoring does not often fit for small and medium enterprises (SMEs), as it typically entails long-term, complex contracts with fixed volumes, which SMEs may find hard to achieve.

FinTech invoice finance platforms provide a solution. With online receivables finance companies, such as *MarketInvoice* of UK, *Fundbox* of US, and *Finexkap* of France, SMEs could monetize their outstanding receivables quickly and easily. In this way, FinTech invoice finance platforms serve the “underserved” group. Specifically, companies can directly connect their accounting software to these invoice finance platforms and apply for a loan based on the value of individual receivables. Since the application is processed mostly automatically, payment can be received almost instantly. These receivable finance companies usually use risk models that consider the frequency with which a business uses the platform and the reliability of its payment. Therefore, after establishing good track record, SMEs may be able to borrow at lower rates.

Supply Chain Finance

Supply chain finance (SCF) is the financing activities that allow supplier to borrow from a bank with the interest rates tied to buyer’s credit rating. The difference between SCF and invoice finance is that the former usually involves a company’s buyer and its credit rating and the latter generally does not.

Consider a SCF transaction on *Taulia*, a specialist FinTech company that provide platforms and software-based service to support SCF operations. First, both the supplier and its buyer connect to *Taulia*. Then the supplier uploads invoices directly to the portal and sends them through an accounting software. After the buyer approves and validates the invoices, the supplier applies for SCF through *Taulia*. After careful monitoring of buyer’s credit worthiness, *Taulia* approves and provides financing for the supplier at a rate consistent with the buyer’s credit rating. Then the buyer fulfills payment to *Taulia* at the invoice maturity day.

FinTech SCF platforms, such as *Taulia*, has several advantages compared to traditional SCF approaches. First, traditional SCF typically has only been efficient to operate at larger scale with buyers of higher credit rating. With technology and big data, FinTech SCF solutions offer the advantage of being efficient at lower scale, making working capital accessible to the entire supply chain, even the small players. Second, FinTech SCF platforms often use a “dynamic discounting” model –it allows SCF at a great discount compared to traditional SCF with banks.

FinTech Payment Solutions vs. Financial Institutions

FinTech solutions discussed in this section still have banks involved, as even with the technology, payment transfers are still between the bank of the money sender and that of the money receivers. In fact, services that appear to be innovative (e.g. Apple pay) are in fact technological devices that make it easier to transfer value across bank accounts. Banks’ ability to provide liquidity and risk management is very much related to their ability to provide payment services. There are obvious and strong economies of scope in providing at the same time liquidity and payment services: customers facing a liquidity need are much better off if they can make payments directly from their deposit account.

As a result of the FinTech payment solutions, many new players enter the market, which increase the competition level FIs face. Many non-bank financial intermediaries, such as payment institutions to electronic money providers, have emerged. In some countries, non-financial companies have entered the market of payment services, who take advantage of their large base of customers. For example, telecommunication companies in China have been offering payment services linked to deposit-like accounts, which often paid higher interest rates than deposits at commercial banks. However, to a large extent, this expansion was possible and profitable in China whereas in most countries, non-financial corporations are not allowed to pay interest rates on their accounts (Vives, 2017).

Technological advantage is relevant in the short-run, when new players can enter the market and exploit their better technologies. For banks, as far as technological adoption is fast enough for them not to lose their network economies, we should expect technological convergence.

The presence of economies of scope between payment services and other business activities that banks cannot replicate is the most interesting issue. These economies of scope arise especially between providers of payment services and of other services typically affected by network externalities, such as Amazon and Apple in consumption and Google in internet services. To generate these transactions, not only the matching must be efficient, it is also essential that both sides of the market, sellers and buyers, lenders and borrowers, are willing to be "on board". In particular, there must be a sufficiently large pool of lenders ready to offer funding to borrowers. This is partly the reason why these IT giants are starting to offer payments and other banking services like (indirectly) consumer credit, where economies of scope are huge in information processing: purchases, payments and internet searches alike allow these companies to evaluate the credit risk of their clients possibly better than banks.

Other economies of scope relate to the possibility of extending consumer credit to customers, that is, the interlinked pricing strategies. For instance, Amazon's store cards that provide consumer credit are issued by a consumer financial service bank, Synchrony, which also manages credit scoring and payments. This creates technological economies of scope by linking electronic purchase platforms with electronic payment platforms. PayPal, the largest world supplier of electronic payment services, started its business as a linked service to eBay, the electronic auction and sale site, even though today Paypal offers services far and above payments on eBay.

CROWDFUNDING AND FINANCIAL INSTITUTIONS

The section discusses how crowdfunding disrupts FIs. Mollick (2014) define crowdfunding as "the efforts by entrepreneurial individuals and groups – cultural, social, and for-profit – to fund their ventures by drawing on relatively small contributions from a relatively large number of individuals using the internet, without standard financial intermediaries" (Mollick, 2014, p. 2). Crowdfunding is sometimes referred to as "alternative finance", as they provide important sources of funding or financing that the entrepreneurial individuals or groups may not be able to get otherwise.

Depending on the type of returns the funders get, crowdfunding comes in four distinct forms: (1) donation-based crowdfunding, (2) reward-based crowdfunding, (3) debt crowdfunding (also called the marketplace lending, peer-to-peer or P2P lending), and (4) equity crowdfunding. Each type may interrupt and/or complement existing financial markets and institutions— for instance, donation-based crowdfunding versus fundraising agencies for non-profits or charitable foundations, reward-based crowdfunding versus seed financing and angel investors, P2P lending versus bank loans, equity crowdfunding versus traditional venture capital and private equity. Crowdfunding has been examined extensively in the finance and entrepreneurship literature (e.g., Agrawal, Catalini, & Goldfarb, 2015; Ahlers et al., 2015; Belleflamme, Lambert, & Schwienbacher, 2013a, 2013b; Lerner, 2013; Mollick, 2014).

Donation-Based and Reward-Based Crowdfunding

In donation-based crowdfunding, funding is given in the form of a donation, based on good wills or social goals. Examples for donation-based crowdfunding platforms include *Razoo*, *GoFundMe*, *Kiva*, and *DonorsChoose* (Liu, 2018). Reward-based crowdfunding can be considered as a pre-sale model, where investors are treated as early customers, allowing them access to the product or service provided by the funded projects at an earlier date, better price, or with some other special benefits, such as being accredited in a movie. The most well-known reward-based crowdfunding platforms include *Indiegogo* and *Kickstarter*.

Donation- and reward-based crowdfunding platforms complement the current markets for charitable giving and start-up financing, respectively. In particular, reward-based crowdfunding provides early start-up funds that later could attracts important FIs such angel investors, venture capital, or even private equity firms. Once these businesses grow at a certain stage and choose to access the public equity market, services of investment banks may be needed. These early funding platforms contribute to the businesses of FIs in a mostly positive way. They also encourage entrepreneurs to pursue their innovative ideas and thereby improving the overall social well-being.

Debt Crowdfunding

Debt crowdfunding refers to the practice of lending money to borrowers without going through a traditional lending institution. Crowdfunded loans are often offered in the forms of (1) term loans, usually unsecured with maturities from 3 to 36 months, (2) revolving lines of credit that provides flexible access to finance, especially for working capital requirement, and (3) merchant cash advances that aim to solve temporary liquidity shortages. Therefore, debt crowdfunding could potentially cover both the long-term and short-term needs of individual borrowers, start-ups and small businesses. Examples of debt crowdfunding platforms include *LendingClub*, *Prosper, FundingCircle,* and *Sofi*.

Debt crowdfunding has the following three important characteristics. First, Maier (2016) finds that debt crowdfunding provides greater convenience—speed, flexibility, simplicity—and process transparency. Applications for these loans can typically be completed within a few hours and do not involve a visit to a physical bank. Funds are then usually made available within less than one week, compared to two to three weeks for banks. For example, in China, Tencent's WeChat now allows individual to apply for uncollateralized loans of up to $30,000 and get a decision in under a minute (Osawa, 2015). In a tight liquidity situation, high speed loan application and approval process can make a significant difference for borrowers.

Second, while business loans extended by banks are secured with collateral, debt crowdfunding most often uses unsecured loans with no collateral requirement. This particular feature benefits some potential borrowers, particularly those in the service sector that usually have stable cash flows but no tangible collateral required by banks.

Third, lenders on these platforms, usually individuals and increasingly institutional investors, have certain characteristics that allow them to take higher risk and operate at lower costs than traditional banks do. Unlike banks that fund themselves with insured and highly regulated deposits and thereby under strict reserve and capital requirements, lenders for crowdfunded debt are not under such regulations and usually have a higher risk appetite. In addition, unlike brick-and-mortar banks that have physical branches and employees to underwrite the loans and incur high compliance costs, FinTech platforms operate with a lean operational costs, which allow them to offer loan at a competitive rates or have some cushion for credit losses at the potentially higher level of risk (Liu, 2018).

Equity Crowdfunding

Equity crowdfunding, also referred to as "crowdinvesting", allows investors to buy equity shares through equity crowdfunding platforms. Investors, as shareholders, enjoy financial returns on investment, if the projects or businesses being funded are successful. Examples of equity crowdfunding platforms include *Seedrs, CrowdCube, FundersClub,* and *AngelList.*

Crowdfunding vs. Financial Institutions

Two main differences exist between crowdfunding platforms and FIs: (1) information and information management, and (2) business model—a marketplace model where the platforms match fund users and fund providers, compared to banks that act as intermediaries and make on-balance sheet loans based on their balance sheet liabilities, and the resulting regulation.

Information and Information Management

First, the entire financial sector builds on information and information management. Recent developments in technology have radically changed the way information is processed by FIs. Traditional FIs mostly rely on (1) hard information, such as balance sheet and income statement for corporate borrowers and personal income, assets, and credit score for individual borrowers, and (2) relationship-based soft information. In contrast, FinTechs function on big data and on the standardization of information through machine learning and artificial intelligence (AI) (Navaretti *et al.,* 2017). For instance, debt crowdfunding platforms, such as *LendingClub* and *Prosper*, use innovative credit scoring models. Such models are data-driven and based on non-traditional big data such as a business's rating on social media (e.g. Yelp), business owners' social network on LinkedIn or Facebook, or satellite data to assess the level of wealth or consumer traffic in a particular area (World Economic Forum, 2015). Utilizing big data, cloud computing, and modern data analysis algorithms, these platforms are able to access credit risks of businesses that banks have traditionally not been able to do, thereby broadening the credit markets for qualified businesses, most of which are small and medium-sized companies.

Considering the information collection, processing, and management of FinTech companies and FIs, there are three implications. First, since FinTech companies' advantage is their ability to collect big data and process them using AI and machine learning, large amount of data is required for pattern recognition. As a result, only platforms with large client base have a sufficient scale to have such data, making it hard for new entrance into the market. Large FIs have an informational advantage, in particular large banks with broad customer base and already digitalized database. Social media and e-commerce companies also have a natural advantage to compete in this area, as they have already collected big data to clearly portrait each individual customer's spending habit as well as creditworthiness.

The second question concerns the different incentives that banks and FinTechs have in processing information. Banks act as delegated monitors for their clients: they screen *ex-ante*, by evaluating in detail the prospects of the potential borrowers and the value of the collateral that they may be posting; they monitor *ex-post* their performance along the whole duration of the lending relationship, possibly enforcing covenants capable of limiting losses in case of default (Diamond, 1984). Thus, they manage the credit risk of the investors, partly holding a share of it in their balance sheets. Moreover, the risk and maturity transformation function carried out by banks, and the inherent structural instability of their balance sheets (risk of bank-runs), provide very strong incentives for better information collection and management than for non-bank institutions, that do not carry out such functions (Diamond and Rajan, 2001). Directly managing credit risk and incentives to collect information seem less strong for many FinTech companies, where platforms provide a marketplace for fund providers and fund users, have an originate-and-distribute function, and do not keep credit risk or liquidity risk on their balance sheet. This different structure may well involve higher adverse selection and moral hazard problem and lower incentives for actively screen investments and monitor *ex post* performances.

Third, how far *hard* data, used by both FinTech and FIs, can fully replace *soft* information of FIs? It is clear, for example, that relationship lending is hard to replace in granting credit to small and medium companies, with still fairly high degrees of opacity in their accounts and future business prospects. Relationship banking is built on human interactions between a loan officer and a prospective borrower. The former is meant to be able to interpret the behavior of the latter and give a meaning and a judgment to the borrower's trustworthiness and other subjective matters. Improving pattern recognition with machine learning, for example in text and verbal communication, may potentially complement (or perhaps replace) this human activity.

Business Model

For the reasons discussed above, we believe it is unlikely that FinTech will supplant banks in the long-run: they will probably live together, possibly becoming more and more similar. Here we further explore the competitive context that will likely emerge and how their different business model will coexist, and how far new entrants and incumbents will behave like complements or substitutes. To answer these questions, we examine the business models of FinTechs and FIs.

Some of the disintermediated or decentralized activities of crowdfunding platforms are based on matching supply and demand. As seen, most of FinTech operators have adopted the "agency model" where they do not retain the risk of the investment (e.g. loans) they originate. In contrast, in the traditional "wholesale model" of banking, banks purchase funds from lenders and resell them to borrowers, and keep credit risks on their balance sheets. Or in the traditional investment firms, such as private equity and venture capital, the general partners also contribute their own money in the equity investment of a portfolio companies, and therefore bear the down-size risk. Another difference between the two business models is on the revenue model. Commercial banks take deposit and make loans, making profit from interest rate margins; whereas PE and VC receive management fee but also see their own equity appreciate. Digital platforms, instead, make money on fees.

FinTech's market place model, or the pure "agency model", has the following advantages. First, since they do not bear the risk on their balance sheet, their risk is lower. Second, they are not regulated as banks and do not have to hold required equity, further cutting down their costs. However, how sustainable is this pure "agency model"? There are two crucial issues here—scale and the quality of borrowers. First, in terms of scale, to generate disintermediated transactions, matching must be efficient and both sides of the market (fund providers and fund users) must be willing to be "on board". The ability to match the two sides of the market and the probability of finding a good partner, grows more than proportionally with the size of the two sides. This property is the driver of the dramatic concentration trends experienced in online markets, where companies like Google and Amazon are essentially winners take all. Also, lending platforms have high fixed costs and low marginal costs. Thus, they need to operate on a large scale, because fees are paid on each transaction and this is what generates the bulk of revenues. Second, in terms of selection of borrowers, platforms are multi or two-sided markets. Since match- makers need both sides on board, profit maximizing fees must factor in the potential reaction of each side. This requires charging comparatively more on the less elastic side of the market and even subsidizing the most elastic side. This has important implications for the quality of the lending process.

BLOCKCHAIN AND FINANCIAL INSTITUTIONS

Blockchain has gain its popularity among the press thanks to the rising Bitcoin price and its increased volatility in late 2017 and early 2018. Bitcoin, along with Ethereum and Ripple, are the most well-known cryptocurrencies. Cryptocurrencies are digital assets that use cryptography to secure transactions, to control the creation of additional units, and to verity the transfer of assets (Brito & Castillo, 2013; Chohan, 2017). With cryptocurrencies, transactions take place between users directly, without an intermediary, and therefore is a decentralized system that cut transaction costs that banks charge.

Cryptocurrencies are only one of the many applications of the rising Blockchain technologies and solutions. Blockchain, simply put, is a secure transaction ledger database shared by all parties in a distributed network, which records and stores every transaction that occurs in the network, creating an irrevocable, auditable, and permanent transaction history (Iansiti & Lakhani, 2017; Yermack, 2017). Blockchain was first developed as a public ledger that records cryptocurrency transactions and later develops wider applications that allow previously untrusting parties to co-create a permanent, unchangeable, and transparent record of exchange and processing without relying on a central authority.

Industries have considered three development stage of the blockchain technology. Blockchain 1.0 refers to the implementation of distributed ledger technology (DLT) on cryptocurrencies. This allows financial transactions based on blockchain technology or DLT. The 1.0 stage is mostly relate to the payment function of traditional FIs, as cryptocurrencies are used as “cash for the Internet”. Blockchain 2.0 involves the use of smart contracts—computer programs that execute automatically based on conditions defined beforehand such as the facilitation, verification or enforcement of the performance of a contract. Smart contracts reduce the costs of verification, execution, arbitration, and fraud prevention and allow transparent contract definition that may overcome some moral hazard problem, and therefore have important applications and impacts on traditional FIs. The 3.0 development stage of blockchain refers to applying blockchain on real business functions and demands. This is where we see blockchain applications on areas such as supply chain management, supply chain finance, financial transactions, condition-based payments, asset management, and Internet of Things (IoT) data collection. These applications and developments will have an ever greater impact on FIs.

Specifically, by providing a common, ubiquitous ledge technology, blockchain could easily reduce the friction created in financial networks when different intermediaries use different technology infrastructures. In addition, the decentralized nature of blockchain can potentially reduce the need for intermediaries to validate financial transactions, thereby replacing some of banks’ functions. The prospect of streamlining infrastructure and/or removing redundant intermediaries from the process creates the opportunity to generate significant efficiency gains.

Finextra (2016) suggests that it is essential to apply blockchain in areas where there is a genuine problem to solve, other than using technology just for the sake of it and that it is equally important to ensure that the problem targeted can be solved by technology in the first place. According to Finextra (2016), the most often-cited uses of blockchain are in transactions rotted in the physical world, where there is plenty of paper that can be digitalized and where a number of parties have to do a similar action but in sequence to enable a transaction to be processed. Examples include mortgage approval process, car ownership through a vehicle's lifecycle (linked to car loan and insurance), and supply chain, among others. The rest of this sector discusses some economics of blockchain technology and some blockchain solutions for FIs.

Record Keeping for Financial Markets Transactions and Trading

The first application discussed is the record keeping function of blockchain for the financial markets transactions and trading. This is based on trustless, permanent, and immutable characteristics of the blockchain technology. This applies well to both real assets and financial assets.

First, existing record-keeping systems of real assets could be moved to blockchains for cost effectiveness and cybersecurity. This can be realized through the blockchain's solution on provenance—that is, tracking the originality and change of ownership throughout the life of real assets. One prominent example is land registries that keep track of real estate titles and transactions. Blockchains also offer an opportunity to record ownership of real assets where no centralized record-keeping system has previously existed. This is the case, for example, for precious metals, gems or artworks. One current application in this area is provided by Everledger, which uses blockchain technology to look after diamonds and other luxury goods with significant financial value.

Second, blockchain can also be used for record keeping of financial assets, in particular in assets and markets where a central authority is missing for keeping records and providing information on counterparties' exposure. This would increase transparency in financial markets, making it easier for counterparties to manage risks and regulators to obtain real-time information. One particularly interesting application relates to private equity for which no central registries exist and where exchange of shares is cumbersome and NASDAQ has started to build a blockchain-based platform to improve private equity trading. Once again, traditional FIs will face competition from such new solutions but they can also take advantage of new technologies by integrating them into FIs' existing businesses.

Similarly, beyond the mere trading of financial instruments, blockchain technology holds considerable promise for achieving true, real-time, straight-through processing of financial transactions. Currently, the post-trading requirements of clearing and settling transactions often take time and involve complex procedures for financial market participants. Using smart contracts for trading, one could imagine that traders could calculate exposures and margin calls right up to the automatic transfer of securities. This could enable a near real-time settlement in cash markets on a gross basis. Blockchain solutions provide huge potential to simplify trade protocols, improve transparency and related risk management, and to save costs. The ultimate implication is that many intermediaries such as clearinghouses and settlement agents, if not adopting the technology in time, could lose their unique positions of being necessary third parties in the financial markets.

Blockchain Solutions for Payments

There are two forms of payments systems—retail and wholesale. Retail payments comprise the bulk of all payments and are linked to lower-value transactions such as the purchase of goods and services and paying one's bills. Wholesale or large-value payment systems tend to involve FIs as intermediaries for settling high-value and often time-critical transactions such as financial market or real estate transactions.

For retail payments, blockchain technology has already begun to reshape the landscape. Cryptocurrencies are already being used for such transactions since the costs of their usage can be much smaller than traditional payment systems. Leading examples are using Bitcoin for person-to- person (P2P) international money transfers. Other applications like Litecoin have lowered the costs associated with cryptocurrencies further by being less restrictive and using a less secure protocol, which allows P2P transactions to be processed much faster than with the original Bitcoin protocol. Ripple, a FinTech payment company, using its Ripple coin, facilitating banks to move money across borders without the necessity of correspondent FIs, such as the SWIFT.

Blockchain technology is a double-edged sword for banks. On the one side, cryptocurrency transactions are competing with banks in the payment area. However, the competition can incentivize traditional banks to become more effective and efficient in serving their customers. On a very positive side, Ripple helps interbank and cross-border transactions, and thereby helping banks retain their customers. Banks should see the potential for Ripple and similar blockchain solutions to cut out clearing and interbank intermediaries and recapture some of the lost profits. At a minimum, one can see that there is room for blockchain technology to provide additional competitiveness for FIs and to push for a more decentralized system with more choice for consumers and room for only the most efficient businesses (Koeppl & Kronick, 2017).

Of course, blockchain technology imposes challenges for intermediaries, who face pressure to make retail payments and simple cross-border payments easier, safer and less costly. Settlement and communication platforms such as Visa, MasterCard, Western Union or SWIFT face the risk that they will become obsolete once cryptocurrencies and blockchain applications for cross-border payments become more commonly accepted. Williams *et al.* (2016) estimate the revenue pool associated with international correspondent banking are between of $150 billion USD to $200 billion USD, and argue that one can assume that a significant share of this revenue will be reduced by blockchain-based payment solutions in the medium run at least.

While blockchain can provide better solution for retail payments, its application on large-value payments system is less clear. Under current blockchain technology, payments cannot be real-time with immediate and ultimate finality and essentially zero risk for the counterparties. Koeppl and Kronick (2017) suggest two reasons. First, there is a period of time, even though short, between processing the transaction and confirming its finality. Second, even with blockchain technology, previously confirmed transactions might not be valid anymore. Therefore, in state-of-the-art, large-value payment systems, the involvement of a third party such as a central bank guarantees immediate and ultimate finality of payments.

Even though traditional blockchain may face challenges for large-value payments system, the permission-based consensus ledgers can be considered as an alternative. In such a system, a small network of nodes maintains the ledger so that alternative, faster consensus protocols can be used that reduce latency and allow for greater scalability with less room for inconsistencies. Settlement finality in such a system might be achievable since the central nodes are known and inconsistencies can be quickly resolved.

Smart Contracts

Smart contracts is another important area for the use of blockchains. According to Kiviat (2015), these digital contracts are “computer protocols that facilitate, verify, execute, and enforce the terms of a commercial agreement”. Examples of smart contract application include real estate transactions, legal contracts and financial trade when the conditions and contents of transactions are registered, the relevant laws and procedures are automatically applied, and the result is notified to the transaction parties.

Blockchain technology allows users to design contracts that are automatically executed following a trigger event, without having to rely on some form of costly third-party monitoring and enforcement mechanism. These decentralized smart contracts allow people who may not know each other to transact in a trustworthy way without intermediaries. Smart contracts, therefore, simplify physical and visual transactions and reduce transaction costs. A prime example of how a blockchain can be used for these smart contracts is the Ethereum platform for distributed computing, which allows users to develop and run their own applications in a distributed fashion across network nodes.

To see how an Ethereum-based smart contracts work in the context for FIs, let's consider a use case to base crowdfunding on a cryptocurrency. Crowdfunding begins with a smart contract being added as a block in the chain. People interested in funding a particular project will contribute funds in the cryptocurrency directly through the smart contract. Then, when the contract's stated time period expires and the overall funding target has been met, the amount contributed will be paid to the project account. If the target is not met, the smart contract returns the contributed funds to the funders automatically. This mechanism eliminates the need for a third party to design, implement and control the entire crowdfunding process. And once again, having multiple records stored in a decentralized way increases computing security, while incentives to fudge the ledger tend to be limited due to the fact that individuals are likely to hold only small stakes in any particular project.

Another example is trade finance—the financing activities related to trade and include transactions of physical goods, money, and the underlying documents, such as sale and purchase agreements, letters of credit, insurance documents, and shipping documents. Trade finance is a complex process, as it is usually involved in international trade. A number of manual checks must be carried out to verify the legitimacy of a client, its trading partners, and the goods being traded, with most checks requiring the physical presence of bank staff. Blockchain and smart contract could significantly improve efficiency of trade finance by automating and optimizing the transaction of goods and documents. The blockchain technology ensures that all parties in the transaction can see, transfer title, and transit shipping documents through a secure network, thereby eliminating many current inefficiencies in international trade. In addition, digital currency could also speed up the payment process.

Another potential use for smart contract is banks' loan contract where the loan terms could be designed using a smart contract and the violation of loan covenants could automatically trigger lenders' intervention. This would be particularly helpful for syndicated loans with a consortium of lenders.

Initial Coin Offerings (ICOs)

Initial Coin Offerings (ICOs) allow companies and entrepreneurs to raise money through sales of tokens or coins. The tokens or coins can be sold on the secondary market (the cryptocurrency exchange) or used in the future to gain products or services (Adhami, Giudici, & Martinazzi, 2018). The rise or fall in token or coin value is normally based on the company's projected product, consumer traction, and/or speculation in by the market (CB Insights, 2017).

ICOs are usually held by teams that build public chains or decentralized blockchain applications in areas ranging from asset management, supply chain management, social networks, to prediction markets.

ICOs are essentially a crowdfunding enabled by smart contracts for the purpose of funding blockchain based companies or projects. As a financing strategy, ICOs are also frequently compared to IPOs of stocks. Table 4 lists the differences between ICOs and IPOs.

The first difference is the stage of the company. An IPO typically occurs at a later stage in a company's development, where the company has viable product and/or service and earned revenue and is close to being profitable. An ICO in comparison is typically for a new, unproven concept that is seeking to raise capital.

The second difference lies in the type of securities issued. In an IPO, companies issue equity shares where investors realize returns through dividends and/or capital gains. In contrast, the ICO issuers usually argue that they do not issue securities, but instead market their coins or tokens as claims of existing or future product or service.

Third, IPOs are highly regulated, whereas ICOs are way less-regulated, or almost self-regulated, although some countries have tightened ICO regulation. The main difference is in the transparency of reporting, KYC (to prevent money laundering) and the protection provided to an investor. Companies that issue their stock for the first time go through a complex IPO process, filing a lengthy IPO prospectus in order to get approved by security commission, while in ICOs companies often just disclose a whitepaper. Another major difference is the listing requirements—in order for an IPO to sell shares and thus provide liquidity to existing shareholders, it must be listed on an exchange. ICOs in comparison are not obligated to list on any cryptocurrency exchange.

The fourth main distinction is the investor type. In order to subscribe for an IPO, an investor must be deemed as sophisticated with basic requirements to be met which the broker will assess. In fact, IPOs are often allocated only to institutional investors such as investment banks, mutual funds and endowments. In an ICO, the investor is not known and there are no requirements on the investor's sophistication.

Implications for financial institutions and market are mostly two folds. First, ICOs provides an alternative for entrepreneurial finance. On the one hand, they could complement the current venture financing market where angel/seed investors, VCs, and early-stage PEs are the main players. On the other hand, ICOs increase the competition for these institutions—if startups can self-finance through a smart-contract enabled crowdfunding at a lower costs, there will be fewer promising projects available for early stage investors. CB Insights (2017) finds that in the third quarter of 2017, all tech angel and seed deals totaled $1.4 Billion USD whereas ICOs totaled roughly $1.3 Billion USD and that ICOs currently account for the vast majority of blockchain seed deals. A second implication would be that it is possible ICOs will take away some of the IPOs, affecting traditional investment banks' IPO business and related revenue.

Table 4. Comparing crypto ICOs and stock IPOs

Categories	ICOs	IPOs
Stage of company	Early stage, even before proof of concept	Late stage, with viable product and service, record of revenue
Type of securities	Tokens and coins that claim future product or service	Equity shares, with dividend and capital gain potential
Regulation	Less-regulated or self-regulated, white papers, do not have to be exchange listed	Tightly-regulated, strict listing requirement, lengthy prospectus filed to security commissions
Investors	General public at the chosen of the issuing company	Sophisticated investors, mostly institutional investors

Source: Author

Consortium

As a positive response to recent FinTech and blockchain developments, certain FIs have established various consortia to develop and build blockchain platforms. For instance, in order to simplify the complex interbank system, twenty-two global banks, including Barclays and RBC, are developing a standard blockchain platform "R3CEV" (Crypto, Exchanges and Venture practice) in partnership with a FinTech corporation, R3. Specifically, R3 is responsible for basic system design and technology development, and global banks are in charge of the test and designing user interfaces by linking to their API. The consortium's joint efforts have created an open-source distributed ledger platform, especially geared towards the financial world as it handles more complex transactions and restricts access to transaction data (Brown, 2016).

Another international consortium, involving 48 companies including Intel and Wells Fargo and led by IBM, is working on collaborative project "Hyperledger project". Hyperledger is to standardize global blockchain technology by allowing various businesses to work together.

These blockchain consortia provide a fast track for the participating FIs to adapt to the blockchain technology.

Future Directions for Blockchain in FIs

Enlarge the Application Area of the Blockchain

As discussed above, the areas where the blockchain is most actively applied in the financial sector are payment and settlement, securities trading, smart contracts, trade finance, and asset management. To expand the use of blockchain technology in the future, research on the efficiency and safety of technology and cost compared to existing systems should be conducted. By combining blockchain technology with direct effects such as simplification of procedures and cost reduction in trade finance, settlement and transfer of funds and record management will be easy and quick. Following the Blockchain 3.0 on its real applications, there needs to be development and expansion of use cases and applications in the financial industry. Blockchain technology is also expected to be used for international remittance and overseas C/P (cash pooling, liquidity management means that minimizes the amount of cash needed by the region/corporation), thereby reducing liquidity risk and reducing management costs. It can also be used for financial management/monitoring by security-based records management.

Blockchain Based on the Closed Distributed Ledger

The move to a closed distributed ledger that does not go through the central bank when payment is made between banks is accelerating. In the field of global financial transactions, a closed distributed service, in which banks and customers are participating, is emerging in the international remittance service. In particular, if smart contracts are introduced in full swing, they will be rapidly applied to the introduction fields of trade finance, compliance, asset management, insurance payment and capital market transactions, which are connected to a large number of stakeholders. Therefore, the blockchain, which is a closed-type distribution ledger, is expected to become an innovation engine of future finance. Microsoft is working on its blockchain technology in conjunction with its business, including trade, real estate and legal contracts. IBM has set up a blockchain laboratory and plans to focus on investments in European and Asian financial markets and services.

Strengthening Consumer Security Needs

As technology develops, consumer needs and related environments are changing. At the same time, there is an increased opportunity for individuals to be infringed by information such as hacking, and there is a strong need for blockchain technology because of the efforts of institutions trying to defend hacking. To encourage market movements, the government and related organizations should recognize the power of blockchains in individual and business transactions, public services, etc., and support them through development of original technologies and finding out best practices.

FUTURE RESEARCH DIRECTIONS

Future Research on Crowdfunding and Medium-Sized Enterprises

Of the three areas of FinTech discussed in this chapter, Crowdfunding has been extensively studies in the literature, whereas studies on payment and blockchain are still in its beginning. On crowdfunding, future research needs to examine how crowdfunding is related to other types of financing and FIs. Is there a life cycle effect where relatively young companies use crowdfunding, then move to angel investors and/or venture capital, then private equity, and eventually an IPO? Whether and how a company's success in crowdfunding leads to success in other types of financing? How could crowdfunding and traditional sources of finance interact, whether it is equity crowdfunding with VC then IPO, or debt crowdfunding with traditional bank loans? Is there an optimal capital structure with crowdfunding and traditional sources?

On payment and blockchain, studies need to examine current stage of developments in these areas. Specifically, there should be some case studies exploring various payment and blockchain solutions and platforms and examining whether and how they interrupt current FIs' operations. As blockchain is such a new area, there needs to be some exploratory studies or review articles that look at economic theories behind blockchain and its various applications, such as cryptocurrencies and smart contracts, and how they impact existing FIs and business organizations. Studies should also examine how FIs interact with blockchain, by developing in-house blockchain solutions, participating in blockchain consortium, or acquiring blockchain companies.

CONCLUSION

This chapter discusses the how three main areas in FinTech, namely, payment, crowdfunding, and blockchain, disrupt FIs and the challenges and opportunities for these FIs. It also suggests ways that FIs cope with FinTech.

REFERENCES

Adhami, S., Giudici, G., & Martinazzi, S. (2018). Why do businesses go crypto? An empirical analysis of Initial Coin Offerings. *Journal of Economics and Business*. doi:10.1016/j.jeconbus.2018.04.001

Agrawal, A., Catalini, C., & Goldfarb, A. (2015). Crowdfunding: Geography, social networks, and the timing of investment decisions. *Journal of Economics & Management Strategy*, *24*(2), 253–274. doi:10.1111/jems.12093

Ahlers, G., Cumming, D., Guenther, C., & Schweizer, A. (2015). Signaling in equity crowdfunding. *Entrepreneurship Theory and Practice*, *39*(4), 955–980. doi:10.1111/etap.12157

Arner, D. W., Barberis, J. N., & Buckley, R. P. (2015). The evolution of Fintech: A new post-crisis paradigm? *Geo. J. Int'l L.*, *47*, 1271.

Bank for International Settlements. (2014). *Trade finance: Developments and issues*. Retrieved September 1, 2017, from https://www.bis.org/publ/cgfs50.pdf

Belleflamme, P., Lambert, T., & Schwienbacher, A. (2013a). Crowdfunding: Tapping the right crowd. *Journal of Business Venturing*, *29*(5), 585–609. doi:10.1016/j.jbusvent.2013.07.003

Belleflamme, P., Lambert, T., & Schwienbacher, A. (2013b). Individual crowdfunding practices. *Venture Capital*, *15*(4), 313–333. doi:10.1080/13691066.2013.785151

Bradford, C.S. (2012). Crowdfunding and the federal securities laws. *Columbia Business Law Review*, *2012*(1), 1-150.

Brito, J., & Castillo, A. (2013). *Bitcoin: A premier for policy makers*. Retrieved January 10, 2018, from https://www.mercatus.org/system/files/Brito_BitcoinPrimer.pdf

Brown, R. (2015). *Introducing R3 Corda™: A distributed ledger designed for financial services*. Retrieved January 10, 2018, from https://www.r3cev.com/blog/2016/4/4/introducing-r3-corda-a-distributed-ledger-designed-for-financial-services

Chishti, S., & Barberis, J. (2016). *The FinTech book: The financial technology handbook for investors, entrepreneurs and visionaries*. Chichester, UK: John Wiley & Sons Ltd. doi:10.1002/9781119218906

Chohan, U. W. (2017). *Cryptocurrencies: A brief thematic review*. Retrieved February 15, 2018, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3024330

Deloitte. (2016). *Disaggregating FinTech: Brighter shades of disruption*. Retrieved December 14, 2017, from https://www2.deloitte.com/us/en/pages/financial-services/articles/disaggregating-the-impact-of-fintech.html#

Diamond, D. W. (1984). Financial intermediation and delegated monitoring. *The Review of Economic Studies*, *51*(3), 393–414.

Diamond, D. W., & Rajan, R. G. (2001). Liquidity risk, liquidity creation, and financial fragility: A theory of banking. *Journal of Political Economy*, *109*(2), 287–327. doi:10.1086/319552

Dietz, M., Khanna, S., Olanrewaju, T., & Rajgopal, K. (2016). *Cutting through the noise around financial technology*. Retrieved February 15, 2018, from https://www.mckinsey.com/industries/financial-services/our-insights/cutting-through-the-noise-around-financial-technology

EY. (2017). *EY FinTech adoption index 2017*. Retrieved June 30, 2018, from https://www.ey.com/Publication/vwLUAssets/ey-fintech-adoption-index-2017/$FILE/ey-fintech-adoption-index-2017.pdf

Finextra. (2017). *Banking on blockchain: Charting the progress of distributed ledger technology in financial services*. Retrieved February 15, 2018, from https://www.ingwb.com/media/1609652/banking-on-blockchain.pdf

Iansiti, M., & Lakhani, K. R. (2017, January). The truth about blockchain: It will take years to transform business, but the journey begins now. *Harvard Business Review*, 118–127.

Insights, C. B. (2017). *Blockchain investment trends in review*. Retrieved July 1, 2018, from https://www.cbinsights.com/research/report/blockchain-trends-opportunities/

International Chamber of Commerce (2017). *2017 rethinking trade & finance*. An ICC Private Sector Development Perspective.

Kiviat, T. I. (2015). Beyond bitcoin: Issues in regulating blockchain transactions. *Duke Law Journal*, *65*, 569.

Koeppl, T. V., & Kronick, J. (2017). *Blockchain technology–What's in store for Canada's economy and financial markets?* Retrieved February 15, 2018, from https://www.cdhowe.org/sites/default/files/attachments/research_papers/mixed/Commentary_468_0.pdf

KPMG. (2017a). *Forging the future: How financial institutions are embracing FinTech to evolve and grow.* Retrieved December 1, 2017, from https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2017/10/forging-the-future-global-fintech-study.pdf

KPMG. (2017b). *Think like a start-up: How to grow in a disruptive market.* Retrieved January 10, 2018, from https://home.kpmg.com/xx/en/home/insights/2017/06/top-of-mind-survey-2017.html

Lehner, O. M. (2013). Crowdfunding social ventures: A model and research agenda. *Venture Capital*, *15*(4), 289–311. doi:10.1080/13691066.2013.782624

Liu, C. (2018). Finance strategies for medium-sized enterprises: FinTech as the game changer. In M. Vemic (Ed.), *Strategic Optimization of Medium-Sized Enterprises in the Global Market* (pp. 162–184). Hershey, PA: IGI Global.

Maier, E. (2016). Supply and demand on crowdlending platforms: Connecting small and medium-sized enterprise borrowers and consumer investors. *Journal of Retailing and Consumer Services*, *33*, 143–153. doi:10.1016/j.jretconser.2016.08.004

McKinsey. (2015). *Supply-chain finance: The emergence of a new competitive landscape*. Retrieved September 1, 2017, from https://www.mckinsey.com/industries/financial-services/our-insights/supply-chain-finance-the-emergence-of-a-new-competitive-landscape

Mollick, E. (2014). The dynamics of crowdfunding: An exploratory study. *Journal of Business Venturing*, *29*(1), 1–16. doi:10.1016/j.jbusvent.2013.06.005

Navaretti, G. B., Calzolari, G., Mansilla-Fernandez, J., & Pozzolo, A. F. (2018). Fintech and Banking. Friends or Foes? *European Economy*, (2), 9-39.

Osawa, J. (2015). *Tencent's WeChat App to Offer Personal Loans in Minutes*. Retrieved September 1, 2017, from http://www.wsj.com/articles/tencent-to-add-personal-loan-feature-to-wechat-app-1441952556

Saunders, A. (2014). *Financial markets and institutions*. McGraw-Hill Higher Education.

Schueffel, P. (2016). Taming the beast: A scientific definition of FinTech. *Journal of Innovation Management*, *4*(4), 32–54.

Vives, X. (2017). The Impact of Fintech on Banking. *European Economy*, (2), 97-105.

Williams, G., Gunn, D., Roma, E., & Bansal, B. (2016). *Distributed Ledgers in Payments: Beyond the Bitcoin Hype*. Retrieved January 10, 2018, from http://www.bain.com/publications/articles/distributed-ledgers-in-payments-beyond-bitcoin-hype.aspx

World Economic Forum. (2015). *The future of FinTech: A paradigm shift in small business finance*. Retrieved January 10, 2018, from http://www3.weforum.org/docs/IP/2015/FS/GAC15_The_Future_of_FinTech_Paradigm_Shift_Small_Business_Finance_report_2015.pdf

Yermack, D. (2017). Corporate governance and blockchains. *Review of Finance*, 7–31.

ADDITIONAL READING

Allen, F., & Santomero, A. (1997). The theory of financial intermediation. *Journal of Banking & Finance*, *21*(11-12), 1461–1485. doi:10.1016/S0378-4266(97)00032-0

Bohme, R., Christin, N., Edelman, B., & Moore, T. (2015). Bitcoin: Economics, technology, and governance. *The Journal of Economic Perspectives*, *29*(2), 213–238. doi:10.1257/jep.29.2.213

Kassinger, T. W., Kaufmann, Z. D., & Traeger, L. (2013). Democratizing entrepreneurship: An overview of the past, present, and future of crowdfunding. *Securities Regulation & Law Report*, *45*(5), 208–217.

Lee, L. (2016). New kids on the blockchain: How Bitcoin's technology could reinvent the stock market. *Hastings Business Law Journal*, *12*, 81–132.

Mackenzie, A. (2015). The FinTech revolution. *London Business School Review*, *26*(3), 50–53. doi:10.1111/2057-1615.12059

PWC. (2016). *Blurred lines: How FinTech is shaping financial services - Global FinTech Report*. Retrieved December 14, 2017, from https://www.pwc.com/gx/en/advisory-services/FinTech/pwc-fintech-global-report.pdf

Sironi, P. (2016). *FinTech Innovation: From Robo-Advisors to Goal Based Investing and Gamification*. West Sussex, UK: John Wiley & Sons Ltd. doi:10.1002/9781119227205

KEY TERMS AND DEFINITIONS

Blockchain: Database of information that offers permanent and unchangeable public ledger for transactions in general and is secure and resistant to modification by design.

Crowdfunding: An umbrella term that refers to the practice of funding a project or business by raising many small amounts of money from a large number of people, typically through the internet.

Cryptocurrencies: Digital assets that use cryptography to secure transactions, to control the creation of additional units, and to verity the transfer of assets.

FinTech: Financial technology, the use of technology in financial service.

Initial Coin Offering (ICO): Sales of tokens or coins offered by blockchain companies looking to raise funds.

Smart Contract: Computer programs that execute automatically based on conditions defined beforehand such as the facilitation, verification, or enforcement of the performance of a contract.

Supply Chain Finance: The financing activities that allow supplier to borrow from a bank or FinTech platform with the interest rates tied to a buyer's credit rating.

Chapter 7
The FABLAB Movement:
Democratization of Digital Manufacturing

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ABSTRACT

The arrival of collaborative contexts to the global economic stage is a latent reality which threatens to change the traditional production models' operation. Likewise, concepts such as Industry 3.0 or even 4.0 refer to the possibility of providing customers and users with unimaginable possibilities compared to the industrial manufacturing inherited from the past centuries. Within this environment, the fabrication laboratories (FabLabs) emerge. In this chapter, the authors approach an exploratory perspective in order to make known the FabLab movement origin and further worldwide development with the intention to highlight their characteristics and the main difficulties they face nowadays. The growing importance that the FabLabs have achieved despite their novelty justifies the precise study of their characteristics according to the importance related to the strong expansion of these laboratories in this decade and its contribution to a major revolution in the collaborative environments associated with the digital manufacturing.

INTRODUCTION

Tackling the characterization of the FabLab movement is not a simple task. Its novelty and the characteristics of its environments can justify the scope of the scientific literature, which limits the results in systematic reviews of documentary and academic bibliographic sources. In spite of this, the term FabLab -Fabrication Laboratory- can be defined with the words of its creator as: *A collection of machinery and pieces joined together by software and developed processes to create things* (Gershenfeld, 2008).

The history of the FabLabs begins with the Professor Neil Gershenfeld own's hand as part of the deployment for the subject "How to Make (almost) Anything" in 2002 (Betts, 2010; George-williams, 2015; Gershenfeld, 2012; Hielscher, Smith, & Fressoli, 2015; Kohtala & Bosqué, 2013; Posch &

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Fitzpatrick, 2012; Willemaerts et al., 2011). This subject, developed in the CBA (Center for Bits and Atoms) dependent on the prestigious MIT -Massachussets Institute of Technology- (Gjengedal, 2010) and funded by the NSF (National Science Foundation) (Tiala, 2011), was needing a laboratory where materials could be generated and assembled at an atomic level (Capdevila, 2014; Cavalcanti, 2013; Eychenne, 2012; Hielscher et al., 2015; Walter-Herrmann & Büching, 2013) in order to analyze the computational properties inherent to the physical systems (International FabLab Association, n.d.).This laboratory was intended to become the cutting edge of a true revolution within manufacturing, leading the transformation through specialized tools in digital manufacturing (Eychenne, 2012; Herrera, 2012) including from 3D printers to laser and CNC cutting machines to allow small-scale production (Capdevila, 2014; Tiala, 2011) proving that FabLabs can be a powerful educational instrument for specific skills in official university programs (Guerra & Sánchez de Gómez, 2016), being used in some cases as a platform for Industry 4.0 development (Angrisani, Arpaia, Bonavolanta, & Lo Moriello, 2018) or even in middle school (Flores, 2018) or primary school (Gennari, Melonio, Rizvi, & Bonani, 2017) fostering que creativity of the students.

Through the CBA, and under the conditions imposed by the National Science Program, Gershenfeld aimed to *explore the union between the applied science of computers and the physical environment* (Troxler, 2014). In addition, as indicated by Eychenne (2012), for Gershenfeld, the Fablabs deserved the same consideration as the Internet development and the Web 2.0, functioning as a democratizing process of the technology usage -in this case, the digital fabrication- by users, converting them into prosumers (Kotler, 1986; Ritzer, Dean, & Jurgenson, 2012; Walter-Herrmann & Büching, 2013) transforming users from simple spectators into protagonists (Gershenfeld, 2005; Kohtala & Bosqué, 2013).

Gershenfeld's vision is complemented with the Sherry Lassiter's vision, president of the FabFoundation, who considers that, in regard to the new century, the emerging economy has new skills and new types of knowledge which will be necessary to compete in an economy based on communication, information and digital media. Agree to this, the FabLabs can provide people with the ability to do things on their own as the fastest mechanism to solve their problems, especially in communities with low access to education or technology (Beyers, 2010), helping people in development zones with the possibility of designing and creating tools to solve local problems (Paio, Eloy, Rato, Resende, & de Oliveira, 2012).

Thus, and with that objective in mind, after the creation of that first FabLab at MIT, it was followed by the construction of others within an interdisciplinary program: in Boston (in 2001 at the South End Technology Centre of Tent City), in Costa Rica (in 2003 at the Technology Institute of Costa Rica), in India (in 2003 at the Science School Vugyan Ashram) and Ghana (in 2003 at the Takoradi Technical Institute), being the FabLab of Norway -Lyngen- the first built in Europe (Hielscher et al., 2015; Troxler, 2014; Troxler & Wolf, 2010). From these first FabLabs creation, the popularity of these ones aroused the creation of a large number of laboratories spread out around the world (Posch & Fitzpatrick, 2012) without the direct funding of MIT, created by groups of people interested in digital fabrication, universities, foundations, etc., but maintaining in some way the CBA involvement in its foundations (Posch & Fitzpatrick, 2012). In spite of the fact that Neil Gershenfeld initially did not seem to want a strong organizational structure for the FabLab network management, their rapid growth -as seen on Table 1- required the creation of an organizational framework to manage different important aspects for the FabLab, resulting in the FabFoundation (Hielscher et al., 2015).

One of the advantages of the FabLabs, because of its configuration and to the particular technological endowment, is the ability that they offer, both to personal users as well as to entrepreneurs and even, companies, to transform ideas quickly into physical objects or design prototypes, improving creation

Table 1. Evolution of open FabLabs by year

Year	Open FabLabs	Source
2003	3	(Kohtala & Bosqué, 2013)
2004	32	(Troxler 2014).
2010	45	(Troxler, 2010)
2011	50	(International FabLab Association, n.d.)
2012	150	(Herrera, 2012; Posch & Fitzpatrick, 2012)
2013	220	(Capdevila, 2014)
2014	400	(FabLabs.io, N.d.) (Capdevilla, 2014)
2015	440	(de Boer, 2015)
2016	1077	(FabLabs.io, N.d.)
2017	1112	(FabLabs.io, N.d.)

Source: Own elaboration

and development process (Álvarez, González de Canlaes & Puentes, 2013; Bosqué, 2013; Buching, Walter-Herrmann & Schelhowe, 2012; Paio, Eloy, Rato, Resende, & de Oliveira, 2012; Velasco, Brakke & Chavarro, 2015; Willemaerts et al., 2011). Likewise, its CAD's design capabilities also allow the experimentation and learning in educational environments (Wolf, Troxler, Kocher, Harboe & Gaudenz, 2013) where they are particularly present, as well as the expression through the new processes and materials in the artistic field (Blikstein & Krannich, 2013; Buching et al., 2012; Krannich, Robben, & Wilske 2012; Mostert-Van Der Sar, Mulder & Remijn, 2013; Paio, Eloy, Rato, Resende, & de Oliveira, 2012; Posch, Ogawa, Lindinger, Haring & Hörtner, 2010; Stager, 2013).That way, from an organizational point of view, the FabLab can be defined as a self-managed organizational device open to the public, which favors exchanges and interactions within a community focused on access, besides the ICT, to numerical technologies (Bouvier-Patron, 2015). These spaces of creation (Wolf et al., 2013) are summarized, as indicated by Troxler (2010), as a learning community environment and of business generation which stimulates learning and development.

MAIN CHARACTERISTICS OF FABLABS

The FabLabs, as a subset itself within the collaborative spaces which belong to the Maker culture (García-Ruiz y Lena-Acebo, 2016, Capdevilla, 2014; Cavalcanti, 2013; Eychenne, 2012; Hielscher et al., 2015; Troxler, 2010) have a number of characteristics and own requirements that define and differ them from other particular spaces. The FabFoundation (Dependent organization from the CBA's FabLab program of the MIT responsible for supporting the expansion of the FabLab at a global area) establishes four criteria on its website, from which a digital manufacturing laboratory can truly be considered a FabLab and can make use of the FabLab Logo in its activities:

- **Public Access:** Fablabs are based on a democratized access to tools, which implies that they must be open for free to the public, or with a paid service system if necessary, at least once a month (Kohtala & Bosqué, 2013).

- **Support and Subscription to the Fab Charter:** A sort of "constitution" or directive (Walter-Herrmann & Büching, 2013) that regulates all the activities to be developed in the fablab based on a number of principles (Troxler, 2009) created in 2006 (de Boer, 2015) and that must be exposed and subscribed by all FabLab (Hielscher et al., 2015; Kohtala, 2013).

In the general version of 2006, the following principles were included in the FabLab Charter (Gershenfeld, 2005):

- ***Mission:*** *The FabLab constitute a global network of local laboratories which promote invention through permitting the access to the digital manufacturing tools.*
- ***Access:*** *You can use the FabLab to do almost anything (that does not hurt anyone); but you must learn to do it by yourself and you must share the use of the laboratory with other users and for other uses.*
- ***Education:*** *Learning in the FabLab is based on the implementation of projects and the learning in the community; you are expected to contribute to the documentation and instruction of other users.*
- ***Responsibility:*** *You are responsible for:*
    - ***Security:*** *Knowing how to work without harming people or to the machinery.*
    - ***Cleaning:*** *Leave the laboratory cleaner than how you found it.*
    - ***Activities:*** *Assist with maintenance, repair, and submission of tools, supplies, and incidents reports.*
- ***Secret:*** *The designs and processes that are carried out in the FabLabs must remain available for individual applications; nevertheless, intellectual property can be protected in the way you choose.*
- ***Commercial Activities:*** *Can be incubated in the FabLab but should not conflict with Free Admission, they will have to grow beyond, instead of the FabLab's place and are expected to benefit inventors, laboratories, and FabLabs networks which have contributed to their success.*

However, and after its revision in 2012, the Fab Charter was updated to:

- ***What Is a FabLab?:*** *The FabLabs constitute a global network of local laboratories which promote invention through allowing access to digital manufacturing tools.*
- ***What Is in a FabLab?:*** *The FabLabs share an evolving repertoire of basic skills to do (almost) anything and to be shared by projects and people.*
- ***What Does the FabLabs Network Provide?:*** *Operational, educational, technical, financial and logistical assistance beyond what is within reach to a single FabLab.*
- ***Who Can Use a FabLab?:*** *The FabLab is available as a community resource, offering open access to individuals and scheduled access to different programs.*
- ***What Are Your Responsibilities?:***
    - ***Security:*** *Do not harm people or damage machines*
    - ***Activities:*** *Help with Lab's cleaning, maintenance and improvement.*
    - ***Knowledge:*** *Contribute to documentation and instruction.*

- ***To Whom Do the Inventions Made in a FabLab Belong to?:*** *Designs and processes developed in the FabLabs can be protected and sold in the way that the inventor chooses, but they will have to be available for users in order to be used and learn from them.*
- ***How Can FabLab Be Used in the Businesses?:*** *Commercial activities can be prototyped and incubated in the FabLab, but they must not conflict with other users. They should be developed beyond the FabLab instead of within the FabLab and are expected that inventors, laboratories and FabLabs networks, which contributed to its success, can be benefitted.*

These regulations introduce the FabLab as a community resource with a set of common tools, procedures and capabilities, consequently open to the public, which respect Open Source thinking and consider that commercial activities can be incubated in their laboratories, although they should later be developed outside of them (de Boer, 2015; Hielscher et al., 2015). This mindset, transmitted through the Fab Charter, enables the approach of Digital Manufacturing processes to entrepreneurs, small business owners and even some industrial processes within the companies themselves to turn an idea into a product for commercial or personal use through the tools and knowledge that previously were exclusive responsibility of professionals and large development environments (Gordon, 2011). Through these regulations, it is specified that any design or process must be available for personal use in the FabLab, so that what is produced there, it will be open content and will remain available both to the users of that FabLab and to all those users who belong to the FabLab network, ensuring open learning processes (Troxler, 2009), without ignoring the protection of the intellectual property and sustainability (Walter-Herrmann & Büching, 2013). In addition, the presence of Fab Charter generalizes the use of available machinery by users independently as opposed to other previously existing digital manufacturing spaces in which it's manipulated only by professionals (Eychenne, 2012). Although the regulations present in the Fab Charter are mandatory for all laboratories in the FabLab network, in many cases their drafting is adapted to the needs depending on the sponsors, managers, users, the public or the goals that the laboratory finally pursues (Eychenne, 2012).

ORGANIZATIONAL STRUCTURES AND OWN TRAINING PROGRAMS

The FabLab environment is accompanied by various organizational structures, outstanding among which are:

FabFoundation

The FabFoundation is a non-profit organization created by the CBA FabLab program of MIT in 2009 and whose mission is *to provide access to the tools, knowledge, financial means in order to educate, innovate and invent by using technology and digital manufacturing to allow anyone to create (almost) anything, generating through it the appropriate opportunities to improving lives around the world* (FabFoundation, 2015; Hielscher et al., 2015). The organization, chaired by one of the of the FabLab's architec and CBA Mannager Program of the MIT (Eychenne, 2012; Kohtala & Bosqué, 2013), Sherry Lassiter, identifies her program on three major aspects: the organizational, the related to business opportunities and the educational aspect (Hielscher et al., 2015).

This way, the FabFoundation manages the organizational section through the .ORG web domain, being responsible for *including the digital manufacturing promotion, the FabLabs' development based on communities and educational contexts, the dissemination of the best practices in digital manufacturing through of the FabLab Network, improving and disseminating research and beneficial projects for the community, funding and enabling FabLabs and digital manufacturing projects to benefit people and communities such as the "Mobile Laboratories" for emergency aids or the FabLab in developed countries", services that include deployment, installation, training and consulting for new FabLabs and support for those already established* (FabFoundation, 2015). Other responsibilities of the organizational services section include data's management and monitoring on the impact in the educational, social and economic environment of the FabLabs network, as well as the communication between them and the organization of the annual Fab meetings (FabFoundation, 2015).

Another aspect strongly associated to the FabFoundation is the educational aspect, where its objective is the popularization of digital manufacturing tools and their processes to all kinds of people, and training and the skills building through formal and informal educational programs (FabFoundation, 2015). Within the educational programs, FabAcademy stands out, a program developed at a global level, which, using some of the network's FabLab as a campus, promotes the operation of machinery and technology involved in digital manufacturing. Due to the lack of dedicated staff, despite the importance of the FabLab Foundation on the FabLabs network, the practical responsibility for its development has to lie on Sherry Lassiter (Hielscher et al., 2015).

FabAcademy

The FabLabs growth coincided with the popularization of the MIT course "How To Do (Almost) Anything" among the users of the FabLabs, which influenced to make the decision of creating the FabAcademy training program (Hielscher et al., 2015). The FabAcademy is a multidisciplinary program which began in 2009, based on the mentioned course "How To Do (almost) Anything" (FabAcademy, 2016; Eychenne, 2012; Hielscher et al., 2015) which provides the required and basic training to be part of the FabLab Network through the multidisciplinary learning. It lasts six months, although you have up to two years to complete it (FabAcademy, 2016). It usually begins the first month of each year, with a teaching load of 60 hours a week full-time (Herrera, 2012) or the recommended 30 hours part-time (FabAcademy, 2016) and it is globally delivered from some of the network's FabLabs (Hielscher et al., 2015) which, are managed and supported by laboratories with more advanced facilities called Super Nodes (FabAcademy, 2016).

In these training programs created and managed by the FabFoundation (shown on Table 2), students participate through their local FabLab in classes taught by video conference (Hielscher et al., 2015) in a partially different model from the distance education one, called distributed education, where they learn together with their peers, tutors and with the machinery in small local groups globally connected through content-sharing and interactive classes (FabAcademy, 2016). This type of training is far from the traditional training and it focuses on self-learning through the projects' development by the user, who through his own documentation and the different web resources usage, shares with the community (Gershenfeld & Prakash, 2004). The training provided in the FabAcademy include the digital manufacturing main applications through the modular learning processes, which are structured according to the different diplomas or individual certificates (FabAcademy, 2016).

Table 2. Individual certificates from the FabAcademy and HTGAA programs

FabAcademy Program Certificates	HTGAA Program Certificates
1. Digital manufacturing, principles and practices (1 Week)	1. Principles and Practices
2. Computer-aided design, manufacturing and modeling (1 Week)	2. (Open) Hardware for Engineering Biology
3. Computer-controlled cutting (1 Week)	3. Next generation synthesis
4. Electronic design and production (2 Weeks)	4. DNA Nanostructures
5. Computer controlled machinery (1 Week)	5. Cell-Free Production
6. Embedded programming (1 Week)	6. Darwin on steroids: Bio design, diversity & selection
7. 3D Modeling (1 Week)	7. Bio production
8. Collaborative technical development and project management (1 Week)	8. Bio molecule sensors
9. 3D scanning and printing (1 Week)	9. Genome Engineering
10. Sensors, actuators and displays (2 Weeks)	10. Fluorescence In Situ Sequencing (FISSEQ)
11. Interfaces and applications programming (1 Week)	11. Synthetic development biology
12. Communications and embedded networks (1 Week)	12. Bio Fabrication and Additive manufacturing
13. Machinery design (2 Weeks)	13. Engineering the Gut Microbiome
14. Digital Manufacturing Applications and Implications (1 Week)	14. Gene Drives & Synthetic Ecosystems
15. Invention, intellectual property and business models (1 Week)	15. Invention, intellectual property and more
16. Project's development of digital manufacturing (2 Week)	16. Final presentations

Source: FabAcademy (2016) and Bioacademany (2016)

Although there is no basic training as a requirement for the program's participation, FabAcademy recommends that its applicants have a previous knowledge of 2D and 3D design, digital manufacturing, electronic programming and web design and development so it is recommended for those who have a medium or poor level of performance in this knowledge, to participate full time in the program (FabAcademy, 2016). The FabAcademy training structure, the final diplomas delivery in the Fab events, the intensity of the course and its difficulty, act as agglutinating elements which enhance the establishment of ties between the participants and therefore contribute to the network generation (Hielscher et al., 2015).

The participation in the FabAcademy does not have an official accreditation by the MIT (Asinari, 2015; FabAcademy, 2016) but it is an independent training which turns the participant into a "self-accredited" demonstrated through the construction of a proofs portfolio reviewed by his local instructor and a regional Guru to be subsequently centralized and evaluated according to the global quality standards (FabAcademy, 2016), this implies that their accreditation is directly shown in the capacities that the individual shows (Hielscher et al., 2015). The obtainment of the FabAcademy diploma recognizes the ability to establish and work in a FabLab and has provided the students with more probabilities to get employment, investment and recognition (FabAcademy, 2016). Many times, once the course is over, the participants become in Gurus who even become part of new FabLabs as managers (Hielscher et al., 2015).

The FabAcademy through its website indicates, as a guideline, that in 2016 the enrollment and enrollment fees for the full program of the FabAcademy diploma were USD 5,000 while the completion of each one of the single modules involved a payment for the student of USD 500 (Asinari, 2015; FabAcademy, 2016). The price, for Europe, was established in euros with an equivalent exchange rate of 0.89€. It is important to note that the website itself indicates that the enrollment rates vary according to the FabLab, even using the 1:1 equivalence rates in the exchange to euros (Asinari, 2015; FabAcademy, 2016). The payment of these amounts, by the student, is divided into three stages: the first payment of €2000 (or $2000) once accepted into the program, the second payment of €1500 (or $1500) once started the course and a third payment of the €1500 (or $1500) prior to the end of the course. The FabLabs that act supplying the training receive their proportional part in two reimbursements, while those who exercise the supernode or Guru services receive their share at the end of the year of the training program (Asinari, 2015). There is a scholarship program able of partially or completely covering the cost of registration fees for students who are experiencing financial difficulties. The partial scholarships will be provided by the local FabLab themselves where the program is given and usually offered as an exchange for a certain number of collaboration hours in the FabLab (FabAcademy, 2016).

About the number of students there has been a clear up growth. In 2012 there were 76 students registered in the program, in 2013 the number increased to 109 students, 126 students in 2014, 221 students in 2015 until reaching 315 students in the 2016 edition (FabAcademy, 2016). In the 2016 edition, FabAcademy registered twelve Super nodes on its website (FabLab Barcelona, Beach Lab Sitges and FabLab León in Spain, FabLab Toscana-Cascina in Cascina, FabLab Taipei in Taiwan, FabLab IL in Israel, FabLab Taipei in Taiwan, FabLab Kamakura in Japan, FabLab Wellington in New Zealand, FabLab Lima in Peru and FabLab Incite Focus in Detroit and AS220 FabLab in Providence, United States) and 72 registered nodes in which the training will be provided (FabAcademy, 2016). In Spain, for the same course, the three available Super-Nodes network were complemented by the existence of three other nodes in which it was possible to carry out the training: Green FabLab Barcelona, FabLab Asturias in Gijón - whose operation in 2016 was doubtful-, FabLab Deusto in Bilbao, FabLab Madrid CEU and FabLab UE in Madrid.

How to Grow Almost Anything

The structure designed by the FabAcademy in their classes development through the highly practical instruction model in local work groups with tutors associated with shared contents and interactive classes taught by global leaders -known as Academany- (BioAcademany, 2016) has originated the creation of other training projects such as How To Grow (Almost) Anything (HTGAA), a bioengineering learning project led by the professor George Church at Hardvard University (FabAcademy, 2016).

According to the information provided by their website bio.academany.org, students in the HTGAA program participate in classes taught by leading academics in their respective fields, which are broadcast every Wednesday for three hours; these classes are recorded and remain available to students throughout the semester. In addition, apart from the classes themselves, the students have access to the equipment and the staff's support of the different FabLab participants two or three days per week to carry out their projects (BioAcademany, 2016).

In 2016, the 16 module program (shown on Table 2), could be completed in 20 FabLabs, three of them located in Spain (Green Lab in Valldaura, CEU in Madrid and Beach Lab in Sitges). For the training registration as a student, the costs are similar to those referred by the FabAcademy system; to get the Academany diploma would imply a cost of 5000USD while each of the individual certificates corresponding to each block would cost 500USD. In both cases, the price would include all the basic materials of the course and a tutorial access to the 14 hours a week FabLab for the projects' implementation.

FabLab@School

The FabLab @ School program emerged from the Stanford University under the guidance of the Professor Paulo Blikstein. It's a consortium that included universities (University of Virginia, Cornell), educational associations as The Society for the information, Technology and Teacher Education (SITE), the Association of Teachers and Mathematics Educators and several commercial firms (as FableVision or Aspex). It was about low cost digital spaces where to be able to do almost anything, oriented to student-centered and project-based learning (Standford Graduate School of Education, 2013), trying to take advantage of the benefits that the existence of FabLabs provides to education through the creation of a new type of FabLabs especially designed for students. According to the website of the project itself, which is already obsolete (in 2016, it was called FabLearn Labs), the characteristics to define this type of FabLab are (Standford Graduate School of Education, 2013):

- *A special focus on education and in connection with the academic disciplines related to Science, Mathematics and Engineering (STEM).*
- *A lower cost of implementation and maintenance, an intensive use of recycled and low cost materials.*
- *Specific design for professorship, materials and workshops, as well as activities for children, aiming to attract them to scientific research.*

One of the objectives of the FabLab @ School program is to get the students (K-12) use the 3D printers combined with the power of mathematics, science and engineering (Stemp-Morlock, 2010). The first of the Fab@School programs was developed at the Stanford University in 2009 and the first Fab@School integrated into a school was developed in 2011 at the 1502 IMEI High-School in Moscow, Russia. In 2016 there was 12 facilities spread all over the planet, one of them in Barcelona, Spain. As part of its funding, the MacArthur and Motorola foundations awarded the program with 435,000USD for the project's expansion, the development of the curriculum and the construction of new 3D printers (Stemp-Morlock, 2010).

Other Structures

The rapid expansion of the FabLab has produced other elements, in addition to the FabFoundation and FabAcademy, that have been appearing and disappearing over time with the intention of organizing the FabLabs network structure and providing the required support to various aspects of the network (Eychenne, 2012) apart from own structures and networks already created in various nations. Despite the initial structures created by MIT for the FabLab management, there have been numerous attempts to improve the organization and the activities developed by the FabLab Network, as well as the dissemination and communication through the use of web domains that in some cases have been disappearing due to lack of use, being abandoned, or being replaced by new management structures (Hielscher et al., 2015), as in the case of the web dedicated to documentation "Fab Moments" (http://fablab.waag.org/fabmoments) whose use has been relegated to the FabLab Waag Society of Amsterdam because the use of a platform for the expected general documentation was not reached.

In this situation is the International Fab Lab Association, formalized in July 2011 from a previous decision adopted at the annual meeting Fab6, with the intention of achieving a greater degree of self-organization and supporting the improvement in the FabLab's visibility, development, diffusion of research, empowerment, and the open design, to only mention some of them, under the approval of the CBA and accepting and abiding by the Fab Charter in its 2012 version. Among the objectives that the International FabLab Association vaguely identifies on its own website to develop in the period between July 2011 and December 2012 highlights (International FabLab Association, n.d.) were:

- *To create a unified list of FabLabs and supervising the required conditions to be part of it.*
- *To organize working groups around common objectives, to resolve some relevant topics and facilitating the distribution of results.*
- *To provide an attractive benefits package for FabLab members in order to encourage their participants in the association.*

For this, the Association set some common characteristics that define FabLab summarized as open centers to the general public (although in some cases the economic structures of the laboratory involve the direct costs recovery) guided by a series of regulations visible in the laboratory - the Fab Charter-, with a public list of common tools to carry out their own processes and connected and communicated with other FabLab of the network, cooperating with them and participating in different initiatives (International FabLab Association, n.d.).

In this way, the International FabLab Association created a rating based on the compliance degree with the requirements indicated in its definition, where the maximum value was “AAAA” and the minimum “CCCC”. Despite all the organizational effort, this association seems not to be active (Eychenne, 2012; Hielscher et al., 2015) and, even, its website does not seem to show updates beyond the first quarter of 2012, although its activity marked the beginning of the creation of platforms and local groups among FabLabs to exchange knowledge and the management of common interests.

The FabEconomy platform emerged as an attempt to promote a new economic paradigm based on the global distribution from the idea of peer-to-peer design and local production (Hielscher et al., 2015). On their website, they try to connect the business world of both, existing and emerging businesses, to the economy in a circular economy model by creating opportunities for the existing FabLabs as an integral part of this network through local manufacturing, global design, the prototyping fabrication or training. On its website, FabEconomy determines different solutions for the three main stakeholders: individuals, companies and FabLabs, guiding them to the different elements of the FabLab Network.

FabConnections aims to set up connections between the ideas generated in the FabLab and the funding sources and business advice of the emerging initiatives of the FabLab (Hielscher et al., 2015). In its website (http://www.fabconnections.org/about), they identify their mission with the connection of the FabLab network with external markets through the creation of opportunities for collaborative work between the FabLabs. Its business model is shown as a service able to organize events, which generate benefits and create opportunities for both, individuals and companies, by dividing their benefits equally between the FabLab involved and the FabFoundation that, according to its website, will use these benefits in the creation of new opportunities and projects, as well as in the FabConnections entity itself. Among the capacities that it offers to the companies, it would be consulting and the appropriate development projects management for specific difficulties that show themselves working as a coordinating and manager element, offering the existing knowledge in the FabLabs’ own network as a service and even training in digital manufacturing processes as a fundamental part in the generation of new business models.

The FabConnect program and its platform were launched in July 2014 at the Fab10 in Barcelona by Simone Amber and Nader Shaterian, as a tool for speeding up and boosting in the usual operation of the FabLab. The main mission of the program is to connect innovation, prototyping and digital manufacturing with the required resources to achieve its evolution. Through its project’s funding program, different FabLab of the network show on their websites some of the business and social projects they develop. These projects participate in competitions (challenges) that reward, among other things, the capacity of replication in any FabLab of the network or the product's simplicity and innovation, to be able to benefit from funding through 1000USD prizes or supervision from different sponsors to reach, in a second stage still in development in 2016, access to a crowdfunding system. The FabConnect platform provides a commited platform where different FabLabs can document their projects by means of plans, photos, explanations, documents and even lists of required material (Eychenne, 2015). Despite of the documentation's importance for the FabLab movement, Simone Amber, member of the FabFoundation management, identifies as one of the main problems of her FabConnect program the detection of projects properly documented or with enough quality that they can comply with the replicability requirements in other FabLab and enhance communication and networking among them (Eychenne, 2015).

Other Tools

FabFolk: Developed as a platform to provide tools to FabLabs users, includes a content aggregator for documentation processes in the early stages of the FabLab movement (Määttä & Troxler, 2011) with the objective of providing equal access to all the supporting tools to the innovative practices developed in the laboratories of Digital Manufacturing (Fabfolk, n.d.). On this platform, an email manager was included under the domain fabfolk.com, which is still active. At the beginning of 2017, this platform already seemed to be inactive.

Fab Share: Both the documentation and the communication within the network are problems for which the FabFoundation and the community itself have tried to create different solutions. One of these solutions is the FabShare platform, which tries to speed up collaboration and exchange between FabLabs through the documentation of projects, showing itself as a clear example of how the FabLabs' own users collaborate to set up structures to improve the network's functioning (Hielscher et al., 2015). FabShare is a space to share projects, providing a repository for the network and establish collaborations (FabFoundation, 2015). On the Fab Share platform, which was available in the URL http://fabshare.org/, is showed links to several solutions, both commercial and free, for FabLab management, the management of the projects developed in the FabLab or repositories of projects and data. Among the FabLab management tools highlighted the presence of the Fab Manager, an Open Source platform launched in May 2015 for the integral management of the services offered by a FabLab or Makerspace and which integrates user management, project management, the management of facilities and reserves developed by the FabLab La Casemate of Grenoble, France. The presence of the Fab Modules system is also relevant a review of the software carried out by Neil Gershenfeld and Fiore Basile used to manage the machinery typically present in a FabLab through a web server with HTML5 capability offered under the Open Source philosophy through a collaborative platform Git Hub (https://github.com/coi-keio/fabmodules-html5). In the project management section, the FabShare platform linked with the solutions Fabble (http://fabble.cc/), GitHub (http://github.com/), Syncthing (http://syncthing.net/), Instructables (http://instructables.com/) and Open Design Contest (http://opendesigncontest.org/) as well as the Mercurial system (https://www.mercurial-scm.org/). In the data repository and search section, the platform linked with the Fab3D tools (http://fab3ds.sfc.keio.ac.jp/), SketchFab (http://sketchfab.com/), Shapedo (http://shapedo.com/), Makeystreet (http://makeystreet.com/) and Thingiverse (http://thingiverse.com/).

CONCLUSION

Fablabs are pieces of a global network that connects users interested in digital manufacturing. Due to the characteristics and culture of these laboratories, they must participate in the open exchange of information regarding to their projects and designs to convert the network in a global design and production structure allowing the exchange of information and the economic growth (Díez, 2012) so that the user feels in this way, as a fundamental part of a wider network (de Boer, 2015). As seen on this article, there are several main characteristics that differentiate FabLab from other collaborative spaces: the existence of a basic equipment list for FabLab in order to achieve greater coordination among laboratories, the common goal of bringing the digital manufacturing closer to the community and even the users' obligation to learn and be able to, by themselves, manage all the available machinery, apart from being able to help and tutoring other users in handling of laboratory machinery (Gordon, 2011; Walter-Herrmann & Büching, 2013).

Opposite to other collaborative ecologies, the FabLabs enjoy of complete independence and are managed completely free by their members who, moreover, are not forced in learning to use the machinery autonomously (George-Williams, 2015). Some authors highlight the importance of users and the active ecologies around the different FabLab which, with their creative attitude, find the motivation to implement the appropriate projects and nurture the existence of digital manufacturing laboratories (Betts, 2010). In this line, the vision provided by Valpreda (2015) is framed in which the importance of the FabLab is highlighted as places where people with different skills, knowledge, cultures and origins coincide thanks to the opportunities that digital manufacturing equipment offer to them and, shares their own work with the documentation, thus considering laboratories as a kind of artisan workshops where technology meets tradition. This way, the most important asset that a FabLab could count on, is its own community or ecosystem (Betts, 2010) and not much the existence of a particular machinery with specific use.

Another of the main features and advantages of the FabLab movement is the creation of a collaborative laboratories network known worldwide as the FabLab Network (de Boer, 2015; George-Williams, 2015). This great network created by the FabLabs disseminated around the globe, acts as a common knowledge structure that leads the information to achieve collaborative design processes and the projects development with the participation of members from different parts of the planet, as well as the distribution of knowledge and the economic growth (de Boer, 2015; Hielscher et al., 2015). In this way, the laboratories would become a "living project in themselves that would feed into knowledge through the network distributing their main processes by the Internet usage" (Díez, 2012) capable of taking advantage of the people's creative potential, to provide freedom to individuals against "the current industrial structure" based on cooperation (Herrera, 2012). In its creation, a large part of the Network's initial functions consisted in establishing new FabLabs and organizing a series of meetings at a global level for the organization. (Eychenne, 2012).

The Fablabs, as digital manufacturing laboratories, deal with very different difficulties for their firm establishment. On the one hand, the list of required machinery by MIT that takes a large investment and that due to import costs (in the case of Latin America can be between 3 and 8 times more expensive than in the United States), to which adds staff, training and those of facilities management expenses (Herrera, 2012). Maintaining these cost structures becomes the first difficulty for the new FabLab establishing and obtaining appropriate funding sources or the institutions finding that house the laboratory as the main concern of the laboratory (Hielscher, 2014).

This way, the economic sustainability is recognized as the priority objective of most of the FabLabs (Kohtala & Bosqué, 2013) and, because of many of the laboratories depend on institutions that house or grant them, the economic results can determine the type of activities that are organized in them, leaving the more open activities a little apart to benefit the activities with a more economic meaning (Troxler, 2014). Trying to solve this type of difficulties and trying to achieve greater economic stability, the FabLab have experienced a variety of business patterns that, in some cases, have directed the policy of the laboratory to more and more commercial environments, becoming closed to the general public (Hielscher et al., 2015) who, in some cases, must pay for the use of machinery, space or even the with the monetization of the experts knowledge (Hielscher, 2014).

In some cases, the educational systems also become barriers to the FabLab establishment, since they do not have a policy of including emerging technologies in the educational systems (Herrera, 2012) which also affects to choose key aspects, such as the personnel who do their work in the laboratory (Tiala, 2011). The bureaucratic procedures also represent a difficulty in the implementation of the FabLab that, in some cases, delay their openings up to 24 months (Herrera, 2012).

Another concern that can be felt in FabLabs is the possibility of community fragmentation in two types of laboratories; those which are embedded in institutions with a more centralized and hierarchical nature or those more decentralized - or polycentric - more oriented to collaborative work, running the risk of a greater focus of attention on the former versus the latter ones even encouraged from the own FabFoundation (Troxler, 2014). The FabLab have evolved adapting themselves to the needs that emerge in fields such as communications, media design and technology or computer science through a greater development in the machinery included as electronic elements, sensors and their dedication to the IoT (Internet of Things) and Open Data in the already known as FabLab+ (Mostert-Van Der Sar et al., 2013) as in the case of the Satadslab from Rotterdam (Holland) (Pucci & Mulder, 2015). In this way, some authors, such as Tomás Díez, director of the FabLab in Barcelona and the responsible for the Fab City project, consider that the FabLab network should follow a road map marked by the following steps (Díez, 2012):

- *The generation of machinery at a smaller scale for use it in laboratories.*
- *The FabLab must be able to produce other Fablabs, giving them, therefore, the necessary skills to generate all the necessary infrastructure.*
- *The development of digital micro-scale elements with modular mounting and dismounting capabilities which allow manipulating materials and operating with their properties to build nano-structures or complex systems with integrated intelligence.*
- *Development of programmable materials which allow building elements without needing for any type of machinery, emulating nature and its capacity for reproduction and evolution, as well as the provision of functionality without the participation of external agents or polluting effects.*

According to Díez (2012), the evolution of the Fablabs would be in that second step, showing a version of FabLab 2.0 in which, through the cultural movement based on Do-It-Yourself and global interconnection, the Fablabs share their content, knowledge and their own processes in such a way that any development can be carried out in any FabLab in the world, including the generation of the existing machines in the FabLab.

REFERENCES

Agrisani, L., Arpalia, P., Bonavolonta, F., & Lo Moriello, R. S. (2019). Academic FabLabs for industry 4.0: Experience at University of Naples Federico II. *IEEE Instrumentation & Measurement Magazine*, *21*(1), 6–13. doi:10.1109/MIM.2018.8278802

Álvarez, N., González de Canales, F., & Puentes, M. (2013). Contextualizando lo digital reflexiones del taller Politics of Fabrication Laboratory de la Architectural Association y la Universidad Católica de Valparaíso. *Revista*, *180*(32), 30–35.

Asinari, L. (2015). Workshop FabAcademy. Ponencia en el Festival Internacional de Arquitectura EME3. Barcelona.

Betts, B. (2010). Bringing The Factory Home. *Engineering & Technology*, *5*(8), 56–58. doi:10.1049/et.2010.0813

Beyers, R. N. (2010). Nurturing Creativity and Innovation Through FabKids: A Case Study. *Journal of Science Education and Technology*, *19*(5), 447–455. doi:10.100710956-010-9212-0

BioAcademany. (2016). *How To Grow Almost Anything - BioAcademany*. Retrieved January 31, 2017, from http://bio.academany.org

Blikstein, P., & Krannich, D. (2013). The Makers' Movement and FabLabs in Education: Experiences, Technologies, and Research. *Proceedings of the 12th International Conference on Interaction Design and Children. IDC '13*, 613–616. 10.1145/2485760.2485884

Bosqué, C. (2013). FabLabs: La démocratie du design. *AA; l'Architecture d'Aujourd'Hui*, *398*, 70–77.

Bouvier-Patron, P. (2015). FabLab et extension de la forme réseau : Vers une nouvelle dynamique industrielle? *Innovations*, *47*(2), 165–188. doi:10.3917/inno.047.0165

Buching, C., Walter-Herrmann, J., & Schelhowe, H. (2012). The C-Model of Interaction between humans and Digital Media in learning environments. *2012 15th International Conference on Interactive Collaborative Learning (ICL),* 1–7. 10.1109/ICL.2012.6402152

Capdevila, I. (2014). Coworking Spaces and the Localized Dynamics of Innovation. The Case of Barcelona. *International Journal of Innovation Management*, *19*(3), 1540004. doi:10.1142/S1363919615400046

Cavalcanti, G. (2013). *Is it a Hackerspace, Makerspace, TechShop, or FabLab?* Retrieved from https://makezine.com/2013/05/22/the-difference-between-hackerspaces-makerspaces-techshops-and-fablabs/

de Boer, J. (2015). The business case of FryskLab, Europe's first mobile library FabLab. *Library Hi Tech*, *33*(4), 505–518. doi:10.1108/LHT-06-2015-0059

Diez, T. (2012). Personal Fabrication: FabLabs as Platforms for Citizen-Based Innovation, from Microcontrollers to Cities. *Nexus Network Journal*, *14*(3), 457–468. doi:10.100700004-012-0131-7

Eychenne, F. (2012). FabLabs Overview. *The Fing (Fondation Internet Nouvelle Generation*). Retrieved from http://fing.org/?Fab-Labs-overview

Eychenne, F. (2015). *Simone Amber: "FabLab Connect produces collaboration between labs."* Retrieved from http://www.makery.info/en/2015/03/09/simone-amber-fab-lab-connect-produit-de-la-collaboration-entre-labs/

FabAcademy. (2016). *Fab Academy*. Retrieved January 31, 2017, from: http://fabacademy.org/

FabFolk. (n.d.). *Fabfolk, a global network of creators.* Retrieved January 31, 2017, from: https://www.fabfolk.com

FabFoundation. (2015). *FabFoundation: FabLabs*. Retrieved January 31, 2017, from: https://fabfoundation.org

FabLabs.io. (n.d.). *FabLabs.io.* Retrieved January 31, 2017, from: https://www.fablabs.io/

Flores, C. (2018). Problem-based science, a constructionist approach to science literacy in middle school. *Interantional Journal of Child-Computer Interaction*, *16*, 25–30. doi:10.1016/j.ijcci.2017.11.001

García-Ruiz, M.E., & Lena-Acebo, F. J. (2016). Cartografía de las ecologías colaborativas. *Economía industrial, 402*, 97-106.

Gennari, R., Melonio, A., Rizvi, M., & Bonani, A. (2017). Design of IoT tangibles for primary schools: a case study. *Proceedings of the 12th Biannual Conference on Italian SIGCHI*. 10.1145/3125571.3125591

George-Williams, S. C. (2015). If You Build It Will They Come?: Building a FabLab in the University of Texas @ Arlington Libraries and Building Faculty Partnerships for Its Use. *122nd ASEE Annual Conference & Exposition*. 10.18260/p.24219

Gershenfeld, N. (2005). *Fab: The Coming Revolution on Your Desktop. From Personal Computers to Personal Fabrication*. Cambridge, UK: Basic Books.

Gershenfeld, N. (2012). How to Make Almost Anything: The Digital Fabrication Revolution. *Foreign Affairs*, *91*(6), 43–57.

Gershenfeld, N., & Prakash, M. (2004). Personal communication fabrication. *The Lyngen Alps. Telektronikk, 3*, 22–26.

Gjengedal, A. (2010). Industrial clusters and establishment of MIT FabLab at Furuflaten, Norway. In *INEER (International Network for Engineering Education and Research) 9th International Conference on Engineering Education.* INEER.

Gordon, L. (2011). Rapid prototyping for the masses. *Machine Design*, *83*(10), 20.

Guerra, A., & Sánchez de Gómez, L. (2016). From a FabLab towards a Social Entrepreneurship and Business Lab. *Journal of Cases on Information Technology*, *18*(4), 1–21. doi:10.4018/JCIT.2016100101

Herrera, P. C. (2012). Perspectivas en los Laboratorios de Fabricación Digital en Latinoamérica. Sigradi. In *Proceedings XVI Conference of Iberoamerican Society of Digital Graphics* (pp. 285-289). Fortaleza, BR: SIGRADI 2012.

Hielscher, S. (2014). *Examining web-based materials A snapshot of UK FabLabs and Hacker- spaces*. Proyect Report. CIED, STEPS Centre, Grassroots Innovations.

Hielscher, S., Smith, A., & Fressoli, M. (2015). WP4 Case Study Report: FabLabs. Report for the TRANSIT FP7 Project. Brighton.

International FabLab Association. (n.d.). *The International FabLab Association Website*. Retrieved from http://empty-ice-3260.herokuapp.com/refinery/

Kohtala, C. (2013). Shaping Sustainability in FabLabs. In Participatory Innovation Conference PIN-C 2013 (pp. 287–290). Lappeenranta University of Technology.

Kohtala, C., & Bosqué, C. (2013). The Story of MIT-Fablab Norway: Community Embedding of Peer Production. *Journal of Peer Production, 5*. Retrieved from http://peerproduction.net/issues/issue-5-shared-machine-shops/peer-reviewed-articles/the-story-of-mit-fablab-norway-community-embedding-of-peer-production/

Kotler, P. (1986). The Prosumer Movement: A New Challenge for Marketers. *Advances in Consumer Research. Association for Consumer Research (U. S.)*, *13*(1), 510–513.

Krannich, D., Robben, B., & Wilske, S. (2012). Digital fabrication for educational contexts. In *Proceedings of the 11th International Conference on Interaction Design and Children*. New York, NY: ACM.

Määttä, A., & Troxler, P. (2011). Developing open & distributed tools for Fablab project documentation. *CEUR Workshop Proceedings*, 739.

Mostert-Van Der Sar, M., Mulder, I., & Remijn, L. (2013). *Fablabs in Design Education*. Paper presented at International conference on engineering and product design education, Dublin Institute of Technology, Dublin, Ireland.

Paio, A., Eloy, S., Rato, V. M., Resende, R., & de Oliveira, M. J. J. (2012). Prototyping Vitruvius, New Challenges: Digital Education, Research and Practice. *Nexus Network Journal*, *14*(3), 409–429. doi:10.100700004-012-0124-6

Posch, I., & Fitzpatrick, G. (2012). First steps in the FabLab. In *Proceedings of the 24th Australian Computer-Human Interaction Conference on - OzCHI '12* (pp. 497–500). New York. ACM. 10.1145/2414536.2414612

Posch, I., Ogawa, H., Lindinger, C., Haring, R., & Hörtner, H. (2010). Introducing the FabLab as interactive exhibition space. In *Proceedings of the 9th International Conference on Interaction Design and Children* (pp. 254–257). New York: ACM. 10.1145/1810543.1810584

Pucci, E. L., & Mulder, I. (2015). Star(t) to Shine: Unlocking Hidden Talents Through Sharing and Making. In Lecture Notes in Computer Science: Vol. 9189. *Distributed, Ambient, and Pervasive Interactions. DAPI 2015* (pp. 85–96). Cham: Springer. doi:10.1007/978-3-319-20804-6_8

Ritzer, G., Dean, P., & Jurgenson, N. (2012). The Coming of Age of the Prosumer. *The American Behavioral Scientist*, *56*(4), 379–398. doi:10.1177/0002764211429368

Stager, G. S. (2013). Papert's Prison FabLab: Implications for the maker movement and education design. In *IDC '13 Proceedings of the 12th International Conference on Interaction* (pp. 487–490). New York: ACM.

Standford Graduate School of Education. (2013). Transformative Learning Technologies Lab. *FabLab@ School.* Retrieved July 16, 2014, from https://tltl.stanford.edu/

Stemp-Morlock, G. (2010). Personal Fabrication. *Communications of the ACM*, *53*(10), 14–15. doi:10.1145/1831407.1831414

Tiala, S. (2011). FabLabs: Re-envisioning Innovation and "Entrepreneering". *ASQ Higher Education Brief*, *4*(5). University of Wisconsin. Stout.

Troxler, P. (2009). Open Content in the Creative Industries: A Source for Service Innovation? In *Supporting service innovation through knowledge management*. Swiss Knowledge Management Forum.

Troxler, P. (2010). *Commons-based Peer-Production of Physical Goods Is there Room for a Hybrid Innovation Ecology?* Paper presented at 3rd Free Culture Research Conference, Berlin, Germany. 10.2139srn.1692617

Troxler, P. (2014). FabLabs Forked: A Grassroots Insurgency inside the Next Industrial Revolution From a Book Programmes National. *Journal of Peer Production, 5*. Retrieved January 31, 2017, from http://peerproduction.net/issues/issue-5-shared-machine-shops/editorial-section/fab-labs-forked-a-grassroots-insurgency-inside-the-next-industrial-revolution/

Troxler, P., & Schweikert, S. (2010). Developing a Business Model for Concurrent Enterprising at the FabLab. *2010 IEEE International Technology Management Conference (ICE)*, 1–8.

Troxler, P., & Wolf, P. (2010). *Bending the Rules: The FabLab Innovation Ecology*. Paper presented at the 11th International CINet Conference, Zurich Switzerland.

Velasco, R., Brakke, A. P., & Chavarro, D. (2015). Computer-Aided Architectural Design Futures. The Next City - New Technologies and the Future of the Built Environment. In *16th International Conference, CAAD Futures 2015* (*vol. 527*, pp. 172–191). Berlin: Springer-Verlag.

Walter-Herrmann, J., & Büching, C. (2013). *FabLab: Of Machines, Makers and Inventors*. Wetzlar: Transcript-Verlag. doi:10.14361/transcript.9783839423820

Willemaerts, C., Dewulf, W., Lambaerts, M., Boeykens, S., Abeele, V. V., Van Aken, J., ... Lauwers, B. (2011). Introducing Engineering Students to Manufacturing in a Fabrication Laboratory (FabLab). *Proceedings of the 1st World Engineering Education Flash Week*, 72–79.

Wolf, P., Troxler, P., Kocher, P., Harboe, J., & Gaudenz, U. (2013). Sharing is Sparing : Open Knowledge Sharing in FabLabs. *Journal of Peer Production, 5*. Retrieved January 31, 2017, from http://peerproduction.net/issues/issue-5-shared-machine-shops/peer-reviewed-articles/sharing-is-sparing-open-knowledge-sharing-in-fab-labs/

KEY TERMS AND DEFINITIONS

Academany: Distributed educational program based on digital fabrication technologies (Fab Academy), synthetic biology (Bio Academy), textile (Frabricademy) developed by the FabLab Network.

Collaborative Ecologies: Communities and spaces, with a variable degree of openness to the public, with objectives and agreed goals by its users in which through learning, prototyping, design, and production processes of both material and immaterial goods, bidirectional exchanges of information, knowledge, technology, skills, and resources are produced between users, between users and society, and between users and the industry.

Digital Fabrication: Fabrication processes where the numerical controls and computers transforms digital information into real physical products.

Do It Yourself (DIY): Individual learning or making process based on individual self-resources.

Do It With Others (DIWO): Social learning or making process based on collaboration and knowledge sharing.

Fab Academy: Distributed learning program conducted by Prf. Neil Gershenfeld where students, at different FabLab locations around the world, can learn digital fabrication technologies.

FabLab or Fab Lab: Collaborative maker spaces where users can manufacture and learn almost anything thanks to a specific machinery, the digital manufacturing processes and the social learning.

How to Grow Almost Anything (HTGAA): Distributed learning program conducted by Prf. George Church where students, at different FabLab locations around the world, can learn about Synthetic Biology, part of the Academany.

Chapter 8
Integrating SMEs Through Cloud:
An Industrial Revolution

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ABSTRACT

In the fourth industrial revolution, one of the major driving force is cloud computing which helps in integration of cloud concepts in manufacturing sectors. Most of the high-end factories have started to adopt industrial automation by incorporating smart manufacturing technologies by incorporating cloud technologies, artificial intelligence, internet of things, big data analytics, cyber physical systems, and several other advanced manufacturing technologies. But, most of the SMEs across countries have not been standardized using such new technologies. This chapter discusses on a scheduling model using grey wolf optimization (GWO) for integrating all SMEs on to Cloud, such that proper decision support can be made for effective resource selection and job completion can be provided to the end users dynamically without any flaws.

INTRODUCTION

The concept of Industry 4.0 is a transformation of factories from production-oriented model to smart factories by incorporating advanced technologies like Internet of Things (IoT), Cloud Computing, Cyber-physical system and other advanced manufacturing technologies. It is sometimes referred to as Industrial Internet of Things (IIoT). Currently, factories have started to adopt advanced technologies and they are becoming highly automated and self-monitoring. Hence a clear framework, architecture

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for bridging the gap between physical industrial assets and digital technologies is required. Industry 4.0 focuses on three major aspects like digitization, integration of horizontal & vertical value chains, digital product descriptions & service offerings and providing opportunities for innovative business models (Geissbauer et al. 2014).

This industrial era enables manufacturing industries to make smart, real-time, timely and efficient decisions by communicating with man-man, man-machine, machine-machine, sensors and so forth. This transformation to intelligent manufacturing helps to improve the business, production and industrial value. Hence, it creates smart, intelligent, flexible, cost effective and reconfigurable production lines to meet the dynamic and global market. These technologies helps the stakeholders to make smart decisions and solve problems in an adaptive manner.

There are four phases in industrial revolution starting from phase 1, which involves usage of steam and water for production, followed by the next industrial revolution which involves electric power for mass productivity. The third industrial revolution is automation of manufacturing sectors through digitization by usage of IT and electronic sectors. Finally, the fourth phase is the Industry 4.0, utilizes IoT, cloud computing, cyber physical systems and other advanced manufacturing models to automate and analyze the business process and this is depicted in Figure 1. Internet of Things (IoT) is a network of internet connected objects like physical devices, home appliances, mechanical or digital machines, vehicles, humans and other different objects for enabling connection, integration and data exchange. Even the human issues are also taken in to account very carefully. Because in a manufacturing system, the efficiency, experience, timing, etc. of the workers are also playing a vital role. In addition, the psychological influences of human give unpredictable results which attracts stress relieving cycles.

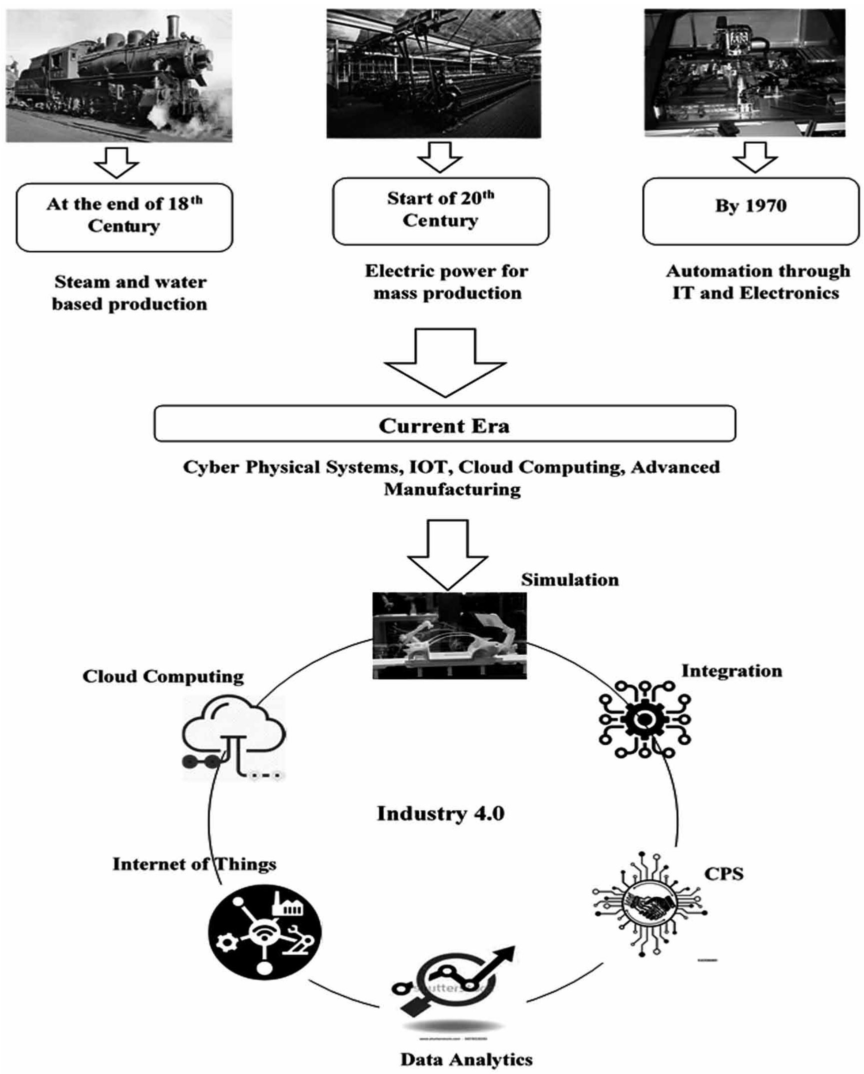
Design Principles

The design principles which support and guide companies to identify and implement Industry 4.0 standards are as follows.

Bauer et al. (2015) proposed four principles used for supporting companies to identify and implement Industry 4.0 scenarios.

- **Interoperability:** This is the capability of physical devices, machines, sensors, and human to connect and communicate via Internet of Things (IoT), Internet of People (IoP).
- **Data/Information Transparency:** This is the application of virtualization concept to transform the physical components as digital models using advanced technologies like IoT, cloud computing etc. The raw data received from sensor are combined to generate higher valued information.
- **Technical Support:** The support systems are used to assist humans for problem solving and quick decision making by combining and visualizing the information. The cyber physical systems are used to physically provide assistance to humans to perform large range of tasks which are risky, unpleasant for the humans.
- **Decentralized Decision Making:** These system has the ability to make decisions autonomously so the decision making is distributed. The tasks are assigned to the higher level decision making systems, only in-case of exceptions, other interference and conflicting tasks.
- **Service Orientation:** This is a design principle which helps the factories to understand and recognize the needs of customers before they are articulated.
- **Modularity:** The companies are adaptable as smart factories by scaling the different modules.

Figure 1. Phases of industrial revolution (industry 4.0)



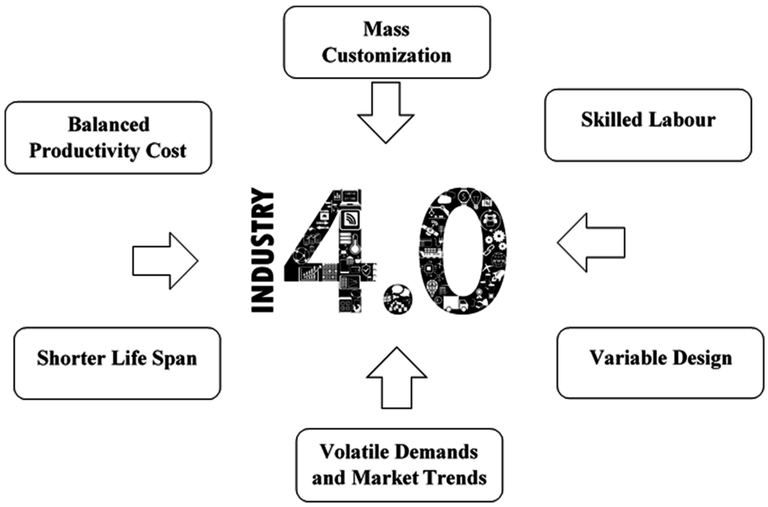
Social and Economic Triggers of Industrial Revolution

The social and economic factors which are crucial to the growth of factories are mass customization, lack of expertise, retirement of skilled labor, variability in product design, changing customer demands and market trends, short project life span and competence with better cost among different firms (Figure 2).

CLOUD COMPUTING AND MANUFACTURING SECTOR

National Institute of Standards and Technology (NIST) definition of cloud computing states that, “The term cloud computing enables pervasive, dynamic, and expedient access to a pool of reconfigurable

Figure 2. Triggers in social and economic view



resources like applications, software's, network, servers, storage and other computing services. These resources can be rapidly allocated to the end users without lot of effort and minimal service provider interaction". The essential characteristics of cloud computing are rapid elasticity, broader network access, on-demand service, resource pooling and measured service (Peter Mell et al. 2011). The main concept behind cloud computing is to offer 'Everything as a Service' which is the main enabling technology behind todays manufacturing firms. The three different models of cloud computing are as follows.

1. **Software as a Service (SaaS):** These types of cloud offer software as a mean of service to the cloud users.
2. **Platform as a Service (PaaS):** This sort of cloud presents the platform for deployment of application and services and thus reduces the cost of buying new hardware for an application.
3. **Infrastructure as a Service (IaaS):** Provides the computing facilities and repository for storage.

In addition to these services, the other services include production, design, testing, simulation and management. The concept of cloud is used to revolutionize production sectors and this can be accomplished by the following scenarios.

- Capture and application of industrial intelligence and knowledge by using rules, analytics and Business Intelligence (BI).
- Rapid launch of supplier portals and effective collaboration platforms tiered with better quality management and effective workflows.
- Design of all the manufacturing services in a centralized repository and integration of all resources through cloud to make it available for manufacturers.
- Accelerating the development of new products and help in attaining the marketing objectives without any delay.
- Automating marketing strategies using cloud to achieve better productivity and sales.

- Relying on multi-tier ERP strategies for reduction in logistic costs, promotion of efficient material planning and supplier management.

Research Challenges in Cloud Manufacturing

Now-a-days internet and relevant technologies are widespread and developing rapidly. Innovation in the manufacturing industry has to be employed for improvement to product quality and finding solutions for manufacturing related problems. Currently, due to globalization aspects of manufacturing business, industries have changed their business model to integrated and collaborative operations rather than centralized vertical operations. Cloud manufacturing is a model that uses advanced manufacturing technologies with the support of information technologies like cloud computing, Internet of Things, virtualization and other computing facilities for the transformation of manufacturing abilities to services.

Industries in current era can optimize productivity by globalizing their productivity with other companies. But, integration of more resources from several manufacturing sectors creates a lot of challenges and complications.

- **Adapt Profitably, Spontaneously and Consistently to Demands:** Industries should be active and concurrent to react rapidly in terms of changing market trends, reduced product life cycle etc.
- **Convergence Towards Automated Technology (AT) and Information Technology (IT):** These industries should also be aggregative, in terms of incorporating with all its partners from diverse regions and there by maintaining a better relationship with each other.
- **Standardization:** The manufacturing platform integrates many different machines, systems, human resources, technologies, business policies and business information. Hence, a standardization mechanism is required for integrating all these decentralized resources in to a reconfigurable resource pool.
- **Security:** The manufacturing resources and data available on cloud should be protected from unauthorized access. Cloud infrastructure provides a secure a platform which meets the requirement of high-end manufacturing equipment.
- **Scalability:** Scalability is another critical issue that should be considered during resource allocation and scheduling. Based on the dynamically changing workload and resource requirements, the manufacturing resources must be scaled based on the demand.
- **Resource Scheduling:** Allocating and scheduling the resources effectively is an important issue in manufacturing industries. Indiscrete resource allocation will have an impact on time and cost and thus affect the overall efficiency of production.
- **Cloud-Based Manufacturing Enterprises With Inclusion of Resources From Small and Medium Sized Enterprises (SMEs):** SMEs are made to adopt decentralized mode of collaboration and supply chain networks. This is done to reduce capital investment and time needed for purchase, operation and maintenance of those resources across all the sites. The use of cloud technology in manufacturing enterprises provides a scalable, reliable and efficient mode of accessing the manufacturing resources from such type of SMEs.
- **Load Conditions on Data Center:** The concurrent resources in cloud platform should be managed properly across a diverse set of jobs on shared physical machines. The load factors that need to be considered are the computation load which signifies the number and size of each VM, the

storage load which depicts the volume of input, output and intermediate data and the network load which represents the traffic during communication.

- **Energy Management:** This signifies a reduction in energy consumption according to the rules and environmental standards. Proper management of energy requires implementation of efficient data centers from a service provider.
- **Workflow Management:** Business process can be represented as a workflow in terms of tasks and resources. The flow of information, invocation of task and synchronization must be done in proper order which would be described by workflow management. This is combined with workflow scheduling for identifying suitable resources for task execution.

Scheduling Perspectives in Cloud Manufacturing

Cloud based enterprises use integration of electronic commerce which include promotion of internet marketing, self-governing research and growth of industries in a view of the current status of enterprises. The main technology used is the Internet, which combines mobile technologies, network & communication technologies and Internet of things.

Virtual cloud enterprises, which are a part of intelligent manufacturing, performs intelligent scheduling operations to schedule manufacturing process. This type of scheduling is based on the actual demand, the resources are organized and provisioned to the customers to ensure reduction in wastage, cost and time of task execution with resources.

Scheduling jobs in cloud manufacturing is a complicated task. A scheduling decision plays a major role in the speed of product development in manufacturing enterprise. Some of the standard scheduling rules involved in the scheduling are First In First Out (FIFO), Earliest Due Date (EDD), Smallest Position Valve (SPV), Shortest Job First (SJF), Slack Time Remaining (STR) and the like.

Jobs are arranged on the basis of the selected scheduling policy and the defined objectives must be calculated. In addition to the common job scheduling policies like Open Job Shop Problem (OJSP) or different Job Shop Problem (JSP), mixed flow operation scheduling also called as Hybrid Flow Shop Scheduling Problem, HF2SP can be utilized for intelligent manufacturing.

SMEs AND INDUSTRY 4.0

Challenges Faced by SMEs Towards Globalization

SMEs play an important role in the development of developing countries like India. Large manufacturing companies have digitalized their production process by the usage of advanced manufacturing technologies and concepts. But, the small scale sectors do not have enough idea and expertise to incorporate new trends on to their business. This is mainly due to the lack of information flow, expertise in all fields, communication gaps and the unavailability of good decision making systems. Sustainability of SMEs depends upon how they adopt new business models to establish dynamic networking, especially when dealing with complex product manufacturing.

Mohd Ghazali Maarof and Fatimah Mahmud (2016) reviewed the challenges faced by SMEs for a successful business in Countries like India and China. The authors after their study concluded that, the resistive mind set of workers for any changes, failure in motivation of labors, effective communication between customers and producers, etc. are dominating challenges for the growth of any SMEs. SMEs are facing challenges during complex decision making situations. Complexity management is very important for an SME, which are missing a lot in today's scenario. Main issues are, mismatch of integration and synergy between SMEs, non-flexible systems due to fixed machinery, ineffective performance monitoring.

Networking between SMEs towards sharing their resources, understanding their strength, etc. are important for overcoming these challenges. There is also a need for a decision support system to address these challenges. Chanwoo et al. (2016) observed, a mismatch between demand and beneficiaries of Programs for SMEs and suggested implementation of R&D planning support programs as an effort to increase investment in technology development and improve the success rate of SMEs.

Battistella et al. (2015) have proposed a road mapping methodology customized for SMEs. This mapping concept presents the association of small medium enterprises coordinated with the help of an intermediary which adds an ecosystem view. The authors have reviewed the challenges faced by Indian SMEs towards Globalization and also on extending the lifetime of SMEs by understanding its strength and weakness.

The major challenges faced by SMEs are as follows:

- Digitization and Automation for optimizing the usage of resources and to reduce downtime using predictive maintenance.
- Lack of comprehensive broadband connections to ensure very fast transfer rates without loss of quality
- Unavailability of Advanced manufacturing technology and Sensor technology

Motivation and Background

In most of the highly populated countries, there is lot of communication gap and understanding about an effective manufacturing platform that suits the manufacturers, suppliers, vendors and customers. According to the report given by Ministry of Micro, Small and Medium Enterprise (MSME), there are several million SMEs which are wide spread all over the countries. Nearly, 45% of each and every industrial output is contributed by the SMEs this in turn accounts for 40% of the total exports. SMEs create 1.3 million jobs every year (Shashank Thanki et al., 2016). The different challenges faced by SMEs are:

- Shortage of funds and finance
- Constrained regulatory policies
- Lack of availability of recent technologies
- Lack of good computing facilities
- Unavailability of proper marketing platforms

Even though there are lot of challenges, proper computing facilities and availability of recent technologies can be provided by usage of Industry 4.0 technologies. Schwab (2016) the author of the book, "The Fourth Industrial Revolution" stated that, all people are in the transition period of doing traditional business. People have started to modify the way of doing things due to automation of things.

Now-a-days, cloud concepts and Software as a Service (SaaS) are becoming highly popular among manufacturers. This is mainly due to the reduction in capital expenditure and labor costs, maintenance costs, cost savings with quicker product development and operational flexibility for accommodating new or additional resources. Due to globalization, many manufacturing enterprises have transformed their way of doing business from centralized to integrated operations.

Currently manufacturing industries are also supported by new technologies like internet, IoT, service based manufacturing, data analytics etc. They are integrated with manufacturing assets like machineries, fleets and facilities. The use of IT related concepts and smart technologies enable manufacturing industry from production based to service oriented model. Manufacturing industries use innovated IT process for improving their core competitiveness in business. Some of the advanced manufacturing concepts includes, Internet of Things (IoT), Networked Manufacturing (NM), Service Oriented concepts (SOA), Manufacturing Grid (MGrid), virtualization and other advanced computing.

Industry 4.0 and Industrial IoT requires usage and adoption of advanced information technology facilities across several industries. Hence, another important paradigm to promote smart manufacturing is edge and fog computing which is used along with cloud computing and Internet of Things (IoT). Both technologies improves productivity, decreases response time, reduces the amount of data transfer across centralized data centers in cloud and decreases network latency. Nowadays, edge computing along with cloud technologies is used widely to work on IoT data to develop smart factories. The services provided by cloud can be moved to the devices that uses it. This is because real time data sharing plays a vital part in digital manufacturing platforms.

Edge or Fog computing is closely related to each other, it is a step ahead of cloud computing that enables data processing on the computing or network node itself which can also referred as the ‘edge’ placed along the path of the data source and center . This computation is performed at the edge of the network with down-streaming of data done for cloud services and up-streaming data done for IoT services (Shi et al., 2016). Thus huge volumes of data can be collected at real time and processed securely at the edge so as to improve network performance. This minimizes the transfer of large volume of data between data nodes and centers, thus relieves the load on central data servers. In order to meet the current dynamic marketing challenges, manufacturers have started to rely on this hybrid model to integrate data from IoT enabled devices like sensors, intelligent machines to create smart factories. Edge computing can be performed by three ways.

- **Local Devices**: Specialized devices can be employed for specific purpose and these are easier to mange
- **Data Center (Local)**: These are used for managing a centralized pool of processing, storage and other resources. They are managed by a third party service provider and provide efficient energy, cost savings.
- **Data Center (Regional)**: These data centers are distributed closer to the data source. They have high processing power, storage than the centralized data center but are expensive and incurs more maintenance cost.

Different technologies have been incorporated in Industry 4.0, which transforms traditional production lines to achieve real time results by utilizing advanced digital manufacturing facilities. These technologies are listed below.

- **Big Data Analytics**: It is the process of discovery and analysis of manufacturing data from traditional and digital sources either on - premise or off - premise. These data will be used by the industries for better and real time decision making.

- **Industrial Internet of Things (IIoT):** This process has become pervasive in industries which involves usage of Internet of Things in manufacturing process. This can also be called as industrial internet which uses the concept of machine learning and big-data analytics to gather the M2M communication and automation to promote business intelligence.
- **Modelling, Simulation, and Visualization**: These technologies allows to analyse, manipulate and simulate the data using modern visualization technologies to allow virtual product development. The three main virtual manufacturing paradigms are design centered, production centered and control centered virtual manufacturing.
- **Autonomous Robots**: These are machine with artificial intelligence capabilities that can work along with humans. They are autonomous in the sense that, they have their ability to work of their own without human intervention for a long extend of time.
- **Cloud Manufacturing**: These are service oriented manufacturing technologies that enable convenient, on-demand resource provisioning from a large pool of networked resources with little service provider interaction on a pay-as-you-go model.
- **Cyber Physical Systems (CPS):** also called as 'Smart Systems' is a collaboration and integration of computational, networking and physical capabilities which promotes emergence of smart services to improve the quality of service in different areas.
- **Addictive Manufacturing:** also referred as 3D-printing. This is the process in which a component is represented as different layers through the usage of depositing material. The materials are build up layer by layer through the usage of raw materials in powder form. Addictive manufacturing enhances flexible design, time to market objectives, lower cost, end product performance etc.
- **Interoperability:** This is required to bring all the elements like humans, machines, CPS, smart factories together and also helps in error free communication, sharing of information across sites through Internet of Things or other technologies.
- **Augmented Reality:** This refers to the integration of perceptual information created by computer on the user view of real world such as to provide a composite view in the production environment.

MAIN FOCUS OF THIS CHAPTER

The main focus of this chapter is to propose, some ideas for integration of Small and Medium scale Enterprises (SMEs) in and around countries to promote globalization. The high end standards used in large factories can also be incorporated into SMEs to create Smart SMEs. The information across SMEs is not shared and distributed properly due to the unavailability of modern technologies, upfront costs and skilled labor.

The decision making process for selection of appropriate manufacturing services from heterogeneous locations should be made effectively. This is done in-order to perform task-resource mapping efficiently such that, the generated schedule optimizes the makespan and cost. In a distributed environment, the determination of execution time of jobs and migration time of jobs is a complicated task. When the service is not available, the job must be shifted to the next resource based on proximity. Such decision making can be made perfectly only if a higher end support system is available.

Also, during the manufacturing process, most of the jobs are dependent. So a failure or delay in one task may in turn affect the other tasks which are dependent to it. Hence to avoid any delay, the tasks must be migrated to some other location if there is a failure. Otherwise, this may introduce a lot of delay in the manufacturing process. When considering QoS parameters, the end users and manufacturers are concerned towards the deadline and budget of the job. So, heuristic scheduling algorithms is proposed in this chapter, which can provide mapping of tasks and resources at the same time reduce both computation cost and time.

Most of the industrial nations have started investing on advanced manufacturing technologies, design and new innovations to suit the modern world. These have derived from the industrial vision, Industry 4.0 which strive towards small and intelligent manufacturing. The usage of computers rooted in most of the manufacturing systems like computer aided design, computer integrated manufacturing, cloud manufacturing etc. All these technologies are said to evolve from existing technologies and manufacturing paradigms. The discussions on the relationships between Industry, its services, technology and methodologies should be known to uncover the basics of cloud manufacturing.

CONCEPTUAL WORKFLOW MODELING

A manufacturing system is accompanied with ‘n’ tasks and each task requires a set of resources for their completion. The main focus of any manufacturing job is to complete the work within minimum makespan and cost. Cost of a manufacturing job can be minimized, only when all the tasks in a workflow completes within a specified time duration. A sample conceptual software workflow that utilizes tasks and resources is represented in Figure 3. The first layer includes the tasks in the application workflow that requires consideration during the evaluation process. The next layer includes the scheduler and the mapping mechanism of provisioning resources to tasks. The task manager is responsible for managing the tasks and the resource configuration.

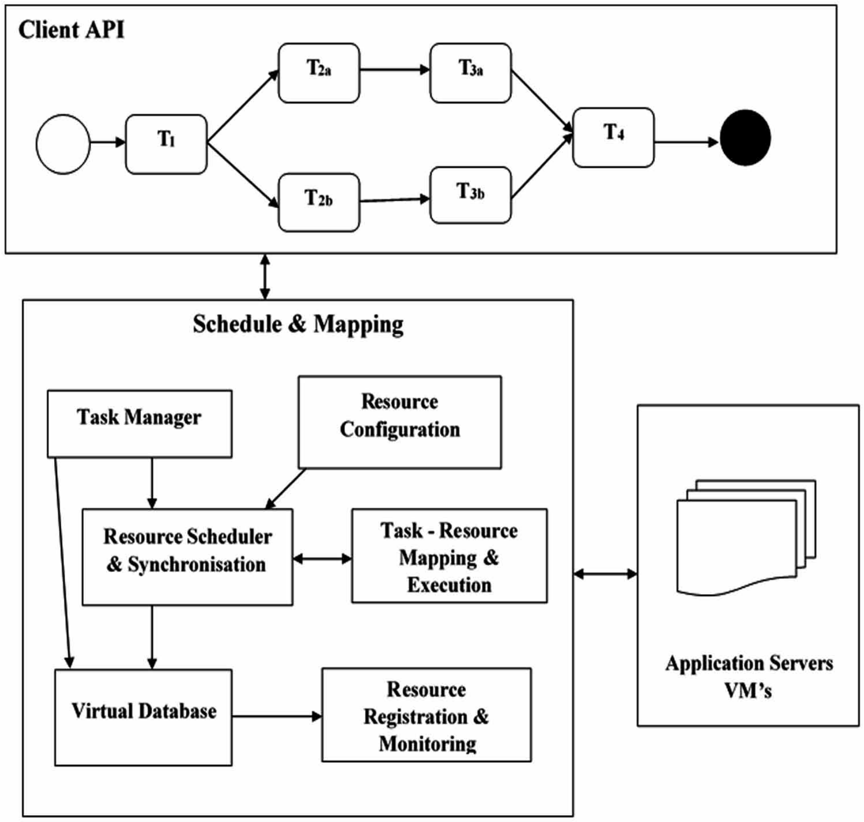
The resource scheduler selects an appropriate resource for task execution from the virtual database. Each resource in the database has to be registered with the service provider and the resource availability should be monitored. The application servers host several VMs for task execution.

Problem Formulation

When considering any manufacturing application, the initial step is to find the set of tasks and resources in the workflow. The identified set of tasks and resources can be denoted as a graph with vertices $'V'$ to represent the tasks $V = \left\{T_1, T_2, \ldots, T_n\right\}$ and edges $'E'$ to represent the communication between the several tasks. The tasks and the resources are assumed to be geographically scattered and distributed across several regions. Resources from SMEs in and around a country can be considered and they are collectively clustered as a resource node and the services are available to different customers on demand. Evolutionary algorithms normally consider evaluation based on the fitness function. Hence, a multi-dimensional fitness function has to be considered and evaluated. The different functions taken for this study is makespan, computation cost of resources, load balance and thereby effective resource utilization. By considering the above constraints, the objective function $'f'$ can be represented as in equation (1).

$$f_1 = min\left\{w_1 Cost, w_2 Makespan\right\} \; f_2 = \max\left\{w_3 Load \;, \; w_3 Util\right\} \tag{1}$$

Figure 3. Sample conceptual software workflow



where 'w_i' denotes weight and f_1, f_2 represent the fitness function.

The execution time of a task T_i on a virtual machine VM, is actually estimated by considering the task size '$T_{size}\left(T_i\right)$'. Let the processing time of task T_i, be P_{T_i} and deg_{VM_i} represent the performance degradation factor which has to be adjusted to satisfy the capacity demands. In some cases, the requested resource could not be allocated immediately due to heavy load in computing site, failure and temporary unavailability of resources. So the tasks have to be computed by utilizing some other resource rather than the resource being referenced. The transfer time is calculated by considering the data produced '$data_{out_j}$' by a virtual machine in one region and the transmission bandwidth 'β'. This might include migration of task from one resource location to another which in turn adds the transfer time while calculating the total execution time. The execution and transfer time of resources is represented in equations (2) and (3).

$$ET_{T_i}^{VM_i} = \frac{T_{size}\left(T_i\right)}{P_{T_i} \times \left(1 - deg_{VM_i}\right)} \tag{2}$$

$$T_{trans}\left(j,K\right) = data_{out_j} \ / \beta \tag{3}$$

$$PT_{T_i}^{VM_i} = \sum_{i=1}^{n} ET_{T_i}^{VM_i} + T_{trans}\left(j,K\right) \text{for all i,j,k} \in \text{N} \tag{4}$$

$$Execution\, time\, of\, the\, workflow,\ T_{exe} = \sum_{i=1}^{n} PT_{T_i}^{VM_i} \tag{5}$$

where '$ET_{T_i}^{VM_i}$' represent the execution time of task T_i on a virtual machine vm_i, $T_{trans}\left(j,K\right)$ represent the transfer time of task when the resource is unavailable in a particular region and $PT_{T_i}^{VM_i}$ represents the total processing time of a job which include both the execution time and migration time of a task as in equation (4) and (5).

The total cost of the workflow can be calculated by estimating the cost of executing a task on the available resources. Cost of a task, also depends on the amount of time a resource is being used by the task. This mapping can be represented as a tuple $m_{t_i}^{r_i} = \left(t_i, r_j, Time_{start}\left(t_i\right),\ Time_{end}\left(t_i\right)\right)$. Thus, the cost of the workflow 'C_{tot}' can be represented in terms of the start, end time of tasks and the cost of executing the task on a particular resource i.e., virtual machine. The total execution cost can be evaluated as stated in equation (6).

$$C_{tot} = \sum_{i=1}^{|R|} C_{VM_{r_i}} \times [(Time_{start}\left(r_i\right) - Time_{end}\left(r_i\right) / \tau \tag{6}$$

Consider that the resources are taken from a pool, which comprises of several manufacturing resources. Different heuristic scheduling algorithms are used for finding the optimal schedule for allocating a VM to a particular task. The problem is formulated by placing the virtual machines on a collection of servers. A data center comprises of a collection of physical servers and the capacity of each server 'C_{Ser}' is the number of VMs that can be accommodated by the server. Each of the datacenter has different instances of VMs and the price of a VM is based on its size. Several jobs may make requests for VM and each task may demand for a capacity 'C_{demand}'. Even though a job demands for a capacity, the amount of resource allocated actually for the request may be represented as 'R_{actual}'. The next objective is to maximize resource utilization and to improve profit. The utilization rate of a datacenter can be represented in terms of the total number of resources provisioned based on request for VM placement and the maximum capacity available in the data center.

REVIEW ON SCHEDULING ALGORITHMS IN CLOUD INTEGRATED MANUFACTURING

Distribution of production depicts the concept of manufacturing as a service. As a result of such a transition, manufacturers are commended to shift from a particular category to a pervaded one. The usage of advanced manufacturing services, Internet of Things, service orientation, cloud computing and other related technology has made such a distribution, management, intelligent matching and searching more reliable (Xu, 2012). The service composition in cloud based manufacturing belongs to a class of NP-Hard problems. By using traditional methods, it is complicated to solve such problems rapidly to produce optimal results.

Halpern and Pignataro (2015) have described the fundamental concepts, components and architectural principles like topological principle, plane separation, classification, shared metadata, service definition and function independence for the construction of Service Function Chaining (SFV). The integration and construction of composite services from different other services dynamically introduces several challenges. A service function is a virtual or physical function which is responsible for the management of received packets with the help of specific constraints.

Network services are value added products, and service providers are facing many challenges due to varying customer demand, technological transformations and advancements, coordinating and controlling resources across various domains, services. Orchestration can be used to automate, control, coordinate and manage the network services. According to National Institute of Standards and Technology (NIST) the definition for the concept of Service Orchestration as, "Orchestration is a process related to the arrangement, coordination, and management of virtualized infrastructure to provide different cloud services to customers" (Bohn et al., 2011).

The network functionalities can be separated from their physical hardware and they can be offered as virtualized services on general purpose servers as Network Function Virtualization (NFV). These NFV's provide dynamic scaling, faster deployment and flexibility by simply implementing them through software without the need of new hardware infrastructure. The concept of orchestration can be used in cloud, web services, network function virtualization and end-to-end networking services. An orchestration service is responsible for coordinating and controlling and provisioning the resources to the customers automatically (Nathan et al., 2018).

Unlike other software industries, a manufacturing industry uses a variety of information like machine availability, raw materials to possess an operation, information related to business and transportation of material needed during the production process. Hence, to manage and schedule the information and resources effectively, proper scheduling algorithms are needed. Meta-heuristic scheduling techniques can be used for providing better solution within a limited time frame and because of its ability and efficiency to solve complicated and larger problems it is popularly used now a days. The different algorithms vary based on its task dependency. When the tasks are dependent then, it can be scheduled only if its parent tasks are already scheduled and this can be called as workflow scheduling. But when the tasks are independent, there is no need to maintain any precedence between tasks and this may be termed as independent scheduling.

Li et al. (2016) proposed a cloud entropy enhanced genetic scheduling algorithm was used to solve multi-objective problems based on matching degree, service composition complexity and harmony degree. The work was evaluated on an Automated Guided Vehicle (AGV) case study to evaluate the convergence of the proposed algorithm towards optimal solution. Optimization algorithm for scheduling manufacturing resources in cloud based environment using improved shuffled frog leaping was described by Xiao et al. (2015). An energy adaptive immune genetic algorithm for improving search based on immune strategy can be used as a mechanism for adapting and adjusting the probabilities of crossover and mutation with reduced time complexity. This strategy produces better solutions and satisfies the efficiency requirements. But however it does not reduce the overall time complexity of scheduling.

Jing Liu et al. (2013) have described a task scheduling model based on deadline constraint to reduce power consumption on data centers and to improve profit of service providers. A multi-objective genetic based search strategy was used, a comparison on energy and profit was made by using low, high and medium workload. A Genetic Algorithm (GA) based task scheduling was used for allocation and execution of tasks. This algorithm can be modelled to reduce the job finish time, cost and to improve resource utilization. Chen (2016) proposed a variation of genetic algorithm using firefly approach to make performance improvement in terms of completion time of tasks. At first, the resources are initialized and GA is used for solution adjustments to find optimal path. Then, firefly procedure is used to update the florescence value but the solution enhancement was not considered in detail.

Several encoding solutions can be used when encoding the population size with the use of GA. One of the classical approaches is to present solutions as a fixed bit of strings. The other methods include direct, permutation and tree based representation where the chromosomes are the vectors used for representing tasks and resources. Initial population is then generated based on precedence of tasks and then fitness function is calculated which may be based on makespan, cost and flow time. Selection operators are then applied which may be based on Roulette wheel or Tournament based representation that are more commonly used. Then, crossover can be applied to the population using the widely used two point or one point cross over mechanism. An adjustable adaptive mutation operator, can be used to modify mutation rate with respect to the fitness function variation.

Zhigang et al. (2014) have proposed that, Particle Swarm Optimization (PSO) model of job scheduling describes the capabilities of equipment on deadlines. The workflow was analyzed on different due dates and the population size is fixed to be 150. A scheduling and optimization mechanism for minimizing cost by using PSO algorithm has been suggested by Wang et al. (2013). The authors have presented an evaluation on cost and CPU time by varying tasks, no of processors and other parameters. A similar algorithm was used for implementing outsourcing of resources in a multitask environment. Auction based resource allocation was done on certain studies where the provisioning mechanism and pricing policy were based on market based models.

Farnaz et al. (2015) have proposed a modified PSO to schedule the tasks in cloud environment and the comparative analysis depicts the performance of their work on task execution time, missed tasks and waiting time by using allocation priority based on Shortest Process Next (SPN), First Come First Served (FCFS) and Highest Response Ratio Next (HRRN). The problem of multidimensional cloud resource utilization ratio and high energy consumption of cloud communication between tasks has been investigated and a cloud data centre based resource scheduling algorithm, which combined resource fusion based on PSO and taboo search technique was proposed. The results of the experimentation show savings in energy consumption of virtual machines of up to 63.6%.

Hybridization strategy of PSO Hybrid was surveyed with other heuristic scheduling algorithms. PSO algorithm was hybridized with other global scheduling procedures like genetic algorithm, differential evolution and adaptive mutation. Performance evaluation was made on some benchmark problems, but an actual real time dynamic environment was not considered. Wang et al. (2013) proposed a hybrid task scheduling was based on ACO and PSO. The initial solution was generated using PSO strategy and finally ACO is used to update the optimal solution. Comparison were made by varying the number of iterations with respect to time of task.

Yi-Tung et al. (2008) have used a combined heuristic optimization algorithm using genetic procedure and particle swarm optimization. Experimental studies were made using 17 test functions and a mathematical modelling was done to derive effectiveness of the proposed approach. QoS based parameters such as cost, execution time and transmission rate was considered for scheduling. A multi-objective pareto evolutionary strategy was used for evaluation based on time and cost of workflow A modified form of DEA can be used improve the rate of convergence in an optimization procedure. Modified DE converges faster than original algorithm and comparison based on average convergence rate were analyzed. But, DE based search can perform only global search so to enhance search, this procedure is hybridized as Hybrid Differential Evolution (HDE). A Bat based scheduling mechanism can be used to narrow or reduce the individual search space. Cloudsim can be considered as the simulation platform to make comparison based on energy consumption of processing resource. Cickova et al. (2010) investigated on flow shop scheduling problem on test data car1 and rec1 from OR library and the efficiency of differential evolutionary algorithm was calculated and validated on the available instances.

The random and dynamic behaviour of ants, searching for their food is imitated by the Ant Colony Optimization algorithm. The commonly used forms of ACO are rank based ant system, Recursive ACO, max-min ACO, continuous orthogonal ACO and Elitist ant based system. Cristian et al. (2013) made experimentation using real time job data and parameter sweep experiments for running an application with high computational requirements. The phenomenon of maintaining balance between the resource loads plays an important role in performance improvement. Various literatures depict that, ACO is well suited for load balancing application in cloud environment due to two properties, which include, ability of ant to move along different nodes to find optimal path, adaptability to parallel environment and organization of itself based on the information gathered locally.

Medhat et al. (2015) proposed a similar algorithm for makespan reduction and several comparisons were made by varying parameters of ACO. But the authors have not taken manufacturing jobs and load balance in to consideration. Xianmin et al. (2015) has discussed an ACO based scheduling algorithm for qualitative analysis to estimate time, cost and quality of services. A multi-objective scheduling can be used to minimize time, cost and load balance and improve the performance of manufacturing tasks.

Grey wolf optimizer can be used to dynamically schedule the resources across welding industries (Chao Lu et al., 2017). This scheduling mechanism can effectively schedule the resources by considering machine break down, job quality and unpredictable delays. A multi-objective grey wolf optimizer with genetic algorithm can be effectively used for reducing makespan, load balance and to manage other instabilities.

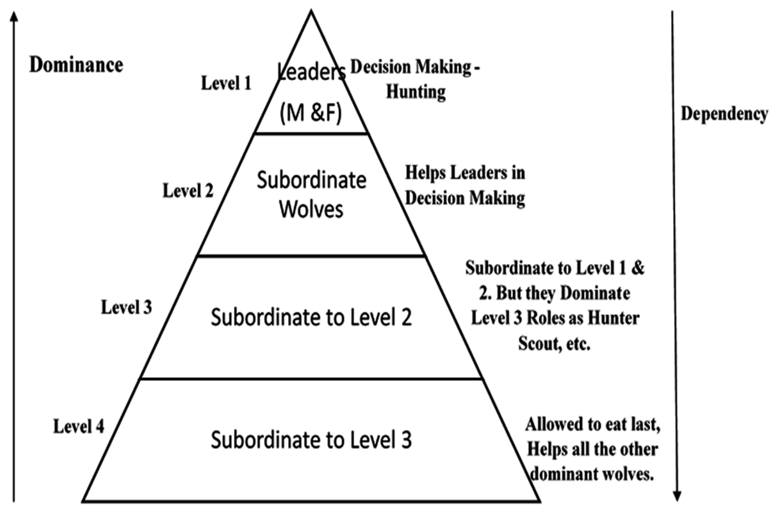
GREY WOLF OPTIMIZATION CONCEPT AND INDUSTRIAL AUTOMATION

Grey Wolf Optimizer Concept

The Grey Wolf Optimizer (GWO) proposed by Mirjalili et al. (2014) is based on the hunting behaviour of Grey Wolves which normally live in packs with group size on an average of 5-12. The hierarchy of grey wolf and its functions is depicted in Figure 4.

The hunting behaviour of wolves can be categorized as follows.

Figure 4. Hierarchy of wolves and their functions in GWO



1. Track, Chase and Approach (Prey)
2. Follow, Encircle and Harass till it (prey) stops moving
3. Attack and capture (Prey)

Encircling the Prey

Before hunting a prey, grey wolves encircle them. All the wolves surround the prey by moving its position. Also the prey is also subjected to change its position. Hence, during each iteration the position of grey wolf and the prey is adjusted.

Hunting the Prey

After the grey wolf predicts the location and distance of the prey, the hunt is leaded by the leader group (Level1). The other wolves in the lower levels also participate in the hunting process. But in the overall search space there is no idea about which is the optimum location of the prey. Based on the movement of wolves from different levels, the optimal position of the prey is adjusted. All the other wolves follow the dominant wolves and updates its best position.

Exploiting Prey

When the prey stops moving, grey wolf builds up their confidence for attacking and starts attacking the prey. Like other evolutionary algorithms like ACO, PSO etc. this algorithm also suffers from local optimum solution. When the first wolf attacks the prey, all the other wolves also starts to attack the prey using the same phenomena and they converge to their solution. Initially during the process of encircling, the grey wolves depart from each other till they analyse a proper way of attack. But, when they start to hunt their prey all the wolves converge together and they start to attack.

Service Composition and Task Scheduling in SMEs: A Software Approach

The process of generating schedules by associating tasks with resources and the resource allocation strategy using GWO method is described as follows.

Schedule Generation by Mapping of Tasks With Resources

The position of the individual i.e., grey wolf in the population should be converted into an appropriate schedule. Initially, the resources are identified as $'R'$, the mapping list of tasks to resources is $'M'$ and initially, $R, M = \left\{NULL\right\}$. The execution time and cost are also set as zero. The selected heuristic algorithm is used for estimating the execution time of the workflow on each resource. The tasks and resources are represented as a matrix where $Time_{exe}\left[i, j\right]$ represent the execution time of the task T_i on the resource R_j which is calculated and $Time_{trans}\left[i, j\right]$, represent the time to transfer a task from one location to another.

Initially, the task-resource mapping must be made and the value of start time is determined on the basis of some scenarios. When a task has no parents, it can start its execution immediately when the resource is available. If the task has parents, then the child can start execution only after its parent task has completed its execution. But, when the requested resource is busy or unavailable, the task is allowed to wait for its execution until the VM is available.

Scheduling Using Grey Wolf Optimization Algorithm

Grey wolf optimizer which is belongs to evolutionary computation is a heuristic algorithm and is based on the behaviour of grey wolves hunting its prey. This behaviour can be mathematically modelled for solving the problems relevant to resource-task mapping. The wolves at the lower level follow the trails of the leaders i.e., their predecessors. The position of the wolf is updated based on its prey during the course of time. Hence each wolf changes its position based on its probabilistic choice with respect to time. By considering the path followed by the predecessors, the remaining participants make their decision making.

When a Virtual Machine (VM) is leased from an IaaS based resource provider, the user can choose among the machines based on their configurations and prices. When taking heterogeneous resources in to consideration, the selection process will have an impact on cost and time of workflow. The algorithm first identifies the dependencies among tasks to reduce the migration time. It then defines a load vector that represents the number of service nodes or VM needed to complete the task within a specified deadline. This load factor is defined for each type of task. Then the consolidated time was computed for the submitted jobs by calculating the individual time for each instance of VM. The tasks were scheduled to a particular virtual machine based on its availability and placement. The VMs are assumed to be distributed across three geographical regions. These locations are the SMEs that host the resources needed to be serviced by the tasks.

The overall procedure for scheduling the resources across different SMEs using the above mentioned algorithm is represented as follows.

Input

Represent the number of tasks, subtasks, resources, available locations, replicated resources. This can be depicted in the algorithm as number of instances, population size 'P_{size}', maximum generation 'G_{max}', number of iterations 'i_{max}', Initial position of the prey and wolf as 'X' and 'Y' respectively.

Output

Optimal solution 'Sol'. The optimal path of resource selection to complete the job in minimum time and cost (maximum fitness function)

//Initialization

1. Randomly generate a set of feasible solution 'P_{rand}'.
2. Consider this in the population 'P'
    a. // Repeat the process below until termination criteria
3. **for** $i = 1$ **to** i_{max}' **do**
4. Evaluate the fitness value of the individual based on the first, next and last best individual position in the search space.
5. Select the best position 'x_i' in the population and update the current best position as the new best position.
6. Update the fitness value and use it for the next iteration
7. Save it as the next population
8. Select a solution 'x_j' from new population
9. If solution *not feasible*
10. Update with feasible solution by modifying $x_j^{'}$
    i. *// Return Solution*
11. Update and return best solution 'Sol'

FUTURE RESEARCH DIRECTIONS

Since, most of the industrial output is from the SMEs modern techniques can be adopted in SME towards its sustainable growth. Currently SMEs could not afford such expense so they are forced to ignore the advantages provided by such type of decision systems. Also, lack of skilled labor and awareness about modern technologies can be educated among SMEs. The upfront costs and maintenance is much less when using cloud oriented technologies but this awareness is not made available. An artificially intelligent network can be used for integrating all SMEs to provide smart manufacturing. The information can be made centralized in cloud and it can be distributed across several geographical locations by using the virtualization technologies. Also, energy efficiency is an important criterion which should be considered. Many large companies has invested a lot in the process of digitalizing their infrastructure but this threatens SMEs because they are not able to invest a huge amount due to their economic situation.

The future research opportunities within the domain in this chapter is to propose a paradigm for integrating several SMEs and to contribute the growth of SMEs towards globalization. Currently, SMEs are unable to take data from different sources they use their own traditional way of logistics, production and finance based on the information discovered in past. By considering industrial automation, such data can be digitalized across several SMEs rather than using an offline analytics. The concept of IoT, Cloud Computing, Computational Intelligence, Analytics and several other advanced manufacturing technologies can be incorporated to make SMEs a global competitor.

CONCLUSION

The problem of integration of SMEs towards Industry 4.0 is an important phenomenon behind the national and global growth of a country. Digitization process of SMEs involve lot of challenges like analysis of vast amount of data and providing a proper decision support system to the end users. Even though there are several challenges in the digitization process, this chapter proposes a software based approach for decision support in choosing the correct resources from the proximal location. This system when incorporated on a large scale will provide a customized support to the stakeholders like suppliers, customers, agents and companies.

Evolutionary computation algorithms can perform well for analyzing and estimation of optimal schedules, and it can compute an optimal schedule for decision making. This digital transformation of SMEs will not happen in a short duration, there is a long way to pave this transformation towards growth. Knowledge transition from large factories to small and medium scale enterprises could provide and support automation to be possible in SMEs. Todays decentralized workflow must be transformed in to a centralized concept by using current popular technologies like cloud computing, Internet of Things, edge computing, advanced manufacturing technologies etc.

REFERENCES

Ahmeda, E. (2017). Mobile Edge Computing: Opportunities, solutions, and challenges. *Future Generation Computer Systems*, *70*, 59–63. doi:10.1016/j.future.2016.09.015

Battistella, C., De Toni, A. F., & Pillon, R. (2015). The Extended Map methodology: Technology road mapping for SMES clusters. *Journal of Engineering and Technology Management*, *38*(4), 1–23. doi:10.1016/j.jengtecman.2015.05.006

Bauer, W., Hammerle, M., Schlund, S., & Vocke, C. (2015). Transforming to a Hyper-connected Society and Economy—Towards an Industry 4.0. *Procedia Manufacturing*, *5*(1), 417–424. doi:10.1016/j.promfg.2015.07.200

Bohn, R. B., Messina, J., Liu, L., Tong, J., & Mao, J. (2011). NIST Cloud Computing Reference Architecture. *IEEE World Congress on Services, IEEE*, *7*, 594-596. http://ieeexplore.ieee.org/document/6012797/

Cho, Park, Son, & Lee. (2016). R&D Support Services for Small and Medium-Sized Enterprises: The different Perspectives of Clients and Service Providers, and the Roles of Intermediaries. *Journal of Science and Public Policy*, *43*(6), 859–871.

Geissbauer, R., Schrauf, S., Koch, V., & Kuge, S. (2014). Industry 4.0 – Opportunities and Challenges of the Industrial Internet. *Survey by PWC*, 1-52.

Halpern, J., & Pignataro, C. (2015). Service Function Chaining (SFC) Architecture. *Internet Engineering Task Force (IETF), Informational*, 1-32.

Lu, C., Gao, L., Li, X., & Xiao, S. (2017). A hybrid multi-objective grey wolf optimizer for dynamic scheduling in a real-world welding industry. *Engineering Applications of Artificial Intelligence*, *57*(1), 61–79. doi:10.1016/j.engappai.2016.10.013

Maarof & Mahmud. (2016). A Review of Contributing Factors and Challenges in Implementing Kaizen in Small and Medium Enterprises. *Procedia Economics and Finance*, *35*(2), 522–531.

Nathan Saraiva de Sousa, F., Danny Lachos Perez, A., Raphael Rosa, V., & Mateus Santos, A. S., & Rothenberg. (2018). Network Service Orchestration: A Survey. *IEEE Communications Surveys and Tutorials*, 1–30.

Seyedali, Mohammad, & Lewisa. (2014). Grey Wolf Optimizer. *Advances in Engineering Software*, *69*(1), 46–61.

Shi, W., Cao, J., Zhang, Q., Li, Y., & Xu, L. (2016). Edge Computing: Vision and Challenges. *IEEE Internet of Things Journal*, *3*(5), 637–646. doi:10.1109/JIOT.2016.2579198

Shi, W., & Dustdar, S. (2016). The Promise of Edge Computing. *Journal of Computers*, *49*(5), 78–81.

Thanki, S., Govindan, K., & Thakkar, J. (2016). An investigation on lean-green implementation practices in Indian SMEs using analytical hierarchy process (AHP) approach. *Journal of Cleaner Production*, *135*(2), 284–298. doi:10.1016/j.jclepro.2016.06.105

ADDITIONAL READING

Cickova, Z., & Stanislav, S. (2010). Flow Shop Scheduling using Differential Evolution. *Management Information Systems*, *5*(2), 8–13.

Cristian, M., Elina, P., & Carlos, G. (2013). An ACO-inspired Algorithm for Minimizing Weighted Flow time in Cloud-based Parameter Sweep Experiments. *Journal of Advances in Engineering Software*, *56*(2), 38–50.

Jing, L., & Guo, Xing., Xing Ming, Z., Fan, Z., & Bai Nan, L. (2013). Job Scheduling Model for Cloud Computing Based on Multi-Objective Genetic Algorithm. *International Journal of Computer Science Issues*, *10*(3), 134–139.

Li, Y. X., Yao, X. F., & Zhou, J. F. (2016). Multi-objective Optimization of Cloud Manufacturing Service Composition with Cloud-Entropy Enhanced Genetic Algorithm. *Journal of Mechanical Engineering*, *62*(10), 577–590.

Medhat, T., Ashraf El-Sisi., Arabi, K., & Fawzy, T. (2015). Cloud Task Scheduling Based on Ant Colony Optimization. *The International Arab Journal of Information Technology*, *12*(2), 129–137.

Toly, Chen., & Yu-Cheng Wang. (2016). Estimating Simulation Workload in Cloud Manufacturing using a Classifying Artificial Neural Network Ensemble Approach. *Robotics and Computer-integrated Manufacturing*, *38*(2), 42–51.

Wang, C., & Chen, K. (2013). Research on the Task Scheduling Algorithm Optimization based on Hybrid PSO and ACO in Cloud Computing. *Computer Modelling and New Technologies*, *17*(5A), 12–16.

Xianmin, W., & Hong, L. (2015). A Cloud Manufacturing Resource Allocation Model Based on Ant Colony Optimization Algorithm. *International Journal of Grid and Distributed Computing*, *8*(1), 55–66. doi:10.14257/ijgdc.2015.8.1.06

Xiao, Y. Y., Li, B. H., Zhuang, C. H., & Lin, T. Y. (2015). Distributed Supply Scheduling Oriented to Multi-Variety Customization. *Jisuanji Jicheng Zhizao Xitong*, *21*(10), 800–812.

Xu, X. (2012). From Cloud Computing to Cloud Manufacturing. *Robotics and Computer-integrated Manufacturing*, *28*(1), 75–86. doi:10.1016/j.rcim.2011.07.002

Yi-Tung, K., & Erwie, Z. (2008). A Hybrid Genetic Algorithm and Particle Swarm Optimization for Multimodal Functions. *Applied Soft Computing*, *8*(1), 849–857.

Zhigang, L., Weitian, Lin., Yejun, G., & Bin, J. (2014). A Discrete Particle Swarm Optimization Algorithm for Job-Shop Scheduling Problem to Maximizing Production. *International Journal of Innovative Computing, Information, & Control*, *10*(2), 729–740.

KEY TERMS AND DEFINITIONS

Advanced Manufacturing Technologies: This is the incorporation of new technologies, processes, management policies, and manufacturing methods to improve and optimize the productivity in business.

Artificial Intelligence: This is the process of simulating human intelligence in machines. It includes the different skills of humans like problem solving, reasoning, knowledge gaining, learning, planning, manipulating, and perception.

Cloud Computing: This is an approach to provide the users a lot of computing service and resources on demand from reconfigurable communication lines which is leased based on usage with minimal provider interaction.

Cloud Manufacturing: This is a paradigm shift from the traditional production-oriented manufacturing process to new service oriented manufacturing. In this process, manufacturing is provided as services to the users.

Cyber Physical Systems: This is an integration of several computational and physical capabilities which are monitored through software algorithms.

Data Analytics: This is the process of analyzing vast amount of data and deriving conclusions based on the results of analysis.

Grey Wolf Optimization (GWO): An evolutionary search procedure based on the chasing principle of grey wolves towards its prey. This is based on the nature evolved computing and it relates each individual based on position update.

Industry 4.0: Also termed as fourth industrial revolution. Industry 4.0 is a convergence of information technology (IT), operational technology (OT), backbones (network and their infrastructure), and technologies like cyber physical systems, IoT, cloud computing, data analytics with other accelerators like artificial intelligence, additive manufacturing, natural language processing, augmented reality, and cognitive computing.

IoT: Internet of things. This is the network of physical objects which are interconnected through network and helps in exchange of information through sensors, actuators, software technologies, etc.

QoS: Quality of service, which is the process of provisioning resources to applications in such a way that it guarantees service level agreements to promote efficiency, performance, reliability, and availability.

Scheduling: This is the process of planning, distributing, allocating, and mapping several computing resources to optimize the overall efficiency.

Smart Factories: Also represented as Industry 4.0. It is described as the usage of cloud computing, internet of things (IoT), cyber physical systems, and other manufacturing technologies to provide digital automation in factories.

SMEs: Small and medium scale enterprises, is an independent entity which has less than 50 workers. Micro-scale industries are incorporated in Indian sectors and mentioned as micro, small, and medium enterprises (MSME). It plays a vital role in the development of any nations.

Chapter 9
High Performance Computing, Big Data, and Cloud Computing:
The Perfect De Facto Trio or Converging Technological Mantras?

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ABSTRACT

If the fourth industrial revolution should be the revolution of values, where people, more than ever, are at the center of everything, it may be the technology that gives us the ability to place ourselves in that privileged position. However, there is consensus that the fourth industrial revolution is not defined by a set of emerging technologies in themselves, but by the transition to new systems that are built on the infrastructure of the digital revolution that we have already lived. The speed of the advances experienced in the last decade, along with the scope and impact of these in society, have allowed us to understand that we have reached a new technological revolution. The convergence, that is the real revolution, not only of digital technologies but also physical and biological will allow humanity to face the great challenges that have been marked for decades or centuries.

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INTRODUCTION

For quite some time High Performance Computing (HPC) (Hager, 2011) has contributed to scientific innovation, industrial competitiveness, and raising living standards. The enormous growth in scientific, social and economic data is leading to great demand for computing resources and an increase in demand for complex simulations and analysis to which the vast technological ecosystem known as Big Data (BD) (Jin, 2015) is trying to respond. Cloud Computing (CC) (Mell 2011) provides the ability to access these extremely large volumes of data, some of which are collected almost in real time, and allows us to enjoy virtually unlimited computing power without having to support the infrastructures, software or services needed.

The CC and BD are, from the outset, *de facto* partners and with the advent of Hadoop, all the advantages of distributed resources can be obtained from a set of physical or virtual machines.

Although in its beginnings the relationship between the CC and HPC was not clear, precisely because one of the aspirations of the Cloud paradigm is to offer infrastructure services, the Cloud could be understood as an alternative to large computing resources and a way to avoid the necessity of acquiring Supercomputers. However, it was not long before HPC infrastructure and service provision were offered through private and public clouds.

HPC and BD could be seen as a marriage of convenience in an attempt to shift the advantages of distributed systems to clustering infrastructures that support HPC. This approach leads us to the obvious association of Big & Quick Data, or perhaps Big Compute, in an attempt to bring the processing speed of supercomputers to big data projects.

It seems appropriate to focus on the possibilities that can be obtained from the expression HPC + BD + CC being the outcome data capture, simulation and the visualization of results, the best possible trio. Perhaps this can be seen as an example of the convergence of a broad set of technological mantras (Open Data, IoT, M2M or Free Software), to process large volumes of a wide variety of data at high speed (machine learning, social technology, business intelligence, sensors or mobile apps).

Those mantras are offering many new ways to reach and capture massive volumes of data that were not even imagined before, making possible to connect distant elements between them and creating metadata from which is possible to extrapolate new knowledge.

Cyber-physical systems are facilitating automation through the IoT and cloud computing, but it is clear that we must have real infrastructures allowing us to offer all types of existing clouds from a technological point of view. The data processing centers play a fundamental role to support the IoT and the virtuality of the hardware equipment that really supports all the contents that big data techniques allow to analyze. Increasingly they require the HPC to process, store and access the large volumes of information that we are generating to convert them into the desired knowledge.

Once the concepts and the advantages of each singular and combined paradigm have been clearly defined, the description of case studies can illustrate the multiplier effect produced by the convergence of these different technologies in order to understand that HPC, BD and CC, separately or together, to address the opportunities and challenges of the 21st century.

Klaus Schwab, author of the book "*The Fourth Industrial Revolution*" predicted that we are on the border of a technological revolution that will fundamentally modify the way we live, work and relate. In its scale, scope and complexity, the transformation will be different from anything that the human race has experienced before (Schwab, 2016). That technological transformation is being frenetic in the last decade driving the Fourth Industrial Revolution (4IR). This chapter will focus on three very specific technological paradigms (HPC, BD, CC) and, maybe the most important, they have arisen independently and at different times, but they are converging naturally to respond to the needs of resources and increasingly decisive services to achieve the 4IR. Although the concepts and principles of supercomputing, data mining and computerized networking services have existed for several decades, it has not been until a few years ago that independently the three technological proposals have not been firmly established.

Perhaps the relationship between BD and CC is more evident and immediate since among the multiple general services that CC offers (software, applications and infrastructures), BD can be considered one of them. However, HPC is already a third agent that could be seen both as a service offered and as the necessary infrastructure to offer certain services. This chapter aims to analyze the interrelationships, dependencies and technical limitations of this trio of technological proposals whose convergence is helping to consolidate the 4IR.

This chapter does not pretend to describe technical details of the mentioned technologies in order not to blur the objective of the book, but rather to help to understand certain concepts and to generate reflections on the multiple facets of the digital revolution in which we are immersed. The rest of the chapter is organized as follows. First, a brief background to understand the scope of the technologies that are collaborating to reach the challenges that humanity has marked, differentiating what people talk about what they really use. Then, in the main section of the chapter, the details of the technological convergence of three apparently different information ecosystems but that are very interrelated, are described. Finally, future research and conclusions are discussed.

BACKGROUND

The Millennium Project (Millennium, 2018) manages a coherent and cumulative process that collects and assesses judgments from over 3,500 people (futurists, scholars, decisionmakers, and business planners) from over 50 countries since the beginning of the project selected by its 63 nodes around the world. Its mission is to improve thinking about the future and make that thinking available through a variety of media for feedback to accumulate wisdom about the future for better decisions today.

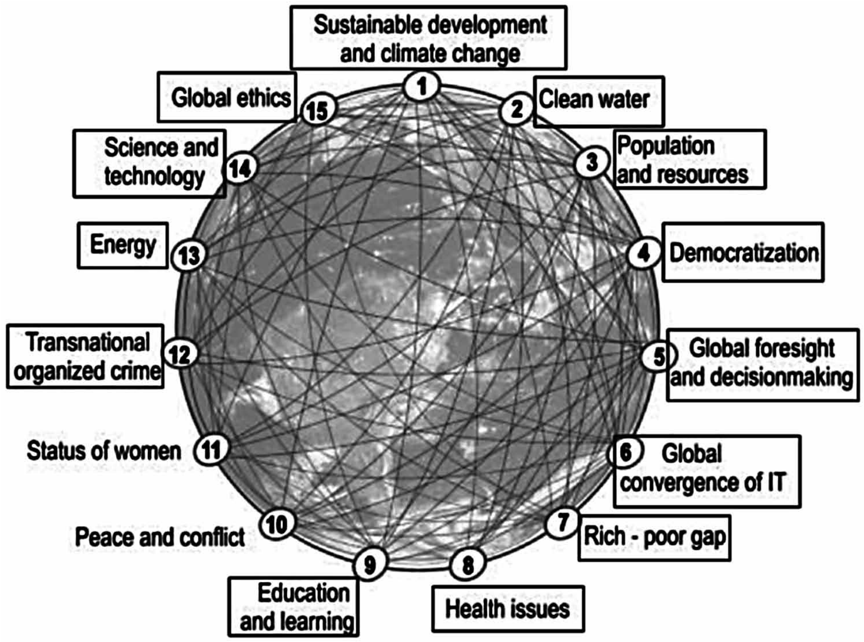
This project identified the 15 Global Challenges that provide a framework to assess the global and local prospects for humanity by 2020 and updated each year, since 1996. The Figure 1 shows the 15 Global Changes and we have framed in red the challenges dependent on (13 of 15) the technological revolution we are experiencing.

The ScienceNews, Magazine of the Society for Science & the Public, proposes the Top 10 Stories of 2017 (ScienceNews, 2018) that range from *Gene editing in human embryos* to *Quantum communication, challenges,* all achieved last year, most of them related to the processing or transfer of information and/or data, in many cases using HPC techniques, BD or CC.

Also, the MIT (Massachusetts Institute of Technology, 2018) has already published 10 Breakthrough Technologies 2018, these advances will change our world the coming years and among them stand out 3-D metal printing, Sensing City, AI for Everybody, Perfect Online Privacy, related to the object of this chapter.

Due to space limitations, it is not the objective of this chapter to describe the technological paradigms HPC, BD and CC (some of them without paradigm) but rather to highlight their relationship with the

Figure 1. Global challenges related to the digital revolution
Source: The Millenium Project (2017)

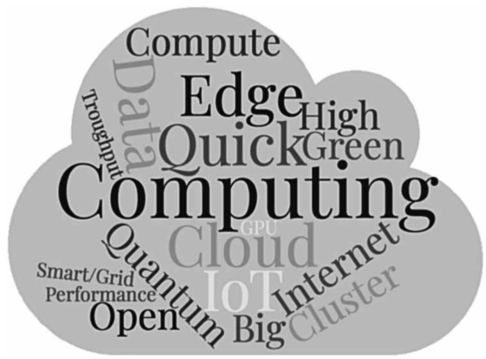


long list of technologies that we have called sociotechnological mantras. This list has been represented in the tag cloud of Figure 2 written in lower case letters, not to punish them, but to emphasize that they are already so widely accepted and used socially that they have quickly become common names and words.

Behind these mantras are the technologies that truly support them and which we have represented in capital letters in the tag cloud of Figure 3 trying to show a perspective of the computational world. These

Figure 2. Sociotechnological mantras of which everyone speaks
Source: COMPUTAEX Foundation

Figure 3. Vision of the computational world
Source: COMPUTAEX Foundation



technologies, with an entity to be paradigm or not, allow technological mantras to become real mass services available to billions of users who must be provided with their longings for connectivity, security, virtuality, availability, speed and ubiquity to communicate with anyone, at any time from anywhere. These premises have been taken not only to leisure and personal life, but also to the professional field in any of the productive sectors and this is what is allowing us to digitize any of our daily activities in this fourth industrial revolution that we also know as society of the information and knowledge. Society formed by citizens who demand Efficiency, Sustainability, Optimum resource management, Services and new opportunities and, in short, Quality of life.

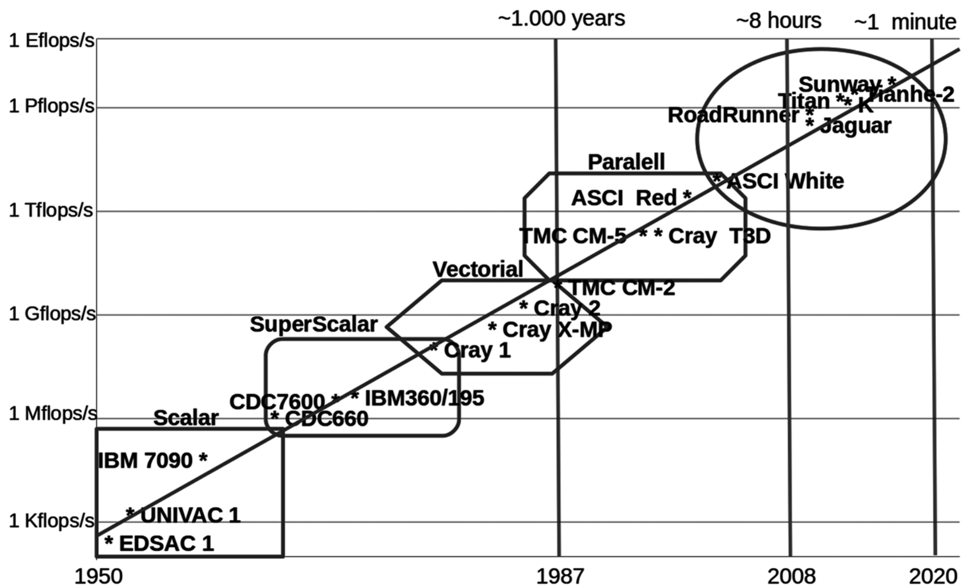
Precisely, a very human characteristic is already a fundamental requirement in the field of technology so that the current technological framework guarantees its services. We refer to the resilience, the ability to return to an original form after having been squeezed, stretched, etc. Also, the ability to recover quickly from illness, misfortune, or troubles. It's what Cary Grant says to Ingrid Bergman in Chained "Dry your tears, baby, and put your foot down". This transferred to the data centers, communications networks and computer applications is, perhaps, better understood with the multiple meanings that the WordReference English Thesaurus provides: elasticity, recoil, adaptability, mutability, buoyancy, elasticity, plasticity or tenacity.

Supercomputers solve major challenges in science, engineering and analytics. Big Data refers to those pieces of knowledge, which are not easy to capture, manage and analyze with traditional tools due to limitations; and Cloud is a model for accessing to a shared pool of computing resources that can be rapidly provisioned. The fusion of supercomputing, data analytics and generalized access to computing resources opens the door to new scientific, technical and business discoveries.

Figure 4 reflects the evolution of how we can face greater challenges and more complex problems. What seemed, not so long, hard and excessively long-lived problems can now be solved in shorter time periods, thanks to the exponential evolution of supercomputing. For instance, the same problem that in 1987 could require a millennium of calculations in the most powerful supercomputer then, can be solved with the current supercomputers in a few minutes. The Top500 list (https://www.top500.org/) maintains the list of the 500 most powerful supercomputers in the world and among them stand out Sunway, Tianhe-2A or Titan.

If the computing power is related to the enormous possibilities of connectivity available at the moment and, with the analytical capacity provided by current applications, the fusion or convergence of HPC +

Figure 4. Evolution of supercomputing
Source: COMPUTAEX Foundation



BD + CC technologies that can be analyzed in this paper may occur. There are already many important projects in these fields, among which we can highlight EGI (European Grid Infrastructure, http://www.egi.eu); the Human Genome Project (https://www.genome.gov); the detection of gravitational waves or the Human Brain Project (https://www.humanbrainproject.eu/)

BD is a voluminous amount of structured, semi-structured and unstructured data which is growing exponentially from various sources around us by internet activity, sensors, nature and society. In recent years, BD has rapidly developed (Hadoop, Spark, Hive, MapReduce, YARN, etc.) into a hot topic that attracts extensive attention from academia, industry and governments. That is why a growing number of BD projects are emerging that we can devote in three types: real-time or “near real-time” data processing; Stored data processing; and different approaches, technical architectures, tools and data. In addition, it is necessary to determine the components of the BD projects:

- **Big Data Technologies:** Hardware and Software.
- Specific methodology.
- Legal aspects related to the manipulation of data and intended uses.
- **Social Component:** Circulation and use of personal data.

Previous components show legal, social, methodological and technological facets that all BD projects have and that must be faced to solve them from the specific objectives of each project.

Since several years before the NIST in 2011 defined what CC is, until now, much has been written about it. After a decade we can all understand that CC *is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.* In fact, and despite appearances, CC is not a new technology, but the evolution of a set of existing technologies, among which we could highlight "virtualization" or "Grid computing", which have converged at a point where it is posed a change of paradigm. A grid computing ecosystem is a processor architecture that combines computer resources from various domains to reach a main objective. In grid computing, the computers on the network can work on a task together, thus functioning as a supercomputer. CC was proposed as an evolving paradigm, with a set of essential characteristics (On-demand self-service, Broad network access, Resource pooling, Rapid elasticity and Measured service) to offer specific service models (SaaS, PaaS and IaaS) on well-defined deployment of cloud models (private, community, public and hybrid). OpenStack (https://www.openstack.org), OpenNebula (https://opennebula.org) or Apache CloudStack (https://cloudstack.apache.org/) are some of the most successful cloud computing projects.

The "cloud" is nothing more than an infrastructure in which resources are virtualized to adapt to the needs of applications dynamically. This allows a better use of the resources that will always be adjusted to the demand and also proposes a new business model based on "pay-as-you-go". Another great advantage is to be able to access the service from anywhere and at any time can have SLA (Service Level Agreement) previously agreed between the client and the provider of cloud services.

All together is what brings to CC the attractiveness that the industry and the productive sector has found in this model that in the specific case of this chapter can be interfaced between HPC and BD.

Among the set of technological proposals that are collaborating especially with the 4IR highlights IoT for the spectacular growth of devices connected to the Internet. Nowadays a massive volume of information is being generated and must be stored and processed in data processing centers that will reliably require BD techniques and, most likely, HPC. Any object could become intelligent while it is equipped with sensors, connected to fixed or wireless networks and equipped with devices that allow it to send and receive information. It can be assessed that this is already being assumed if remembered that there are more than 18,000,000,000 connected IoT devices. And what is more important, the forecast is that in 2020 there will be about 30,000,000,000 devices (5 IoT devices/person). IoT provides Internet connection to anything at any time and place, moreover offers access to an "smart" world that will generates enormous amounts of information from the professional and personal spheres.

For a couple of years, two hot topics have appeared around IIoT (Industrial Internet of Things) that are bringing a new vision to data computing. It's about Fog computing and Edge computing. Both technologies pursue the same, but applying very different methods for the collection, processing and sending of data. In Fog Computing the data is collected, processed and stored in the network through an IoT gateway or "fog node". This information is transmitted to this gateway from several sources in the network where it is processed and the higher value data is transmitted back to those devices that can take advantage of it. Edge Computing goes a step further in localized processing and focuses on data sources or sensors. Instead of performing most of the processing on a centralized server, each device on the network plays its own role in the processing of information.

The Open Data (Brunswicker, 2015) ecosystem has also emerged with great relevance, taking advantage of the existence of the large volumes of data that are being produced with their progressive digitization. In this ecosystem of data, are the governments who provide their public data to companies, citizens and governments themselves.

Digital technologies have open collaboration ecosystems and many countries are promoting laws to open their data in an attempt to provide all the public information they manage to the rest of society. In addition, companies provide the data they consider open to governments, citizens and the companies themselves. The ecosystem is completed with the data provided by citizens that are supplied to companies, governments and the rest of society. This new ecosystem is generating new business models for companies that find in open data an opportunity to provide services that did not exist before. It is another demonstration of how digitalization generates opportunities and professions that did not exist despite the fact that there are opposing opinions because of the effect that robotization can mean for the traditional productive system.

Precisely the robotizacion or the automation introduces a serie of risks to which the 4IR has to face, as is the impact that is having in the employment. The studies carried out (Benedikt Frey, 2016) show that the probability of computerization decreases with the degree of responsibility, the educational level, the predisposition to training retraining and the adaptation to new forms of work, such as teleworking. The data shows that approximately 1 in every 3 jobs is at high risk of digitization, even is said that everything that a worker is able to write down on a paper on their usual activity is susceptible to be digitized, although it is true that many professions are being generated that did not exist a decade ago (data centiner, influencer, app developer, youtuber, data scientist, etc.). In the field of technology that is the subject of this chapter, what is truly remarkable and very worrying is the lack of trained professionals or those with skills in HPC, BD and CC. It is estimated that, even in developed countries, more than a third of its young population is not prepared to face the challenges posed by digital transformation. And what is worse, there is a really worrying lack of STEM (science, technology, engineering and mathematics) vocations (especially female ones) that need to be resolved in order to properly handle the disruptive change that is taking place in the short and medium term, no matter how long-term benefits are perceived. There is not a problem of employment, in fact it is a problem of training in specialized profiles, as, for example, the lack of more than one million experts in cybersecurity.

MAIN FOCUS OF THE CHAPTER

This section aims to focus on the problem of the integration of the three paradigms, a really complex task because they are very different technological proposals, arising at different times and with different objectives. We start from the idea that complete integration is not possible without redefining a new paradigm that reflects the convergence of the three ecosystems. HPC is the computing infrastructure; CC the communications technology to access the computing infrastructure; and BD the services to access large volumes of data using HPC infrastructures through the cloud. It could be able to insert BD services on CC infrastructures in order to access large volumes of data using HPC infrastructures.

To simplify the problem, the technologies are matched, comparing them and analyzing their integration possibilities two by two with supercomputing as a necessary requirement. Without going into technical depth, advantages and limitations for integration are exposed, ending this section with the exposition of the *de facto* trio (which is not standard).

There are several sectors of industry (Earth sciences, Life sciences, Engineering, Financial services, Computer sciences, etc) in which the following reasoning can be applied at present and in which there are known cases of use such as the following: weather simulation, Geographic Information Systems, Flow dynamics, 3D rendering, Engineering simulations, Genomics, Computational Chemistry, Capital management, etc.

HPC + BD

In the time that was needed to evaluate a single hypothesis, now thousands are evaluated, which considerably improves our speed and guarantee of success.

An estimate is that 80% of all data today is unstructured; unstructured data is growing 15 times faster than structured data and the total volume of data is expected to grow to 163 zettabytes (1 ZB=10^{21} bytes) by 2025 (David Reinsel, 2017), considering that it is estimated that humanity has generated in its entire history 20 ZB.

The challenge resides in unstructured data (multiple forms and from a wide variety of sources) that Big Data really is: information gathering, sensors, logs, emails, social media, pictures and videos, medical images, transaction records, GPS signals, etc.

Analytical methods of BD can be divided, in general, into two categories. On the one hand, those who focus on the search (the needle in the haystack) and those focused on the discovery (needle between needles). The main difference between both methods is the tool that is used to find what is sought. While to look for a needle in a haystack the best tool can be a magnet, to locate a specific needle among hundreds of them, the best tool would be a magnifying glass. In the case of BD, the tools are very different depending on the needs and we want to analyze the feasibility of applying HPC as a resource in BD projects.

BD represents the storage of large amounts of data -the technology to capture, manage and process them efficiently in a reasonable amount of time-, and data mining is responsible for identifying the relevant information and extracting it from large amounts of data.

Data Mining discovers patterns and trends structuring information with algorithmic procedures to evaluate data applied to blocks with a certain size and complexity. Its objective is to extract information from any data set using software tools and transform them for better understanding later. Although data mining uses statistics for some of its functions, it is not an analytical tool. It is more: it feeds on artificial intelligence, machine learning, statistics, graphic computing, mass processing and using database systems as raw material for its processes. If BD is the technology, data mining is the tool or set of techniques to manage the asset that is the data through classification and analytical tasks (correlation, progression, prediction, etc.).

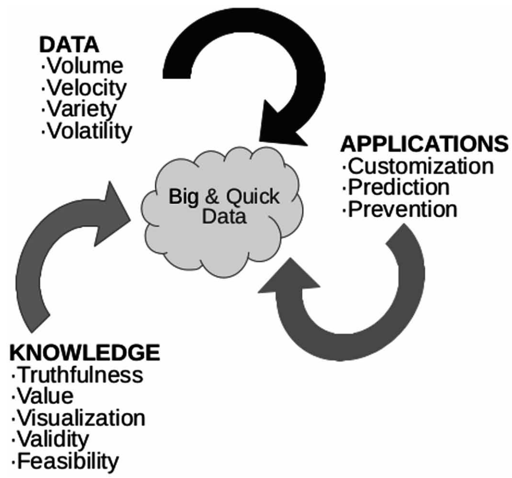
Figure 5 shows the main characteristics of BD in order to obtain the best possible knowledge of the available data processed with the many existing applications. We have added the adjective quick a big data because in the context of HPC, speed is precisely one of the main characteristics that can be contributed to the massive processing of data from multiple sources and with different formats.

Big Data has been synonymous with HPC for sometimes but the differences are very important. Today, the majority of HPC Big Data workloads will be based on traditional simulation and modeling techniques. There are also a multitude of tools to follow the stages of BD processing flow as seen in the Big Data Landscape 2017 (here: http://mattturck.com/wp-content/uploads/2017/05/Matt-Turck-FirstMark-2017-Big-Data-Landscape.png).

HPC satisfies the three phases of typical workflow:

- Data capture and filtering.
- Analytics.
- Results visualization.

Figure 5. Big and Quick Data (main characteristics)
Source: COMPUTAEX Foundation



To the three phases, the speed of computation is very important and that is precisely what we want to contribute to BD from HPC.

In order to understand the full potential of BD, we have to pair it with HPC (Big&Quick data or big compute). High Performance Data Analytics (HPDA) confluence HPC and Big Data Analytics deployed onto HPC-style configurations. Today and tomorrow deploy new forms of HPC configurations.

To extract insights from unstructured data will use the same HPC infrastructures: clustered compute and storage servers interconnected using very fast and efficient networking.

High speed and low latency interconnect network is an important feature to keep in mind in the convergence of HPC and BD technologies and in this case, Infiniband interconnect technology in supercomputing (112G-IB-FDR Infiniband over 100 times faster than even 10Gbps Ethernet), but RDMA for Apache Hadoop it is also an excellent high speed, low latency interconnect option for big data platforms.

The convergence of HPDA, including the use of Hadoop with HPC infrastructure is underway and there are already software (i.e, Moab and Intel HPC Distribution for Apache Hadoop), a milestone in the big data ecosystem that allows Hadoop workloads to run on HPC systems. Some organizations have the ability to expand beyond a siloed approach and leverage both their HPC and big data investments together, for example, Lustre and Hadoop combine to bring Big Data analytics to HPC configurations.

Hadoop is the most famous open source application framework that reduces the processing time for the growing volumes of data. Implements a high-performance, scalable, and agile information foundation to support near real-time analytics and HPDA capabilities. Really is a cost-effective data factory for collecting, managing and filtering increasing volumes of data for use by enterprise applications. Hadoop is also being used for data archiving and distributed architecture where both data and processing are distributed across multiple servers. It is mainly used for analytics applications that process and analyze large volumes of data, especially unstructured data such as logs, social media data, email, network, image, video, and sensor data. Big data for definition.

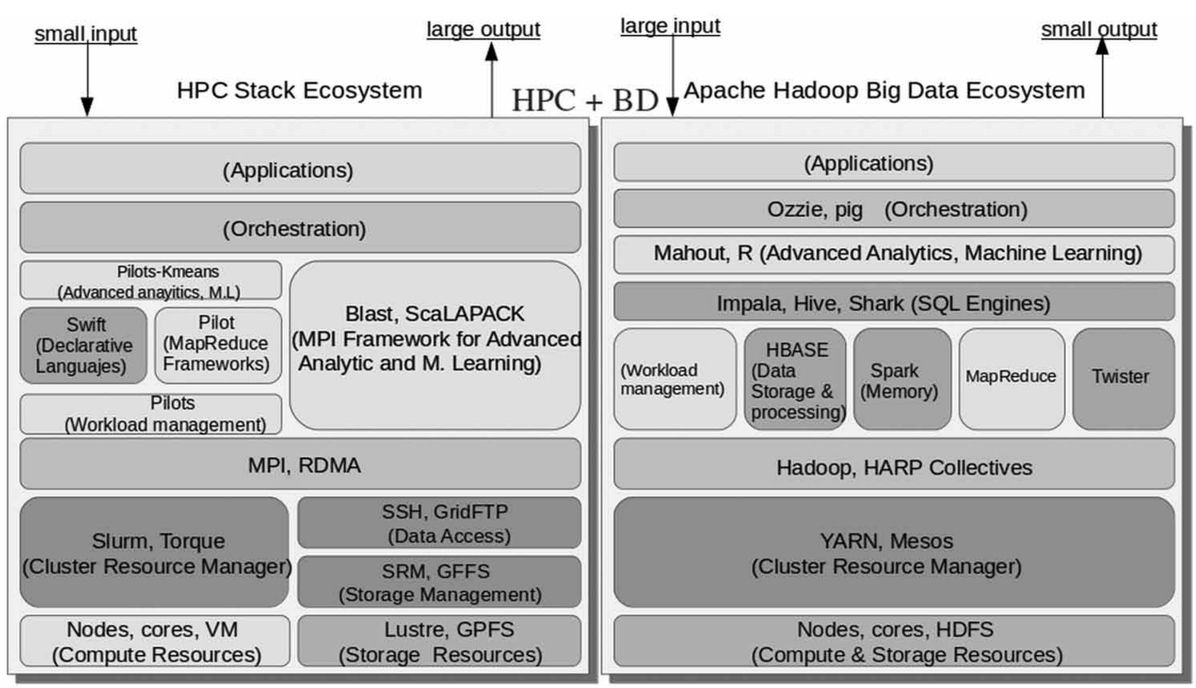
On the other hand, Lustre parallel File System is an open-source, massively parallel file system designed for high-performance and large-scale data used in most world's fastest supercomputers that scales to tens of thousands of clients and tens or even hundreds of petabytes of storage, and this is the main HPC feature that needs to be solved to achieve integration with BD and there are already attempts for the Integration of Hadoop with Lustre parallel File System. To understand the complexity of this integration it is important to know some details and that is why Figure 6 presents the protocols stacks and applications of HPC and Apache Hadoop Big Data Ecosystem (Jha, 2014).

But, in addition, the data centers, especially those related to HPC, must guarantee the following fundamental and robust services which can be viewed as a whole as the resilience discussed in the previous section:

- Reliability, concerned with the ability of the data center or components to perform its required functions under stated conditions for a specified time.
- High availability, of resources that users should be able to have always at their disposal.
- Serviceability, putting resources and computer services within the reach of users.
- Security, of the information generated, processed, stored and transferred.
- Governance processes, that allow the administration of resources and provision of services, and
- End-to-end support.

Keep in mind that HPDA is the architecture to provide high performance data analytics services and as a different architecture of HPC, it also supports applications different from those of HPC. HPC supports: scalable computing, high bandwidth, low latency, minimizes movement of data load in memory and moves data for load or check point. However, HPDA adapts better to distributed computing, divide-and-win, maximizes data movement and low cost processor-memory- interconnection and memory.

Figure 6. HPC pairing with BD
Source: Adapted from Shantenu Jha et al. (2014)



Although the fusion between HPC and BD is still far away, the convergence between both worlds is feasible although there are many limitations to overcome.

HPC was built for scientific applications (small input, large output) while BD was built to process large volumes of data (large input, small output). While the most utilized applications in HPC such as MPI, OpenMP and CUDA were developed by scientists for scientific purposes in HPC community, Hadoop (developed by Yahoo) was not designed by HPC community and MapReduce was developed by Google. The most popular tools of BD were not created to solve problems in fundamental science; they were created to provide a service for the masses.

Hadoop is implemented in Java that does not seem the best platform to interact with a supercomputer, not supports multi-tenancy and the HDFS filesystem is slower than GPFS that is part of HPC.

To reach convergence, it would be necessary the increasing computational requirements. Several arguments serve to justify the use of other parallel processing paradigms and, above all, argue for the use of the Cloud as a service deployment.

HPC and CC

Hadoop is a framework (set of methodologies and tools associated with a programming language) software designed for massive parallel processing (running on a massive parallel platform). Perhaps has passed the time when parallel computing was only within the reach of a small community of specialized scientists, developers and experts. In any case, the infrastructures must be designed, programmed and managed in specialized centres.

The Cloud allows us the ability to access extremely large amounts of data — some of which is being collected to in near real-time — and to tap into virtually unlimited computing power.

IaaS provides Big Data On-demand self-service through broad network to access resource pooling.

The Cloud computing principle of elasticity guarantees the scalability of machines and resources. This scalability it allows that virtual machines can be installed on systems designed and developed for parallel processing. It is already well-known that Big Data technology is immersed in Cloud computing and a good example of this is Cassandra, a standard database specially designed to be integrated into cloud managed clusters.

We can not forget that behind the undefined cloud concept there are very specific infrastructures that provide the resources shared by thousands of users. For this, the data centers play a very important role because provide the following advantages: high availability, high capacity (of storage, processing and access to information), security and reliability of information and energy efficiency.

It is very important to understand that the capacity to produce and store data has grown exponentially in recent years, but the ability to process and use that data has not kept pace, in part because of the lack of knowledge or the lack of support technology (BD or data mining), because of the access barrier posed by access costs (HPC) or because more accessible access roads (CC) are not yet mature. However, there are already commercial proposals for HPC services in the cloud designed so that scientists, engineers, researchers, innovators or financiers can face complex problems that require great computing capacity by contracting services in the cloud.

Pay-per-use systems allow the community to choose individual services where you only pay for what is needed during the time needed, without long-term contracts or licenses for use. This provides significant degrees of freedom and savings in fixed costs and changes the existing model so far in which only HPC could be used by acquiring a supercomputer or accessing public or private supercomputing centers.

In fact, we are already facing a new business model that allows access to HPC cloud services at scalable costs based on specific needs, timeframe and budget availability.

To the classic services in HPC of computation and storage can be incorporated others more customized as databases, orchestration, visualization, networks or provision of servers on demand depending on the needs of the applications and the problems to solve.

HPC, BD, and CC

At this moment we can ask ourselves the following question: is a perfect trio HPC + BD + CC?

It may not be a simple question to answer because it would be necessary to go into technical details of remarkable complexity. However, it is possible to simplify the arguments that allow us to answer the question.

It is possible to successfully bring the three worlds (paradigms) together:

- Data-intensive, that, through the BD tools, allows to capture, process, analyze, store and process information coming from different sources with different formats.
- Quick Computing, possible thanks to the computing power that HPC provides with infrastructures that were initially thought for other types of more scientific applications and that are now more typical of the enormous amounts of information generated and consumed by citizens and their organizations.
- BD as a Service of a cloud that allows to understand that BD is an application that can be used as a remote service and that HPC is an infrastructure that can be contracted to the taste of users who do not have supercomputing resources.

The challenge is, to merge the three worlds and try to produce environments that have:

- the high performance of HPC, that can be obtained through the cloud as if a supercomputer were available to obtain high performance BD services.
- the usability and flexibility of Big Data landscape that could be within the reach of supercomputing environments that currently do not have the wide range of tools and applications BD.
- and the commodities of Cloud computing that allows contracting HPC infrastructures or BD applications as a service.

Although there are not too many commercial or experimental proposal that resolves the complete merger of this technological trio, we can speak of a *de facto* trio that is progressively resurrecting the convergence problems of HPC, BD and CC. Figure 7 presents the most frequent activities (capture, simulation, analytics, visualization) involved in big data projects, where supercomputing and cloud computing can play an important role. Users expect to have the necessary resources or services to carry out their projects.

Perhaps the degree of convergence complexity of the three worlds is more evident by looking at Figure 8, related to the protocol stack and the levels at which we can place the technologies involved. Although the three proposals may have their base in the deepest layer, we preferred to represent only in the physical layer the supercomputing by the dependence that HPC has on the hardware of computation. However, we can see BD one level above, trying to abstract a degree of complexity if we consider

Figure 7. Convergence HPC + BD + CC for quality of life
Source: COMPUTAEX Foundation

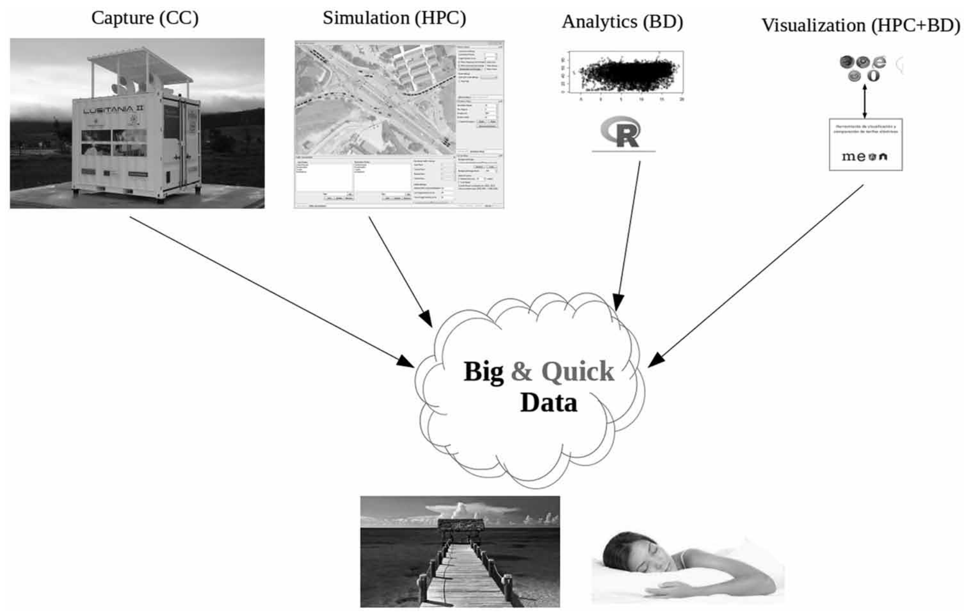
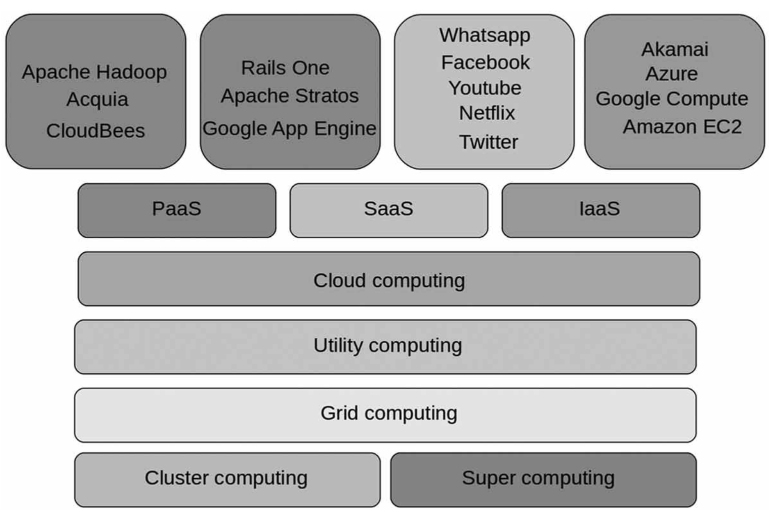


Figure 8. Relationship of sociotechnological mantras with the computational ecosystems
Source: COMPUTAEX Foundation



it independent of the structure of computers and communications. Following the same simplification we have considered that CC would be a level above to imply that the cloud is closest to the application software layer where users are demanding specific services.

Understanding the technical complexities associated with the integration of technologies that are so differentiated is already difficult. The challenge is to achieve real convergence that can end in the merging of the three worlds.

In the previous section the disadvantages have been exposed to be able to support BD in HPC. In fact, HPC is a perfect example of a big data platform that runs better internally in a data center than through the cloud, although commercial solutions already exist and many supercomputing centers offer services that may be of interest to evaluate. In the BD world, not every company needs HPC, but nearly all who work with BD have adopted Hadoop-style analytics computing. When a company is going to run a job in a supercomputer only once or twice every two weeks, they should go to the cloud to host their HPC. But if they are using HPC resources and running jobs multiple times per day, they are wasting money running in the cloud and should highly consider running their own in-house operation for supercomputing. But just use Hadoop for analytics it is cheaper, easier for the staff, and might even be able to run in the cloud.

FUTURE RESEARCH DIRECTIONS

BD is a powerful tool to boost the 4IR that generates and needs data that comes from IoT and Open Data and needs the open collaboration. But it is still necessary to equip open collaboration researchers with new datasets in different topics, as well as novel analytical techniques on high performance infrastructures (HPC) and new computational models (CC). BD appears widely in science, business, finance, governments, in private life, etc. There are already many BD applications and services, e.g. real-time systems monitoring, big healthcare data analytics, financial market activity monitoring. Therefore, appropriate systems and algorithms are required to deal efficiently with BD.

But BD, like everything on the Internet, also has improper uses that can be exploited by those who want to take advantage of its potential. And they have already emerged generating great alarm as lived by the social network Facebook that after a data leak of 50,000,000 users lost 14% ($ 58,000,000,000) of its value on the stock market in less than a week. The problem in this case has been in the management of data that has been collected, analyzed, sold and used inappropriately. BD with HPC tools allows to process large volumes of information in a very short time. These duly correlated data can be used to influence elections, shake demonstrations, generate opinion streams and produce fake news in an interested way. This is just one of the most striking cases but many are already in just five years and many companies, so we can say that poor data management is not a failure or an error, but one of the characteristics of the service that It has to be one of the fields of open research to improve the viability of the paradigm in the coming years. This problem is becoming a real plague for our society because propaganda nanotargeting can make a technological ecosystem die successfully.

In the field of the 4IR it is very important to highlight also the dangerous concentration of data in international monopolies that, without being a field of technological research, if it is sociological, economic, legal and political. For example, Microsoft owns LinkedIn; Facebook of Instagram and WhatsApp; Amazon of AWS; Yahoo has developed Hadoop; Alibaba of more than 18 affiliated companies that dominate Asia and already extends to the rest of the world; and Google developed MapReduce and is able to find 10,080,000,000 articles that contain the word "*google*" in half a second.

For last years CC has been widely used by the scientific community, governments and industry as users can benefit from the best computing infrastructures at low costs. CC's adoption by citizens and enterprises is increasing, however there are critical issues which require attention, such as security and trust, to ensure data integrity and confidentiality. Although the true emergence of CC has not been more than 10 years, the problems that from their beginnings were intuited in relation to the security and privacy of the information have not been slow to appear and they do it more often and more seriously. It is not the same to take advantage of the technological paradigm of CC applied to a private cloud, than to do it carelessly in a public cloud. It is not the same to use cloud services in the personal sphere than to do it in the professional, business or governments. The virtuality, ubiquity and mobility provided by CC does not allow us to know where the infrastructures that are being used are really located, which has strong implications that need to be resolved and even more so if CC is used to support BD or HPC.

But, perhaps, the future research opportunities within the domain in this chapter is the proposal of a true paradigm that is capable of bringing together the three ecosystems that have been tried in this chapter. As explained, HPC has more than 60 years of experience and has always evolved hand in hand with researchers, while BD and CC have as many years as we have in the 21st century and their developments are due to the most powerful companies in the sector.

CONCLUSION

In fourth industrial revolution in which we are already immersed no one denies that it is directly linked to digitalization. This implies that it will be necessary to adapt traditional production methods to the new reality. Digitization is already assuming the generation of huge amounts of information that must be stored, processed, analyzed, accessed, protected and distributed. Therefore, new techniques are necessary and others that are not so new must converge to help solve information management. In order not to get lost in a great soup of letters and acronyms that we adopt as changing mantras every few months, we can understand that the three paradigms HPC, BD and CC can collaboratively add their potential to help solve the problem.

Problem that has a great technical complexity that needs to be solved because the challenge is really exciting since practically any human project or activity carries or will be associated with the extraction and processing of information (Big Data+HPC), from different sources or sensors (Internet of Things), equipped with a layer of intelligence (Smart), based on a ubiquitous infrastructure (Cloud Computing) and with open access for all Citizens (Open Data), to develop an intelligent citizen/city/region/country (Smart all) working in network.

Technologies of high complexity that, separately or converging, are consolidating the 4IR that is changing the world and offering opportunities to all those who are willing to adapt to the changes of the digital revolution. It is appropriate to remember that in 1589 the clergyman William Lee invented the first machine for knitting stockings that Queen Elizabeth I of England did not accept to patent because of the impact it would have on employment. Lee took his invention to France where it was patented and the revolution of the textile industry began.

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REFERENCES

Benedikt Frey, C., & Osborne, M. A. (2016). The future of employment: How susceptible are jobs to computerisation? Oxford Martin School, University of Oxford.

Brunswicker, S., Bertino, E., & Matei, S. (2015). Big Data for Open Digital Innovation - A Research Roadmap. *Big Data ResearchVolume*, *2*(2), 53–58. doi:10.1016/j.bdr.2015.01.008

David Reinsel, D., Gantz, J., & Rydning, J. (2017). *Data Age 2025: The evolution of Data to Life-Critical. Seagate*. Retrieved from https://www.seagate.com/files/www-content/our-story/trends/files/Seagate-WP-DataAge2025-March-2017.pdf

Hager, G., & Wellein, G. (2011). *Introduction to High Performance Computing for Scientists and Engineers*. Boca Raton, FL: CRC Press Taylor & Francis Group.

Jha, S., Qiu, J., Luckow, A., Mantha, P., & Fox, G. C. (2014). A Tale of Two Data-Intensive Paradigms: Applications, Abstractions, and Architectures. In *Big Data (BigData Congress), IEEE International Congress on.* (pp. 1-8). IEEE.

Jin, X., Wah, B. W., Cheng, X., & Wang, Y. (2015). Significance and Challenges of Big Data Research. *Big Data Research*, *2*(2), 59–64. doi:10.1016/j.bdr.2015.01.006

Mell, P., & Grance, T. (2011). *The NIST Definition of Cloud Computing*. Retrieved from https://csrc.nist.gov/publications/detail/sp/800-145/final

MIT Technology Review. (2018). Retrieved from https://www.technologyreview.com/lists/technologies/2018/

Schwab, K. (2016). *The Fourth Industrial Revolution*. London: Crown Business.

ScienceNews. (2018). *Magazine of the Society for Science & the Public*. Retrieved from https://www.sciencenews.org/editors-picks/2017-top-10

The Millennium Project. (2018). Retrieved from http://www.millennium-project.org

ADDITIONAL READING

Chen, D., Hu, Y., Cai, C., Zeng, K., & Li, X. (2017). Brain big data processing with massively parallel computing technology: Challenges and opportunities. *Software, Practice & Experience*, *47*(3), 405–420. doi:10.1002pe.2418

Guota, A., & ... . (2013). The Who, What, Why, and How of High Performance Computing in the Cloud. *Proceedings of the 5th IEEE International Conference on Cloud Computing Technology and Science*. (pp. 1-8). IEEE. Bristol, United Kingdom.

Manyika, J., & ... . (2011). *Big Data: The next frontier for innovation, competition, and productivity*. San Francisco, USA: McKinsey & Company.

Prajapati, V. (2013). *Big Data Analytics with R and Hadoop*. Birmingham, UK: Packt Publishing Ltd.

Shi, W., Cao, J., Zhang, Q., Li, Y., & Xu, L. (2016). Edge Computing: Vision and Challenges. *IEEE Internet of Things Journal*, *3*(5), 637–646. doi:10.1109/JIOT.2016.2579198

Sosinsky, B. (2011). *Cloud Computing Bible*. Indianapolis, Indiana, USA: Wiley Publising, Inc.

Sterling, T., Anderson, M., & Brodowicz, M. (2018). *High Performance Computing, Modern Systems and Practices*. Cambridge, MA, USA: Elsevier.

Zhang, Q., Cheng, L., & Boutaba, R. (2010). Cloud computing: State-of-the-art and research challenges. *Journal of Internet Services and Applications*, *1*(1), 7–18. doi:10.100713174-010-0007-6

KEY TERMS AND DEFINITIONS

Big and Quick Data: The big data that we propose to obtain as a result of the pairing of BG with HPC.

Big Data: A voluminous amount of structured, semi-structured, and unstructured data from various sources around us, such us Internet, sensors, nature, and society.

Cloud Computing: A proposal to provide a pool of configurable computing resources through on-demand network access that can be rapidly provisioned and released with minimal management effort or service provider interaction.

Data Mining: Process that tries to discover patterns in large volumes of data sets. It uses the methods of artificial intelligence, machine learning, statistics, and database systems.

High Performance Computing: The use of super computers and parallel processing techniques for solving complex computational problems.

High Performance Data Analysis: HPC and BD convergence.

Internet of Things: The ever-growing network of physical objects that feature internet connectivity and the communication that occurs between these and internet-enabled devices and systems.

Machine Learning: A scientific discipline in the field of artificial intelligence that creates systems that learn automatically. Learning in this context means identifying complex patterns in millions of data.

Open Data: Philosophy and practice that seeks to make certain data freely available to everyone, without restrictions of copyright, patents, or other control mechanisms.

Supercomputing: Processing of massively complex or data problems using the concentrated compute resources of multiple computer systems working in parallel (supercomputer).

Section 2

Need to Innovate to Overcome Social Challenges

Chapter 10
Digital Social Innovation:
Fundamentals and Framework of Action

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ABSTRACT

The fusion of the social economy with the digital economy, together with the essential need for social organizations to innovate in order to face challenges not satisfied by using traditional methods, led to what is known as digital social innovation: the use of digital technologies to allow or help to carry out social innovations. We are facing a developing field of study, in full evolution and with a high and recent level of global activity, which makes it a true global movement. This, together with the fact that DSI practices still lack unanimous and systematized criteria, calls for identifying what DSI is and what should be understood by it. Therefore, this chapter aims to configure and illustrate the conceptual framework of DSI, detail the barriers that are limiting its momentum, and formulate a general scheme of action for good practices in DSI.

INTRODUCTION

In a scenario of global economic and regulatory crisis, institutions and researchers in social sciences increasingly highlight the importance of the emerging social economy, a new axis of the economy that unites public and private sectors to create new relationships and social values (Bryer et al., 2012)[1].

In its midst we are facing an incipient field of study that is the result of the movement that is taking place worldwide and that is evolving at an accelerated and unexpected pace as much due to the number of initiatives—from grassroots community projects to large national companies and global networks that are causing a paradigm shift—as the variety of their approaches: Social Innovation (SI), understood

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synthetically as that which generates new ideas for solving social problems. It is, in short, a sector that is in full expansion around the world (Buckland and Murillo, 2013) for the growing interest it arouses.

The reason for all this can be found in the emergence of new social problems—such as climate change, the scarcity of resources, demographic transformation, massive immigration or high youth unemployment—that coexist with other already chronic ones such as unemployment, social inequalities, an aging population, environmental deterioration and the explosion of certain chronic diseases (Simon et al., 2014), all of them in need of new approaches that make it possible to find solutions that the methods applied in the past have not been able to solve (Murray et al., 2010). On the one hand, and while western governments face these growing social challenges through a wide range of public social services, there is no guarantee that economic growth will allow these public services to continue (Dinant et al., 2017). This is progressively creating budgets that are unaffordable for governments, even more so in undeveloped countries. On the other hand, market solutions are insufficient for solving these growing social needs in today's world.

Faced with this panorama, the world is being forced to find new ways to avoid social exclusion and protect the environment. This is where SI emerges as a new approach that faces this serious deficit through the participation of supporting agents and beneficiaries in the search for new solutions.

This must be so given that there is a growing disconnection between traditional services and new needs. SI is found to be a key vehicle for developing new ways of tackling complex social challenges at local, national and international scales arising from the committed work of individuals and groups in civil society, research groups, academic institutions, companies, governments, NGOs, social movements and the multiple networks created between groups. It is precisely these last groups that have caused a great advance in SI by the appearance of new approaches and ways of managing social changes.

These reasons have instigated a global lift-off of SI in the last decade and, with it, the need for a new paradigm—as in previous technological and social transformations. The nature and global effervescence of this field give rise to a large number of SI definitions, as well as innumerable tools and mechanisms for promoting SI radiating from all types of organizations and governments. In short, we aim to identify a notion of SI which is as widely accepted as possible, as well as the most effective SI mechanisms to find the best types of approaches, and defining and determining the social impact of these innovations and their long-term viability. All this heterogeneity and lack of clarity is reflected in a set of questions that are part of the global debate around SI: What does SI mean? Where are its limits? How is its impact measured? And what are the key success factors of a specific SI initiative?

On this path, SI has found a great ally in ICT (Information and Communication Technologies) with its enormous potential to develop creative and advanced solutions. One example is the digital networks in the service of SI: these allow for the creation of virtual communities as well as new formulas for collaborating, which in turn allow the co-creation of local and global products and solutions that are more economically sustainable and replicable in other contexts. This is what is known as Digital Social Innovation (DSI).

Although in global, national and local environments, ICT has become a powerful tool for social development (Díaz, 2015), DSI goes further by applying a process of appropriation of ICT by social agents, that is to say, they internalize the value of ICT as a reference to enhance social development (Carabaza, 2012).

In short, and already at the beginning of the so-called Fourth Industrial Revolution, dealing with the world of SI is equivalent to including it within the digital economy. We are dealing with the evolution of

SI to Digital Social Innovation (DSI) as an expression of the *bigger mind*: human and machine capacities working together to solve social challenges (Mulgan, 2017).

One of the most dynamic and organized territories in DSI is the European Union (EU). It is not in vain that the number of European DSI organizations has doubled since 2015 (Stokes and Baeck, 2017). The Helsinki Conference (2006) marks one of the international milestones when searching for the impulse of DSI. The motto of the Helsinki Manifesto, *we have to move quickly, before it is too late*, summarized the spirit of the proposed actions: the renewal of the European research system, in order to create a new open innovation environment, focused on the user and on the network, as well as the creation by EU and other countries attending the European Network of Living Labs (2006) or *eLivingLabs*, public-private partnership in which companies, governments, and nations will work together to prototype, validate, and test new services, businesses, markets, and technologies in real contexts, at different scales and in different activities, such as cities, metropolitan areas, rural areas, and virtual networks of collaboration between real and virtual actors. From this last element would arise new services, companies, markets and technologies, and sectors based on new technologies with the aim of creating jobs and new products (Finquelievich, 2007). These proposals allowed the beginning of the consolidation of DSI in Europe and its progressive expansion towards the whole world.

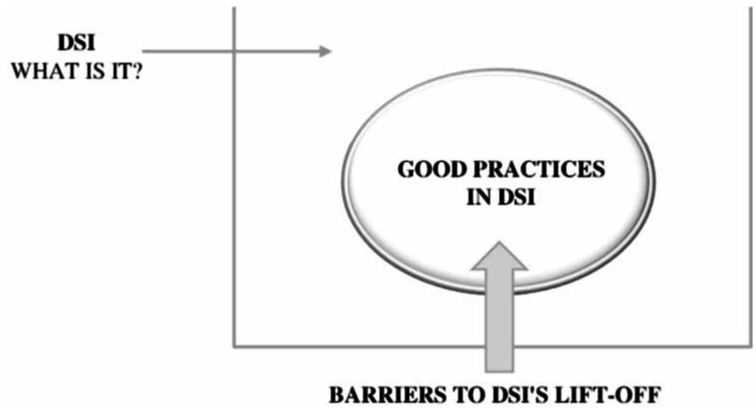
These initial stages are definitively consolidated in the EU with *Europe 2020 Strategy*, the EU's growth and employment agenda in this decade, which identifies innovative, smart, sustainable, and inclusive growth as a way to overcome the structural deficiencies of the EU, improve its competitiveness, and maintain a sustainable social market economy. The Horizon 2020 Program, the research axis of the *Europe 2020 Strategy*, financed the first systematic network analysis of the emerging ecosystem of DSI in Europe: the Nesta project (Nesta, 2018), whose results show that the new scenario has favoured the appearance of a more collaborative economy with new ways of working and citizen participation in which the most used digital technologies are Open Networks, Open Data and Open Hardware and for whose purposes the networks of Collaborative Intelligence, Collaborative Action or Collective Impact, and Resilience have been created; it also offers an online interactive map with the main projects (1,037) and existing organizations (1,946) of DSI in Europe (Digital Social Innovation, 2018), with 74% of the latter concentrated in the UK (361), France (246), Italy (222), Spain (160) and Holland (108), and notes both the limitations and that much remains to be done in this field in the continent apart from the fact that projects do not achieve the desired momentum to become global.

The study of DSI is even more of a work in progress at a global level given the incipient digital technologies of great potential and their natural evolution and that of their applications in the social field. Actually, SIs, including DSIs, consist of re-evaluating and exploring current systems as needs and values change (Nicholls et al., 2015).

This is why the practices in the field of DSI, although they are growing rapidly, lack unanimous and systematized criteria on which are best, where they are being produced, who the digital social innovators are and what policies and strategies can be applied to boost their growth (Empodera, 2018). The social nature of technology and, therefore, DSI is still in its infancy, with few services on a global scale. Hence, DSI is still considered as an emerging area of study (DSI EU, 2018a).

With the aim of helping to order this considerable vagueness, this chapter considers the objectives not only of identifying what a digital innovation is in the social sphere, but also of what should be understood as good practice in DSI. The latter requires the prior objective of identifying and structuring the barriers that are slowing the growth of DSI as well as their solutions. Figure 1 shows this approach to

Figure 1. Scheme of the proposed objectives
Source: Own elaboration



the questions that we are proposing and which allow a first understanding of this reality as an emerging line of research (Eckhardt et al., 2016).

To achieve these objectives, the conceptual framework of DSI will be configured and illustrated, while the barriers that hold it back will be located and a general scheme of action will be considered, which can be considered as *good practices in DSI*.

CONCEPTUAL FRAMEWORK FOR DIGITAL SOCIAL INNOVATION

The Social Economy

The so-called Social Economy (SE) represents the disciplinary framework in which SI exists. SE is characterized by the great diversity of types of entities that make it up, based on the work of Social Economy Europe, of the European Commission and of the European Economic and Social Committee, this last entity especially, outlining conceptual limits for the EU —a reference in this field— that are structured in two areas (Monzón et al., 2010):

- Characteristics common to all of SE would be the following (Carta Europea de Principios de la Economía Social, 2002):
    - People and social objects are taken into consideration more than capital
    - Solidary and responsible behaviour
    - Combination of the interests of user members and/or the general interest
    - Independence from public authorities
    - They are free and private entities, that is, they do not form part of, nor are they controlled by, the public sector. In short, they are independently created by civil society.
    - Generally they are organizations, that is, endowed with their own legal personality.
    - They have decision autonomy, that is, they have full capacity to choose and cease their governing bodies, as well as to organize all their activities. In short, they are managed democratically by means of their majority partners controlling the total power of the organization.

  - They have freedom of accession.
  - If there is distribution of profits or surpluses among the partners, it is done in accordance with the activity they perform within the organization.
  - They are *entities for people*, not *for capital*, that is, created to meet the needs of people. Therefore, although they are financed by *investors*, like any other economic activity, they do not work for them because they carry out an economic activity with the fundamental mission of meeting the needs of the people to whom the activity is destined, and play no part in paying back the investors who finance it.
- According to the report on SE in the EU by Monzón and Chaves (2012), SE is formed by the following two subsectors:
  - **Sub-Sector of *Market* Producers:** Basically made up of cooperative and labour societies, mutual savings banks and mutual societies, business groups controlled by the aforementioned, *empresas de inserción* (insertion companies) and other social enterprises, and certain non-profit entities in the service of the SE. Their organizations show three characteristics:
    i. They are mainly companies, that is, producers for the market: companies whose production is basically destined for sale in the market at economically significant prices.
    ii. They are created to meet the needs of their partners such that they are entities in which the partners are generally also users of the market activity.
    iii. They can distribute profits or surpluses among their members, not by taking into account the capital—or any other form of contribution—provided by them, but instead according to the activity that the members carry out with the entity.
  - Sub-sector of *non-market* producers: made up fundamentally of associations, foundations and other non-profit entities, such that all of them supply their production mainly for free or at economically insignificant prices. These are professional or scientific associations, charities, help and assistance, consumer groups, religious associations, political parties, churches, and social, cultural, recreational or sports clubs; they are joined by other non-profit private institutions that are financed by non-financial corporations or financial institutions and that produce cultural, recreational, and social services, etc., which are provided free of charge to individuals. In short, they are non-profit entities in the strictest sense.

Given the profile of these entities, SE shows a series of profound social impacts, especially since the beginning of the current global economic crisis:

1. Perhaps the greatest value created by SE is employment because SE helps to correct the three main imbalances in the labour market: unemployment, the instability of employment, and the social and work exclusion of the unemployed. This is because of its contribution to generating new jobs or maintaining those of sectors or companies in crisis, to improving the level of stability in employment, to bringing jobs out of the black economy, to maintaining trades and creating new ones, and to allowing excluded groups to be included. SE has become a powerful creator of employment in important economies around the world.
2. It fights for social cohesion in various fields. With regards to social exclusion, which derives into socio-labour exclusion, SE complements and above all precedes public action in its fight against this form of marginalization by demonstrating its great capacity for the social and work integration of people and areas in need—especially associations, foundations, and social enterprises.

It also finds solutions to new forms of exclusion, related with access to services, such as financial exclusion, consumer exclusion, and citizen participation. In short, *empowerment* formulas coordinated by SE entities especially at the local and regional levels.

3. Contribution to local and territorial development. In an international scenario of globalization and relocation of companies like the current one, organizations involved in SE allow the anchoring of social and economic activity to the territory of origin as a vehicle for dynamizing it. The virtues of democratic management and citizen participation of SE contribute to this, and manage to directly link with civil society in that territory, in the course of its own economy and in the design of its specific development model. Thus, SE acts on population fixation and local development.
4. SE entities have demonstrated a great ability to adapt to the new globalized and highly competitive environment: in general, its competitiveness has been similar to that of traditional private companies, or even greater in large markets, mainly due to the practice of networking very typical of SE and its sense of efficiency (given its better use of resources). The numerous new business and social initiatives of a large part of SE have also diversified the business activity of the economy and the new agents involved in it, an activity that is very focused on the provision of services with great potential in the future (disability; care for the elderly; child care; educational, health and sociocultural services; immigrants; and other excluded groups).
5. The social organizations are very much in direct contact with the recipients of their production. This turns them into powerful antennas that capture new unmet needs in order to transfer them to public administrations and to traditional companies or to directly develop creative, innovative solutions themselves: SE and innovation walk hand in hand given their very nature. SE has had its greatest success particularly in the field of technological innovation, through the generation of SE innovation systems—alliances between agents in the territory—and innovative knowledge.

The power of SE's impact is being especially reinforced with the intensive application of ICT to its projects as one of the great opportunities that must be exploited. (Gargallo and Pérez, 2009).

Notion of Innovation

The term *innovation* has been used in an interdisciplinary way, a fact related to the great diversity of existing definitions (Rodríguez et al., 2012). This large number of meanings, its heterogeneity and its evolution have led some analysts to call innovation a *quasi-concept* (Prandi and Cano, 2015). Schumpeter (Schumpeter, 1992) already conceived innovation as a "creative destruction" that is successful when it is carried out. If innovation requires creativity as an essential prerequisite (Cutler, 2000), what is sought is to achieve a change that adds value when implemented, that is, we can conceive innovation as the successful execution of creation (Heunks and Roos, 1992). In short, new ideas that work (Mulgan et al., 2007a).

With appropriate adaptations to SE organizations, we will understand innovation in a company to be the introduction of a product (goods or service) or a new or significantly improved process, or a new marketing or organizational method that is applied to the practice of the company, to the organization of work, or to external relations (Manual de Oslo, 2005). But it is only considered innovation if its introduction is sold or applied successfully. From this we infer the existence of these four types of innovation, listed in Table 1, a classification compatible with that which divides innovation depending on the degree of novelty that it represents in terms of incremental innovation (small innovations, in

Table 1. Types of business innovation according to the element that is innovated

Type of innovation	Concept
Product Innovation	Introduction of new or significantly improved goods or services in terms of their characteristics or possible uses.
Process Innovation	Introduction of a new or significantly improved production or distribution method.
Commercial Innovation	Introduction of a new marketing method that involves important improvements in the design or presentation of the product, in its positioning, its promotion, or in its price.
Organizational Innovation	Introduction of a new method of organization applied to business practices, work organization, or the external relations of the company.

Source: Manual de Oslo (2005)

order to maintain competitiveness) and disruptive or radical innovation (great novelty, which entails transcendental changes for the sector).

The innovative activity depends, to a great extent, on the variety, quality, and structure of the relations of the organization with agents that have the strategic resources to innovate. Thus, the organization must form alliances with suppliers, customers, competitors, research centres, universities, and public administrations, among others. This collaborative relationship is intentional, the result of which forms the innovation system. All this helps us to understand the facilitating role of ICT in innovation processes.

Social Innovation

When we talk about Social Innovation (SI) we talk about innovating in the SE, two very close companions as we have already commented. SE has demonstrated its innovative capacity in all types of innovation: in products (particularly in social welfare services, such as support services for dependents and socio-cultural services), in processes, and in commercial and organizational innovation.

Economic theory, scarce in terms of SI, considers that SE outperforms the traditional public and private economy in the generation of innovative products, especially in the production of social welfare services, due to the existence of trust in an environment of asymmetric information between the agents, the satisfaction of heterogeneous demands, and its strong sense of relational products. And this superiority is not only based on the offer of new products to meet new social demands, but also on social organizations' ability to configure a new development model, transforming settled values and culture in search of a systemic change. All this has caused large global areas, such as the EU through the European Commission, to strongly promote market acceptance of SI solutions (Innovation Union Initiative, 2010; Social Investment Package, 2013).

These factors have promoted innovation in SE by social entities throughout the world (Guerra and Sánchez, 2016) to turn SI into a real movement that has evolved at an accelerated pace for some years, and which we can synthesize conceptually as the conceiving of new ideas that solve social problems. This scenario, full of social initiatives ranging from grassroots community projects to large national companies and global networks, is causing a paradigm shift (Buckland and Murillo, 2013a).

It is true that the enormous amount and variety of social initiatives, however, causes many authors to deny the current and future possibility of a definition of SI. This is particularly true when we step out from the academic field to the field of the SE professional, for whom the definition of SI is a second-order issue since they are really interested in generating adequate environments for the development of social innovations and assume that SI is a *quasi-concept* in constant evolution due to it continually engaging in new challenges and becoming infected by changes in the system and actors. Hence, SI is considered as an eminently practical and applied concept (Buckland and Murillo, 2013b). As a result, there is no universally accepted definition of SI; and there, precisely, lies one of its most important and, at the same time, most attractive characteristics.

However, we must make an effort at least to delimit the boundaries of what we should understand by SI. The term SI receives numerous meanings but lacks consensus in the research and professional community. Thus, it oscillates between synthetic definitions, such as new ideas developed to cover basic unmet needs of society (Bacon et al., 2008; Social Innovation Exchange, 2018) and which are effective, or new ideas that work for the fulfilment of social objectives (Mulgan et al., 2007b) and broader ideas such as that deliberately directed towards a social need that results from obtaining a great idea and making it work, giving social organizations great value to the efficiency, sustainability and justification of the process; the generation, selection and implementation of ideas that become reality must produce the maximum value or social impact (Rodríguez et al., 2012). In any case, SI is that which is not only good for society but also improves the ability of people and groups to act; in short, actions aimed at improving human well-being.

Table 2, Table 3, Table 4, Table 5, Table 6 and Table 7 show cases that illustrate SI. They are all SI social enterprises.

Table 2. Global cases of Social Innovation

INITIATIVE: **Aravind Eye Care System (India)**. Founded in 1976. Sector: Health
PRESENTATION Aravind Eye Care System is the largest ophthalmological centre in the world since it serves millions of patients annually. It is known internationally because it provides excellent treatment to poor rural populations.
TWO SI PRINCIPLES: A - Operational efficiency achieved by transferring patients from reception to postoperative care within two hours. B - It has two types of patients, although all receive identical surgical care: those who do not have economic resources—or very few—and those who do have them and, therefore, receive more comfortable stay services. Applies a cross-subsidy model that allows half of the patients—the first type—to pay practically nothing, while paying clients—the second type—pay the cost of the former and a little more to guarantee financial sustainability.

Source: Own elaboration from Fundación Schwab (2013)

Table 3. Global cases of Social Innovation

INITIATIVE: Education For Employment (EFE) (Egypt, Jordan, Morocco, Palestine, Tunisia and Yemen). Founded in 2002. Sector: Youth, education and employment
PRESENTATION It addresses two problems: the lack of skills to meet the needs of the private sector due to poor educational systems and the limited opportunities for talented young people with low-income to enter the labour market due to their lack of contacts or social skills.
SOCIAL INNOVATION The SI consists of a Board of Directors made up of prominent personalities from the field of business and education committed to the crisis of youth unemployment. EFE analyses the market in each country to identify the sectors with the greatest shortage of qualified job seekers, and then presents their offer to the main employers in these sectors: in exchange for EFE's commitment to train new entrants in the skills they need, the companies commit themselves in advance to hire a certain number of young low-income graduates from these training programs.

Source: Own elaboration from Fundación Schwab (2013)

Table 4. Global cases of Social Innovation

INITIATIVE: **Health Leads (USA)**. Founded in 1996. Sector: Health
PRESENTATION US primary care physicians are overburdened with patients, especially in low-income areas. For this reason, they adequately attend to the usual ailments but do not have time to deal with other fundamental aspects for the health of their patients: Is the family adequately fed? Have water and electricity supplies been cut off due to lack of payment?
SOCIAL INNOVATION Its SI is to use a workforce that can take care of this second level of health care consisting of students from local universities and colleges, all of them volunteers and chosen after a selection and training process. These students commit to dedicating up to ten hours a week for at least one year. After evaluating the needs of the patient, they help them to access the fifty basic resources appropriate to their problem: food aid, day care vouchers, educational programs, negotiating with the utility companies to reconnect cut supplies, etc.

Source: Own elaboration from Fundación Schwab (2013)

Table 5. Global cases of Social Innovation

INITIATIVE: **Cinepop / Hormiga (Mexico)**. Founded in 2004. Sector: Urbanism, citizen participation, and technology.
PRESENTATION Great difficulties of the low-income population to access cinema.
SOCIAL INNOVATION The applied SIs were sequential: A - Since that the price of movie tickets in Mexico does not allow this form of entertainment to most Mexicans, this initiative created an outdoor cinema consisting of a giant inflatable screen that could be installed in less than two hours in any public square. Complete families in low-income neighbourhoods went to enjoy a night of fun, which popularized the initiative. B - This helped to discover the ability to empower people through an emotional connection, which was very encouraging if it was low-income clients, especially in rural areas and in the urban periphery. Cinepop began to produce original content and educational programs, and later converted into a platform called Hormiga. Hormiga has created a social impact proposal consisting of local governments offering physical space, security services and electricity and, in exchange, receiving a very effective communication platform to send selective messages to broad audiences. Hormiga incorporates educational programs on health, family budgets, social values, environment, etc. both before and after the screening of the film, while often renting space to the sponsoring companies in the form of inflatable stalls to sell products destined to those attending (microcredits, affordable medical consultations, mobile phones with discounts, etc.).

Source: Own elaboration from Fundación Schwab (2013)

Table 6. Global cases of Social Innovation

INITIATIVE: **CIES (Brazil)**. Founded in 2008. Sector: Health
PRESENTATION There are many countries that use mobile units to improve access to quality health care, especially in remote regions or in poor neighbourhoods due to the shortage of doctors per thousand inhabitants.
SOCIAL INNOVATION The SI consists of complementing the existing health care services with sustainable mobile units from the economic point of view designed to provide high quality specialized care for free or at a very affordable price. To do this, they have developed mobile units that, unlike traditional units, can provide services in more than ten medical specialties, including examination rooms and operating rooms that can apply specialized treatments to a maximum of 250 patients per day at an average cost of BRL 19 (USD 10) each. In addition, they work closely with local governments as an interest group to influence public health policy and collaborate with universities to train the specialists they need.

Source: Own elaboration from Fundación Schwab (2013)

Table 7. Global cases of Social Innovation

INITIATIVE: Endeavor Global (Latin America, Middle East and Southeast Asia). Founded in 1997. Sector: Business development
PRESENTATION Entrepreneurs in emerging countries face tremendous cultural and structural obstacles (lack of reference models, contacts, capital, management skills, etc.) that impede the growth of their companies and, with that, the economies of their respective countries. If the entrepreneurial training, incubators and accelerators, all aimed at the initial phases of their business, are all working, then the problem is to be found in the growth phase of the companies.
SOCIAL INNOVATION The SI consists of applying Endeavor's model of attraction, which operates in 17 countries through a system similar to a franchise, and which works based on a rigorous process of selecting high-impact candidates for Endeavor's subsidiary in that country. Once selected according to their talent and potential, entrepreneurs have access to an excellent network of knowledge and business experience to which they can go in search of tutoring, strategic advice, contacts, and other forms of collaboration. In this way, Endeavor also improves the ecosystem in which its companies operate by connecting them with important executives in local companies thereby creating an extensive support system.

Source: Own elaboration from Fundación Schwab (2013)

The main axes of SI are extracted from the most recurrent and used definitions:

1. Novelty and success of the idea implemented due to its social impact (European Social Innovation Research, 2013).
2. Its intention to solve a basic social problem, often systemic, that creates value for society as a whole instead of individual value (Phills et al., 2008), for which it usually resorts to hybrid solutions that use already existing elements but in a novel way.
3. Its aspiration of being a systemic transformation by improving capacities, assets, value systems and/or creating new collaborative relationships such that all this improves the capacity of society to act in the sense of transforming social norms and institutions—citizen empowerment—especially in the search for good governance and transparency (Gerometta et al., 2005).
4. SI is intersectorial and collaborative in its work through networking for the exchange of ideas, values, and resources to develop SI. It allows multi-government decisions and develops in an open and inclusive system where confidence acquires an unprecedented weight (Prandi and Cano, 2015).
5. Economic feasibility and sustainability of the projects.
6. It is mostly carried out and disseminated by organizations with mainly social objectives (Mulgan et al., 2007a).
7. Integration of private capital with public and philanthropic support: the most complex and important social problems cannot be assimilated, let alone solved, without involving non-profit, public and private sectors (Stanford, 2018).

Regarding types of SI, it covers the referrals of product, process and commercial or organizational innovations of the Oslo Manual but, in contrast to the innovations of traditional companies, SIs try to fulfil their own mission of generating social change (Guía IS, 2018). However, the field of possibilities for these four types of SI is very broad because an SI may even include such things as a principle, a specific social movement, a model, a form of interaction or social action, a legislative article, an action, or a combination of these. Hence, it is people, movements, and civil society organizations that mainly contribute to promote initiatives of this nature, as well as companies, governments and the academic world. In Table 8 a new sample of this plurality is collected.

Table 8. Sample of plurality in Social Innovation

Initiative	Description of Its Activity
Charter Schools	Publicly funded primary or secondary schools that operate free from some of the regulations that typically apply to public schools. Administrators, teachers, and parents thus have the opportunity to develop innovative teaching methods.
Emissions Trading	A pollution control program that uses economic incentives to reduce emissions. A cap is set on the total amount of a certain pollutant that can be emitted, and permits to pollute are issued to all participating businesses. Those with higher emissions can buy credits from businesses that have reduced their emissions. Over time, the cap is reduced.
Fair Trade	An organized movement that establishes high trade standards for coffee, chocolate, sugar, and other products. By certifying traders that pay producers a living wage and meet other social and environmental standards, the fair trade movement improves farmers' lives and promotes environmental sustainability.

Source: Stanford (2018)

In line with all this heterogeneity, and at an operational level, a large number of tools and methods used throughout the world have been identified to apply SI with a process perspective and to promote the SI emanating from SI centres, academic centres, public bodies, and other organizations interested in the promotion of SI that can be adapted according to the context and the needs of the specific problem (Murray et al., 2010; Keane et al., 2014; Mata, 2018a, 2018b; Simon et al., 2014; Stokes et al., 2017).

Digital Economy

The challenges posed by the emergence of the Internet on an economic, social, political and educational scale has caused the emergence of the Digital Economy (DE). Although today's flexible and rapidly changing environments preclude a single closed definition of DE, we can state that DE refers to the intense presence of ICT in the economy (Hidalgo et al., 2010), and it is substantiated in these key factors: Internet, E-Commerce, Contents—Processes—Digital media (Informe OCDE, 2002), amplified by all the recent technological possibilities of enormous potential: Cloud Services, Big Data, Artificial Intelligence, Internet of Things, Virtual Reality, Blockchain, etc. In sum, DE refers to an economy based on ICT technologies as a means of communication and creation of value.

The conversion to digital requires working with different rules that revolutionize the relationships between actors and business models (OCDE, 2014). This translates into a reduction of barriers and costs of access, in an improvement in production, and in the appearance of new forms of consumption.

In relation to the Internet, Arroyo et al. (2017) point to the emergence of digital platforms—especially in native DE organizations—as voluntary or necessarily collaborative agent connectors, and to the enormous volume of data that can be stored, processed, and turned into business intelligence—even more so with the Cloud, Supercomputing, and Big Data and Open Data—as the two main pillars that support the DE.

DE can also be defined according to the effects that ICT generates in the economy, highlighting the best treatment of consumers, workers, and other agents linked to organizations, as well as the impact on products, processes and structures. All this means that SE has acted as an irreplaceable lever for SI.

Even more so if we remember that the levels of trust between the agents that interact for an SI achieve a fundamental value. The approach is quickly explained: on the one hand, trust is created with proximity and familiarity; on the other, the contexts of social inequalities cause distance between members of the same group and, therefore, a weak trust between them. Therefore, in societies with less inequality, confidence levels increase.

But there are two more parameters that determine trust: the degree of interaction and transaction between strangers, and the amount of information and level of transparency. In a digital context, although it is capable of generating greater information asymmetries with respect to others, both parameters increase exponentially, from which an increase in confidence is inferred. So much so that it goes from an *offline* trust (outside the internet) to an *online* trust, an innovation in itself and a disruptive one at that (Mazzella and Sundararajan, 2016).

This greater confidence that allows the virtual, results in an improvement between actors (or within the same group) in the ability to work. Furthermore, in the DE, trust and reputation are usually used as synonyms. And reputation represents a strategic intangible asset when it comes to gauging the value of today's organizations.

Digital Social Innovation

The use of ICT in SI has been the object of extensive treatment (Millard et al., 2014; Misuraca et al., 2015; Bria, 2015) due to its role in promoting, developing and maintaining SI initiatives by facilitating cooperation and the networking that these initiatives require—especially for vulnerable groups (Eckhardt et al., 2016).

All the research lines referred to above converge in the one related to DSI. Although DSI is an extensive field and in full change, it can be understood by DSI as the innovation that uses ICT to allow or help carry out SI. Specifically, it is a collaborative SI class in which innovators, communities, and users work together using digital technologies to co-create knowledge and solutions for a broad spectrum of social needs and do so at an unthinkable scale and speed before the birth of the Internet (Bria et al., 2015; Digital Social Innovation, 2018; Halpin & Bria, 2015). Table 9 and Table 10 provide a summary of success stories that reflect the basic characteristics of DSI in order to illustrate its concept.

These technologies have provided powerful, ubiquitous, and cheap tools which have enabled new ways of innovating in the social arena while at the same time strengthening other areas. It can even be said that the barriers to SI related to communication, participation, and size have disappeared (Simon

Table 9. Case of Digital Social Innovation-I

INITIATIVE: **Doctoralia** (origin: Spain). Area: worldwide. Sector: Digital health (eHealth)
DESCRIPTION Online platform designed from a network that interconnects health professionals with patients who choose private medicine. This allows users to locate the most appropriate professional for their needs, see the ratings of different professionals, and arrange online visits.
SOCIAL IMPACT • Offers software to help verified healthcare professionals to manage their patients and visits, their online visibility and respond to the comments of their users, among other functionalities. In addition, it disseminates health advice and recommendations for the entire population through social networks. • Patients can select professionals, manage their visits, and ask questions or queries. In addition, it encourages patients to participate and leave comments, while the reviews of professionals help to build their online reputation. • 11 million users per month around the world. Its database stores 3.5 million professionals and private health centres. Adapted to 20 countries.

Source: Own elaboration from Arroyo et al. (2017)

Table 10. Case of Digital Social Innovation-II

INITIATIVE: *Hack Your Future:* **Supporting refugees into employment through coding** (origin: The Netherlands). Area: The Netherlands. Sector: Help for refugees
DESCRIPTION Coding school to help refugees in the Netherlands. It is supported by 40 volunteers who are software developers, training the refugees in person once a week and online at other times.
SOCIAL IMPACT • Trains refugees in the Netherlands in the skills necessary to obtain a decent and adequately remunerated job as software developers. • After a six-month training program, the refugees come into contact with companies with a view to their recruitment. • No need to attend training classes on an on-going basis, which allows refugees to carry out other activities.

Source: Own elaboration from Nesta (2017a)

et al., 2014): digital technologies can mobilize communities, share resources, and distribute power, all of them powerful SI facilitators. In short, this technology is transforming the way SI operates such that it becomes based on the creative, collaborative, and open community. Table 11 illustrates this last component of the DSI.

Some of the areas in which virtual technologies are achieving social impact range from health and care to digital democracy, through integration and migration, food, environment and climate change, or learning and capacity development. In addition to the cases presented, Table 12 provides others by sectors to show this variety.

DSI incorporates the following characteristics to the axes that we identified for SI (Arroyo et al., 2017; Bria et al., 2015; Stokes et al., 2017; Murray et al., 2010; Nesta, 2018; Digital Social Innovation, 2018):

- It adopts new technological trends of the digital age in an innovative way. One of its pillars is open knowledge, hardware and above all *open source* software and *open data* in its maximum expression.
- Its social impact grows exponentially, especially thanks to the Internet.

Table 11. Case of Digital Social Innovation-III

INITIATIVE: ***CitizenLab*** (origin: Brussels). Area: at first principio Brussels, but can be replicated to other areas. Sector: Citizen participation and democracy
DESCRIPTION Civic engagement platform in which citizens co-create their city and their communities with the help of the Internet. It was begun by three university students who wished to do something about the lack of participation of citizens, and consists of a process for creating prototypes and business development.
SOCIAL IMPACT • Provides a more democratic, transparent, and collaborative solution for the decision making of municipalities and all types of governments. • Governments more focused on citizens. • Greater participation of citizens in local affairs: presenting ideas, collaborating on projects and discussing how to improve their neighbourhoods (example: how to renovate the Kapermolenpark, in the city of Hasselt, Belgium). • The government announces the results of the participation. • Software in the cloud, easy to use, and intended for mobile devices. • In-depth data analysis for better results.

Source: Own elaboration from CitizenLab (2018)

Table 12. Cases of Digital Social Innovation by sector

Initiative	Sector	Description of its activity
OLIO: Sharing food to reduce waste (UK)	Environment	Free software application that connects neighbours for sharing left over and unwanted food given that the UK discards £12,500 million worth of food. At the same time, it allows people to meet and improves social cohesion.
OpenCare: Co-creating solutions to healthcare challenges (EU)	Healthcare	OpenCare is a global community that works together to create open and collaborative health and social assistance solutions. Gathers people online and offline to share stories, create prototypes and test new ideas, solve problems and refine solutions together. Based on open source technologies and digital manufacturing (maker), it aims to apply a more user-centred healthcare, driven by the community and, therefore, responding to the needs of people in the 21st century.
Decide Madrid: Distributing power and decision-making (Spain)	Democracy	Decide Madrid is the citizen participation platform of Madrid, the capital of Spain. Its functions are: • Proposing new laws • Debating: anyone can start a debate on any topic • Participatory budget: part of the city budget is decided through the platform • Consultations on urban planning, so far with binding decisions Open source, modular software was used, called Consul, and it is already being used by other cities with the same participatory purposes.
Open Corporates: Uncovering global corporate networks (UK)	Accountability and Transparency	Open Corporates works to make information about companies more accessible, discoverable, and usable, so that civil society, citizens, and journalists can hold the corporate world to account and understand its workings better. It is now the largest open database of companies in the world (100 million companies) and shares data on corporate entities as open data under the share-alike attribution Open Database Licence. Open Corporates has also been an important player in major journalism stories.
Roma Makers: Bringing making into schools (Italy)	Education, work and skills	Roma Makers, one of Italy's first makerspaces, embarked on the project to create 20 makerspaces in the country. It has become a hub for designers, hobbyists, and creatives. It wanted to increase public engagement in the maker movement, particularly from young people, and worked with schools in the Italian capital to set up mini-makerspaces equipped with digital fabrication tools and the daily support of at least one skilled "minimakers trainee". It hopes to equip a young generation with the skills and motivation to take part in the maker movement, to contribute to a more sustainable environment, and to solve social challenges through new technologies.

Source: Own elaboration from Nesta (2017b, 2017c, 2017d, 2017e, 2017f)

- Greater economic sustainability of the projects, favoured by the frequency of external financing and investment in the DE and by greater social capital of its organizations (Vargas, 2013).
- Collaboration between the agents involved or *co-innovation*: SE organizations, companies, public administrations, universities, research centres, communities, etc. This in such a way that there is a correlation between collaboration and innovation: greater collaboration begets greater innovation.

In this way, DSI distances itself from innovation as a linear process, developed by an organization, and becomes a multifaceted, dynamic, and interdependent process in which different interest groups participate.

This networking arises because the SI, including the DSI:

- Are characterized by the process of implementation of the idea being more important than the idea itself. The co-innovation process, which aims to outline the idea and decide how it is applied in a specific context, may be more difficult in its beginnings; but once the participation framework of each agent is configured, networking to develop the idea can flow faster and easier.

- Cannot always be taken on by a single person, organization, or sector, particularly in a complex and accelerated context like the current one. Moreover, much of the successful outcome will depend on an adequate diversity of nature, resources, and even different languages provided by the different agents involved.

For this, it is important that the participating actors share values and objectives, but it is also decisive for success to involve all the stakeholders from the very beginning of the project, forming a specific ecosystem—of innovation—that creates bonds of trust between them and shares knowledge and experience that each one accumulates in this field, largely the result of past mistakes when innovating. Since it is an alliance, each participant in it must identify very well the strategic objectives and the key competences that it will contribute and will receive from this collaboration.

For these reasons, to form an ad hoc innovation ecosystem, it is necessary to know in depth the environment and its needs, as well as the organizations and the *market* formed by the users of the product. This in addition to the appropriate method to configure the alliance in order to make it work.

An example of this dynamic is represented by the *Change Labs*, recently created precisely for social co-innovation. It is a systemic, participatory, and creative approach for advancing in complex and important social challenges, a space of co-creation in which a team of people who represent the actors of a specific social system meet in order to speak, act and learn with the aim of improving their system in some way. By working together, in addition to building capacities to work with others in order to co-create new solutions, they analyse the issue with an integral, systemic, and holistic vision which would not have been the case without collaboration. The solution to the specific social problem that is being faced is fully developed in these laboratories (Mata, 2018c).

- They are based on a high level of trust between the people/groups that interact to innovate for the common good, and for which powerful digital tools are available. Society rewards the organization/organizations that develop the initiative handsomely in terms of trust or reputation, especially online. This characteristic comes from the fact that the generation of trust is a factor shared by many social actions given that it is one of the key peculiarities of this new DE.
- Open Innovation. This starts from the fact that innovation always seeks to find the best ideas and represents the greatest opportunities for the organization wherever they find it. For this, the Open Innovation paradigm emerges, of great application in DSI, based on the fact that organizations can and should use both internal and external ideas, as well as internal and external paths, to try to generate value in the user. This opening is integrated into the culture and planning of the organization (Chesbrough, 2003), so it will be part of their DNA. To this open innovation comes a greater exercise of informative transparency.

In short, easy access to the Internet together with the ability of people and organizations to combine their skills through collaborative innovation—co-innovation and open innovation as a particular part of it—are contributing decisively to the promotion and strengthening of DSI (Bass, 2014).

- It enables citizens to be even more aware individually and collectively, as well as to use this awareness while acting.
- Scalable and replicable initiatives, for which the virtual environment is firmly allied. Scalability, a term widely used in digital organizations, is the property of increasing the size of an organization

without compromising its normal functioning. For its part, replicability is the virtue of a successful project to be able to reproduce itself in contexts other than the one of origin.

- Initiatives that have a small entry threshold in relation to the massive social impact they can achieve.

This total theoretical framework is completed by integrating the three major areas that make up its nature as represented in Figure 2.

BARRIERS TO DIGITAL SOCIAL INNOVATION

Stokes et al., (2017) classify barriers to the growth of DSI in Europe in the categories summarized in Table 13.

1. Barriers at the macro level (ecosystem), that is, from the point of view of financing, training in skills and abilities, and assimilation of DSI by civil society and the public sector.
2. Barriers at the project level

Figure 2. Nature of Digital Social Innovation
Source: Own elaboration based on the sources cited in the Conceptual Framework of Digital Social Innovation

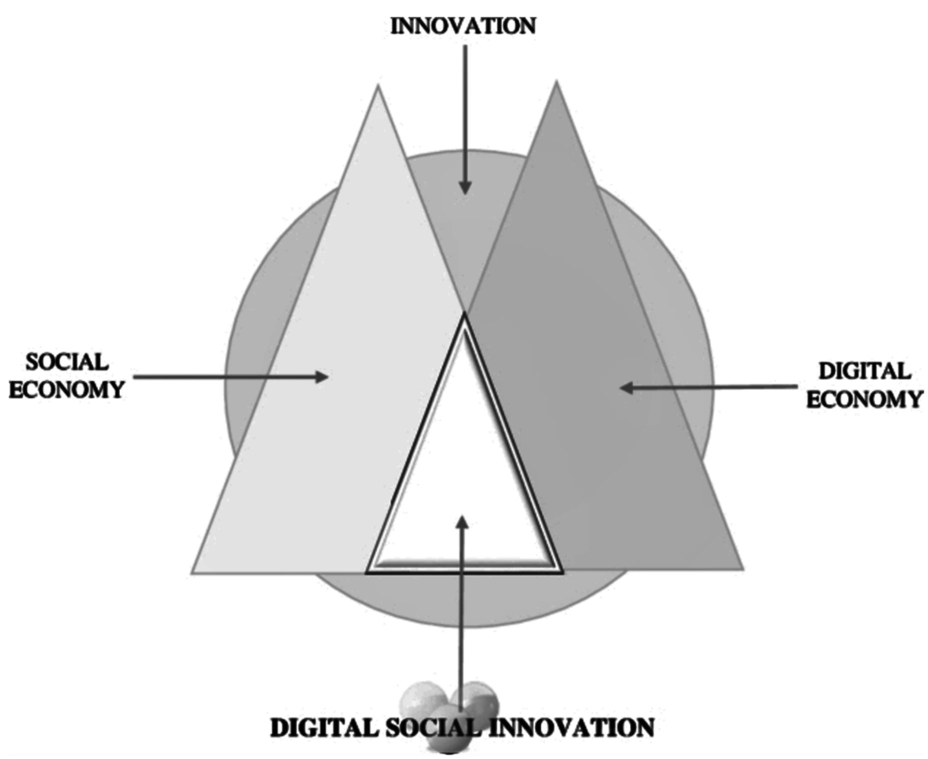


Table 13. Barriers to the growth of DSI

Type	Barrier: Description	Solutions
BARRIERS AT THE MACRO LEVEL (ECOSYSTEM)	Financing (a key challenge for professionals): - Difficult access to financing for DSI, being insufficient—especially compared to non-social digital innovations—as well as often inflexible, and unevenly distributed. - A lack, especially in certain stages—initial—of the development of innovations and in certain less developed countries.	Private and public funders of SI should ensure that DSI organizations and projects are feasible as a way to grant financing. Some formulas: ● Give visibility to DSI projects as investment options for financial agents and encourage them to invest in them ● Develop technology for specific DSI programs ● Launch attractive collaboration offers among civil society organizations and DSI projects ● Design new business models and methods for attracting financing (Phills et al., 2008).
	Related to the previous point, there is little help for projects with more future to become sustainable so that they generate social impact on a large scale because the funding has tended towards individual initiatives, which benefits them but is of little use for the DSI sector as a whole.	Policies and financing should focus on supporting intermediation units and organizations, collaborative infrastructures such as incubators, accelerators, event organization, work networks, training initiatives, meetings, etc., that would benefit entire communities and not just specific initiatives.
	Preparation in capacities and abilities: - A shortage of deep digital skills in diversified areas. - A habitual lack of commercial management skills in DSI professionals, such as commercial planning, marketing, and communications. - Low professionalization in the area of cooperation between public sectors, private sectors and civil society, and in the role of collaborators of intermediate actors throughout the innovation process (Eckhardt, 2016).	Training of DSI professionals (Cubillos et al., 2017) so that they are equipped to a similar level as those that are not socially oriented, attracting more professionals trained in these skills, and encouraging the exchange of knowledge among professionals.
	Slowness in the adoption of digital tools by civil society organizations due to a lack of digital skills in its employees, of digital leadership, of digital strategies, and an ignorance and lack of awareness of digital trends and their opportunities.	The strong demand and budgetary restrictions will mean that these organizations invest in digital, backed by public administrations and funders, in addition to adopting a DSI approach adjusted to their level of digital maturity.
	- The public sector has not yet assimilated the possibilities of DSI to offer better services at a lower cost: it lacks this awareness - A lack of widespread adoption of DSI by the public sector. This is due to barriers common to all forms of innovation: insufficient public digital skills, complex acquisition processes, lack of infrastructure, and political resistance.	Assimilation of the public sector of its relevant role in DSI, demonstrating it by means of policies and infrastructure favouring digital. In sectors with a large public sector presence or monopoly, such as education and health, this may be the only way that DSI can generate social impact at scale.
BARRIERS AT THE PROJECT LEVEL	DSI professionals need greater participation of citizens in projects, something complicated but very important for their success, due to reasons such as lack of market research and users, ignorance of methods and communication channels, or development of products which are not in demand. In reality, DSI ecosystems are still in their infancy.	Investors and funders should allocate resources to the training of professionals, including those who work in areas for increasing citizen participation in the project and generation of DSI ecosystems.
	DSI professionals sometimes do not take into account the digital exclusion that their products can generate.	Make sure that the degree of digital inclusion of the recipients of the product is total: products open to all.
	Deficits in the consideration and calculation of the social impact generated by the products: DSI initiatives must work, but insufficient interest in their impact on the part of financiers, investors, civil society organizations, and the public sector, as well as the fact that professionals do not understand or measure these results, make it difficult to know.	Better understanding of how DSI is affecting people, society, and the environment to determine if it is a good investment of time and money. This done in the knowledge that there is no single way to measure social impact and increase it.
	Stakeholders' insufficient knowledge of business models and DSI growth strategies: few projects have achieved social impact at scale. Thus, factors such as open sourcing versus industrial or intellectual property protection, or collaboration versus traditional competition, are alien to many non-social business models. In consequence: it is still not clear how a DSI can improve its impact and be financially sustainable.	Greater research and knowledge exchange that helps to identify, typify and develop sustainable business models and growth. All this knowing that there is no single way to do it.

Source: Own elaboration from Stokes et al., (2017), Stokes and Baeck (2017)

TOWARDS A FRAMEWORK OF ACTION: GOOD PRACTICES IN DIGITAL SOCIAL INNOVATION

The barriers that are limiting DSI and the adequate response to them offer a useful scenario to infer guidelines for carrying out appropriate DSI activities, which is known as *good practice in DSI*.

Although there are numerous success stories in DSI, its journey has only just begun because there are still few initiatives that reach their potential levels. There are many routes and approaches that should be implemented to promote the expansion of DSI.

The growing interest in SI, including DSI, increasingly demands that the most effective approaches are determined and their impact and long-term viability analysed. The result is a global debate on SI focused on what it means, where its limits are and what the key success factors are for projects and organizations to design and develop DSI effectively, that is, with social impact—local or global.

We divide the success of a DSI factors into two levels (Stokes et al., 2017; Rodríguez et al., 2012):

1. Strategic level
2. General principles of action level

1. Strategic Level

The following are listed:

- General strategies for innovation are:
    - These organizations should have the continuous ability to anticipate or adapt to changes in the environment as a means of long-term effective initiatives. This requires keeping up-to-date with said changes, including technological changes.
    - Given that the mission is the key differentiating factor of social entities, the previous point suggests that the mission should be considered changeable, even if it succeeds, due to changes in reality and, therefore, in the problems to be solved.
    - Innovation should be integrated into the culture of the organization, while aligning with the members that created it and its mission.
    - Entities should apply a perspective of process vision when innovating, that is, managing innovation. This would result in the improvement of many internal operating processes, more effective networking actions, and even mergers between organizations.
    - The previous point implies having leaders that promote innovation and who also have the ability to carry it out, as well as teams that are balanced in both abilities and adaptable to projects and circumstances. The management team should feel confident enough to innovate, especially senior management. They should have both capacities and not be dominated, as is usual, by mentalities only concerned with the implementation of innovation itself and aimed at results (Dyer et al., 2011).
    - The continuous rotation of staff hinders the mission of the organization. It is advisable that there are mixed teams made up of paid staff and volunteers invited to co-create in the initiatives. This would also add an external, fresh, and transversal vision that encourages attractive ideas to be executed.

    - The measurement of performance in these organizations and initiatives is complicated by relying on external factors, management interests, and the preferences of the stakeholders involved. This difficulty generates greater aversion to risk: it is essential to measure the social impact generated by a project.
- Resource strategies. To be highlighted are:
    - The need to have people and organizations that have the technical and technological capabilities necessary to develop DSI projects. This can be helped by the creation of collaborative networks around these capabilities.
    - The need to have staff trained in the methodologies and practices that we know as Innovation Management. This happens, moreover, by establishing an organizational climate prone to creativity, as well as promoting, recognizing, and evaluating new ideas.
- Management strategies. Of note are:
    - Focusing the organization on its competitive advantages and understanding who else is working on similar innovations.
    - Having an internalised business plan and a solid management team that comes from different areas and sectors, and not only from internal promotion.
    - Diversifying financing and having the necessary liquidity. The existing barriers in the financial and incentive structures and formulas require a cultural change in the organization.
    - The application of technology in areas also necessary but not considered, such as the management and control of expenditure.

2. General Principles of Action Level

This acts as a supra-level and so we divide it in two:

- Activity guidelines:
    - Associative thinking: innovative thinkers have the interdisciplinary ability to connect fields, problems, ideas, and solutions that are apparently unrelated.
    - Great observational capacity to search for trends and patterns in order to detect new needs and generate new ideas: in search of new social challenges. An excellent starting point for this is the constant formulation of questions that challenge what exists with curiosity, passion, and a sense of commitment.
    - Work collaboratively through networks as a channel for effective innovation: when everything is shared, debate, exchange, and rethinking of ideas are encouraged. These are good ways to innovate. All the interest groups or agents of DSI should work together: professionals, governments, legislators, private sector, financiers, citizens, collaborating organizations, and the research community. In order to achieve this, the exercise of transparency within the organization is key.
    - In rapidly changing environments, organizations must learn quickly and effectively. However, learning is not about avoiding mistakes, but about learning from them and correcting them quickly. And to learn from failures, it is extremely advisable to apply the processes that make up Knowledge Management.
- General macro-factors. Buckland and Murillo (2013a, 2015) point out the five factors for success listed in Table 14.

- **Factor 1:** Given that an SI (DSI) arises with the aim of solving one or several social problems, the need to measure the degree of its achievement is evident. Although it is a research area to which important efforts are being devoted to define information techniques, the definition of indicators, and the measurement of performance, there is still a deficit in the calculation of the impact that must be overcome until such a point that it is considered evidently fulfilled.
- **Factor 2:** In the era of collaboration and networks, an SI cannot work if you work in isolation. It should be taken into account that initiatives can cross sectors and combine them in search of the desired social value, that is, hybridize. It must also be assumed that the projects can hybridize in the form of management, or the most convenient form may be chosen, such as public, private and lack of profit, if that allows for the solving of the social need put forward. Therefore, the boundaries between the mentioned sectors are increasingly blurred. In this sense, it is very interesting to observe the world of hybrid organizations as such.
- **Factor 3:** Despite the great diversity of SI forms, the requirement of long-term economic sustainability must be met in general. The techniques for attracting financing must also be subject to innovation itself. One of the variables that can guarantee long-term sustainability is efficiency, so it is essential for projects to implement low-cost implementation strategies.
- **Factor 4:** Special emphasis on applying open innovation models and tools. Some of the models of open social innovation are collaborations, licenses, mergers and acquisitions, spin-offs, franchises, or federations. All the while being aware that it is necessary to investigate in depth ways in which to improve management processes in distributed systems—those in which several parties collaborate to achieve a social objective.
- **Factor 5:** The ability to scale or replicate innovation is important for two reasons:
  - Many of the problems that afflict society are global (climate change, environmental deterioration, mass migrations), so they demand global solutions.
  - Many systems have been globalized (such as the financial system) or operate on a large scale. SI that works in one territory can often be extended to another—with possible adaptations.

Table 15, Table 16 and Table 17 provide several cases that demonstrate the success of implementing these five factors.

Table 14. Key factors for the success of digital social innovation

	Variable	Questions to be asked
1	Social impact	To what extent does the initiative solve the problem addressed and achieve the desired social transformation?
2	Intersectorial Collaboration	Who has the most interest in the success of the initiative and what mechanisms do they have?
3	Economic sustainability and viability in the long term	How is the initiative financed and what strategies have been adopted to ensure its survival?
4	Opening innovation	Is it a closed or open innovation? Can it be replicated by others? Is it based on any previous concept? What innovative features does it have?
5	Scalability and replicability	To what extent can the initiative be expanded or multiplied? Under what conditions can it be replicated in a different situation?

Source: Buckland and Murillo (2013a, 2015)

Table 15. Success cases of Digital Social Innovation-I

INITIATIVE: **TRAITY** (origin: Spain. Operating in various countries). Founded in 2012.		
DESCRIPTION Startup that has developed an online reputation system based on digital fingerprints. Their vision is to create a more inclusive world, in which offline reputation can be credited to give opportunities that would otherwise be vetoed. Its motto is *Traity gives superpowers to trusted people*.		
SUCCESS FACTORS	SOCIAL IMPACT	4.5 million registered users.
	INTERSECTORIAL COLLABORATION	It has several agreements with traditional national and international insurance companies that develop projects in the InsurTech sector. Collaborates with different universities in the generation of knowledge concerning digital trust from a technical and ethical point of view.
	ECONOMIC SUSTAINABILITY AND LONG-TERM VIABILITY	Received funding from Seedcamp (European fund for seed capital of a technological nature). Later, it was hosted by *500 Startups* (accelerator in Silicon Valley) and in 2014 received about 5 million risk capital from different investors in a round of financing.
	OPENNESS OF INNOVATION	It is creating an online reputation standard based on a scale of personal reliability, adding information available online and verified with offline information so that the user can employ it as an asset to access opportunities that are traditionally measured according to the risk. Part of open and transparent innovation. Bases its technological development on open source and blockchain, and publishes demos of its advances in its web.
	SCALABILITY AND REPLICABILITY	The model has been presented as an example of a successful innovation in various international congresses. It is in the process of international expansion, including to the Asian market.
PRIZES, CERTIFICATES AND ACKNOWLEDGEMENTS		Winner of BizCamp (Tel Aviv, 2012) Winner of Seedcamp (Berlin, 2012) Winner of Digital Insurance Agenda DIAmond Winner of BBVA Open Talent 2013 Winner of Spain Internet Startup 2013 Winner of Emprendedor XXI de La Caixa (Madrid, 2013)

Source: Arroyo et al. (2017) from Hagel (2015)

Table 16. Success cases of Digital Social Innovation-II

INITIATIVE: **PLAYGROUND** (origin: Spain. Operating in various countries. Global reach). Founded in 2008.		
DESCRIPTION Digital communication platform that aims to generate social change by telling stories in an empathic way. It is directed towards millennials. Its motto is *Wake up*.		
SUCCESS FACTORS	SOCIAL IMPACT	More than 11 million followers on Facebook, with a steady rate of growth, and some 100,000 on Twitter. In 2016 it was among the top 6 video *publishers* on Facebook and remains among the top 10.
	INTERSECTORIAL COLLABORATION	Started collaborating with music festivals and, through PlayGround Do, told stories together with Greenpeace and UNICEF.
	ECONOMIC SUSTAINABILITY AND LONG-TERM VIABILITY	Its main source of income is PlayGround Studio, a content creation agency for third parties. It is in the process of selling a small part of the company to investors in order to consolidate the initiative.
	OPENNESS OF INNOVATION	It is an information and action platform (*Like, Share & Do*), with a vocation to inform and provide tools for the community to transform their own reality.
	SCALABILITY AND REPLICABILITY	It has global reach, with one channel in Spanish and one in English, and has plans to translate into 8 other languages, while increasing staff fivefold.
PRIZES, CERTIFICATES AND ACKNOWLEDGEMENTS		Prize for best online publication awarded by El País (2009) Notodo Prize 2009 for best Internet project

Source: Arroyo et al. (2017) from Hagel (2015)

Table 17. Success cases of Digital Social Innovation-III

<table>
<tr><td colspan="3">INITIATIVE: COMOODLE (origin: Kirklees, West Yorkshire, UK). Started in 2014.</td></tr>
<tr><td colspan="3">DESCRIPTION
Collaborative economy platform that allows the local authority, community groups, and business sectors to share assets in the area of stuff, space, and skills. Invites citizens and community groups to offer, lend, and borrow spaces, skills, and assets such as vehicles, tools, and buildings to provide the community with ancillary services that increasingly fall outside the scope of government. The role of the local authority changes from being the traditional service provider to being a facilitator.</td></tr>
<tr><td rowspan="5">SUCCESS FACTORS</td><td>SOCIAL IMPACT</td><td>Audacious and unique initiative promoted by the municipality to transform the way in which the local authority interacts with the community sector to provide public services. Promotes the creation of relationships, collaboration, and sharing between community groups and businesses to offer social services that the city can no longer offer. Hence, it forms part of the so-called Collaborative Economy.
The data generated seeks to demonstrate that it provides measurable savings, creates social value, and orders social priorities defined at the local level.</td></tr>
<tr><td>INTERSECTORIAL COLLABORATION</td><td>Strong involvement of internal interest groups (actors) within the municipality and external stakeholders with the community sector.
First contact with the business sector and with other cities of the Joint Authority of West Yorkshire, the rest of the UK and Europe.
Regular communication with the City Mayors international network of city mayors.</td></tr>
<tr><td>ECONOMIC SUSTAINABILITY AND LONG-TERM VIABILITY</td><td>In 2014, Bloomberg Philanthropies awarded a grant of £795,700 to run the project for three years (2015–2017), which is the main financial source of the project, and there are also municipal funds and other major contributions. In 2017, a Sustainability Plan was drawn up.</td></tr>
<tr><td>OPENNESS OF INNOVATION</td><td>Innovation open to the entire active community in the form of resilience, responsibility and co-creation: aims to create a strong collaborative culture and transform the way in which people relate to the local authority and work together for the benefit of the community.</td></tr>
<tr><td>SCALABILITY AND REPLICABILITY</td><td>It is a very scalable concept, with platform technologies, which are open source. It is ready and intends to launch in other cities.</td></tr>
<tr><td colspan="2">PRIZES, CERTIFICATES AND ACKNOWLEDGEMENTS</td><td>The project is in the process of development, for which it has received initial recognition (such as the second prize in the Bloomberg Mayors Challenge)</td></tr>
</table>

Source: Arroyo et al. (2017) from Hagel (2015)

FINAL THOUGHTS

As another step in the enormous creation of value and complicity of ICT, the global movement of DSI seeks to advance by converting designed and implemented experiences into social transformations. If initially it arose to satisfy social needs not addressed by governments or the market through the application of digital technology, the large number of projects being carried out and its scale, together with the intentionality of creating this social value, make DSI a powerful vehicle for social progress and for systemic change: this last function is even more important than the first.

More specifically, if most of the DSIs have consisted of combining many elements in a new way to obtain new products or processes, these give more fundamental innovations in the sense that they radically transform some of the basic systems on which we depend—healthcare, learning, housing, food, etc.—and, therefore, produce systemic changes.

We should not forget that people, ideas, and resources must be shared to achieve both dimensions of DSI. In other fields, the demand and supply of these elements do not connect automatically. But the technology sector does have a wide variety of strongly connected institutions: specialists in technology transfer, academic publications, venture capital companies, technology surveillance systems, technology consultants, etc. which, placed at the service of SI, act as social connectors that perceive tendencies and possibilities not visible to the directors of said social entities. In these social connectors and their effectiveness lies a good part of the results that DSIs can achieve as creators of innovations of social impact and transformation. This is one of the reasons why it is difficult for technology and the economy to understand innovation without linking it to sociology.

Here lies the true value of DSI: in its final power to improve current social systems and, therefore, to improve today's society as a whole, and to do so fluently due to its connectors, with speed to adapt to the constant changes of the current environment, and with the power of all digital technology as a tool whose extreme relevance in the field of SI must be internalized to a much greater degree by the actors involved.

After shedding light here on the concepts involved in the field of DSI, it should be assumed that the important structural obstacles that are limiting its lift-off, and that we have identified, will only be slowly and gradually resolved and that, therefore, successful DSI projects will also only be implemented at the same pace. A pace that should be accelerated by the undeniable social utility which that would entail.

REFERENCES

Arroyo, L., Murillo, D., & Val, E. (2017). *Confiados y confiables. La fabricación de la confianza en la era digital.* Instituto de Innovación Social (Esade). Retrieved December 23, 2017, from https://www.slideshare.net/ESADE/estudio-confiados-y-confiables-la-fabricacin-de-la-confianza-en-la-era-digital/1

Bacon, N., Faizullah, N., Mulgan, G., & Woodcraft, S. (2008). *Transformers: how local áreas innovate to address changing social needs*. London: NESTA.

Bass, C. (2014). Social Enterprise through Digital Desig. *Stanford Social Innovation Review*. Retrieved December 12, 2017, from https://ssir.org/podcasts/entry/social_enterprise_through_digital_design

Brian, F., Sestini, F., Gascó, M., Baeck, P., Halpin, H., Almirall, E., & Kresin, F. (2015). *Growing a digital social innovation ecosistem for Europe: DSI Final Report.* Brussels: European Commission. Retrieved March 2, 2018, from https://www.nesta.org.uk/sites/default/files/dsireport.pdf

Bryer, A., Carrier, J. G., Cooper, C., & Ferández, M. ª I., Goddard, V., & Kasmir, S. (2012). *Las políticas de la economía social desde una perspectiva antropológica.* Madrid, Spain: Fundación EOI. Retrieved February 14, 2018, from https://www.eoi.es/es/savia/publicaciones/19615/las-politicas-de-la-economia-social-desde-una-perspectiva-antropologica

Buckland, H., & Murillo, D. (2013a). *Vías hacia el cambio sistémico.* Instituto de Innovación Social (Esade). Retrieved October 14, 2017, from http://itemsweb.esade.es/wi/research/iis/publicacions/2013-04_Antenna-cast.pdf

Buckland, H., & Murillo, D. (2013b). *La Innovación Social en América Latina. Marco conceptual y agentes*. Instituto de Innovación Social (Esade). Retrieved October 18, 2017, from https://www.slideshare.net/ESADE/informe-la-innovacin-social-en-amrica-latina-45162162

Buckland, H., & Murillo, D. (2015). *The Quest for precision. Antenna for Social Innovation. Instituto de Innovación Social*. Esade.

Carta Europea de Principios de la Economía Social. (2002). Déclaration finale commune des organisations européennes de l´Économie Sociale, CEP-CMAF, 20 juin 2002.

Chesbrough, H. (2003, Spring). The era of Open Innovation. *MIT Sloan School of Management*, 35-41.

CitizenLab. (2018). *Civic engagement made really easy.* Retrieved March 20, 2018, from https://www.citizenlab.co/

Conferencia de Helsinki. (2006). *Manifiesto de Helsinki*. Retrieved February 2, 2018, from elivinglab.org/files/Helsinki_Manifesto_201106.pdf

Cubillos, R., Quintero, A. I. C., & Valencia, M. A. (2017). *Colección académica de ciencias sociales. ROAD*. Retrieved March 22, 2018, from http://road.issn.org/issn/2422-0477-coleccion-academica-de-ciencias-sociales

Cutler, L. (2000). Creativity: Essential to technological innovation. *Research Technology Management*, *43*(6), 29–30. doi:10.1080/08956308.2000.11671391

de la Mata, G. (2018a). *Manual de la Innovación Social: de la Idea al Proyecto.* Retrieved December 10, 2017, from http://innovationforsocialchange.org/buy-ebooks/

de la Mata, G. (2018b). *The top 10 Social Innovation Practices*. Retrieved February 20, 2018, from http://innovationforsocialchange.org/downloads/top-10-social-innovation-practices/

de la Mata, G. (2018c). *Labs for Change*. Retrieved March 5, 2018, from http://innovationforsocialchange.org/metodologias-2/nuestra-metodologia-de-cambio-labs-for-change/

Digital Social Innovation. (2018). *About DSI4EU*. Retrieved 15 March, 2018, from https://digitalsocial.eu/about-the-project

DSI EU. (2018a). *About the DSI4EU Project. Digital Social Innovation*. European Union. Retrieved January 20, 2018, from https://digitalsocial.eu/es/about-the-project

Dyer, J., Gregersen, H., & Christensen, C. (2011). *The Innovator's DNA: Mastering the Five Skills of Disruptive Innovators*. Boston, MA: Harvard Business Review Press.

Empodera. (2018). Trazando el mapa de la Innovación Social Digital en Europa. *Empodera*. Retrieved February 25, 2018, from http://empodera.org/trazando-el-mapa-de-la-innovacion-social-digital-en-europa/

European Network of Living Labs. (2006). Retrieved January 12, 2018, from http://www.openlivinglabs.eu/

European Social Innovation Research. (2013). *Measuring and Mapping Social Innovation: About the Discussion.* Retrieved November 16, 2017, from https://www.socialinnovationexchange.org/insights/measuring-and-mapping-social-innovation-about-discussion

Finquelievich, S. (2007). Innovación, tecnología y prácticas sociales en las ciudades: hacia los laboratorios vivientes. *Revista. Iberoamericana de Ciencia, Tecnología y sociedad, 3*(9), 135-152.

Fundación Schwab. (2013). *El rompimiento del pensamiento binario: guía de políticas para extender la innovación social*. Fundación Schwab para la Iniciativa Empresarial Social. Retrieved March 4, 2018, from http://www.esade.edu/esocialhub/centro-de-conocimiento/recursos/el-rompimiento-del-pensamiento-binario-gu%C3%ADa-de-pol%C3%ADticas-para

Gerometta, J., Haussermann, H., & Longo, G. (2005). Social Innovation and Civil Society in Urban Governance: Strategies for an Inclusive City. *Urban Studies (Edinburgh, Scotland)*, *42*(11), 2007–2021. doi:10.1080/00420980500279851

Guerra, A., & Sánchez, L. (2016). Social Entreperneuship Taxonomy: Extremadura Case (Spain). In *Handbook of Research on Social Entrepreneurship and Solidarity Economics*. IGI Global. doi:10.4018/978-1-5225-0097-1.ch019

Guía, I. S. (2018). *Guía de la innovación social.* European Commission (UE). Gobierno de Asturias. Retrieved December 15, 2017, from http://movil.asturias.es/Asturias/descargas/PDF_TEMAS/Asuntos%20Sociales/guia_innovacion_social.pdf

Hagel, J. (2015). The power of platforms. In E. Kelly (Ed.), *Business Ecosystems Come of Age*. Deloitte University Press.

Heunks, F., & Roos, H. (1992). Entrepreneurs in a changing cultural context. In Transnational Business in Europe, Economic and Social Perspectives. Tilburg, The Netherlands: Tilburg University Press.

Hidalgo, A., Chaparro, J., Hernández, Á., Iglesias, S., Pascual, F., Agudo, Á. F., ... Feria, V. H. (2010). *Economía Digital*. Madrid, Spain: Fundación EOI.

Informe, O. C. D. E. (2002). *Measuring the Information Economy*. Retrieved January 15, 2018, from https://www.oecd.org/sti/ieconomy/1835738.pdf

Innovation Union initiative. (2010). *Innovation Union*. Retrieved November 12, 2017, from http://ec.europa.eu/growth/industry/innovation/policy/social_es

Keane, T., Caffin, B., Soto, M., Chauhan, A., Krishnaswamy, R., van Dijk, G., & Wadhawan, M. (2014). *DIY - Development Impact and You: Practical Tools to Trigger and Support Social Innovation*. Nesta – Rockefeller Foundation. Retrieved March 15, 2018, from http://www.esade.edu/esocialhub/centro-de-conocimiento/recursos/the-open-book-social-innovation

Manual de Oslo. (2005). *Manual de Oslo. Directrices para la recogida e interpretación de información relativa a innovación* (3rd ed.). OEDC/European Communities. Retrieved November 16, 2017, from www.madrid.org/bvirtual/BVCM001708.pdf

Mazzella, F., & Sundararajan, A. (2016). *Entering the Trust Age.* Francia: BlaBlaCar.

Monzón, J. L., Antuñano, I., & Marco, F. (2010). *Sectores de la Nueva Economía 20+20. Economía Social*. Madrid, Spain: Fundación EOI.

Monzón, J. L., & Chaves, R. (2012). *La Economía Social en la Unión Europea. Comité Económico y Social Europeo (CESE)*. Unión Europea. Bruxelles, Belgique: Unidad de visitas y publicaciones.

Mulgan, G. (2017). *Big Mind: How Collective Intelligence Can Change Our World*. Princeton University Press.

Mulgan, G., Ali, R., Halkett, R., & Sanders, B. (2007a). *In and out of sync: The challenge of growing social innovations*. London: Nesta.

Mulgan, G., Tucker, S., Ali, R., & Sanders, B. (2007b). *Social Innovation: What it is, why it matters and how it can be accelerated. Oxford Said Business School*. London: Skoll Centre for Entrepreneurship.

Murray, R., Caulier, J., & Mulgan, G. (2010). *The open book of social innovation*. The Young Foundation – Nesta. Retrieved March 3, 2018, from http://www.esade.edu/esocialhub/centro-de-conocimiento/recursos/the-open-book-social-innovation

Nesta. (2017a). *Stories of digital social innovation: Migration*. Retrieved March 15, 2018, from https://www.nesta.org.uk/blog/stories-digital-social-innovation-migration

Nesta. (2017b). *Stories of digital social innovation: Environment*. Retrieved March 15, 2018, from https://www.nesta.org.uk/blog/stories-digital-social-innovation-environment

Nesta. (2017c). *Stories of digital social innovation: Healthcare*. Retrieved March 15, 2018, from https://www.nesta.org.uk/blog/stories-digital-social-innovation-healthcare

Nesta. (2017d). *Stories of digital social innovation: Democracy*. Retrieved March 15, 2018, from https://www.nesta.org.uk/blog/stories-digital-social-innovation-democracy

Nesta. (2017e). *Stories of digital social innovation: Accountability and transparency*. Retrieved March 15, 2018, from https://www.nesta.org.uk/blog/stories-digital-social-innovation-accountability-and-transparency

Nesta. (2017f). *Stories of digital social innovation: Education, work and skills*. Retrieved March 15, 2018, from https://www.nesta.org.uk/blog/stories-digital-social-innovation-education-work-and-skills

Nesta. (2018). *Why are we doing this?* Retrieved March 1, 2018, from https://www.nesta.org.uk/project/digital-social-innovation

Nicholls, A., Simon, J., & Gabriel, M. (2015). *New Frontiers in Social Innovation Research*. London, UK: Palgrave Macmillan. doi:10.1057/9781137506801

OCDE. (2014). The digital economy, new business models and key features. In *Addressing the Tax Challenges of the Digital Economy*. Paris, France: OECD Publishing.

Phills, J. A. Jr, Deiglmeier, K., & Miller, D. T. (2008). Rediscovering Social Innovation. *Stanford Social Innovation Review*. Retrieved from https://ssir.org/articles/entry/rediscovering_social_innovation

Prandi, M., & Cano, J. A. (2015). *Coinnovación social.* Esade (Insitituto de Innovación Social) – Fundación Abertis. Retrieved January 12, 2018, from https://www.slideshare.net/ESADE/coinnovacin-social-claves-para-connotar-desde-la-colaboracin

Rodríguez, E., Carreras, I., & Sureda, M. (2012). *Innovar para el cambio social.* Programa Esade-PwC de Liderazgo Social 2011-2012. Esade (Instituto de Innovación Social) – U. Ramon Llull. Retrieved February 5, 2018, from http://itemsweb.esade.es/wi/research/iis/publicacions/2012-InnovarParaCambioSocial-web.pdf

Schumpeter, J. (1992). *Capitalism, Socialism and Democracy*. London: Routledge.

Simon, J., Millard, J., Keller, J. R., Carpenter, G., Schimpf, G., & Leszek, P. (2014). *Doing Social Innovation. A Guide for Practitioners.* Social Innovation Europe. Retrieved November 24, 2018, from http://www.esade.edu/esocialhub/centro-de-conocimiento/recursos/doing-social-innovation-guide-practitioners

Social Innovation Exchange. (2018). Retrieved November 18, 2017, from https://www.socialinnovationexchange.org/about-us

Social Investment Package. (2013). *Employment, Social Affairs & Inclusion (EaSI).* Retrieved November 12, 2017, from http://ec.europa.eu/growth/industry/innovation/policy/social_es

Stanford. (2018). *Defining Social Innovation*. Center for Social Innovation. Stanford Graduate School of Business. Retrieved December 21, 2017, from https://www.gsb.stanford.edu/faculty-research/centers-initiatives/csi/defining-social-innovation

Stokes, M., & Baeck, P. (2017). Number of European 'tech for good' projects doubles in two years. *Financial Times*. Retrieved January 25, 2018, from https://www.ft.com/content/6dc79e0e-8db1-11e7-9580-c651950d3672

Stokes, M., Baeck, P., & Baker, T. (2017). *What next for Digital Social Innovation?* European Union. Eddie Copeland. Retrieved January 18, 2018, from https://www.nesta.org.uk/publications/what-next-digital-social-innovation-realising-potential-people-and-technology-tackle-social-challenges

Stokes, M., Baeck, P., & Baker, T. (2017). *What Next for Digital Social Innovation?* European Union. Retrieved January 4, 2018, from https://www.nesta.org.uk/publications/what-next-digital-social-innovation-realising-potential-people-and-technology-tackle-social-challenges

Vargas, J. G. (2013). Sustentabilidad organizacional y capital social organizacional para el desarrollo ambiental y económico. El caso de las micro y pequeñas empresas en la explotación del tule Typha spp de la Laguna de Zapotlán. *Revista de Formación Gerencial*, *12*(1), 292–326.

KEY TERMS AND DEFINITIONS

Barriers to DSI: Obstacles that inhibit DSI from being undertaken.

Digital Economy: Refers to an economy based on ICT technologies as a means of communication and value creation.

Digital Social Innovation (DSI): Innovation that uses digital technologies to enable or help carry out SI.

Good Practices in DSI: Real DSI cases that, if they respect the framework of action that considers them *good*, become success stories in DSI.

Innovation: In a company, it consists of the introduction of a product (goods or services) or a new or significantly improved process, or a new marketing or organizational method that is applied to the practice of the company, to the organization of work or to external relations. But it is only considered innovation if its introduction is sold or applied successfully.

Social Economy (SE): The set of microeconomic entities, companies of people, free and voluntary, private, that is created from civil society, and that, with democratic decision processes, develop an economic activity with the priority of satisfying the needs of people, before giving back to or repaying their investors.

Social Innovation (SI): That innovation that generates new ideas destined to solve social problems, that is to say, innovation in the social economy.

ENDNOTE

1 For the purposes of this work, the term *social* covers strictly social, environmental, and good corporate governance.

Chapter 11
Organizations of Social Entrepreneurship in Croatia:
Entrepreneurial Orientation in the Context of Performance

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ABSTRACT

This chapter focuses on organizations of social entrepreneurship (SE) in Croatia. It primarily aims to 1) measure the level of their entrepreneurial orientation (EO), and social, economic, and overall performance; 2) explore the relationship between organizational EO and these three types of performance. While the topic represents a heavily investigated research field in the context of commercial entrepreneurship, it hasn't caught much attention among researchers of SE. So far, none of the above-mentioned variables have been empirically investigated within the SE scene in Croatia. The sample included 46 organizations, each represented by one highly ranked executive. The main findings revealed a relatively high level of organizational EO and social, economic, and overall performance, as well as a positive relationship among the variables.

INTRODUCTION

This study explores social entrepreneurship (SE) in Croatia. It focuses on the entrepreneurial orientation (EO) of organizations in the context of their performance.

The paper starts with basic definitions of key terms. Hence, SE organizations are conceptualized as social mission-oriented organizations that start and continuously run businesses and use them as a

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means necessary for accomplishing their social missions (Dees, 1998; Dees & Anderson, 2003; Pomerantz, 2003; Mair & Marti, 2006). An example of a social mission is improvement of the quality of life among people who live in poverty. EO stands for the "degree" of entrepreneurship (Morris & Sexton, 1996). According to Miller's definition (1983; Miller & Friesen, 1983), it consists of three dimensions: innovation, proactiveness, and risk taking. "Innovativeness is the predisposition to engage in creativity and experimentation" (e.g. developing new business models and products); "proactiveness is an opportunity-seeking, forward-looking perspective", but, unlike innovativeness, it does not necessarily include introducing novelties (e.g. exploiting commercial opportunities before competitors do); and "risk taking involves taking bold actions by venturing into the unknown" (Rauch, Wiklund, Lumpkin, & Frese, 2009, p. 763; Pearce, Fritz, & Davis, 2010; Morris, Webb, & Franklin, 2011). Performance of SE organizations, due to the nature of their goals, embraces social and economic performance (Arena, Azzone, & Bengo, 2015). Social performance covers the realm of social mission achievement, while economic performance refers to commercial/financial aspects of organizations (Bagnoli & Megali, 2011; Arena et al., 2015).

The rationale for the study emerges from the following insights. The role of EO in performance of commercial entrepreneurship organizations has been heavily investigated over the last three decades (Rauch et al., 2009; Zur, 2013). Therefore, for the purpose of taking an inventory of the research field, Rauch et al. (2009) analyzed 51 studies conducted between 1986 and 2006 (encompassing 14259 organizations in total). The conclusion revealed that "businesses are likely to benefit from pursuing an EO", which makes this kind of investigations relevant for scholars and practitioners (Rauch et al., 2009, p. 778). However, the subject has not captured great attention among researchers of SE – despite the fact that an immense portion of SE organizations all over the world often faces serious economic performance difficulties due to various internal (e.g. staff with weak commercial and governance skills) and/or external factors (e.g. creditors and investors lack interest for business cooperation) (Hines, 2005; Morris, Coombes, Schindehutte, & Allen, 2007; Battilana & Dorado, 2010; Meadows & Pike, 2010; Young & Kim, 2015).

Within the SE scene in Croatia, neither the relationship nor each of the variables alone was empirically investigated.

The paper is organized through five sections: the research background section, which contains elaboration of the basic features of SE organizations and presentation of previous research findings on the topic; research aims and hypothesis; the methodology; the results; and the discussion and conclusion.

BACKGROUND

The Basic Features of SE Organizations

Since a widely-accepted, comprehensive understanding about distinctive features of SE does not exist (Dacin, Dacin, & Matear, 2010; Hill, Kothari, & Shea, 2010; Bacq & Janssen, 2011), the authors briefly elaborate on several key aspects of the kind of organizations this study explored.

1. **The Ultimate Aim:** It represents a fundamental difference between organizations of commercial and social entrepreneurship (Dees, 1998). Unlike the first ones, the ultimate aim of an SE organization is not to maximize profit for the owners/shareholders but to "create social value for the public good" (Dees, 1998; Austin, Stevenson, & Wei-Skillern, 2006, p. 3; Martin & Osberg, 2007; Bacq

& Janssen, 2011). Therefore, since being social mission-driven is a "conditio sine qua non", even the most socially responsible profit-driven organizations (e.g. big ones with highly influential CSR departments or small/medium-sized ones based on solidarity and fair-trade principles), despite all the social benefits they produce, cannot be labelled as a part of SE (Dees & Anderson, 2003; Bacq & Janssen, 2011).

2. **Usage of Different Types of Income Streams:** Before proceeding, it is important to state that throughout the paper the term social mission-driven organizations will be used interchangeably with the term not-for-profit organizations (Nicholls, 2006). Hence, this aspect reveals a fundamental difference between traditional not-for-profits (e.g. advocacy NGO's) and SE organizations (Nicholls, 2006). Namely, the entire body of not-for-profits has two income streams at disposal: the non-commercial income stream, i.e. money from grants, donations, and public subsidies; and the commercial income stream, i.e. money from trading products in the free market (Nicholls, 2006; see: Dees, 1998). While traditional not-for-profits either do not use the commercial income stream at all or (occasionally) use it as the accessory/supportive income stream, money that comes from trading products in the free market represents a necessity for the sustainability of SE organizations (Nicholls, 2006; Nicholls & Cho, 2006).
3. **Social Impact:** The SE field consists of local scope, limited resource small-scale ventures involved in meeting local, often less prominent social needs; local to national scope ventures that address social needs through their own formal platforms complementary or alternative to official social institutions; and/or predominantly national scope ventures in charge of (formal) platforms built to completely replace ineffective official social institutions (Zahra, Gedajlovic, Neubaum, & Shulman, 2009).
4. **Hybrid/Dual Management Logic:** SE organizations operate in an environment where for-profit and not-for-profit logic need to be applied simultaneously (Mort, Weerawardena, & Carnegie, 2003; see: Bruneel, Moray, Stevens, & Fassin, 2016). To be able to recognize and fully exploit business opportunities, i.e. to make money, they use commercial skills, techniques, and logic (Pomerantz, 2003). However, regardless of (financial) costs, the for-profit logic won't be applied at the expense of social mission achievement and social values an organization stands for (Mort et al., 2003).
5. **Profit Distribution:** A possible financial surplus (profit) usually gets completely reinvested into the business – although, it also might be distributed among shareholders/members of an organization, but only "to a limited extent, thus avoiding a profit maximizing behavior" (Nicholls, 2006; Defourny & Nyssen, 2010, p. 47).
6. **Business Industries:** SE organizations can be active within any of the business industries (Nicholls, 2006). Commercial activities can be organized in a way that either directly create social benefits or don't (Fowler, 2000). While in the first case these activities are social mission-related, in the latter case they just serve as a source of income for mission achievement (Fowler, 2000).
7. **Legal Forms:** SE spans a wide range of legal forms: from traditional not-for-profit legal forms such as associations, foundations, and charities; traditional for-profit forms such as sole proprietorships, limited liability companies, corporations, and cooperatives; to hybrid (for profit and not-for-profit) forms tailored for SE such as "Community Interest Company" in the UK or "Social Purpose Company" in Belgium (Nicholls, 2006; Bacq & Janssen, 2011).
8. **The Approach Towards Internal and External Environment:** SE organizations treat their employees/members, beneficiaries, business partners, customers, public, nature, and the legal framework in a fair, respectful way (Bagnoli & Megali, 2011). The exact content of the fairness

and respectfulness depends on the context an organization operates within. As an illustration, while democratic decision making is crucial in SE cooperatives, it does not represent a necessity in an SE limited liability company started by a single person.

To conclude, this way of defining SE has traditionally been less represented in the continental Europe than in the UK and USA (Kerlin, 2006; Defourny & Nyssens, 2010). Taking into account the subject of the study, the authors opted for the business-oriented conceptualization where the focus is on the commercial aspect of not-for-profits (Huybrecht & Nicholls, 2012). The presented features (almost exclusively) consist of the ideas authored by business school-affiliated scholars (e.g. Anderson, Austin, Bacq, Bagnoli, Dees, Janssen, Mair, Martin, Mort, Nicholls, Zahra) and SE business-oriented professionals (Osberg, Pomerantz).

Previous Research Findings on EO and Performance Among Not-For-Profits

Since for-profits and not-for-profits are led by two fundamentally different logics, none of the research results from the for-profit context was included in this analysis. Furthermore, within the not-for-profit context, the researchers identified only two studies on the subject that dealt explicitly with SE organizations (Duvnäs, Stenholm, Brännback, & Carsrud, 2012; Miles, Verreynne, Luke, Eversole, & Barraket, 2013). Therefore, most of the papers discussed below investigated not-for-profits in general. To acknowledge, as much as possible, the differences between traditional not-for-profits and SE organizations, the authors excluded from the analysis papers about not-for-profits which, due to their nature, obviously cannot be labelled as SE organizations (in the way this paper defines them). For example, the authors excluded the study by Caruana, Ewing, & Ramaseshan (2002), which explored the level of entrepreneurship in Australian not-for-profits because the kind of investigated organizations were public services (which are funded by taxes).

Among conceptual, non-empirical insights, authors reported that entrepreneurial orientation could empower commercially active not-for-profits with numerous (business) strengths and opportunities. For instance, in comparison with conservative organizations, entrepreneurially oriented ones are more likely to be brand-oriented and strategically positioned in the market, more likely to deliver novelty products and prompt tailor-made solutions, maintain and broaden the customer base, maintain and broaden the base of beneficiaries, attract donations and grants, attract and keep skilled workers, and (as the result) have increased profits (Morris, Coombes, Schindehutte, & and Allen, 2007; Morris et al., 2011; Coombes, Morris, Allen, & Webb, 2011; Lumpkin, Moss, Gras, Kato, & Amezcua, 2013). Gamble and Moroz (2014, p. 77) proposed that “a combination of EO and two other key factors, a social mission orientation and financial sustainability orientation, will be a strong predictor of high-growth organizational performance”.

The empirical research findings are divided into three subsections, each discussing the relationship between EO and one dimension of organizational performance. Indicators of performance used in each of the previous studies are presented in the brackets. In most of these studies EO was conceptualized through the three “Miller’s dimensions” (innovativeness, proactiveness, and risk taking).

EO of not-for-profits was found to be mostly positively related to social performance. Coombes et al. (2011) analyzed different types of US not-for-profits and reported EO as positively related to performance in the realm of social purposiveness (e.g. “participation with school/educational programme”, “overall influence on cultural development within your local community”). Hong and Cho (2012) reported innovativeness of not-for-profits in South Korea as positively related, but risk taking as non-significantly related to social performance (the paper did not specify the indicators used to measure performance).

The relationship between EO and economic/financial performance was mostly non-significant. Miles et al. (2013) analyzed different types of Australian not-for-profits - EO was non-significantly related to economic performance (organization's effectiveness and efficiency in comparison with its competitors, aspects of financial sustainability); Morris et al. (2007) analyzed different types of US not-for-profits - EO was non-related to financial performance (revenues, changes in assets, expenses); Coombes et al. (2011) analyzed different types of US not-for-profits - EO was non-significantly related to financial performance (total revenues, net assets, organization's fundraising ratio); Duvnas et al. (2012) analyzed Finnish social enterprises – Innovativeness was non-significantly related to financial performance (operating profit, turnover). However, in Anderson and Helm's (2012) study on different types of US not-for-profits EO was positively related to financial performance (administrative and program expenses, total revenues, surplus margin), while Voss et al. (2005) explored US not-for-profit theatres and concluded that the relationship between each of the three EO dimensions and financial performance varied according to the performance indicator used (royalty revenue, ticket revenue, contributed revenue).

Regarding organizational overall performance, EO was mostly positively related to it. Pearce et al. (2010) analyzed US religious congregations - EO was positively related to performance (member attendance, money voluntarily given by members); Bhuian, Menguc, & Bell (2005) investigated US not-for-profit hospitals - EO was positively related to performance (the paper did not specify the indicators used to measure performance); Barrett, Balloun, & Weinstein (2005, p. 219) analyzed US not-for-profits in health care and education sector – EO was "highly correlated" with performance (this year's vs. last year's performance, the organization's performance vs. the performance of its competitors); Hu and Pang (2013) analyzed different types of not-for-profits in China - the degree of entrepreneurship was positively related to performance (organization's reputation, scope of social mission related activities, ability to achieve the social mission, aspects of financial sustainability). A partially different research finding was revealed by Chen and Hsu (2013), who reported the innovativeness and risk-taking among Taiwanese not-for-profits as curvilinearly related to overall performance (organization's prospect, employees' satisfaction, beneficiaries' satisfaction, the degree of coordination among employees).

Besides the presented, empirical contributions to the analyzed research field were also made through explorations of EO of not-for-profits alone (e.g. Rossheim, Kim, & Ruchelman, 1995; Helm & Anderson, 2010; Davis, Marino, Aaron, & Tolbert, 2011; Lurtz & Kreutzer, 2017), various aspects of SE performance alone (e.g. Spencer, Brueckner, Wise, & Marika, 2016), and the effects of certain variables on the relationship between them (e.g. Chen & Hsu, 2013), as well as through a couple of PhD theses that explored the EO-performance relationship (e.g. Mayberry, 2011; Unchaper, 2013; Ofem, 2014).

MAIN FOCUS OF THE CHAPTER

Research Aims and Hypothesis

The research aims are: a) to measure the level of entrepreneurial orientation of SE organizations in Croatia, b) to measure their social, economic, and overall performance, and c) to explore the relationship between EO and social, economic, and overall performance among these organizations.

Based on the previous research findings in the topic, three hypotheses are set up. EO is expected to be: 1.) positively related to social performance (based on the findings of Coombes et al., 2011), 2.) non-significantly related to economic performance (based on the findings of Miles et al., 2013; Morris et al., 2007; Coombes et al., 2011; and Duvnas et al., 2012), and 3.) positively related to overall performance (based on the findings of Pearce et al., 2010; Bhuian, Menguc, & Bell, 2005; Barrett, Balloun, & Weinstein, 2005; and Hu and Pang, 2013).

Methodology

The data was collected between February and April 2017 using an on-line questionnaire administered via e-mail. The sample, both SE organizations and their members, was selected purposefully. Two criteria were used for the selection of organizations. First, they had to be active in 2017 and possess all the SE features presented in the Research background section. Additionally, and more specifically, at least 25% of their annual income in any year between 2013 and 2015 had to be realized through commercial activities, i.e. by trading products in the free market. This criterion was introduced to make a tangible distinction between traditional social mission-driven organizations (e.g. NGOs) and SE organizations. It needs to be emphasized that this is the first study among empirical investigations on SE in Croatia that made a tangible distinction of any kind between these two types of organizations. The time frame and the proportion of the commercial income stream were defined in line with the "Strategy for the Development of Social Entrepreneurship in the Republic of Croatia for the period 2015-2020", where SE encompassed social mission-oriented organizations that make or plan to make at least 25% of triennial income through entrepreneurial activities[1] (Strategija, 2015, p. 8). The particular three-year period (2013-2015) was analyzed because, at the time the data was collected, 2015 was the last year for which the information about the income structure among Croatian not-for-profits was available. The data necessary for identifying the eligible organizations had been previously collected within the scientific project "iPRESENT-Installation Project for REsearch about Social ENTrepreneurship" (conducted by the Institute of Social Sciences Ivo Pilar and funded by the Croatian Science Foundation). Regarding the selection of members of the organizations, each organization was represented by one highly ranked executive (e.g. owner, CEO, president, managing director).

Based on the presented sampling procedure, the researchers identified 48 organizations of SE in Croatia. All of them were contacted and 46 responded with valid responses. Two organizations did not respond at all. The response rate of 95.8% was achieved through numerous telephone reminder calls to the non-respondents. Concerning the size of the sample, if a clear distinction between for-profits, traditional not-for-profits, and SE organizations is applied in research, a relatively small national sample size is not uncommon for smaller countries. As an illustration, the previously discussed Finnish study (Duvnas, 2012) included 26 SE organizations in the final sample.

The final sample included 21 cooperatives (45.6%), 12 associations (26.1%), 11 limited liability companies (23.9%), and 2 social welfare institutions (4.3%) involved in a wide range of business activities: agricultural activities; food processing; manufacture of voice-controlled assistive technology, concrete products, textiles, clothing, souvenirs, accessories, furniture, cosmetics, and didactic materials; flyer distribution; construction work; real estate, green area, and canal maintenance; moving, house painting, and carwash services; repair and maintenance of household goods; transportation; retail; food service; hostel accommodation; publishing and printing; graphic design; event management; renting workspaces; human health services; social work activities without accommodation; waste management; education, accounting, consultancy, advertising, and market research services. The analyzed organizations were founded between 1996 and 2016, although 33 (71.7%) of them were founded from 2008 onwards. Furthermore, 22 organizations (47.8%) operated in local markets, 20 (43.5%) in the national market, and 4 (8.7%) in international markets. The number of employees varied between 0 and 16; 34 (73.9%) organizations had 5 or less, while 5 (10.9%) organizations had 10 or more. The number of volunteers varied between 0 and 60; 38 (82.6%) organizations had 5 or less, 5 (10.9%) organizations had 10 or more.

Regarding the research instruments, in the not-for-profit context EO was measured by various questionnaires most of which were based on a couple of instruments created for measuring EO within the for-profit context (e.g. Miller & Friesen, 1983; Covin & Slevin, 1989; Lumpkin & Dess, 1996). This study relied on an adapted version of Morris and Joyce's (1998) scale; it is the scale based on the Miller and Friesen's (1983) EO conceptualization and measuring instrument. In Morris and Joyce's (1998) study the scale produced the three expected factors (innovativeness, risk taking, and proactivenesss) and Cronbach's alpha of 0.800. In the present research participants were asked to indicate the extent to which they agree/disagree with 14 statements about the organization they represented (e.g. "Our management philosophy emphasizes the avoidance of heavy expenditures on developing new programs"). The responses were captured on the 5-item Likert type scale (1=Strongly disagree - 5=Strongly agree). The instrument produced Cronbach's alpha of 0.837. The scale was unidimensional because the Miller EO conceptualization (1983; Miller & Friesen, 1983), this study is based on, is "strongly associated" with "the unidimensional (a.k.a. "composite dimension") view of EO" (Covin & Wales, 2011, p. 681).

In the light of the presented broad range of indicators that was used to measure performance of social mission driven organizations, the following element needs to be emphasized. Economic performance can be measured both objectively (i.e. using the "accounting approach" based on clear/tangible business outcomes such as annual net profit) and subjectively (i.e. by investigating someone's perception of performance) (Barrett et al., 2005; Bagnoli & Megali, 2011). On the other hand, since certain social outcomes of SE ventures are quite unclear/intangible (e.g. increased public awareness about mental health-related issues among long term unemployed people), social performance cannot be measured objectively, but only subjectively (Austin et al., 2006; Lumpkin et al., 2013). In the present study, economic performance was explored solely through the subjective measurement approach. The usage of this approach is common in the investigated field (e.g. Voss & Voss, 2000; Barrett et al., 2005; Miles et al., 2013; Liu et al., 2014; Liu et al., 2015) due to "difficulties in obtaining correct financial data that is of similar nature and period among respondents", and due to "the outright refusal by many to release such information" (Barrett, 2005, p. 218).

Hence, organizational performance was explored using an adapted version of the instrument of Miles et al. (2013) and, to a lesser extent, of Hu and Pang (2013). These instruments measured social and economic performance of social enterprises and not-for-profits in general. In the study of Miles et al. (2013), the reported Cronbach's alpha for social performance scale was 0.74, and 0.71 for economic performance scale. In the present study participants were asked to indicate the extent to which they agree/disagree with 18 statements about the organization they represented. Social performance was measured through 10 statements (e.g. "Beneficiaries/members are satisfied with our services"), and economic performance through 8 statements (e.g. "We use a variety of revenue sources to ensure financial safety"). The socio-economic, i.e. overall performance instrument was composed of joint social performance and economic performance instruments (18 statements in total). The responses were captured on the 5-item Likert type scale (1=Strongly disagree - 5=Strongly agree). The social performance instrument produced Cronbach's alpha of 0.809, economic performance instrument of 0.869, and overall performance instrument of 0.869.

Results and Discussion

This section comprises the description analysis of the variables (entrepreneurial orientation, and social, economic, and overall performance) and the correlation analysis of the variables.

Table 1 illustrates a slightly non-normal distribution of results in the case of overall performance while all the other variables reported non-significant difference from the normal distribution of results.

Furthermore, regarding the EO results, almost all the organizations scored in the upper half of the theoretical range of the scale (14-70). Only one organization (2.2%) scored slightly below the median of the theoretical distribution. The results placed social performance of all the organizations in the upper half of the theoretical range of the scale (10-50). The lowest result was placed at the median of the scale range. Regarding economic performance, most of the results were placed in the upper half of the theoretical range of the scale (8-40). Five organizations (10.9%) scored below the median of the scale range. The overall performance results revealed that almost all the organizations scored in the upper half of the theoretical range of the scale (18-90). Only one organization (2.2%) scored one point below the median of the theoretical distribution.

Table 2 illustrates the correlation analysis of the variables. Since the overall performance results were not normally distributed, along with Pearson's correlation coefficient, Spearman's coefficient was also calculated (the results in the brackets).

As shown in the table above, entrepreneurial orientation of SE organizations in Croatia was strongly positively related to their social performance. The finding supports the first hypothesis (on a positive relationship between the variables) and is consistent with the result of Coombes et al. (2011). EO was also strongly positively related to organizational economic performance. This finding does not support the second hypothesis (on non-significant relationship between the variables) and is consistent with the

Table 1. Descriptive indicators for EO, social, economic, and overall performance

Variable	N	min	max	M	SD	Skew	Kurt	KS-z	p
Entrepreneurial orientation	46	39.0	69.0	56.15	6.922	-0.126	-0.283	0.082	0.200
Social performance	46	30.0	49.0	42.09	5.120	-0.546	-0.718	0.124	0.074
Economic performance	46	18.0	39.0	30.11	5.087	-0.082	-0.525	0.070	0.200
Overall performance	46	53.0	86.0	72.20	8.617	-0.419	-0.415	0.146	0.015

Source: Own elaboration

Table 2. Correlations between the variables (N=46)

	Entrepreneurial Orientation	Social Performance	Economic Performance	Overall Performance
Entrepreneurial orientation	-			(0.765**)
Social performance	.648**	-		(0.824**)
Economic performance	.693**	.425**	-	(0.832**)
Overall performance	.794**	.845**	.843**	-

**p < 0.01
Source: Own elaboration

result of Anderson and Helm (2012). Finally, EO was strongly positively related to organizational overall performance, which supports the third hypothesis (on a positive relationship between the variables) and is consistent with the results of Bhuian et al. (2005), Barrett et al. (2005), Pearce et al. (2010), and Hu and Pang (2013).

Furthermore, although the sample reported a slightly stronger relationship between EO and economic performance than between EO and social performance, the difference was not found to be statistically significant (Fisher's Z-Transformation: $z=0.380$; $p=0.704$).

Additionally, the table reveals social performance as positively related to economic performance of SE organizations in Croatia.

The discussion embraces five aspects of the results.

First, if the study did not include only social mission-driven organizations that made at least 25% of annual income through commercial activities, some fundamental characteristics of the national SE scene would most likely look significantly different. As an illustration, Šimleša, Bušljeta Tonković, & Puđak (2016) and Šimleša, Puđak, Majetić, & Bušljeta Tonković (2015) did a mapping of the scene for the period between 2013 and 2014 without applying this specific criterion in the sampling procedure (the rest of their criteria for selecting organizations broadly corresponds to this study's basic selection criteria). Hence, while the authors (of this paper) identified 48 SE organizations on the scene, they identified 95 of them in 2013 and 90 in 2014. Furthermore, 60% of all organizations included in their mapping for 2014 was founded until (and including) 2008, and associations were found to be the most represented legal form (48.9%). In the present study, the most represented legal form were cooperatives (45.6%) and 71.7% of organizations were founded from 2008 onwards. The relatively high proportion of organizations that were founded during the economic crisis in Croatia (2008 onwards) might be related to the economic crisis setting alone. Namely, on the one hand, the overall lack of money in the market led to increased social needs and decreased ability of official institutions to fulfil them (e.g. to provide more social transfers). On the other hand, the unstable and shrinking job market might have triggered some unemployed, socially sensitive people to look for self-employment opportunities and start SE organizations.

Second, the relatively high level of EO and socio-economic performance of the SE organizations might be related to the sampling procedure, i.e. again with the "25%" criterion. Namely, it seems reasonable to expect that social mission-driven organizations that made notable financial achievements by trading products in the free market demonstrate a significant degree of entrepreneurship. Furthermore, it also seems reasonable to expect that these organizations report a relatively high level of economic performance that, consequently, enables them to better achieve their social missions/social purpose, i.e. to reach a relatively high level of social performance (see: Pomerantz, 2003). In the light of this reasoning, it would be interesting to explore how much the results would change if the research embraced all not-for-profits in Croatia that made, for instance, at least 15% of annual income through commercial activities.

The relatively high level of economic performance might as well be related to the fact that it exhibits the respondents' perception of their organization's economic performance. Again, it would be interesting to explore how much the result would change if some tangible/objective economic data (e.g. financial reports) was added to the analysis.

The relatively high level of EO might also be related to certain features of environment the SE organizations operate within. Namely, a complex, turbulent, uncertain (even hostile) environment accompanied by the overall lack of funding options might force social mission driven organizations (their managers) to think and act as entrepreneurially as possible (Morris et al., 2007).

Third, the finding regarding the unsupported hypothesis on non-significant relationship between EO and economic performance might be related to differences in the approach taken for economic performance measurement. Namely, this paper's findings were the result of subjective measurement, and the previous research findings (which the hypothesis was derived from) were the result of predominantly objective measurement.

Fourth, the revealed positive relationship between social and economic performance was rather expected. Namely, as previously mentioned, a better commercial/economic performance enables SE organizations to perform better in the social realm. On the other hand, if an organization demonstrates a solid social performance, it seems reasonable to expect that this will positively reflect on its market position (e.g., gain more customers), and, consequently, on its economic performance (Dees & Anderson, 2003).

Fifth, while the strengths and opportunities of being entrepreneurial in the not-for-profit context are quite clear at this point, what about potential organizational threats and weaknesses of nurturing EO in this realm? Following the work of Morris et al. (2007; 2011), and Lumpkin et al. (2013), being overly entrepreneurial might shift an organization's primary focus and key resources from enhancing the social dimension (social mission achievement) to enhancing the economic/commercial dimension. This could, the above-mentioned authors underlined, endanger its social performance and brand reputation, which might lead to dissatisfaction of all major stakeholders. For instance, if beneficiaries' needs are inadequately served and this gets widely/publicly recognized, it seems reasonable to expect that neither employees/members and volunteers nor customers, donors, grant providers, and public would be interested in further supporting or collaborating with such an organization. However, even if being overly entrepreneurial did not negatively reflect on any aspect of the venture, it still might be a highly controversial subject for the above-mentioned stakeholders who might just have a more conservative general image of how a social mission-driven organization should operate (Morris et al., 2011).

SOLUTIONS AND RECOMMENDATIONS

Two basic recommendations regarding the improvement of EO and the overall (socio-economic) organizational performance are to be presented. First, it might beneficial for a part of managers (management teams) to make the mental switch from being entrepreneurial activists to becoming social-mission oriented entrepreneurs. This could, consequently, encourage them to (further) enhance their commercial skills and competences. Second, regarding the need to balance between accomplishing commercial and social goals (on the daily basis), it might be beneficial to assign each of these activities to different teams (within the same organization) and open the "spaces of negotiation" between them i.e. open the space where the for-profit and not-for-profit logic would/could interact and complement each other (Battilana, Metin, Pache, & Model, 2015).

FUTURE RESEARCH DIRECTIONS

The presented results could provoke new thematically akin investigations. For instance, what are the determinants of socio-economic performance and EO among SE organizations in Croatia? Is there a turning point in their relationship, i.e. is there a level of EO where its relationship with performance shifts from being positive to negative? What are the moderators of that relationship? What are the most efficient managerial practices for securing a beneficial social and economic performance? For example, what does it take for WISEs (Work Integration Social Enterprises) to successfully deal with the necessity of employing a significant number of people from vulnerable populations (e.g. mentally disabled, long-term unemployed people) and achieving/maintaining financial self-sustainability? This paper can be a starting point for authors dedicated to answering these and other similar questions.

CONCLUSION

The results revealed a relatively high level of EO as well as social, economic, and overall performance among SE organizations in Croatia. Furthermore, their EO was strongly positively related to the social, economic, and overall performance. The social performance was found to be positively related to the economic performance. The major value of the study lies in the fact that: a) none of the previous empirical studies on SE in Croatia made a clear, tangible distinction between traditional not-for-profits and SE organizations, and b) neither performance nor entrepreneurial orientation of SE organizations was previously empirically investigated within the national scene.

REFERENCES

Andersson, F. O., & Helm, S. (2012). *Do Socially Entrepreneurial Nonprofits Perform Better: An Empirical Exploration.* Paper presented at New York University's Stern Conference on Social Entrepreneurship, New York, NY. Retrieved March 1, 2017, from http://bloch.umkc.edu/faculty-staff/documents/andersson-helm-conference.pdf

Arena, M., Azzone, G., & Bengo, I. (2015). Performance Measurement for Social Enterprises. *Voluntas*, *26*(2), 649–672. doi:10.100711266-013-9436-8

Austin, J., Stevenson, H., & Wei-Skillern, J. (2006). Social and Commercial Entrepreneurship: Same, Different, or Both? *Entrepreneurship Theory and Practice*, *30*(1), 1–22. doi:10.1111/j.1540-6520.2006.00107.x

Bacq, S., & Janssen, F. (2011). The multiple faces of social entrepreneurship: A review of definitional issues based on geographical and thematic criteria. *Entrepreneurship and Regional Development*, *23*(5-6), 373–403. doi:10.1080/08985626.2011.577242

Bagnoli, L., & Megali, C. (2011). Measuring Performance in Social Enterprises. *Nonprofit and Voluntary Sector Quarterly*, *40*(1), 149–165. doi:10.1177/0899764009351111

Barrett, H., Balloun, J. L., & Weinstein, A. (2005). The impact of creativity on performance in non-profits. *International Journal of Nonprofit and Voluntary Sector Marketing*, *10*(4), 213–223. doi:10.1002/nvsm.25

Battilana, J., & Dorado, S. (2010). Building sustainable hybrid organizations: The case of commercial microfinance organizations. *Academy of Management Journal*, *53*(6), 1419–1440. doi:10.5465/amj.2010.57318391

Battilana, J., Metin, S., Pache, A. C., & Model, J. (2015). Harnessing Productive Tensions in Hybrid Organizations: The Case of Work Integration Social Enterprises. *Academy of Management Journal*, *58*(6), 1658–1685. doi:10.5465/amj.2013.0903

Bhuian, S. N., Menguc, B., & Bell, S. J. (2005). Just entrepreneurial enough: The moderating effect of entrepreneurship on the relationship between market orientation and performance. *Journal of Business Research*, *58*(1), 9–17. doi:10.1016/S0148-2963(03)00074-2

Bruneel, J., Moray, N., Stevens, R., & Fassin, Y. (2016). Balancing Competing Logics in For-Profit Social Enterprises: A Need for Hybrid Governance. *Journal of Social Entrepreneurship*, *7*(3), 263–288. doi:10.1080/19420676.2016.1166147

Caruana, A., Ewing, M. T., & Ramaseshan, B. (2002). Effects of some Environmental Challenges and Centralization on the Entrepreneurial Orientation and Performance of Public Sector Entities. *Service Industries Journal*, *22*(2), 43–58. doi:10.1080/714005076

Chen, H. L., & Hsu, C.-H. (2013). Entrepreneurial orientation and firm performance in non-profit service organizations: Contingent effect of market orientation. *Service Industries Journal*, *33*(5), 445–466. do i:10.1080/02642069.2011.622372

Coombes, S. M. T., Morris, M. H., Allen, J. A., & Webb, J. W. (2011). Behavioural Orientations of Non-Profit Boards as a Factor in Entrepreneurial Performance: Does Governance Matter? *Journal of Management Studies*, *48*(4), 829–856. doi:10.1111/j.1467-6486.2010.00956.x

Covin, J. G., & Slevin, D. P. (1989). Strategic Management of Small Firms in Hostile and Benign Environments. *Strategic Management Journal*, *10*(1), 75–87. doi:10.1002mj.4250100107

Dacin, P. A., Dacin, M. T., & Matear, M. (2010). Social Entrepreneurship: Why We Don't Need a New Theory and How We Move Forward from Here. *The Academy of Management Perspectives*, *24*(3), 37–57.

Davis, J. A., Marino, L. D., Aaron, J. R., & Tolbert, C. L. (2011). An Examination of Entrepreneurial Orientation, Environmental Scanning, and Market Strategies of Nonprofit and For-Profit Nursing Home Administrators. *Nonprofit and Voluntary Sector Quarterly*, *40*(1), 197–211. doi:10.1177/0899764009351112

Dees, J. G. (1998). *The Meaning of Social Entrepreneurship*. Retrieved 15 February, 2017, from http://www.sosyalinovasyonmerkezi.com.tr/yayin/2020010002.pdf

Dees, J. G., & Anderson, B. B. (2003). For-Profit Social Ventures. *International Journal of Entrepreneurship Education*, *2*, 1–26.

Defourny, J., & Nyssens, M. (2010). Conceptions of Social Enterprise and Social Entrepreneurship in Europe and the United States: Convergences and Divergences. *Journal of Social Entrepreneurship*, *1*(1), 32–53. doi:10.1080/19420670903442053

Duvnäs, H., Stenholm, P., Brännback, M., & Carsrud, A. L. (2012). What are the Outcomes of Innovativeness within Social Entrepreneurship? The Relationship Between Innovative Orientation and Social Enterprise Economic Performance. *Journal of Strategic Innovation and Sustainability*, *8*(1), 68–80.

Fowler, A. (2000). NGDOs as a moment in history: Beyond aid to social entrepreneurship or civic innovation? *Third World Quarterly*, *21*(4), 637–654. doi:10.1080/713701063

Gamble, E. N., & Moroz, P. W. (2014). Unpacking Not-for-profit Performance. *Journal of Social Entrepreneurship*, *5*(1), 77–106. doi:10.1080/19420676.2013.834457

Helm, S. T., & Andersson, F. O. (2010). Beyond taxonomy- An empirical validation of social entrepreneurship in the nonprofit sector. *Nonprofit Management & Leadership*, *20*(3), 259–276. doi:10.1002/nml.253

Hill, T. L., Kothari, T. H., & Shea, M. (2010). Patterns of Meaning in the Social Entrepreneurship Literature: A Research Platform. *Journal of Social Entrepreneurship*, *1*(1), 5–31. doi:10.1080/19420670903442079

Hines, F. (2005). Viable social enterprise: An evaluation of business support to social enterprises. *Social Enterprise Journal*, *1*(1), 13–28. doi:10.1108/17508610580000704

Hong, J. H., & Cho, D. H. (2012). The Effects of Market Orientation, Entrepreneurial Orientation and Social Networks on the Social Performance of Non-profit Organizations. In *Computer Applications for Web, Human Computer Interaction, Signal and Image Processing, and Pattern Recognition. Communications in Computer and Information Science* (pp. 240–248). Berlin: Springer. doi:10.1007/978-3-642-35270-6_33

Hu, Y., & Pang, X. (2013). Social Entrepreneurial Orientation and Performance of Nonprofit Organizations: An Empirical Study in China. *Journal of Applied Sciences (Faisalabad)*, *13*(19), 3989–3994. doi:10.3923/jas.2013.3989.3994

Huybrechts, B., & Nicholls, A. (2012). Social Entrepreneurship: Definitions, Drivers and Challenges. In *Social Entrepreneurship and Social Business: An Introduction and Discussion with Case Studies* (pp. 31–48). Wiesbaden: Springer-Gabler. doi:10.1007/978-3-8349-7093-0_2

Kerlin, J. A. (2006). Social Enterprise in the United States and Europe: Understanding and Learning from the Differences. *Voluntas*, *17*(3), 247–263. doi:10.100711266-006-9016-2

Lumpkin, G. T., & Dess, G. G. (1996). Clarifying the Entrepreneurial Orientation Construct and Linking It to Performance. *Academy of Management Review*, *21*(1), 135–172. doi:10.5465/amr.1996.9602161568

Lumpkin, G. T., Moss, T. W., Gras, D. M., Kato, S., & Amezcua, A. S. (2013). Entrepreneurial processes in social contexts: How are they different, if at all? *Small Business Economics*, *40*(3), 761–783. doi:10.100711187-011-9399-3

Lurtz, K., & Kreutzer, K. (2017). Entrepreneurial Orientation and Social Venture Creation in Nonprofit Organizations: The Pivotal Role of Social Risk Taking and Collaboration. *Nonprofit and Voluntary Sector Quarterly*, *46*(1), 92–115. doi:10.1177/0899764016654221

Mair, J., & Marti, I. (2006). Social entrepreneurship research: A source of explanation, prediction, and delight. *Journal of World Business*, *41*(1), 36–44. doi:10.1016/j.jwb.2005.09.002

Martin, R. L. & Osberg, S. (2007). Social entrepreneurship: the case for definition. *Stanford Social Innovation Review, 5*(2).

Mayberry, C. L. (2011) *Social entrepreneurs: the role of entrepreneurial orientation and leadership style in non-profit organizations* (Unpublished doctoral dissertation). The University of British Columbia, Vancouver, Canada.

Meadows, M., & Pike, M. (2010). Performance Management for Social Enterprises. *Systemic Practice and Action Research*, *23*(2), 127–141. doi:10.100711213-009-9149-5

Miles, M. P., Verreynne, M.-L., Luke, B. G., Eversole, R., & Barraket, J. (2013). The Relationship of Entrepreneurial Orientation, Vineentian Values and Economie and Social Performance in Social Enterprise. *St John's University- Review of Business*, *33*(2), 91–102.

Miller, D. (1983). The correlates of entrepreneurship in three types of firms. *Management Science*, *29*(7), 770–791. doi:10.1287/mnsc.29.7.770

Miller, D., & Friesen, P. H. (1983). Strategy-Making and Environment: The Third Link. *Strategic Management Journal*, *4*(3), 221–235. doi:10.1002mj.4250040304

Morris, M. H., Coombes, S., Schindehutte, M., & Allen, J. (2007). Antecedents and Outcomes of Entrepreneurial and Market Orientations in a Non-profit Context: Theoretical and Empirical Insights. *Journal of Leadership & Organizational Studies*, *13*(4), 12–39. doi:10.1177/10717919070130040401

Morris, M. H., & Joyce, M. L. (1998). On the measurement of entrepreneurial behavior in Not--for--profit organizations: Implications for social marketing. *Social Marketing Quarterly*, *4*(4), 93–104. doi:10.1080/15245004.1998.9961027

Morris, M. H., & Sexton, D. L. (1996). The concept of entrepreneurial intensity: Implications for company performance. *Journal of Business Research*, *36*(1), 5–13. doi:10.1016/0148-2963(95)00158-1

Morris, M. H., Webb, J. W., & Franklin, R. J. (2011). Understanding the Manifestation of Entrepreneurial Orientation in the Nonprofit Context. *Entrepreneurship Theory and Practice*, *35*(5), 947–971. doi:10.1111/j.1540-6520.2011.00453.x

Mort, G. S., Weerawardena, J., & Carnegie, K. (2003). Social entrepreneurship: Towards conceptualization. *International Journal of Nonprofit and Voluntary Sector Marketing*, *8*(1), 76–88. doi:10.1002/nvsm.202

Nicholls, A. (2006). Introduction. In A. Nicholls (Ed.), *Social Entrepreneurship. New Models of Sustainable Social Change* (pp. 1–35). Oxford, UK: Oxford University Press.

Nicholls, A., & Cho, A. N. (2006). Social entrepreneurship. The structuration of a field. In A. Nicholls (Ed.), *Social Entrepreneurship. New Models of Sustainable Social Change* (pp. 99–118). Oxford, UK: Oxford University Press.

Ofem, B. (2014) *Entrepreneurial orientation, collaborative networks, and nonprofit performance* (Unpublished doctoral dissertation). University of Kentucky, Lexington, KY.

Pearce, J. A. II, Fritz, D. A., & Davis, P. S. (2010). Entrepreneurial orientation and the performance of religious congregations as predicted by rational choice theory. *Entrepreneurship Theory and Practice*, *34*(1), 219–248. doi:10.1111/j.1540-6520.2009.00315.x

Pomerantz, M. (2003). The Business of Social Entrepreneurship in a "Down Economy". *Business (Atlanta, Ga.)*, *25*(2), 25.

Rauch, A., Wiklund, J., Lumpkin, G. T., & Frese, M. (2009). Entrepreneurial Orientation and Business Performance: An Assessment of Past Research and Suggestions for the Future. *Entrepreneurship Theory and Practice*, *33*(3), 761–787. doi:10.1111/j.1540-6520.2009.00308.x

Rossheim, B. N., Kim, P. S., & Ruchelman, L. (1995). Managerial Roles and Entrepreneurship in Nonprofit Urban Arts Agencies in Virginia. *Nonprofit and Voluntary Sector Quarterly*, *24*(2), 143–166. doi:10.1177/089976409502400205

Šimleša, D., Bušljeta Tonković, A., & Puđak, J. (2016). Društveno poduzetništvo u Hrvatskoj: Od prepoznavanja do primjene. *Revija za Sociologiju*, *46*(3), 271–295.

Šimleša, D., Puđak, J., Majetić, F., & Bušljeta Tonković, A. (2015). *Mapping New Horizons. Report on the state of social entrepreneurship in Croatia 2015*. Zagreb: Institute of Social Sciences Ivo Pilar.

Small Business Service. (2005). *Social Enterprise Survey Across the UK*. Retrieved on 16 January 2018 from www.dti.gov.uk/socialenterprise

Spencer, R., Brueckner, M., Wise, G., & Marika, B. (2016). Australian indigenous social enterprise: Measuring performance. *Journal of Enterprising Communities: People and Places in the Global Economy*, *10*(4), 397–424. doi:10.1108/JEC-10-2015-0050

The Government of the Republic of Croatia. (2015). Strategy for the Development of Social Entrepreneurship in the Republic of Croatia for the period 2015-2020. Zagreb, Croatia: Author.

Uncapher, P. C. (2013) *The Relationship between Entrepreneurial Orientation and Organizational Effectiveness: An Analysis of How Entrepreneurial Orientation is Manifested in the Nonprofit Context* (Unpublished doctoral dissertation). St. John Fisher College, Rochester, NY.

Voss, Z. G., Voss, G. B., & Moorman, C. (2005). An empirical examination of the complex relationships between entrepreneurial orientation and stakeholder support. *European Journal of Marketing*, *39*(9/10), 1132–1150. doi:10.1108/03090560510610761

Young, D. R., & Kim, C. (2015). Can social enterprises remain sustainable and mission focused? Applying resiliency theory. *Social Enterprise Journal*, *11*(3), 233–259. doi:10.1108/SEJ-02-2015-0005

Zahra, S. A., Gedajlovic, E., Neubaum, D. O., & Shulman, J. M. (2009). A typology of social entrepreneurs: Motives, search processes and ethical challenges. *Journal of Business Venturing*, *24*(5), 519–532. doi:10.1016/j.jbusvent.2008.04.007

Żur, A. (2013). Entrepreneurial Orientation and Firm Performance - Challenges for Research and Practice. *Entrepreneurial Business and Economics Review*, *1*(2), 7–28. doi:10.15678/EBER.2013.010202

ADDITIONAL READING

Carvalho, A., & Sampaio, M. (2017). Volunteer management beyond prescribed best practice: A case study of Portuguese non-profits. *Personnel Review*, *46*(2), 410–428. doi:10.1108/PR-04-2014-0081

Cooney, K. (2011). An Exploratory Study of Social Purpose Business Models in the United States. *Nonprofit and Voluntary Sector Quarterly*, *40*(1), 185–196. doi:10.1177/0899764009351591

Habaradas, R. B., & Aure, P. A. H. (2016). Managing Social Enterprises in the Philippines: Challenges and Strategies. *Journal of Legal*. *Ethical and Regulatory Issues*, *19*(2), 39–56.

Håkansson, M., Holden, J. R., Eriksson, A., & Dellve, L. (2017). Managerial Practices that Support Lean and Socially Sustainable Working Conditions. *Nordic journal of working life studies, 7*(3), 63-84.

Imperatori, B., & Cataldo Ruta, D. (2015). Designing a social enterprise: Organization configuration and social stakeholders' work involvement. *Social Enterprise Journal*, *11*(3), 321–346. doi:10.1108/SEJ-08-2014-0034

Moreau, C., & Mertens, S. (2013). Managers' competences in social enterprises: Which specificities? *Social Enterprise Journal*, *9*(2), 164–183. doi:10.1108/SEJ-01-2013-0005

Sanchis-Palacio, J. R., Campos-Climent, V., & Mohedano-Suanes, A. (2013). Management in social enterprises: The influence of the use of strategic tools in business performance. *The International Entrepreneurship and Management Journal*, *9*(4), 541–555. doi:10.100711365-013-0262-7

KEY TERMS AND DEFINITIONS

Economic Performance: Economic performance refers to organizational performance within the realm of commercial activities (i.e., market competition).

Entrepreneurial Orientation: Entrepreneurial orientation refers to the level organization's entrepreneurial behavior.

Overall Performance: Overall performance encompasses social and economic organizational performance.

Social Entrepreneurship: A form of entrepreneurship where actors are not primarily profit-driven but social mission-driven.

Social Performance: Social performance refers to organizational performance within the realm of social mission-achievement and other non-commercial activities.

ENDNOTE

[1] The same commercial income stream related criterion (25%) was used in the UK survey conducted by the Small Business Service (2005).

Chapter 12
Managing Social Innovation Through CSR 2.0 and the Quadruple Helix:
A Socially Inclusive Business Strategy for the Industry 4.0

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ABSTRACT

The quadruple helix models are widely used when you want to have an integrating vision of the strategies used to combat poverty in emerging countries, including Mexico. The objective of this chapter is to propose a novel model of quadruple helix based on ethics and CSR 2.0 that can lay the foundations to develop the Industry 4.0 in emerging countries. To achieve this objective, the author distinguishes between CSR 1.0 and 2.0. Second, these concepts are united with the economy of the common good and the economy of solidarity. These conceptual bases will allow us to develop the relationship between business ethics and the Industry 4.0 to reach some conclusions.

INTRODUCTION

When applied to desired social changes, social innovation is composed of changes in the cultural and regulatory business structure that optimizes collective resources focused on improving socioeconomic development (Heiskala, 2007). These changes are reinforced with the use of Corporate Social Responsibility (CSR) 2.0 policies integrated into a quadruple helix model that is proposed in the chapter. The combination of this socially comprehensive business strategy reinforces the firm and increases its efficiency and the generation of EBITDA (Earnings Before Interests, Taxes, Depreciation, and Amortization). The objective of this work is to propose a Model of Quadruple Helix rooted in CSR 2.0 and the Economy of the Common Good with the goal of promoting the Industry 4.0 grounded in ethics.

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Although Bowen (1953) is considered the modern father of the CSR, also Bernard (1938) and Kreps (1940) have seminally thought about this issue (Milian, 2015). These seminal works have been enlarged by Davis (1960, 1967), cited by Schwartz and Carroll (2003), in which he asks what the entrepreneur owes to society (social mortgage)(Ramírez, 2016; Saiz-Álvarez, 2017a) and what responsibility companies have in front of the community. The role of the entrepreneur in almost all the entrepreneurial ecosystems of the planet is fundamental, especially when technology is applied (Bernal-Conesa *et al.*, 2017). These ecosystems create triple helix models (Carlsson and Stankiewicz, 1991; Carlsson *et al*., 2002; Edquist, 2005; Bergek *et al*., 2005) defined by their diffuseness, heterogeneity, intense focus on institutions, low visibility of the role of individuals in the innovation process, and system boundaries (Ranga and Etzkowitz, 2013). Triple helix models that are drifting toward quadruple helix models (Figure 1). As a result, quadruple helix models are permeating both civil societies and organizations, the need for greater awareness and social support towards the most disadvantaged and that population at risk of social exclusion. Models formed by the positive effects created by the interaction between:

- *Universities*, defined by the 7-K (Know-how, know-why, know-who, know-where, know-whom, know-when, and know-what) (Saiz-Álvarez and García-Ochoa, 2008);
- *Non-governmental organizations* (NGOs) established by the social assistance and the fight against poverty and inequality;
- *Business organizations*, with the creation of positive externalities regarding job creation and wealth for a good part of society; and
- The *public sector*, whose processes of public intervention, mainly through fiscal policy, generate crowding-in effects to benefit the population.

The Latin American and the Caribbean (LAC) countries are strengthening quadruple helix models for social change. While in developed nations individual entrepreneurship is the predominant one, in the developing countries it would be more desirable to create a social enterprise that aims to integrate the most disadvantaged communities, as well as to achieve a process of sustainable social change. Thanks to social entrepreneurship, combined with CSR-based business policies, the methods of social transformation lead to the achievement of more just and solidary societies defined by the creation of a broad middle class that sustains with the payment of taxes to the State. For this reason, public intervention in developing countries is more necessary due to the crowding-in effects it generates since the private sector is fragile. In this sense, the model existing in the countries of the first world must necessarily be different from that which arises in the third world if a real social change is desired.

Based on Carayannis and Campbell (2008) who affirm that the quadruple helix is formed by the sum of multi-level innovation systems and networks, knowledge clusters, and technology-based life cycles, the quadruple helix model defined in this work is created by the amount of:

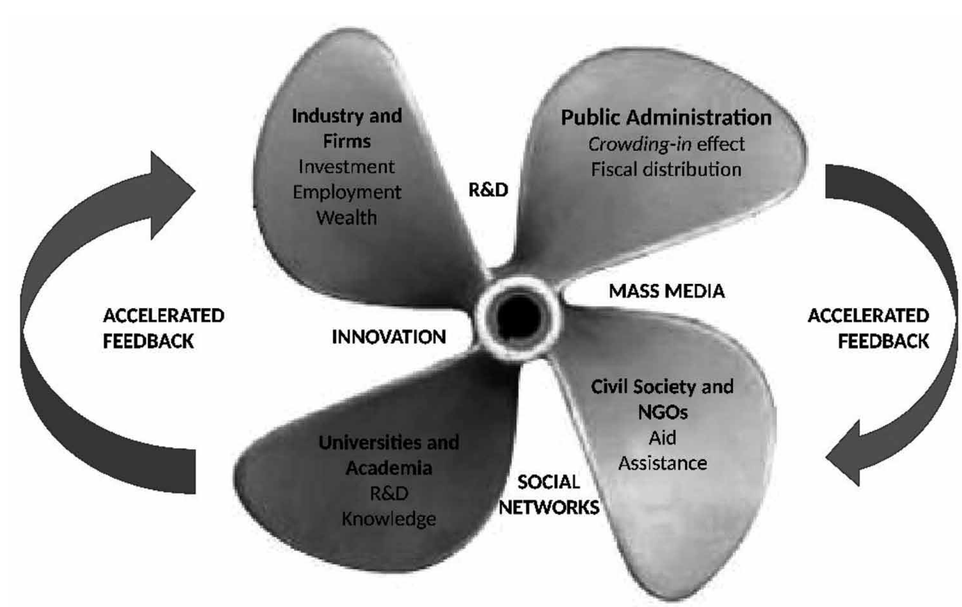
1. *Universities and academia*, characterized by R&D, knowledge, and innovation;
2. *Industry and firms*, where the combination of investment and employment is vital to creating social wealth;
3. *Civil Society and NGOs* focused on aid and social assistance, and
4. *Public Administration* directed to develop crowding-in effects and fiscal distribution through a progressive tax system.

5. This theoretical quadruple helix model is also defined by including accelerated feedback formed by the merge of industrial R&D, the intensive use of mass media, the development of social networks between universities, civil society and NGOs, and public administration. The combination of these economic variables determines competitiveness, innovation, and R&D, which are drivers to develop the Industry 4.0 (Briones-Peñalver et al., 2018) that can benefit the society through CSR policies. Resulted from this constant interaction, social and economic wealth are both created.

Corporate Social Responsibility (CSR) is crucial in quadruple helix models, as is defined as the "compliance with society's economic, legal, ethical and discretionary expectations about business organizations at any given time" (Carroll, 1979: 500). Expectations to be met in the medium and long-term to generate social change. Carroll (1991) states four levels of CSR responsibility: economic (having benefit), legal (obeying the law), ethics (ethical behavior) and philanthropic (being a good corporate citizen). However, it is not enough to comply with all four levels of responsibility, as CSR-based companies must invest more in intellectual capital, physical environment, and relations with stakeholders (Mendizábal, and Tufiño, 2015).

These investment processes have made CSR evolve, although this evolution has not been the same in all countries, is the highest distance among the European nations and the nations of Latin America and the Caribbean, although there might be no significant difference among the LAC countries, but there are significant differences on this matter among European nations, as organizations in the North and West do much better in comparison with organizations in the South and Eastern Europe. The best CSR strategy is the one that is carried out locally to fully adapt it to a specific context (Ikeda, Ferranty, and Mendes, 2015) and thus have a social impact. Social impact that will lead to social change that is desirable for the entire population and the economy in general. We will see this evolution in the following epigraph.

Figure 1. The Quadruple Helix Model
Source: Adapted from Harbers, Van Waart, and Visser (2015) and Lindberg, Lindgren, and Packendorff (2014)



BACKGROUND

CSR 1.0.: Philanthropy and Charity

It must be conducted by the ethical behavior of organizations (public or private) to guide CSR by benevolence and kindness (CSR 1.0), which strengthens the pride of belonging to the firm (John et al., 2017). Besides, this pride enhances the process of attraction and retention of the best intellectual capital (Lim and Greenwood, 2017). By definition, ethical behavior eliminates cases of corruption, regardless of where they occur. In this respect, Adda, Azigwe, and Awuni (2016) distinguish between three levels of ethics:

1. The law that determines what practices and norms are allowed or prohibited to establish the minimum degree of welfare and legal certainty to be met in society;
2. Organizational policies and procedures to guide companies and individuals in their decision-making process, and
3. The moral stance defined by ethical-driven decision-making when there is no ad hoc law approved for that purpose.

In this ethical process, the State (in its various organizations and schemes of action that change slightly among nations) has a vital role in fighting corruption. With corruption it is not possible to implement CSR-based policies and, consequently, to generate social change. Therefore, the fight against corruption must be holistic, at all levels, regardless of the public or private ownership of organizations.

Complementary to avoiding corruption practices, particularly in some Latin American and the Caribbean countries (Table 1), firms must generate EBITDA (Earnings Before Interests, Taxes, Depreciation, and Amortization) to carry out CSR-based policies. At least, a percentage of this business benefit is aimed at improving the social environment of companies, which enhances their brand and corporate reputation, and complements public policies carried out with the same objective.

It is important to note that companies often confuse CSR with philanthropy or charity, and even with humanism (Lamoneda, 2016). The difference comes because, while philanthropy and charity alleviate misery at the level of distribution, humanism seeks to annihilate indigence at the level of production (Kuljic, 2016). However, CSR aims to provide a way of life for those most in need. In short, and as the English proverb states, ‘Give a man a fish, and you feed him for a day; teach a man to fish, and you feed him for a lifetime.’ As a result, the beneficiary learns and in the medium term will not live either from philanthropy or charity.

Philanthropy and charity-based business policies have a more significant impact when are done by worldwide-known corporations. Chen and Lee (2017) show that just large and well-known medium-sized enterprises when applying CSR, augment their market value and, in the case of being listed on the Stock Exchange, increase their market capitalization, measured as the market value of the shares multiplied by their market value (price). For this reason, the impact of CSR on Microenterprises and Small and Medium Enterprises (SMEs) is meager and even inexistent. As a result, when SMEs apply CSR-based policies, they make it for ethical, philanthropic or charitable reasons.

One of the keys to successful CSR-based design and implementation is the resilience of those who apply it. In fact, for an organization to be more resilient, it has to diversify its leadership, so that the company has several leaders with high capacity of entrainment within the organization and thus reduce risks. This diversification of leaders also influences the democratization of the firm, both in the knowledge

Table 1. Corruption levels in Latin America and the Caribbean

2016 Rank	Country	2016 Score	2015 Score	2014 Score	2013 Score	2012 Score
21	Uruguay	71	74	73	73	72
24	Chile	66	70	73	71	72
41	Costa Rica	58	55	54	53	54
60	Cuba	47	47	46	46	48
79	Brazil	40	38	43	42	43
87	Panama	38	39	37	35	38
90	Colombia	37	37	37	36	36
95	Argentina	36	32	34	34	35
95	El Salvador	36	39	39	38	38
101	Peru	35	36	38	38	38
113	Bolivia	33	34	35	34	34
120	Dominican Republic	31	33	32	29	32
120	Ecuador	31	32	33	35	32
123	Honduras	30	31	29	26	28
123	Mexico	30	31	35	34	34
123	Paraguay	30	27	24	24	25
136	Guatemala	28	28	32	29	33
145	Nicaragua	26	27	28	28	29
166	Venezuela	17	17	19	20	19

Source: *Transparency International (2018)*

of the processes within the company and in the greater transparency that exists within it. This method of corporate democratization and therefore higher openness can be the first step towards the signing of joint ventures with other public and private organizations, both domestic and foreign. This process is even more efficient when the organization's human resources are clear about the vision, mission, and values of the company, as well as the objectives of the company.

However, when organizations only conceive CSR as philanthropy and charity, no results are achieved in the medium and long-term. That is why it can not be considered a valid CSR, but a timely aid process to solve a specific problem, without resulting in lasting social change. Therefore, the ideal situation is to refine the RSC to transform CSR 1.0 into CSR 2.0. A process described in the following section.

CSR 2.0.: Conscious Responsibility and Integral Management

With CSR 2.0 companies and organizations are entering the Age of Responsibility defined by a comprehensive transformation of business structures based on CSR, environmental sustainability, and the common good. To achieve this triple objective, companies must

1. Have full sustainability in their productive and commercial processes and be directed towards a transformational leadership that shares knowledge towards the advantages of sustainability. To

this end, companies have to articulate “blue skies,” that is, to achieve great objectives with great visions through policies anchored in transformational leadership.

2. Adopt CSR-based policies and the creation of foundations and, where appropriate, labor cooperatives and cooperative entrepreneurship among firms to enhance partners’ entrepreneurial status (Rezazadeh and Nobari, 2018), to create business groups that can compete successfully in international markets and thus achieve social change.
3. Empower women, trying to reconcile work and family life, as empowerment is defined as the decision-making ability of a woman regarding her strategic and non-strategic life choices (Ballon, 2018). The feminine gender plays a fundamental role in the humanity, for the procreation of the human species, as in the labor and familiar world. Hence, it is desirable that there should be no discrimination regarding labor and wages, since social justice must be given priority in any situation, regardless of the size and characteristics of the organization.
4. Change the vision and objectives of innovation, by moving from the sole benefit of the company to the whole society thanks to CSR. An impact in which the technology has a fundamental role that we could summarize synthetically in the following formula:

$$INN = (B+I+T) \times A$$

being INN = Innovation, B = Benefit, I = Investment, T = Technology, and A = Attitude

Have corporate transparency, that is, be honest and clear before the stakeholders (stakeholder group) to make the business sustainable. With transparency, the degree of commitment of the stakeholders is greater.

5. Adopt ISO 26000 standards to ensure good governance in the organization following a holistic and interdependent approach based on seven principles:
   a. Adopt human rights at work avoiding labor exploitation, especially child labor exploitation;
   b. Participate actively in the development of the community so that there are positive externalities within it;
   c. Protect consumers by offering products and services with the best price-quality ratio possible in the market;
   d. Perform work practices, especially among the youngest, to ensure continuity in the tasks to be performed in the company;
   e. Conduct fair operating practices within organizations fostering intrapreneurship and social justice, and
   f. Implement safe environmental policies to achieve sustainable and shared business activities (in the sense of not increasing the gap between rich and poor).
6. Conduct policies based on leadership, to reduce risks in the corporation and meet, as far as possible, the sustainability objectives.

Based on all of the above, CSR 2.0 is “a new form of integrated and innovative management of companies” (Lamoneda, 2016: 63). Companies operating in the Latin America and the Caribbean nations apply CSR 2.0-based corporate policies when are demanded by their stakeholders, mainly clients who have a more significant social awareness of these corporate practices. This social-oriented behavior results from the characteristics of the European model based primarily on solidarity, cooperation, and mutual aid through the Structural Funds, formed by the sum of the European Regional Development Fund (ERDF), European Social Fund (ESF), Cohesion Fund, European Agricultural Fund for Rural Development (EAFRD), and European Maritime and Fisheries Fund (EMFF). With less intensity than in Europe, the Latin American consumer expects and appreciates, in particular, any certification or seal that demonstrates there is no economic, social and ecological dumping in the products or services they acquire.

Certifications, stamps, and logos shown by socially responsible companies can attract socially responsible consumers and stakeholders, what reinforces the corporate's reputation image. As a result, sales increase and new investors are invited to expand the company. So, by following Sajardo (2009), the badge to be granted CSR companies should be graded, so that only those institutions and businesses that comply with more than 80 percent of the proposed CSR measures should bear the 'High RSC', while the 'Medium CSR' mark will be for companies between 50 percent and 80 percent, and 'Low CSR' for those who did not reach 50 percent in their CSR application. Given its social impact, the implementation of CSR-based strategies positively affects the United Nations Millennium Development Goals (MDGs), the Human Development Index, and the Social Progress Index what benefits humankind.

Regarding CSR as a useful tool to fight poverty following the MDGs, there are two opposing views, according to Valor and Merino (2007). The first is provided by multilateral organizations, such as the United Nations and the World Bank Group, and business organizations, such as the World Business Council for Sustainable Development, the Global Reporting Initiative (GRI) and the International Business Leaders Forum. For these organizations, the 'CSR is, by its very nature, private sector development and is the perfect complement to the efforts of governments and multilateral organizations' (Jenkins, 2005: 525). In fact, they affirm that 'economic growth is the way to reduce poverty, so the company appears as a central element in the strategy for its eradication' (Valor and Merino, 2007: 5). The second view is more critical concerning CSR, as both civil society and non-governmental organizations (NGOs) tend to be more skeptical about the results of implementing policies based on CSR in society.

Where there is no possibility of discussion is about the impact on the Human Development Index (HDI) of corporate policies based on CSR. The more effective the policies carried out by companies regarding CSR are, the greater will be the HDI. Education and health, alone or simultaneously, positively affects HDI and the final effect depends on how the company applies CSR. In fact, the HDI is an indicator created by the United Nations Development Program (UNDP) to calculate the level of development that nations have in terms of GDP per capita in purchasing power parity (PPA), education (adult literacy level, level of education achieved, and length of years of compulsory education) and health (life expectancy at birth). The HDI provides values between 0 and 1, with 0 being the lowest rating and 1 the highest value. From these values, countries are classified into countries:

- With high human development (HDI> 0.8)
- With an average human development (0.5 <HDI <0.8)
- With low human development (HDI <0.5)

In addition to the HDI, there is also the Gender Inequality Index (GDI), introduced by the United Nations Development Program (UNDP) in its 2010 Human Development Report. It measures inequality in terms of reproductive health, maternal and infant mortality rate, the proportion of female parliamentary seats held by women, the proportion of men and women over 25 who have attended at least secondary education, and their economic situation, measured by female participation in the labor market and the participation rate in the female labor market over 15 years of age.

The HDI enhanced in 2105 with a new indicator called the Index of Social Progress (IPS) elaborated by a group of private institutions integrated into the Social Progress Imperative. The IPS has an advantage over the HDI that focuses on the variables that lead to social performance exclusively measuring the welfare of society. Therefore, it only calculates the indicators that point to social progress regarding protection (basic human needs, essential well-being, and opportunities for development), leaving aside the economic variables (GDP per capita regarding PPP). CSR policies also have a positive influence on this indicator by improving it, mainly regarding providing entrepreneurship to achieve higher social welfare.

In the next section, we will analyze the relationship between CSR and the Economy of Common Good and Solidarity Economics. It was decided to refer to the connection of CSR and the Economy of Common Good and Solidarity Economics, as these two types of the New Economy are currently booming in the LAC countries.

From CSR to the Economy of Common Good, and Solidarity Economy

At the beginning of the XXI century, the Austrian economist Christian Felber sought to establish an alternative economy to neoliberalism and to German Ordoliberalism, which he called the Common Good Economy (from German, *Gemeinwohl-Ökonomie*). This type of economy aims to adopt the economic objectives of companies to the principles emanating from the Constitution, according to which the economy has to serve the general interests and not exclusively the profit and benefit of a few. In particular, Christian Felber relied on Article 151 of the Bavarian State Constitution (from German, *Länder*), which states that 'all economic activity serves the common good.'

In fact, the Economy of the Common Good is part of the so-called New Economy, as well as the Collaborative Economy (to achieve social improvements through collaboration), Solidarity Economy (to alleviate poverty and improve the quality of life based on solidarity) Social Economy (to seek the collective good), Green Economy (to respect the environment), Circular Economy (to recycle residues), and Blue Economy (to achieve higher efficiency and to create wealth applying the knowledge accumulated over millions of years by the nature) (Pauli, 2011). Proposals emanated from the New Economy aim to find new ways to economic growth and social welfare, taking into account the natural environment.

Within the Economy of the Common Good, which started as a social engineering project in October 2010 among a group of companies from several countries, the objective of companies is to contribute to the common good having EBITDA secondary importance. That is why, in the Economy of the Common Good, corporations use the Balance of Common Good instead of using the Balance Sheet, which takes into account five variables endowed with a substantial social impact: human dignity, solidarity, social justice, sustainability ecological, and democratic participation and transparency. According to this model, companies following policies based on the common good should be rewarded by the economic model and public systems, as it happens in the EU after the approval of the document titled: 'The Economy of Common Good: a model sustainable economic development oriented towards social cohesion.'

The Economy of the Common Good is an improvement of the CSR (Almoneda, 2016) in trying to satisfy with values to benefit each one of the stakeholders. The 2015 European Economic and Social Committee (EESC) applied the Economy of the Common Good 'in the European and national legal frameworks to move towards a single European market through a more ethical economy based on European values and the achievements of social responsibility policies, creating synergies aimed at reinforcing them' (1st EESC Recommendation), as 'the Economy of the Common Good relies on civil society organizations, business, and universities, as is considered a viable model to reinforce values and social cohesion while promoting a responsible economic system. In fact, it has the backing of more than one hundred local groups, about two thousand companies, and various social organizations.' (3rd EESC Recommendation) The EU is looking for a European ethical market in line with the European 2020 strategy, defined by the progressive use of renewable resources, so that no gasoline and diesel motor vehicles will be sold after 2040 for its definitive disappearance in 2050 (Saiz-Álvarez, 2017b); the development of an European brand; ethical public procurement; and the promotion of moral internal commerce, consumption and ethical banking. That is why in the EU the development of the most crucial moral is trading in the world where the highest salaries do not have to exceed ten times the lowest and where all investments are made in ecologically sustainable projects. All these ideas, once adopted, can also be applied in the LAC nations.

The second type of economy currently booming, especially in some LAC countries, is the Solidarity Economy. This kind of economy is guided by the following principles (Saiz-Álvarez, 2016): [1] *Principle of Subsidiarity*, according to which the objective is to maximize well-being through an efficient allocation of resources, taking into account values, fair trade, social justice) that guide all economic decisions. Values-centered on the person (humanistic values), spirituality (religious values) or both, because the absence of such values dehumanizes people; [2] The search for the *common good*, always seeking the maximization of social welfare; [3] A necessary *solidarity* based on social justice where the state has a vital supervision role because its actions are oriented to the promotion of efficient competition, and market supervision to avoid the fragmentation of societies (Levy, 2017). That is, the intervention must be proportional and gradual in the exercise of the legal powers of control and control legally granted, without there being cases of corruption that have to be quickly addressed.

Labor Market and Industry 4.0

'Glocalization' characterizes today's business world whereby (generally multinational) companies think globally and act locally. Within this transformation process towards more sustainable business projects, transnational corporations have a fundamental role to play, especially after the arrival of the Fourth Industrial Revolution (Industry 4.0). In fact, for an organization to be considered a multinational, it must make direct investments abroad and actively manage those operations as part of the company, both in strategic and organizational terms (Bartlett and Ghoshal, 1992), human resources, providers, investors, and distributors must be fully internationalized.

The implementation process of Industry 4.0 is possible due to M2M (Machine-to-Machine) processes linked to the Internet of Things (IoT). These IoT-based methods connect to wireless and non-wireless networks and allow greater integration of enterprises into real-time computer communication, but will be more vulnerable in case of cyber attacks from remote computers. That is why it is essential to strengthen cyber security to avoid damage to computer systems as part of the industry's communications system. Based on the combination of IoT (Internet of Things), ICT (Information and Communication Technologies), CBS (Cyber Systems), EAI (Enterprise Architecture & Integration) and MC (Maker Culture), Industry 4.0 creates intelligent factories capable of being continuously adapted to the changing needs of consumers. Advanced technology embedded in smart businesses reduces energy and input use and optimizes the allocation of scarce economic resources. Because of these changes, Industry 4.0 tends to carry out continuous processes to minimize the costs of production with the digitalization of products and services with the final objective of reaching global markets achieved thanks to the constant and instantaneous intercommunication between the different workstations that make up the production, offices and payment chains. In intelligent plants, intelligent machines and tools can self-diagnose, so it is possible to have remote control of all processes to ensure safety and better integration into the global production system.

Also, when creative industries apply IoT-based practices in their production plants, artificial intelligence provides links and communications across internal and external networks, achieving a higher degree of flexibility required in random situations. This greater flexibility allows for some level of personalization or adaptation, for example, by modifying some characteristics of the products destined for them and guaranteeing some dates of delivery of product or service. Therefore, it is entirely possible to manage a large-scale production of custom goods and services without keeping excessively large stocks. As a result, smart factories can more quickly implement JIT (Just in Time) and Kaizen business policies, leading to less waste of resources.

The arrival of Industry 4.0 will profoundly change the labor market, mainly for the following reasons:

1. New business models merge virtual and real worlds, and by applying digitization, they include automation and robotics in product manufacturing (Götz and Jankowska, 2017).
2. Future labor mobility will be much more intense by brain circulation among companies and organizations located in different countries, and even continents. Abilities and skills will remain for a limited amount of time in each job (but they will be very productive, and endowed with clear and defined goals), which will lead to high turnover.
3. Competition between smart factories will be more robust because consumers will have access to an unlimited amount of information when buying a product or service. Artificial intelligence embedded in devices, for example, will reduce communication barriers by having simultaneous cyber translators, so that it will be possible to speak in a language while our interlocutor listens in their mother tongue. These technological advances will tend to unify markets to create a single global market.
4. There would be a healthy development of P2P (Person to Person) communication generating a considerable amount of data (big data) that will be stored in very powerful computers and repositories.

As a result, in Industry 4.0, a new, ubiquitous enterprise is born, where smart firms design, manufacture and sell anywhere, anytime, and where CSR-based policies will become increasingly important and necessary, especially in SMEs. As a result, there is an unlimited production capacity and almost a permanent availability of products and services (Chen, and Tsai, 2017), with markets being fully global, and multinational companies eager to co-invent social solutions, build local capacity and infrastructure in emerging markets, and reconcile social and economic value creation (Yin and Jamali, 2016). Industry 4.0 reveals opportunities for decentralization, efficiency, and self-regulation, especially when linked to JIT (Just-in-Time) policies and Kanban systems (Hofmann and Rüsch, 2017), which in turn encourages the development of multimodal transport that facilitate and expedite the transportation of goods across the planet. As a result, Logistics Activity Zones (ZAL) will increase worldwide, whether customs warehouses, free warehouses or free zones, all of them defined by having tax advantages and not being subject to regular customs procedures.

On the other hand, global ecosystems of industries tend to create clusters of firms. Creation accelerated by economies of agglomeration, positive externalities linked to closer and stable business cooperation, and especially to digital transformation based on collaboration and trust, especially in the introduction and testing phases. These agglomerates (clusters) of companies facilitate the formation of strategic alliances (joint ventures) to expand and conquer new market niches.

Due to R&D and innovation, and primarily when CSR-based policies impulse innovation (Ratajczak and Szutowski, 2016), Industry 4.0 will intensively use control automation; the intelligent factory will produce fewer parts (even one by one) as its highly technical production will always be cost-effective. As a result, fewer resources are needed, and the waste will diminish. As a result, companies and the global business ecosystem will strengthen by improving their relationships with their environment through less waste. As a result, the social impact generated is essential, especially when there is a quadruple helix and the business ecosystem strengthens by the surge of business incubators and accelerators throughout the system.

From a macroeconomic perspective, Industry 4.0 will amplify the trend of the Kondratiev longwave cycle, so that it will help generate higher levels of wealth when it is the expansive phase of the period. Therefore, it is of interest to carry out a study on the impact of intellectual property born of innovation in the global value chain of the company, because innovation will be even more is the engine of the growth of the global economy.

Business Ethics and Industry 4.0

Throughout this process of change, business ethics plays a fundamental role. The study of ethics primarily refers to identifying, evaluating and selecting appropriate values to be used as standards of judgment, and then applying such determinations to achieve acceptable results (Beer, 2015). Therefore, ethics from a strategic point of view is the planned action towards the common good that does not transgress any principle of what is morally agreed upon in the organization and society to prevent corruption before it occurs (Slager, 2017).

The cultural dimension influences the firm so that societies marked by social concerns are characterized by the search for the common good, as it happens in the EU, while Japanese companies are more committed to the environment. However, companies around the world adopt similar patterns of CSR practices, but their degree of development is strongly determined by institutional characteristics (Esteban, Villardón, and Sánchez, 2017).

On the other hand, in this search for the common good by companies is directly related to the democratization of the economy that seeks to 'humanize the economic sphere through promoting and encouraging the participation, mainly in management, of all internal agents involved in the activity of economic organization' (Calvo, 2014: 200). In this way, democratic values such as freedom, equality or human dignity are integrated within the company and, in this way, humanized by thinking more about the professional that works in it than on generating profit.

When opening Industry 4.0 to global markets, the importance of ethics is more considerable, being a type of knowledge of those who seek to guide human action in a rational sense (Lorenzo and Peris, 2012) avoiding corruption-based business practices, although, unfortunately, it is very high in the LAC countries (Table 1) due to the high levels of poverty and illiteracy in the region, low level of population studies, a poorly assimilated democracy freedom with debauchery, social inequality, and the connivance of the media that do not fulfill their duty to inform, and if they do, misrepresent information (Warf and Stewart, 2016).

Finally, with the onset of Industry 4.0, if corruption is not efficiently combated from now on, corruption levels will be expected to increase, as firms are fully inserted into global markets and, at least a priori, they move higher volumes of capital. For this reason, it is essential that LAC countries should combat corruption, both from the Public Administrations and from business organizations. Moreover, for this purpose, it is obligatory both to reduce poverty and to increase levels of literacy in the population. A strategic policy that it is even more necessary to apply if developing nations want to offer a higher standard of living to their communities.

CONCLUSION

The current world is rapidly changing with the advent of a new international economic order by 2050 to be led by the People's Republic of China (1st), India (2nd), United States (3rd), and Indonesia (4th)(PWC, 2017), while the Centre for Economics and Business Research (CEBR) predicts that China ($34,338 bn) will surpass the US ($32,996 bn) in terms of GDP by 2030 (CEBR, 2015). In fact, and according to the World Bank data for 2016, the People's Republic of China ($21.4 Tln) has passed the United States ($18.6 Tln) in GDP at PPP (Purchasing Power Parity), while according to Bloomberg data, China overtook the USA almost a decade ago in terms of manufacturing output (Smith, 2017). In this process of change, technology-based production processes are giving way to the so-called Fourth Industrial Revolution at least partially based on the creation of global value chains. As a result, and initially started in Germany (Lu, 2017), Industry 4.0, also called 'Intelligent Manufacturing,' 'Industrial Internet' or 'Integrated Industry' is emerging where entrepreneurs have a vital role to play. This concept is complemented by global value chains interacting around the planet.

The full implementation of Industry 4.0 in the LAC countries deals with the obligation to establish and strengthen global value chains in the world market, since industries have not fully consolidated them (Masiero, Ogasavara, Jussani, and Risso, 2017), which leads to a loss of business opportunities, and even the reduction of existing market niches by not being able to cope with competition. Inclusion in global value chains of non-business intermediaries, joint strategies, relational capital that strengthens the quality-guided selection process, and goal-oriented equitable distribution rules to foster collaboration and accurate information will facilitate coordination in the global value chains of companies, so it would be very desirable to create (or at least try) LAC multinational corporations, as the EU has been doing for some decades. As a result, both the creation of these LAC multinationals on a large scale and the implementation of processes based on business rationality and the non-waste of productive resources will positively affect society as a whole. As a result, LAC corporations will reduce risks, and global value chains located in different industries and countries around the globe will foster innovation and the development of new productive and commercial capacities within companies (Kano, 2017).

CSR is part of social innovation and influences directly on business development thanks to the accelerated feedback generated in the quadruple helix. Fueled by R&D, innovation, mass media and social networks, CSR-based business policies tend to diminish social imbalances with the help of the crowding-in effects generated after State intervention. These results accelerate both social and economic changes where firms and universities also play a pivotal role to stimulate these changes. The LAC countries are undergoing drastic economic, social and legal reforms to adapt their societies to the challenges born from the financial and business globalization that these societies are recently facing. As a result, the Western-defined CSR paradigm must be broadened (Pisani *et al*., 2017) to include these structural changes mainly connected to an increasingly active R&D, and a higher competitiveness in a "glocal" sense as drivers of the Industry 4.0 (Bernal-Conesa *et al*., 2017; Jamali *et al*., 2017), and the adoption of a radical innovation democratized by globalization and the Internet.

Finally, the Industry 4.0 will lead to structural changes in world economies, so nations need to integrate into regional blocs if they wish to take advantage of the synergies created by integration processes. However, economically or politically isolated countries, mainly in Africa, will remain underdeveloped and the gap will widen, as the industrialization processes bear positive results. We are living in a global village characterized by the intensive use of ICTs that make life easier for people, while it expands and opens new horizons for companies to start new businesses at the cost of being more productive, efficient and dynamic. Moreover, in this sense, the Industry 4.0 will accelerate and strengthen this process.

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REFERENCES

Adda, G., Azigwe, J. B., & Awuni, A. R. (2016). Business Ethics and Corporate Social Responsibility for Business Success and Growth. *European Journal of Business and Innovation Research*, *4*(6), 26–42.

Ballon, P. (2018). A Structural Equation Model of Female Empowerment. *The Journal of Development Studies*, *54*(8), 1303–1320. doi:10.1080/00220388.2017.1414189

Bartlett, C. A., & Ghoshal, S. (1992). *Managing Businesses Abroad. A Transnational Solution* [Gerenciando empresas no exterior: a solução transnacional]. São Paulo, Brasil: Makron Books.

Beer, L. A. (2015). *A Strategic and Tactical Approach to Global Business Ethics*. Business Expert Press.

Bergek, A., Jacobsson, S., Carlsson, B., Lindmarki, S., & Rickne, A. (2005). Analysing the Dynamics and Functionality of Sectoral Innovation Systems–A Manual. In 10 Year Anniversary DRUID Summer Conference, Copenhagen, Denmark.

Bernal-Conesa, J. A., Briones-Peñalver, A. J., & Nieves Nieto, C. (2017). CSR Strategy in Technology Companies: Its Influence on Performance, Competitiveness, and Sustainability. *Corporate Social Responsibility and Environmental Management*, *24*(2), 96–107. doi:10.1002/csr.1393

Bernard, C. I. (1938). *The Functions of the Executive*. Boston, MA: Harvard University Press.

Bowen, H. R. (1953). *Social Responsibilities for the Businessman*. New York: Harper.

Briones-Peñalver, A. J., Nieves Nieto, C., & Bernal-Conesa, J. A. (2018). Analysis of Corporate Social Responsibility in Spanish Agribusiness and its Influence on Innovation and Performance. *Corporate Social Responsibility and Environmental Management*, *25*(2), 182–193. doi:10.1002/csr.1448

Calvo, P. (2014). Business Ethics, Social Responsibility, and Communicative Goods [Ética Empresarial, Responsabilidad Social y Bienes Comunicativos]. *Tópicos. Revista de Filosofía*, *47*, 199–232.

Carayannis, E. G., & Campbell, D. F. J. (2009). 'Mode 3' and ¿Quadruple Helix': Toward a 21st Century Fractal Innovation Ecosystem. *International Journal of Technology Management*, *46*(3/4), 201–234. doi:10.1504/IJTM.2009.023374

Carlsson, B., Jacobsson, S., Holmén, M., & Rickne, A. (2002). Innovation Systems: Analytical and Methodological Issues. *Research Policy*, *31*(2), 233–245. doi:10.1016/S0048-7333(01)00138-X

Carlsson, B., & Stankiewicz, R. (1991). On Nature, Function, and Composition of Technological Systems. *Journal of Evolutionary Economics*, *1*(2), 93–118. doi:10.1007/BF01224915

Carroll, A. B. (1979). A Three-Dimensional Conceptual Model of Corporate Performance. *Academy of Management Review*, *4*(4), 497–505. doi:10.5465/amr.1979.4498296

Carroll, A. B. (1991). The Pyramid of Corporate Social Responsibility: Toward the Moral Management of Organizational Stakeholders. *Business Horizons*, *34*(4), 39–48. doi:10.1016/0007-6813(91)90005-G

CEBR (Centre for Economics and Business Research). (2015). *World Economic League Table 2016 Highlights*. Author.

Chen, R. C. Y., & Lee, C. (2017). Assessing Whether Corporate Social Responsibility Influence Corporate Value. *Applied Economics*, *49*(54), 5547–5557. doi:10.1080/00036846.2017.1313949

Chen, T., & Tsai, H.-R. (2017). Ubiquitous Manufacturing: Current Practices, Challenges, and Opportunities. *Robotics and Computer-integrated Manufacturing*, *45*, 126–132. doi:10.1016/j.rcim.2016.01.001

Davis, K. (1960). Can Business Afford to Ignore Social Responsibilities? *California Management Review*, *11*(3), 70–76. doi:10.2307/41166246

Davis, K. (1967). Understanding the Social Responsibility Puzzle: What Does the Businessman Owe to Society? *Business Horizons*, *10*(4), 45–50. doi:10.1016/0007-6813(67)90007-9

Edquist, C. (2005). Systems of Innovation: Perspectives and Challenges. In J. Fagerberg, D. C. Mowery, & R. R. Nelson (Eds.), *The Oxford Handbook of Innovation* (pp. 181–208). New York: Oxford University Press.

Esteban, V. A., Villardón, M. P. G., & Sánchez, I. M. G. (2017). Cultural Values on CSR Patterns and Evolution: A Study from the Biplot Representation. *Ecological Indicators*, *81*, 18–29. doi:10.1016/j.ecolind.2017.05.051

Götz, M., & Jankowska, B. (2017). Clusters and Industry 4.0 – Do They Fit Together? *European Planning Studies*, *25*(9), 1633–1653. doi:10.1080/09654313.2017.1327037

Harbers, M., Van Waart, P., & Visser, E. (2015). Value Sensitive Design of Smart Cities. *5th Decennial Aarhus Conference*, Aarhus, Denmark.

Heiskala, R. (2007). Social innovations: structural and power perspectives. In T. Hämäläinen & R. Heiskala (Eds.), *Social innovations, institutional change and economic performance. Making sense of structural adjustment processes in industrial sectors, regions and societies*. SITRA. doi:10.4337/9781847206992.00009

Hofmann, E., & Rüsch, M. (2017). Industry 4.0 and the Current Status as Well as Future Prospects on Logistics. *Computers in Industry*, *89*, 23–34. doi:10.1016/j.compind.2017.04.002

Ikeda, G., Ferranty, M. L., & Mendes, F. (2015). CSR Strategy on Multinationals. Dilemma between Local Adaptation and Internationalization [Estratégia em RSC em Multinacionais: Dilema entre Adaptação Local e Internacionalização]. *Pensamento & Realidade*, *30*(4), 1–20.

Jamali, D., Karam, C., Yin, J., & Soundararajan, V. (2017). CSR Logics in Developing Countries: Translation, Adaptation and Stalled Development. *Journal of World Business*, *52*(3), 343–359. doi:10.1016/j.jwb.2017.02.001

Jamali, D., Lund-Thomsen, P., & Jeppesen, S. (2017). SMEs and CSR in Developing Countries. *Business & Society*, *56*(1), 11–22. doi:10.1177/0007650315571258

John, A., Qadeer, F., Shahzadi, G., & Jia, F. (2017). Corporate Social Responsibility and Employee's Desire: A Social Influence Perspective. *Service Industries Journal*, *37*(13-14), 819–832. doi:10.1080/02642069.2017.1353081

Kano, L. (2017). (in press). Global Value Chain Governance: A Relational Perspective. *Journal of International Business Studies*.

Kreps, T. J. (1940). Measurement of the Social Performance of Business. *The Annals of the American Academy of Political and Social Science*, *343*(1), 20–31. doi:10.1177/000271626234300104

Kuljic, T. (2016). Altruism, Philanthropy, and Humanism–The Conceptual-Historical Aspects of Solidarity. *Sociologija*, *58*(4), 525–551. doi:10.2298/SOC1604525K

Lamoneda, D. I. (2016). The Economy of the Common Good and New Economies. A New Scale of CSR? [Economía del Bien Común y Nuevas Economías. ¿Una Nueva Escala de la RSC?]. *Tiempo de Paz*, *122*, 61–67.

Levy, D. (2017). Risk and the Cosmopolitanization of Solidarities. *Journal of Risk Research*.

Lim, J. S., & Greenwood, C. A. (2017). Communicating Corporate Social Responsibility (CSR): Stakeholder Responsiveness and Engagement Strategy to Achieve CSR Goals. *Public Relations Review*, *43*(4), 768–776. doi:10.1016/j.pubrev.2017.06.007

Lindberg, M., Lindgren, M., & Packendorff, J. (2014). Quadruple Helix as a Way to Bridge the Gender Gap in Entrepreneurship: The Case of an Innovation System Project in the Baltic Sea Region. *Journal of Knowledge Economy*, *5*(1), 94–113. doi:10.100713132-012-0098-3

Lozano, J., & Peris, J. (2012). Businesses and Human Development. The Potential of the Multinational Companies for Human Development [Empresas y desarrollo humano: El potencial de las compañíás trasnacionales para el desarrollo humano]. In *Responsabilidad Social Empresarial*. Pearson.

Lu, Y. (2017). Industry 4.0: A Survey on Technologies, Applications, and Open Research Issues. *Journal of Industrial Information Integration*, *6*, 1–10. doi:10.1016/j.jii.2017.04.005

Masiero, G., Ogasavara, M. H., Jussani, A. C., & Risso, M. L. (2017). The global value chain of electric vehicles: A review of the Japanese, South Korean and Brazilian cases. *Renewable & Sustainable Energy Reviews*, *80*, 290–296. doi:10.1016/j.rser.2017.05.148

Mendizábal, G., & Tufiño, B. (2015). Challenges of the CSR in Face of Workers' Human Rights. The Case of Mexico [Desafíos de la responsabilidad social corporativa (RSC) frente a los derechos humanos de los trabajos: El ejemplo mexicano]. *Alegatos. Revista Jurídica de la Universidad Autónoma Metropolitana*, *91*, 591–610.

Milian, L. (2015). *CSR. Origin and Evolution in the Spanish and European Business Environment* [Responsabilidad Social Corporativa. Origen y Evolución en el Entorno Empresarial Europeo y Español]. Madrid, Spain: Pontifical University of Comillas.

Pauli, G. (2011). *The Blue Economy* [La Economía Azul]. Barcelona, Spain: Tusquets.

Pisani, N., Kourula, A., Kolk, A., & Meijer, R. (2017). How global is international CSR research? Insights and Recommendations from a Systematic Review. *Journal of World Business*, *52*(5), 591–614. doi:10.1016/j.jwb.2017.05.003

PWC (PriceWaterhouseCoopers). (2017). *The Long View. How will the global economic order change by 2050?* London: PWC.

Ramírez, D. N. (2013). *The Social Mortgage* [La Hipoteca Social]. McGraw-Hill.

Ranga, M., & Etzkowitz, H. (2013). Triple Helix Systems: An Analytical Framework for Innovation Policy and Practice in the Knowledge Society. *Industry and Higher Education*, *27*(4), 237–262. doi:10.5367/ihe.2013.0165

Ratajczak, P., & Szutowski, D. (2016). Exploring the Relationship between CSR and Innovation. *Sustainability, Accounting, Management, and Policy Journal*, *7*(2), 295–318. doi:10.1108/SAMPJ-07-2015-0058

Rezazadeh, A., & Nobari, N. (2018). Antecedents and Consequences of Cooperative Entrepreneurship: A Conceptual Model and Empirical Investigation. *The International Entrepreneurship and Management Journal*, *14*(2), 479–507. doi:10.100711365-017-0470-7

Saiz-Álvarez, J. M. (2017a). Entrepreneurial ICT-based Skills and Leadership for Business Ethics in Higher Education. In Handbook of Research on Technology-Centric Strategies in Higher Education Administration. Hershey, PA: Information Science Reference.

Saiz-Álvarez, J. M. (2017b). *Mexico and the European Energy Source Shift.* Monterrey, Mexico: EGADE Business School-Tecnológico de Monterrey.

Saiz-Álvarez, J. M., & García-Ochoa, M. (2008). Outsourcing and Strategic Alliances in the New Knowledge Economy [Externalización de Servicios y Alianzas Estratégicas en la Nueva Economía del Conocimiento]. *Economía Industrial*, *370*, 135–141.

Sajardo, A. (2009). *CSR* [La Responsabilidad Social de las Empresas]. Valencia, Spain: Tirant lo Blanch.

Schwartz, M. S., & Carroll, A. B. (2003). Corporate Social Responsibility: A Three-Domain Approach. *Business Ethics Quarterly*, *13*(4), 503–530. doi:10.5840/beq200313435

Slager, R. (2017). The Discursive Construction of Corruption Risk. *Journal of Management Inquiry*, *26*(4), 366–382. doi:10.1177/1056492616686839

Smith, N. (2017, October 18). Who Has the World's No. 1 Economy? Not the U.S. *Bloomberg*.

Transparency International. (2018). *Corruptions Perceptions Index*. Retrieved from https://www.transparency.org/research/cpi/overview

Valor, C., & Merino, A. (2007). Firms and Poverty. The Role of CSR [Empresa y Pobreza. El Papel de la Responsabilidad Social Corporativa] (Unpublished document). Madrid: Madrid City Hall.

Warf, B., & Stewart, S. (2016). Latin American Corruption in Geographic Perspective. *Journal of Latin American Geography*, *15*(1), 133–155. doi:10.1353/lag.2016.0006

Yin, J., & Jamali, D. (2016). Strategic Corporate Social Responsibility of Multinational Companies Subsidiaries in Emerging Markets: Evidence from China. *Long Range Planning*, *49*(5), 541–558. doi:10.1016/j.lrp.2015.12.024

KEY TERMS AND DEFINITIONS

Corporate Social Responsibility: Set of business policies designed and implemented to improve their corporate image and their relationship with customers, while also changing the socio-economic environment where they are deployed.

Industry 4.0.: Term coined by the German government to define the intelligent company, that is, a vision of digital manufacturing with all processes interconnected by the internet of things (IoT). When firms act on a "global" scale, the IoT evolves to the industrial internet of things (I2oT) when the corporation acts on a "glocal" scale.

Integral Management: It consists of a management style tool that develops the talent of those who hold management positions focusing their potential on results that result in the welfare of the stakeholders, mainly of customers, workers, and shareholders.

Kaizen: Defined by Masaaki Imai consists in the continuous improvement of all the productive and commercial processes of a company to maximize efficiency and EBITDA.

Logistics Activity Zone (LAZ): A maritime and/or terrestrial area defined by a tax reduction to optimize and reduce supply chain costs.

Ordoliberalism: Current of thought also called the social market economy and born in the University of Freiburg that unites the positive results of state intervention (crowding-in effects) with the business freedom to achieve internal equilibria (low unemployment and low inflation) and external balances (equilibrium in the balance of payments) in a nation.

The Economy of the Common Good: Economic project promoted by the Austrian economist Christian Felber that aims to implement and develop a sustainable alternative economy to financial markets.

Chapter 13
Evaluating the Role of Research and Development and Technology Investments on Economic Development of E7 Countries

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ABSTRACT

This chapter aims to evaluate the effects of research and development on economic growth, export, and unemployment rate in emerging economies. Within this scope, E7 countries are taken into the consideration. Additionally, annual data of these variables for the periods between 1996 and 2016 is tested by using Dumitrescu Hurlin panel causality analysis. It is concluded that research and development expenditure has a positive effect to increase the export amount for these emerging economies. On the other hand, it is also identified that there is not a causality relationship between research and development with economic growth and unemployment rate. Therefore, it is recommended that emerging economies should take necessary actions to increase research and development investment to have higher amount of export. Hence, it can be possible for these countries to minimize the negative effects of current account deficit. In addition to this issue, it can also be seen that making research and development investment plays a key role to improve the economic performance of these countries.

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INTRODUCTION

Research and development refers to the creative working in order to increase the knowledge (Pavlinek, 2017). This subject also includes the usage of this information to increase the development (Rollins et. al., 2017; Leil and Bertz, 2014). While making this kind of analysis, it is aimed to provide improvement in the science and technology. Therefore, it gives a chance to the companies to increase competitive power by developing new product or services. Additionally, it has an important effect on the development of the countries (Gao et. al., 2017).

It is accepted that research and development expenditure plays a key role on many different macroeconomic factors. For example, making research and development investment has a contributing effect on the economic performance of the countries (Obinata, 2016). This condition can provide high living standards for the people who live in these countries. Moreover, because economic growth is an important indicator for economic performance of the countries, it will increase the image of these countries (Kotler and Gertner, 2002).

In addition to this aspect, research and development investment gives also the chance to create more qualified products and this situation can have a positive influence on the export amount (Carboni and Medda, 2018; Guarascio et. al., 2017). By increasing the export amount, the countries can decrease current account deficit which is one of the most significant problems for the economies. Furthermore, it can also be said that research and development investment is very beneficial to decrease unemployment rate (Tsai, 2018).

It can also be understood that research and development has a significant role for the emerging economies (Brem and Wolfram, 2014; Hou et. al., 2018). They are the economies which have not developed yet; however, they have a potential to be a developed country. Therefore, these economies should give high importance to research and development. The main reason for this condition is that by focusing on research and development, they can create new products and services to improve financial performance (Ren et. al., 2015).

Similar to this aspect, the main purpose of this study is to understand the effect of research and development on macroeconomic factors, such as economic growth, export amount and unemployment rate. Within this framework, annual data of E7 countries for the periods between 1996 and 2016 is analyzed by using Dumitrescu Hurlin panel causality analysis. Therefore, it can be possible to give recommendations to improve the economic performance of these countries. The novelty of this study is to assess the role of R&D and ICT on 3 different macroeconomic factors at the same analysis. Therefore, by focusing on a significant topic for emerging economies, it is believed that this study makes an important contribution to the literature.

This study consists of 5 different parts. After this introduction part, the second section gives information about the studies related to research and development in the literature. In this part, the missing area in the literature regarding this aspect can be identified. Additionally, the third part explains the quantitative information about research and development in both developed and developing countries. Moreover, an application on E7 countries is detailed in the fourth section. Finally, analysis results and recommendations are shared in the last part.

LITERATURE REVIEW OF RESEARCH AND DEVELOPMENT

Research and development and information and technology investment are so popular subjects in the literature that it attracted the attention of many different researchers. Owing to that condition, there are lots of studies that focus on the relationship between these investments and macroeconomic factors. Some selected studies regarding research and development are given on Table 1.

Table 1 gives information that most of the studies focus on the relationship between research and development and economic growth. For example, Guloglu and Tekin (2012) made a study in order to understand this relationship in OECD countries. As a result of Granger causality analysis, it is defined that there is bidirectional causality between economic growth and research and development expense. Additionally, Silaghi et. al. (2014) and Komal and Abbas (2015) reached the same conclusion with the help of GMM methodology. Moreover, Yüksel (2017) also emphasized this relationship for European countries by using Dumitrescu Hurlin panel causality analysis.

In addition to these studies, Hunady and Orviska (2014) and Freimane and Balina (2016) tries to analyze the role of research and development expense on economic development of European countries. By using regression analysis, it is concluded that research and development expenditure has a significant influence on the economic improvement of these countries. Bayarcelik and Taşel (2012) and Blanco et. al. (2016) also reached this conclusion with the same approach. On the other side, Jangraiz (2015) and Avram et. al. (2014) identified that there is an important relationship between these variables by using different methods.

Table 1 also shows that some studies focused on the relationship between export amount and the research and development expenditure. For instance, Shelvia and Sulasmiyat (2017) tried to understand this relationship in Indonesia. As a result of regression analysis, it is identified that export amount of the countries can be increased with the help of research and development. In addition to this study, Bojnec and Ferto (2014), Dilling-Hansen and Smith (2014) and Aw et. al. (2008) reached the similar conclusion with the help of the same methodology. Moreover, Girma et. al. (2008) and Podmetina et. al. (2009) also defined that research and development plays an important role to increase export amount by using different approaches.

Furthermore, it can be seen that some studies in Table 1 concentrated on the relationship between research and development expenditure and unemployment problem. For example, Georgiou (2010) tried to understand this relationship for European countries. According to the regression analysis result, it is concluded that research and development expenditure has an important effect to decrease unemployment problem. Parallel to this study, Chusseau and Hellier (2008) also emphasized the similar issues by using the same methodology. On the other side, Rycx et. al. (2008), Garofalo et. al. (2008), Hellier and Chusseau (2008) and Miyamoto (2010) stated the same relationship with the help of other approaches.

While considering the studied in the literature, it can be understood that the subject of research and development attracted the attention of many researchers. Another important point is that many different methodologies are taken into the consideration in these studies, such as regression, GMM, VAR and Granger causality analysis. It can also be seen that these studies mainly focused on the relationship between research and development with economic growth, export and unemployment. It can be concluded that there is a need for a new study that concentrates on the effect of research and development investment on these 3 topics at the same time.

Table 1. Some Studies about Research and Development

Authors	Scope	Methodology	Result
Rycx et. al. (2008)	Literature Review	Descriptive Statistics	There is a significant relationship between research and development investment and unemployment.
Aw et. al. (2008)	Taiwan	Regression	Research and development expenditure is a way of increasing export.
Chusseau and Hellier (2008)	European Countries	Regression	Increasing research and development investment has a negative influence on unemployment.
Girma et. al. (2008)	England and Ireland	Probit	Research and development expenditure leads to higher export.
Garofalo et. al. (2008)	Literature Review	Descriptive Statistics	Unemployment problem can be minimized with the help of research and development investment.
Hellier and Chusseau (2008)	Literature Review	Descriptive Statistics	Research and development expenditure decreases unemployment problem.
Podmetina et. al. (2009)	Russia	Survey	Companies should give importance to research and development investment to increase their export amount.
Georgiou (2010)	European Countries	Regression	Research and development expenditure has an important effect to decrease unemployment problem.
Miyamoto (2010)	Case Study	Search and Matching Model	Research and development expenditure is a significant aspect for the countries to employ more people.
Guloglu and Tekin (2012)	OECD Countries	Granger Causality Analysis	There are two-way causality relationships between research and development and economic growth.
Bayarcelik and Taşel (2012)	Turkey	Regression	Research and development expenditure has a positive influence on the economic growth.
Hunady and Orviska (2014)	European Countries	Regression	Increasing research and development is a way of having economic development.
Dilling-Hansen and Smith (2014)	Denmark	Regression	Export amount can be increased by making investment on research and development.
Silaghi et. al. (2014)	Central and Eastern European Countries	GMM	Economic growth of the countries is affected by research and development.
Avram et. al. (2014)	Romania	VAR Analysis	Research and development is an important cause of economic growth
Bojnec and Ferto (2014)	OECD Countries	Regression	Research and development plays an important role to increase export amount.
Komal and Abbas (2015)	Pakistan	GMM	Economic development can be provided with the help of research and development.
Jangraiz (2015)	Literature Review	Descriptive Statistics	Economic growth is influenced by research and development.
Blanco et. al. (2016)	United States	Regression	Research and development leads to economic development.
Freimane and Balina (2016)	European Countries	Regression	Focusing on research and development is very beneficial for economic growth.
Yüksel (2017)	European Countries	Dumitrescu Hurlin Panel Causality Analysis	There is a causality relationship between research and development and economic growth.
Shelvia and Sulasmiyat (2017)	Indonesia	Regression	Export amount of the countries can be increased with the help of research and development

R&D ACTIVITIES AND ICT INVESTMENTS IN THE DEVELOPING AND DEVELOPED ECONOMIES

R&D in Developing and Developed Economies

Economic growth is totally driven by human desire. Poverty is not destiny and written in stone for developing countries so proper and sustainable projects and policies should be defined and implemented. Investment in human capital especially in R&D can serve as driving forces for development since innovation and R&D plays an important role in both high-technology products and early development process (Batabyal and Yoo, 2017; Khan et. al., 2017). With respect to early development process, R&D allows developing countries to catch up developed countries and serves an adoption forces for achieving foreign technology. In order to define the role of R&D in the economic growth, Asian countries such as China, Japan, South Korea and India should be properly investigated because they became important economies create high-technology, influence world economy. Table 2 shows that advanced countries allocate more funds for innovation and R&D so developing countries should pay attention to innovation process and show regard to one of the significant lessons of the past four decades associated with Asian countries above mentioned since the established innovation capacities improved by R&D activities plays a pivotal role in economic development (Reddy, 1997; McMichael, 2011).

ICT Investments in the Developing and Developed Economies

Many economic theories and economics have tried to explain how economic growth smoothly increases and which determinants drive economic growth. Previous studies focused on saving rates, capital or labor which can improve economic performance, but the seminal works conducted by Romer (1986) and Lucas (1988) constructed the endogenous growth model and their studies has based on endogenous factors that

Table 2. Share of total global R&D spending (%)

Region	2014	2015	2016
North America	29.1	28.5	28.4
US	26.9	26.4	26.4
Caribbean	0.1	0.1	0.1
All North America	29.2	28.5	28.5
Asia	40.2	41.2	41.8
China	19.1	19.8	10.4
Europe	21.5	21.3	21.0
Russia	3.1	2.9	2.8
South America	2.8	2.6	2.6
Middle East	2.2	2.3	2.3
Africa	1.0	1.1	1.1
Total	**100**	**100**	**100**

Source: World Bank (2018a)

designate economic growth. According to the endogenous growth model, the engine of growth is human capital and the accumulation of human capital continuously spurs economy (Lucas, 1993). However, Pilat and Lee (2001) emphasized that sources of economic growth cannot be merged into one because each country has different social, economic and demographical situations but some of the sources can be used by all countries in order to reach better economic conditions.

Once for all, productivity plays a vital role in the wealth of country and its economic performance since enjoying higher living standards and earning higher wages result from productive. Thus, researchers and economic theories have tried to determine the influencing forces of productivity. Knowledge and innovation are accepted as one of the most fundamental sources of productivity. Knowledge economy is one of the most attracted topics because all economies will be on hiding to nothings; in other words, have no future if they do not focus on knowledge-intensive activities. Many prominent economics emphasized that technological progress associated with knowledge economy and innovation determines sustained long-term growth (Cardona et. al, 2013). Within this scope, in this part, we will try to highlight the role of Information and Communication Technologies (ICTs) in economic growth and productivity since ICTs are main admitting of innovation.

Moreover, advances in technology have been in consensus since the improvement of technology obviously accelerates the path of economy. A number of inventions may have significant effect on households' life and the ways in which firms operate either production or business. Information and communications technology (ICT) are accepted as the most known examples. ICT can be defined as general-purpose technology which diffuses to all sectors. ICT influences economic growth by virtue of both as component of aggregate output and as component of aggregate inputs (Bresnahan and Trajtenberg, 1995).

In terms of ICT and knowledge-economy, US economy is well-documented events associated with knowledge economy since US economy have experienced high growth rate, low unemployment and inflation on contrary to other industrialized countries since the second half of the 1990s. A great number of empirical studies have been conducted to investigate how US can achieve this successful economic performance and most of them underlined that investment in ICT is one of the most significant determinants. Other industrialized countries have decided on drawing attention to ICT and redesigned their economical schedule and recently many studies emphasized that ICT has a stimulated effect on productivity and economic growth in European and OECD countries in spite of the lower efficiency in comparison with US (Marrano et. al, 2009; Papaioannou and Dimelis 2007; Jung et. al, 2013).

Limited OECD countries' economies are characterized by ICT, considerable Ireland, Korea, Japan, Finland and US have accelerated their productivity and economic growth since 2000 because the investment in ICT and usage ICTs require highly skilled employment, huge funds and sufficient infrastructure. As a result, only few countries are to specialize and generate new ICT technology.

A number of studies employed the growth accounting approach in order to define the impacts of new technology on production and the results of studies reached a conclusion that the productivity can be improved as resulting from three channels (Magalhaes and Afonso, 2017; Astini and Tafiprios, 2017). First way is that advancement of technology has positive impact on multi-factor productivity (MFP) which decreases the cost of production, improves working conditions and provides new opportunity of goods, services or modes of operations. Second, new capital goods which lead to the higher capital intensity can be invested with the help of the positive impact of new technology on labor productive. Finally, using new technologies allow firms to employ new modes of operation which incrementally improve production process at low cost (McElwain et. al., 2017; Go et. al., 2016).

In terms of firm level, ICT adoption is able to accelerate and improve business channels and the economic literature has incrementally accepted the role ICTs as reshaping business operation. ICTs lead to faster and improved communication and diminishing coordination costs, assisting decision making process and rapid accessing information. ICTs also help firms to generate better communication system and improve innovation capacities. Internal process, the control of inventory and the utilization of equipment play an important role in the competitive world and thus the sufficient availability of ICT is able to serve as enabling factors (Grazzi and Jung, 2015; Arvanitis and Loukis, 2009; Atrostic et al., 2004; Gilchrist et. al., 2001).

ICT innovations play also an important role the employment. ICT serves as an important infrastructure for all economy and plays a stimulating role in the production. With respect to production side, the spreads of ICT and innovations have inhibiting effect on unit cost of production which spurs additional production generating higher employment. These expected results depend on the price elasticity of final demand and the degree of competition in the production (OECD, 2012). In addition to the relationship between ICT and employment related to production side, ICT also generate green and smart economy which demand for highly skilled and specialist jobs. According to OECD (2012), 3.7% of total employment in OECD countries is linked to ICT industry.

AN APPLICATION ON E7 COUNTRIES

Data Set and Scope

In this study, it is aimed to understand the effects of research and development expenditure on macroeconomic factors, such as economic growth, export and unemployment. For this purpose, annual data for the periods between 1996 and 2016 is considered. Additionally, E7 countries (Brazil, China, India, Indonesia, Mexico, Russia and Turkey) are defined as the scope of the study. However, Indonesia is taken out of the scope because research and development data is not available for this period. This data is provided from the website of the World Bank. The descriptive statistics of these variables are demonstrated on the Table 3.

Dumitrescu Hurlin Panel Causality Tests

Dumitrescu Hurlin panel causality test is aimed to analyze the causal relationship between the variables. The main advantage of this methodology is that it can be used for panel data. Only requirement of this model is that the variables should not have unit roots. The equation of this methodology is demonstrated below (Dumitrescu and Hurlin, 2012).

$$Y_{i,t} = a_i + \sum_{k=1}^{K} Y_i^k Y_{i,t-k} + \sum_{k=1}^{K} B_i^k X_{i,t-k} + \varepsilon_{i,t} \tag{1}$$

In equation (1), Y and X refer to the variables of which causality relationship is evaluated. Moreover, K explains the optimum lag interval. In addition to these aspects, α gives information about the constant

Table 3. Descriptive Statistics of the Variables

Descriptive Statistics / Variables	R&D	ICT	Export	Growth	Unemployment
Mean	0.89	9.71	22.89	4.86	6.73
Median	0.89	9.83	23.34	5.24	5.40
Maximum	2.19	11.03	44.06	14.23	14.70
Minimum	0.25	8.13	6.73	-7.82	2.50
Std. Dev.	0.38	0.76	7.86	4.11	3.20
Skewness	0.91	-0.14	0.08	-0.71	0.77
Kurtosis	4.40	2.05	2.74	3.45	2.41
Jarque-Bera	27.84	5.06	0.50	11.66	14.17
Probability	0.00	0.07	0.77	0.00	0.00
Sum	111.72	1,214	2,861	608	842
Sum Sq. Dev.	18.26	73.12	7,663	2,100	1,277
Observations	125	125	125	125	125

(World Bank, 2018b)

term and B refers to the coefficient of the variables. Some studies, in which Dumitrescu Hurlin panel causality analysis is performed, are shown according to their subjects on Table 4.

Table 4 demonstrates that Dumitrescu Hurlin is very popular in the literature. Therefore, this methodology was preferred by many different researchers in various subjects. For instance, many researchers considered this approach in order to define the relationship between electricity consumption and economic growth (Salahuddin and Alam, 2016; Tonkovic and Hussain, 2017). In addition to this aspect, it is also used to evaluate the relationship between energy consumption and economic growth with the help of this methodology (Bakırtaş and Akpolat, 2018; Destek and Aslan, 2017; Dinçer et. al., 2017). Moreover, it is also seen that the relationship between foreign direct investment and economic growth is evaluated in many different studies by using Dumitrescu Hurlin panel causality analysis (Adalı and Yüksel, 2017; Latif et. al., 2017; Paramati et. al., 2016). Affitionally, the relationship between tourism industry and economic growth is also identified with this methodology (Alam and Paramati, 2017;

Table 4. Studies related to Dumitrescu Hurlin panel causality analysis

Subject	References
The relationship between electricity consumption and economic growth	Chen and Fang (2017), Doğan et. al. (2016), Furuoka (2017), Salahuddin and Alam (2016), Tonkovic and Hussain (2017), Zhang et. al. (2017)
The relationship between energy consumption and economic growth	Al Irani and Trabelsi (2016), Bakırtaş and Akpolat (2018), Destek and Aslan (2017), Dinçer et. al. (2017), Hasanov et. al. (2017), Kahia et. al. (2017)
The relationship between foreign direct investment and economic growth	Adalı and Yüksel (2017), Latif et. al. (2017), Paramati et. al. (2016)
The relationship between tourism industry and economic growth	Alam and Paramati (2016), Alam and Paramati (2017), Doğru and Bulut (2017), Paramati et. al. (2017), Zaman et. al. (2016)
The relationship between financial development and economic growth	Furuoka (2015), Salahuddin and Alam (2016), Kılıç (2015), Abubakar et. al. (2015), Aydın and Malcıoğlu (2016), Dinçer et. al. (2018)

Doğru and Bulut, 2017; Paramati et. al., 2017; Zaman et. al.,2016). Finally, it can also be understood that Dumitrescu Hurlin panel causality analysis is taken into the consideration in order to evaluate The relationship between financial development and economic growth (Furuoka, 2015; Salahuddin and Alam, 2016; Kılıç, 2015; Abubakar et. al., 2015).

Analysis Results

In order to understand the effect of research and development expenditure on economic growth, export and unemployment rate with Dumitrescu Hurlin panel causality test, the first step is making stationary analysis of the variables. Within this framework, Im, Pesaran and Shin panel unit root test is considered. The details of this analysis are given on Table 5.

Table 5 gives information that all 4 different variables have unit root because their probability values are greater than 0.05. Therefore, the first differences of these variables are taken into the consideration. As it can be seen from Table 5, all first difference probability values are lower than 0.05. This shows that all variables can become stationary while takin the first difference. After stationary analysis, Dumitrescu Hurlin panel causality analysis is performed to reach the objective. The details of this analysis are demonstrated on Table 6.

Table 6 gives information that the hypothesis of "Research and Development Does Not Homogeneously Cause Export" can be rejected when lag equals 1 because the probability value is lower than 0.05. In other words, it can be concluded that research and development investment is a significant indicator of export for these emerging economies. In addition to this situation, the conditions in which lag is equal to 2 and 3 are also analyzed with the aim of robustness check. However, it can be seen that the probability values for other lags are greater than 0.05. Thus, it can be said that this relationship is not

Table 5. Im, pesaran and shin panel unit root test results

Variables	Level Value (prob)	First Difference Value (prob)
Research and Development	0.2259	0.0001
Information and Technology Investment	0.6463	0.0083
Economic Growth	0.2716	0.0000
Export	0.2659	0.0035
Unemployment	0.2056	0.0001

Table 6. Dumitrescu Hurlin panel causality test results

Hypothesis	Lag 1	Lag 2	Lag 3
Research and Development Does Not Homogeneously Cause Export	**0.0492**	0.3357	0.7841
Research and Development Does Not Homogeneously Cause Economic Growth	0.7560	0.6404	0.1063
Research and Development Does Not Homogeneously Cause Unemployment	0.9235	0.2724	0.6230
Information and Technology Investment Does Not Homogeneously Cause Export	0.9024	0.6038	0.9142
Information and Technology Investment Does Not Homogeneously Cause Economic Growth	**0.0641**	0.7730	0.8510
Information and Technology Investment Does Not Homogeneously Cause Unemployment	0.1285	0.9583	0.8362

significant when lags are equal to 2 and 3. This situation shows that the reliability of this result is low. This relationship is also emphasized in many different studies in the literature (Shelvia and Sulasmiyat, 2017; Bojnec and Ferto, 2014; Dilling-Hansen and Smith, 2014; Aw et. al., 2008). They recommended that research and development should be performed more effectively so as to increase the export amount.

In addition to this situation, it is understood that the probability values of the hypothesis of "Research and Development Does Not Homogeneously Cause Economic Growth" and "Research and Development Does Not Homogeneously Cause Unemployment" are higher than 0.05 for all 3 different lags. Because of that condition, it can be concluded that these hypotheses cannot be rejected. That is to say, there is not a significant relationship which shows that research and development investment can lead to economic growth or unemployment.

Moreover, it is also identified that the null hypothesis of "Information and Technology Investment Does Not Homogeneously Cause Economic Growth" can be rejected when the lag is equal to 1. The main reason is that the probability value is lower than 0.1. This situation refers that it is statistically significant at 10% significance level. It gives information that information and technology investment is the main cause of economic growth for E7 economies. Therefore, it can be said that the government should take an action in order to increase this investment. Within this framework, there may be some government subsidies that attract the attention of the investors for this area. While looking at the literature, it is seen that Hunady and Orviska (2014) and Freimane and Balina (2016) also underlined the same conclusion. In these studies, they recommended that resources should be allocated more to the technology development.

On the other hand, it can also be defined that the null hypothesis of "Information and Technology Investment Does Not Homogeneously Cause Export" and "Information and Technology Investment Does Not Homogeneously Cause Unemployment" cannot be rejected. The main reason behind this condition is that the probability values of these hypothesis are greater than 0.1 for all different lags. This issue explains that there is not a causality relationship between information and technology investment with export amount and unemployment rate for E7 economies.

SOLUTIONS AND RECOMMENDATIONS

In this study, it is aimed to understand the effect of research and development and information and communication technology expenditure on the macroeconomic factors, such as economic growth, export and unemployment rate. For this purpose, Dumitrescu Hurlin panel causality analysis is performed. Moreover, it is concluded that research and development investment have a positive effect on export while it does not have a significant effect on economic growth and unemployment rate. While considering these aspects, it can be said that emerging economies should give importance to the research and development investment in order to increase export amount. Having higher amount of export has a significant contribution to decrease current account deficit. Therefore, it can be said that research and development investment play a key role for emerging economies to minimize this important problem. Therefore, it can be recommended that these countries should take necessary actions to increase research and development activities. In addition to this aspect, it is also concluded that there is a causality relationship between information and technology investment and economic growth for E7 economies. By looking at this conclusion, it can be recommended that the governments in these economies should give incentives to the companies to make information and technology investment so that it has a significant influence on economic development. In other words, it can be strongly recommended that resources should be allocated more on research and development, and technology investment. Hence, by producing a valuable product with the help of this condition, the products of these countries will be preferred more by the customers. Another important point is that the areas of research and development should be defined according to the products that have to be imported. Owing to this aspect, emerging economies do not have to import these products and it has a decreasing effect on current account deficit.

FUTURE RESEARCH DIRECTIONS

This study focuses on the relationship between research and development expenditure with economic growth, export and unemployment rate. For this purpose, E7 countries are taken into the consideration. Additionally, Dumitrescu Hurlin panel causality analysis is used in this study to reach this objective. Therefore, it can be said that this study makes an important contribution to the literature by analyzing a significant subject for these emerging economies. However, this study may be enlarged in many different ways in the future. First of all, the number of the countries analyzed can be increased in a new study. This situation increases the accuracy of the results. Moreover, a new methodology may be implemented in order to see this relationship. In addition to these aspects, this situation may also be analyzed for developed economies or there can be a comparison between developing or developed economies.

CONCLUSION

Research and development come to the mean of creative working with the aim of increasing knowledge level. Owing to the usage of this knowledge, companies can develop new product and services. Hence, they can increase their competitive power in order to survive in the competitive environment. Another advantage of research and development is related to macroeconomic factors. For example, making research and development investment leads to economic development. In addition to this aspect, because of developing new and qualified products, research and development investment has a significant contribution to the export amount. This situation also helps to decrease current account deficit problem. Another benefit of this investment is related to the decreasing of unemployment rate since it causes companies to increase their investments.

As it can be understood, research and development investment is also very significant for emerging economies. These economies have not reached the developed status yet. Nevertheless, it is thought that they have potential to grow (Ersin and Eti, 2017). Therefore, it can be said that these countries should increase investment amount so that it can contribute economic growth. In other words, by making investment in research and development, these countries can improve technology, so they can develop new and qualified products. Owing to these conditions, their products can be preferred by the consumers and this issue causes export amount to increase.

Parallel to this aspect, in this study, it is aimed to evaluate the effects of research and development on economic growth, export amount and unemployment. Within this context, E7 countries are considered in order to reach this objective. Annual data of the variables between 1996 and 2016 is examined by using Dumitrescu Hurlin panel causality analysis. In the first process, Im, Pesaran and Shin panel unit root test is performed to understand whether these variables are stationary or not. It is defined that all these four variables have unit root so that the first differences of them are considered in the analysis process.

According to the results of Dumitrescu Hurlin panel causality analysis, it is determined that research and development investment is a significant indicator of export for these emerging economies when lag is equal to 1. However, this relationship cannot be found when lags are 2 and 3. On the other side, it is understood that the hypotheses of "Research and Development Does Not Homogeneously Cause Economic Growth" and "Research and Development Does Not Homogeneously Cause Unemployment" are rejected for all 3 lags because probability values are higher than 0.05.

It is also identified that information and technology investment is the main reason of economic growth for E7 economies because its probability value is lower than 0.1. Therefore, it can be said that the government should take an action to increase this investment, such as giving government subsidies to attract the attention of the investors. On the other hand, it can also be defined that there is not a causality relationship between information and technology investment with export amount and unemployment rate for E7 economies.

While considering these issues, it is recommended that emerging economies should give importance to the research and development investment in order to increase export amount. Because it has a significant contribution to the economic development and decreasing effect on current account deficit problem, it can be said that it plays a key role for emerging economies to be a developed country. This study aims to make important contribution to the literature by analyzing an important topic for emerging economies. However, it is believed that a new study, which makes comparison between developed and developing countries, can also be beneficial.

REFERENCES

Abubakar, A., Kassim, S. H., & Yusoff, M. B. (2015). Financial development, human capital accumulation and economic growth: Empirical evidence from the economic community of West African States (ECOWAS). *Procedia: Social and Behavioral Sciences*, *172*, 96–103. doi:10.1016/j.sbspro.2015.01.341

Adalı, Z., & Yüksel, S. (2017). Causality relationship between foreign direct investments and economic improvement for developing economies. *Marmara İktisat Dergisi*, *1*(2), 109–118.

Al Iriani, M. A., & Trabelsi, M. (2016). The economic impact of phasing out energy consumption subsidies in GCC countries. *Journal of Economics and Business*, *87*, 35–49. doi:10.1016/j.jeconbus.2016.04.004

Alam, M. S., & Paramati, S. R. (2016). The impact of tourism on income inequality in developing economies: Does Kuznets curve hypothesis exist? *Annals of Tourism Research*, *61*, 111–126. doi:10.1016/j.annals.2016.09.008

Alam, M. S., Paramati, S. R., Shahbaz, M., & Bhattacharya, M. (2017). Natural gas, trade and sustainable growth: Empirical evidence from the top gas consumers of the developing world. *Applied Economics*, *49*(7), 635–649. doi:10.1080/00036846.2016.1203064

Arvanitis, S., & Loukis, E. N. (2009). Information and communication technologies, human capital, workplace organization and labour productivity: A comparative study based on firm-level data for Greece and Switzerland. *Information Economics and Policy*, *21*(1), 43–61. doi:10.1016/j.infoecopol.2008.09.002

Astini, R., & Tafiprios, T. (2017). The Application of Three Orientation (Market, Technology and Entrepreneurship Orientation) and Global Mindset as Efforts to Increase the Growth and Export Performance: Evidence from Micro, Small and Medium Sized Industries of Teak Furniture in JAVA Island. *International Journal of Economic Perspectives*, *11*(1), 1731–1742.

Atrostic, B. K., Boegh-Nielsen, P., Motohashi, K., & Nguyen, S. (2004). *IT, Productivity and Growth in Enterprises: Evidence from new international micro data*. The Economic Impact of ICT–Measurement, Evidence and Implications.

Avram, A., Avram, C. D., & Avram, V. (2014). Research and development expenditures between discretionary costs and source for economic growth. *Romanian Journal of Economics*, *39*(2), 49–66.

Aw, B. Y., Roberts, M. J., & Xu, D. Y. (2008). R&D investments, exporting, and the evolution of firm productivity. *The American Economic Review*, *98*(2), 451–456. doi:10.1257/aer.98.2.451

Aydın, M., & Malcıoğlu, G. (2016). Financial Development and Economic Growth Relationship: The Case of OECD Countries. *Journal of Applied Research in Finance and Economics*, *2*(1), 1–7.

Bakirtas, T., & Akpolat, A. G. (2018). The Relationship between Energy Consumption, Urbanization, and Economic Growth in New Emerging-Market Countries. *Energy*, *147*, 110–121. doi:10.1016/j.energy.2018.01.011

Batabyal, A. A., & Yoo, S. J. (2017). On research and development in a model of Schumpeterian economic growth in a creative region. *Technological Forecasting and Social Change*, *115*, 69–74. doi:10.1016/j.techfore.2016.09.020

Bayarcelik, E. B., & Taşel, F. (2012). Research and development: Source of economic growth. *Procedia: Social and Behavioral Sciences*, *58*, 744–753. doi:10.1016/j.sbspro.2012.09.1052

Blanco, L. R., Gu, J., & Prieger, J. E. (2016). The impact of research and development on economic growth and productivity in the US states. *Southern Economic Journal*, *82*(3), 914–934. doi:10.1002oej.12107

Bojnec, Š., & Fertő, I. (2014). Research and development spending and export performance by the technological intensity of the products. *Ekonomický časopis*. *Journal of Economics*, *62*(10).

Brem, A., & Wolfram, P. (2014). Research and development from the bottom up-introduction of terminologies for new product development in emerging markets. *Journal of Innovation and Entrepreneurship*, *3*(1), 9. doi:10.1186/2192-5372-3-9

Bresnahan, T. F., & Trajtenberg, M. (1995). General purpose technologies 'Engines of growth'? *Journal of Econometrics*, *65*(1), 83–108. doi:10.1016/0304-4076(94)01598-T

Carboni, O. A., & Medda, G. (2018). R&D, export and investment decision: Evidence from European firms. *Applied Economics*, *50*(2), 187–201. doi:10.1080/00036846.2017.1332747

Cardona, M., Kretschmer, T., & Strobel, T. (2013). ICT and productivity: Conclusions from the empirical literature. *Information Economics and Policy*, *25*(3), 109–125. doi:10.1016/j.infoecopol.2012.12.002

Chen, Y., & Fang, Z. (2017). Industrial electricity consumption, human capital investment and economic growth in Chinese cities. *Economic Modelling*.

Chusseau, N., & Hellier, J. (2008). Social policies and R&D subsidies: Impact on inequality, unemployment, growth and the tax burden. *International Journal of Manpower*, *29*(3), 239–262. doi:10.1108/01437720810878905

Destek, M. A., & Aslan, A. (2017). Renewable and non-renewable energy consumption and economic growth in emerging economies: Evidence from bootstrap panel causality. *Renewable Energy*, *111*, 757–763. doi:10.1016/j.renene.2017.05.008

Dilling-Hansen, M., & Smith, V. (2014). R&D, export and productivity: Testing the Bustos model on Danish data. *Applied Economics Letters*, *21*(11), 733–737. doi:10.1080/13504851.2014.884695

Dinçer, H., Yüksel, S., & Adalı, Z. (2017). Identifying Causality Relationship between Energy Consumption and Economic Growth in Developed Countries. *International Business and Accounting Research Journal*, *1*(2), 71–81. doi:10.15294/ibarj.v1i2.9

Dinçer, H., Yuksel, S., & Adalı, Z. (2018). Relationship Between Non-Performing Loans, Industry, and Economic Growth of the African Economies and Policy Recommendations for Global Growth. In *Globalization and Trade Integration in Developing Countries* (pp. 203–228). IGI Global. doi:10.4018/978-1-5225-4032-8.ch009

Dogan, E., Sebri, M., & Turkekul, B. (2016). Exploring the relationship between agricultural electricity consumption and output: New evidence from Turkish regional data. *Energy Policy*, *95*, 370–377. doi:10.1016/j.enpol.2016.05.018

Dogru, T., & Bulut, U. (2017). Is tourism an engine for economic recovery? Theory and empirical evidence. *Tourism Management*.

Dumitrescu, E. I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic Modelling*, *29*(4), 1450–1460. doi:10.1016/j.econmod.2012.02.014

Ersin, İ., & Eti, S. (2017). Measuring the Waste-Conscious and Saving Habits of the Youth in Turkey: The Sample of Istanbul Medipol University. *International Journal of Islamic Economics and Finance Studies*, *3*(3), 41–49.

Freimane, R., & Bāliņa, S. (2016). Research and development expenditures and economic growth in the EU: A panel data analysis. *Economics and Business*, *29*(1), 5–11. doi:10.1515/eb-2016-0016

Furuoka, F. (2015). Financial development and energy consumption: Evidence from a heterogeneous panel of Asian countries. *Renewable & Sustainable Energy Reviews*, *52*, 430–444. doi:10.1016/j.rser.2015.07.120

Furuoka, F. (2017). Renewable electricity consumption and economic development: New findings from the Baltic countries. *Renewable & Sustainable Energy Reviews*, *71*, 450–463. doi:10.1016/j.rser.2016.12.074

Gao, Y., Wu, J., & Hafsi, T. (2017). The Inverted U-Shaped Relationship between Corporate Philanthropy and Spending on Research and Development: A Case of Complementarity and Competition Moderated by Firm Size and Visibility. *Corporate Social Responsibility and Environmental Management*, *24*(6), 465–477. doi:10.1002/csr.1420

Garofalo, A., Rycx, F., & Paolo Vinci, C. (2008). Unemployment, innovation and R&D: Introduction. *International Journal of Manpower*, *29*(3), 192–197. doi:10.1108/01437720810878879

Georgiou, M. N. (2010). *R&D, Government Debt and Unemployment: An Empirical Analysis for Europe (1998-2007)*. Some Comments.

Gilchrist, S., Gurbaxani, V., & Town, R. (2001). *Productivity and the PC Revolution.* Center for Research on Information Technology and Organizations Working paper, University of California.

Girma, S., Görg, H., & Hanley, A. (2008). R&D and exporting: A comparison of British and Irish firms. *Review of World Economics*, *144*(4), 750–773. doi:10.100710290-008-0168-6

Go, A. W., Sutanto, S., Zullaikah, S., Ismadji, S., & Ju, Y. H. (2016). A new approach in maximizing and direct utilization of whole Jatropha curcas L. kernels in biodiesel production–Technological improvement. *Renewable Energy*, *85*, 759–765. doi:10.1016/j.renene.2015.06.073

Grazzi, M., & Jung, J. (2015). *ICT, innovation and productivity: evidence from Latin American firms*. Google Scholar.

Guarascio, D., Pianta, M., & Bogliacino, F. (2017). Export, R&D and New Products: A Model and a Test on European Industries. In *Foundations of Economic Change* (pp. 393–432). Cham: Springer. doi:10.1007/978-3-319-62009-1_17

Guloglu, B., & Tekin, R. B. (2012). A panel causality analysis of the relationship among research and development, innovation, and economic growth in high-income OECD countries. *Eurasian Economic Review*, *2*(1), 32–47.

Hasanov, F., Bulut, C., & Suleymanov, E. (2017). Review of energy-growth nexus: A panel analysis for ten Eurasian oil exporting countries. *Renewable & Sustainable Energy Reviews*, *73*, 369–386. doi:10.1016/j.rser.2017.01.140

Hellier, J., & Chusseau, N. (2008). *Social Policies and R&D Subsidies: Impact on Inequality*. Unemployment and Growth.

Hou, D., Li, G., & Nathanail, P. (2018). An emerging market for groundwater remediation in China: Policies, statistics, and future outlook. *Frontiers of Environmental Science & Engineering*, *12*(1), 16. doi:10.100711783-018-1027-x

Hunady, J., & Orviska, M. (2014). Determinants of Foreign Direct Investment in EU Countries–Do Corporate Taxes Really Matter? *Procedia Economics and Finance*, *12*, 243–250. doi:10.1016/S2212-5671(14)00341-4

Jangraiz, K. H. A. N. (2015). The role of research and development in economic growth: A review. *Journal of Economics Bibliography*, *2*(3), 128.

Jung, H. J., Na, K. Y., & Yoon, C. H. (2013). The role of ICT in Korea's economic growth: Productivity changes across industries since the 1990s. *Telecommunications Policy*, *37*(4-5), 292–310. doi:10.1016/j.telpol.2012.06.006

Kahia, M., Aïssa, M. S. B., & Lanouar, C. (2017). Renewable and non-renewable energy use-economic growth nexus: The case of MENA Net Oil Importing Countries. *Renewable & Sustainable Energy Reviews*, *71*, 127–140. doi:10.1016/j.rser.2017.01.010

Khan, H. U. R., Zaman, K., Khan, A., & Islam, T. (2017). Quadrilateral Relationship Between Information and Communications Technology, Patent Applications, Research and Development Expenditures, and Growth Factors: Evidence from the Group of Seven (G-7) Countries. *Social Indicators Research*, *133*(3), 1165–1191. doi:10.100711205-016-1402-6

Kilic, C. (2015). Effects of Globalization on Economic Growth: Panel Data Analysis for Developing Countries. *Petroleum-Gas University of Ploiesti Bulletin, Technical Series, 67*(1).

Komal, R., & Abbas, F. (2015). Linking financial development, economic growth and energy consumption in Pakistan. *Renewable & Sustainable Energy Reviews*, *44*, 211–220. doi:10.1016/j.rser.2014.12.015

Kotler, P., & Gertner, D. (2002). Country as brand, product, and beyond: A place marketing and brand management perspective. *Journal of Brand Management*, *9*(4), 249–261. doi:10.1057/palgrave.bm.2540076

Latif, Z., Latif, S., Ximei, L., Pathan, Z. H., Salam, S., & Jianqiu, Z. (2017). The dynamics of ICT, foreign direct investment, globalization and economic growth: Panel estimation robust to heterogeneity and cross-sectional dependence. *Telematics and Informatics*.

Leil, T. A., & Bertz, R. (2014). Quantitative systems pharmacology can reduce attrition and improve productivity in pharmaceutical research and development. *Frontiers in Pharmacology*, *5*, 247. doi:10.3389/fphar.2014.00247 PMID:25426074

Lucas, R. E. Jr. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, *22*(1), 3–42. doi:10.1016/0304-3932(88)90168-7

Lucas, R. E. Jr. (1993). Making a miracle. *Econometrica*, *61*(2), 251–272. doi:10.2307/2951551

Magalhães, M., & Afonso, Ó. (2017). A multi-sector growth model with technology diffusion and networks. *Research Policy*, *46*(7), 1340–1359. doi:10.1016/j.respol.2017.05.004

Marrano, M. G., Haskel, J., & Wallis, G. (2009). What happened to the knowledge economy? ICT, intangible investment, and Britain's productivity record revisited. *Review of Income and Wealth*, *55*(3), 686–716. doi:10.1111/j.1475-4991.2009.00344.x

McElwain, M. A., Zhang, R. Y., Drmanac, R., & Peters, B. A. (2017). Long Fragment Read (LFR) Technology: Cost-Effective, High-Quality Genome-Wide Molecular Haplotyping. *Haplotyping: Methods and Protocols*, 191-205.

McMichael, P. (2011). *Development and social change: A global perspective: A global perspective*. Sage Publications.

Miyamoto, H. (2010). R&D, unemployment, and labor market policies. *Japan and the World Economy*, *22*(3), 198–205. doi:10.1016/j.japwor.2010.03.006

Obinata, T. (2016). The Contribution of Research and Development Investments by Sectors to GDP Growth (No. CIRJE-J-279). CIRJE, Faculty of Economics, University of Tokyo. (in Japanese)

Papaioannou, S. K., & Dimelis, S. P. (2007). Information technology as a factor of economic development: Evidence from developed and developing countries. *Economics of Innovation and New Technology*, *16*(3), 179–194. doi:10.1080/10438590600661889

Paramati, S. R., Alam, M. S., & Chen, C. F. (2017). The effects of tourism on economic growth and CO2 emissions: A comparison between developed and developing economies. *Journal of Travel Research*, *56*(6), 712–724. doi:10.1177/0047287516667848

Paramati, S. R., Ummalla, M., & Apergis, N. (2016). The effect of foreign direct investment and stock market growth on clean energy use across a panel of emerging market economies. *Energy Economics*, *56*, 29–41. doi:10.1016/j.eneco.2016.02.008

Pavlinek, P. (2017). Research and Development. In *Dependent Growth: Foreign Investment and the Development of the Automotive Industry in East-Central Europe* (pp. 107–147). Cham: Springer. doi:10.1007/978-3-319-53955-3_4

Pilat, D., & Lee, F. C. (2001). *Productivity Growth in ICT-producing and ICT-using Industries*. Academic Press.

Podmetina, D., Smirnova, M., Väätänen, J., & Torkkeli, M. (2009). Innovativeness and international operations: Case of Russian R&D companies. *International Journal of Innovation Management*, *13*(2), 295–317. doi:10.1142/S1363919609002303

Reddy, P. (1997). New trends in globalization of corporate R&D and implications for innovation capability in host countries: A survey from India. *World Development*, *25*(11), 1821–1837. doi:10.1016/S0305-750X(97)00079-X

Ren, S., Eisingerich, A. B., & Tsai, H. T. (2015). How do marketing, research and development capabilities, and degree of internationalization synergistically affect the innovation performance of small and medium-sized enterprises (SMEs)? A panel data study of Chinese SMEs. *International Business Review*, *24*(4), 642–651. doi:10.1016/j.ibusrev.2014.11.006

Rollins, M., Rodriguez-Franco, C., Haan, T., & Conard, S. (2017). *Research and Development wildland fire and fuels accomplishments and outcomes. FS-1086*. Washington, DC: US Department of Agriculture, Forest Service.

Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, *94*(5), 1002–1037. doi:10.1086/261420

Rycx, F., Garofalo, A., & Vinci, C. P. (2008). *Unemployment, innovation and R&D* (No. 2013/6589). ULB--Universite Libre de Bruxelles.

Salahuddin, M., & Alam, K. (2016). Information and Communication Technology, electricity consumption and economic growth in OECD countries: A panel data analysis. *International Journal of Electrical Power & Energy Systems*, *76*, 185–193. doi:10.1016/j.ijepes.2015.11.005

Shelvia, S., & Sulasmiyati, S. (2017). Affecting Factors of Foreign Direct Investment: Export and Gross Domestic Expenditure on Research and Development in Human Capital Concept (a Study in Indonesia Period 2009-2016). *Jurnal Administrasi Bisnis*, *50*(4), 123–130.

Silaghi, M. I. P., Alexa, D., Jude, C., & Litan, C. (2014). Do business and public sector research and development expenditures contribute to economic growth in Central and Eastern European Countries? A dynamic panel estimation. *Economic Modelling*, *36*, 108–119. doi:10.1016/j.econmod.2013.08.035

Tonkovic, M. P., & Hussain, S. A. (2017). Residential and non-residential electricity dynamics. *Energy Economics*, *64*, 262–271. doi:10.1016/j.eneco.2017.04.003

Tsai, S. B. (2018). Using the DEMATEL model to explore the job satisfaction of research and development professionals in china's photovoltaic cell industry. *Renewable & Sustainable Energy Reviews*, *81*, 62–68. doi:10.1016/j.rser.2017.07.014

World Bank. (2018a). *Research and Development Expenditure (% of GDP).* Retrieved from https://data.worldbank.org/indicator/gb.xpd.rsdv.gd.zs

World Bank. (2018b). *The World Bank*. Retrieved from http://www.worldbank.org/

Yüksel, S. (2017). The impacts of research and development expenses on export and economic growth. *International Business and Accounting Research Journal*, *1*(1), 1–8. doi:10.15294/ibarj.v1i1.1

Zaman, K., Shahbaz, M., Loganathan, N., & Raza, S. A. (2016). Tourism development, energy consumption and Environmental Kuznets Curve: Trivariate analysis in the panel of developed and developing countries. *Tourism Management*, *54*, 275–283. doi:10.1016/j.tourman.2015.12.001

Zhang, C., Zhou, K., Yang, S., & Shao, Z. (2017). On electricity consumption and economic growth in China. *Renewable & Sustainable Energy Reviews*, *76*, 353–368. doi:10.1016/j.rser.2017.03.071

KEY TERMS AND DEFINITIONS

Current Account Deficit: It is the condition in which foreign currency which comes to the country is lower than the foreign currency that is paid to the foreign countries. It is accepted as one of the most indicator of financial crisis.

Developed Country: It refers to the country which has high economic performance in comparison with the developing and least developed countries.

Developing Country: It means the country which has not reached the developed status yet. Nevertheless, it is believed that this has a potential to grow.

Dumitrescu Hurlin Panel Causality Analysis: It is a type of causality analysis in which panel data is analyzed. It is an advanced form of Granger causality analysis.

E7 Countries: It refers to the seven countries which have the highest economic performance in the class of emerging economies. These are Brazil, China, India, Indonesia, Mexico, Russia, and Turkey.

Economic Growth: It is calculated the difference between gross domestic product amount of the country in different periods. It is accepted as the most important indicator of the economic performance of the countries.

Export: It is the process of selling domestic good to the foreign countries.

Stationary Analysis: It aims to identify whether there is a unit root in the series or not.

Unemployment Rate: It is calculated as the ratio of unemployed people to the labor force. The important point in this situation is that people who are searching job are only included in the labor force.

Section 3

Innovation in Training and Education

Chapter 14
Educational Innovation Techniques Based on Assessment and Development of Student Potential

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ABSTRACT

How do we wish to structure the universities of tomorrow? There is probably no single response to this question, but it is possible to make a contribution from the work psychology perspective that offers ways and mean to achieve higher quality in university teaching. The aim of this chapter is to describe various educational innovation activities, based on models and applications developed in the field of human resources, that make it possible to meet the needs and challenges that universities will have to face in the immediate future. The proposed activities arise from personal and career development assessments and place the student at the center of the process, since the commitment of universities is to develop student potential as far as possible in order to ensure that in their professional lives former students have the knowledge and competencies required of them by society.

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INTRODUCTION

One of the goals of university is to prepare students to effectively practice a profession, and for the knowledge and competencies acquired to therefore benefit society. Others are to generate knowledge, to find solutions to problems that arise and to contribute to improvements in people's quality of life and wellbeing. Whether these aims are achieved depends to a large degree on the members of the university community (Alonso, Berrocal and Calles, 2012).

University teaching as we know it is on the verge of disappearing. The main strength of the university system is probably the social recognition of the qualifications it certifies, which have for many years offered a guarantee allowing assumptions to be made as to the knowledge and competencies of those graduating from any higher education centre.

However, the current opportunities in terms of access to information allow sufficiently motivated individuals to acquire knowledge of a particular professional area by themselves. If this is the case, how long will it take businesses to implement tests that enable them to assess the caliber of individuals regardless of what they have studied and which qualifications they have acquired?

This all becomes particularly relevant if one considers that many students continue to attend on-site classes in order to take notes of what the teacher says – information that they could obtain via other means. Moreover, study programmes are closed and slow to change when advances in society and the labour market require them to do so; they do not always fit the access profiles of a proportion of students.

What aspects is it necessary to change in terms of the training of university students? What would have to happen for universities to continue to train the most highly qualified professionals in the country? How do we wish to structure the universities of tomorrow?

The aim of this chapter, then, is to describe various educational innovation activities that make it possible to meet the needs and challenges that universities will have to face in the immediate future.

All the proposed activities place the student at their centre, since the commitment of universities is to develop their potential as far as possible in order to ensure that in their professional lives, former students have the knowledge and competencies required of them by society.

For this purpose, the subject-matter will be addressed from the perspective of personal assessment and development, with specific examples that provide evidence of how the new challenges of on-site university teaching can be met. Though there are many advantages to distance learning, being present in person is and will continue to be irreplaceable for the achievement of certain objectives and development of certain competencies.

We will examine three different proposals from the area of assessment: a model to identify needs in terms of transversal competencies, open space technology, and the "what you want to happen" technique. In terms of development and intervention, we will discuss three actions: flipped learning, gamification and peer learning in mentoring programmes. All the proposals are aimed at ensuring that universities prepare their students for new jobs, new ways of working and new forms of interaction with society and the environment.

ASSESSMENT PROPOSALS

From the perspective of assessment, when students are assigned to each centre of studies (based on their interests, their average academic scores and the average of a knowledge-based entry examination), these centres assume that the students have the same initial level of knowledge and apply standard programmes for all of them. Perhaps one could make this assumption from the point of view of knowledge (though the "introductory courses" provided before the start of the academic programme to even out knowledge levels suggest that this is not the case), but what about transversal competencies?

Do students have similar levels in digital, language, teamwork, planning and organisational competencies? Obviously not, yet it does not appear important to pay attention to competencies with such importance in any degree course for the various tasks and activities to be carried out. It seems that responsibility for assessing transversal competencies falls to the teachers of each subject, yet these are strategic needs. As such, they should be assessed on a standard basis in each centre, with an identification of what to assess and how to do so and different measures being taken over time.

The first proposal, in terms of assessment, is to present a model that permits the identification of training needs in terms of transversal competencies for each degree. For this purpose, a procedure is proposed that uses various techniques (surveys, interviews, focus groups) to identify gaps and suggest effective ways of covering them. The phased assessment model that is used in the context of personal assessment in work psychology will be proposed, with an outline of how it can be implemented at no cost by using the service-learning project model, involving students and developing their competencies through real practices whose results benefit the organisation to which they belong. Examples will also be offered of tools for gathering information and each phase of the process will be described.

Identification of Training Needs in Terms of Transversal Competencies for University Students

The Europe 2020 strategy allocates the responsibility for boosting employability and socio-labour inclusion of young people to educational institutions, implementing the adoption of competence-based education within the European university learning framework. In order to join up labour market demand and university education, the European Framework of higher education qualifications established two kinds of competencies in this respect: specific, and generic or transversal. The specific competencies are restricted to the specific field related to each qualification, while transversal competencies are closely linked to social and labour demand and must therefore enhance the employability of graduates (González & Wagenaar, 2003)

Various models attempt to identify the transversal competencies of the academic context (Berrocal *et al.*, 2013, Martínez-Clares & González-Morga, 2018; Tejada & Ruiz, 2016) or the perception that university students have of their basic competencies with relation to the processes for assessing their learning (Rodríguez, Ibarra and Cubero, 2018). The pioneering and most widely accepted model for classifying competencies was proposed in the Tuning Project (González & Wagenaar, 2003) and distinguishes between instrumental, intrapersonal and systemic competencies.

Within the current framework of higher education, transversal competencies have become essential and necessary across all syllabuses of the various university qualifications. It is considered that students must acquire them on an on-going basis as they study and pass the different subjects and topics established in their study programmes. However, there are no established mechanisms to assess the needs of incoming university students and there is no provision as to how the acquisition and assessment of these competencies will be embedded in educational programmes. Nor is there any indication as to how the universities will assess the level of incoming students in such competencies in order to identify their suitability for the new environment, or the level of graduate students in order to establish whether there has in fact been any learning and development over the course of their journey through the university.

In the context of human resources, one of the key aspects of implementing changes is establishing the training needs that people will have in order to respond to such shifts. In other words, shortcomings or problems in terms of carrying out their workplace tasks are identified and training plans are established to cover such shortcomings (Robins & Coultier, 2012; Beever and Rea, 2016). Once the needs have been identified, the knowledge, skills and attitudes that must be acquired in order to cover such shortcomings are determined. This will result in improved job performance. But before deciding which training courses will be provided and which employees will attend them, it is necessary to identify the conduct that the position requires of its occupants if it is to be performed to a high level, since the needs analysis will be conducted based on the gaps between the conduct required of the employee and the conduct that the employee is actually displaying.

The experience that is presented below has the aim of detecting and identifying educational needs in transversal competencies for various undergraduates' degrees from the perspective of work psychology and human resources. It is proposed as a project under the service-learning model, firstly because it consists of an activity to be performed by undergraduate students within the framework of subjects related with personal assessment and development in employment contexts, under the supervision of teachers and tutors who are experts in human resources. Moreover, secondly, the project outcomes will have a beneficial impact for the university community.

In this case, educational needs in transversal competencies are identified on the basis of knowledge and experience of the main actors involved in learning and education: the students, teachers and coordinators of qualifications. To conduct the project, it is proposed to use various information-gathering techniques, both quantitative (questionnaires) and qualitative (interviews with key persons and focus groups).

The different phases of the project are presented below. These phases coincide with the phases of assessment processes in organisational contexts (Hidalgo & Castaño, 2011; Honkanen & Nyman, 2002; ISO-10667, 2011; Nikolaou & Oostrom, 2015).

1. **Setting Assessment Aims:** Focused on identifying the educational needs of university students in transversal competencies. This is a question of identifying the problem (why are we going to act?) and the aims (for what purpose are we going to act?).
2. **Defining Assessment Criteria:**
    a. It is initially necessary to produce the description of the student's profile, identifying the tasks and activities that students have to carry out. The various tasks are grouped into higher categories or main functions. The description of the role also identifies the organizational citizenship behaviour, adaptation and potential counterproductive behaviour.
    b. The criteria or dimensions of conduct that are necessary for the effective and efficient performance of the student's role are defined.
    c. The transversal competencies necessary for the performance of the role are identified.
3. **Design of Information-Gathering Techniques:** The techniques will be implemented by the students and supervised by the teachers of the subjects involved in the project, who will be in charge of coordinating the products made by their students. The techniques used will be quantitative (questionnaires) and qualitative (interviews and focus group). As different actors are involved, questionnaires are designed to collect information from students. Three interview scripts are designed (for degree students, teachers and coordinators) and the focus group scripts are aimed at students. It must be taken into account that the objective is to collect information with respect to both the importance of the identified transversal competencies and the level that is desirable in

order to perform the role of student. There must also be a focus on the level that students should have on completion since the ultimate goal is to improve graduate employability. Therefore, having identified the various competencies, it is necessary to establish the extent to which there are gaps between the profile of requirements defined for the role of student and the level of competencies demonstrated by incoming students. The gaps that exist will allow us to identify the educational needs of incoming students and to establish specific educational actions to develop the relevant competencies.

4. **Procedure and Implementation of Assessment Sessions:** Once the instruments have been produced, students from higher academic years will carry out the assessment by applying the various techniques to the relevant actors. The assessment will be conducted during the second term, so that first-year students have had the opportunity to observe which difficulties they face in performing the role of student in the new university context. The techniques will also be applied to second, third and fourth-year students, in order to know the perception about their own level and the importance for their student role performance in the light of their experience. The students will also contact course and qualification teachers and coordinators to organise appointments for interviews. Finally, the focus groups will be carried out by selecting participants in accordance with the participation criteria established when designing the technique. The various techniques will be applied under tutor supervision.
5. **Analysis of Results and Preparation of Report:** The process memorandum will be prepared. This memorandum will present the description of student profile, the transversal competencies identified, and the educational strengths and needs detected for the student group. Another product of this service-learning project will be the production of a quantitative assessment instrument containing the key transversal competencies and conduct associated with them, to enable optimal performance of the role of student. Finally, an intervention proposal will be prepared that establishes educational and development actions and any other kind of action that permits the minimisation of weaknesses detected among the students.
6. **Communication of Results to the Various Actors and to the Organisation:** The project results will be notified to all actors – students, teachers and management at the university.
7. **Follow-Up and Evaluation:** Based on the information arising out of this project, follow-up mechanisms will be established to verify that students complete the various university degrees with the levels of competencies required both within the academic context and by the labour market. This entails periodic review and updating of the relevant transversal competencies in both environments.

Example

Some of the preliminary results from the application of the service-learning project at UCM are set out below.

The main functions identified for the student profile were:

- Attendance at and participation in classes
- Studying and preparing for subjects
- Completing assessed activities (examinations, presentations, case studies, research, group projects)
- Completing other educational activities (tutorials, seminar and conference attendance)
- Participating in and being committed to university life

The competencies identified by students to perform the student profile were: communication, analysis and synthesis, responsibility, planning and organisation, initiative, digital skills, dealing with stress, autonomous learning, problem-solving, continuous learning, interpersonal relationships, flexibility, teamwork, and academic integrity.

For example, the competence of academic integrity was defined as respecting the rules of the university, including complying with ethical and deontological values when engaging in academic activities.

The "What You Want to Happen (WWH)" Technique

The methodology used is based on participative and group techniques for the development of people and organisations. These techniques prioritise communication, reflection and creativity with a focus on problem-solving. The information gathered is qualitative and anonymous. The technique was designed by Ana Calles, Francisca Berrocal and Miguel A. Alonso in the context of an education innovation project at Universidad Complutense de Madrid (UCM). The "what you want to happen" technique (Alonso, Berrocal and Calles, 2012) is comprised of two distinct phases:

Phase One: Involves asking the members of a certain community what they want to happen within it. This is an open and thought-provoking question, offering each individual a protagonist's role in terms of verbalising the future that they desire. In general, different means are established for the receipt of participant responses (including email, panels, social media or Internet forums, and questionnaires). Various information-gathering techniques are used to increase the number of responses and adapt to the preferred participation style of each person.

The proposals made are analysed and categorised on the basis of the issues raised. The most commonly occurring suggestions are chosen for a second phase, provided that the issue in question is susceptible to change.

Phase Two: During the second phase (once the most frequently cited subjects have been selected), participants are asked to offer suggestions and actions to achieve the change in question (to be carried out by others, but also with contributions from the individuals themselves). This results in the implementation of specific actions. This second information-gathering phase corresponds to the "how" (what can be done to make it happen?). The various actors contribute ideas to achieve what they want, describing the conduct that they are prepared to engage in. The responses received are again analysed and categorised on the basis of the points they have in common; the information is structured to provide readable results and facilitate the production of conclusions. The technique seeks active commitment from each participant, asking that they include at least one thing that they themselves can do to achieve the desired goal.

The positive and constructive methodology means that a series of proposals can be produced that in some way entail positive critical incidents that participants would like to arise. Notwithstanding this, many proposals relate to issues that clearly require improvement or rectification and represent negative critical incidents.

Example

The technique was first applied in the Psychology Faculty at UCM. The participants were students, teachers and staff from the Psychology Faculty. The various actors in the faculty were asked the question *"what do you want to happen?"*, which they could answer through various means. Responses were received from 570 people: 535 students, 23 scholars and 12 members of administrative staff.

Participant responses were collected via the following means: Twitter, Internet forums, large panels located in the Psychology Faculty upon which participants could write, in classrooms, and through individual interviews.

The results obtained for the first question of "*what do you want to happen*?" were categorised in various areas. The highest number of proposals were focused on the area related with improvements to teaching management (201 suggestions). These included making class attendance flexible, altering timetables, changes to the study programme or to the programmes of the subjects, reducing the number of students per class, a higher number of elective subjects, a greater variety in terms of degree content, examination-related aspects (opportunities to increase marks, partial examinations, being able to choose the form of examination, more explicitly practical work), price and management of enrolment, more information about career and professional opportunities, research, and grants.

Another frequently mentioned area was facilities (196 people wanted improvements), particularly with relation to IT equipment, classrooms, photocopiers, the cafeteria, the library and common spaces.

Management of teaching aspects and facilities have an indirect impact on teaching as environmental factors. However, the third block of responses, set out below, refers directly to the work of academic staff.

Suggestions in this regard also appeared repeatedly (on 137 occasions), related with improving the work of teachers in class, improving the quantity and quality of internships, use of different methodological technique in or outside of class (conferences, round-table discussions, discussion groups, case studies, group work, flipped classrooms, and use of new technologies for learning support), changes in how class is given, tutorial-related aspects, and the need to assess teachers and for those assessments to be used to address teachers' weak points, attitudes and competencies (increased friendliness, involvement, motivation, flexibility, and better teaching competencies).

The second phase involved the selection of three aspects based on the number of suggested improvements received and because it was felt that students could contribute solutions to achieve the improvements. Students were in fact asked not only what could be done, but also what they could do in order to achieve the change. Other matters had been raised more frequently, such as improvement of facilities or administration, but students have little influence or opportunity to effect improvements in these areas. During this second phase, 489 students provided written answers in the classroom to the question: "What should be done to achieve…?" The three issues were achieving more external internships, making classes more dynamic and interesting, and increasing learning in the faculty. A group meeting was also held with delegates and interviews with key actors to obtain additional information. The intention was to agree upon specific conclusions and proposed actions that would permit the problem in question to be addressed over the short, medium and long term. Finally, a round-table debate took place at which key actors engaged in dialogue regarding the various proposals made, analysing them and discussing possible implementations pathways from each perspective and frame of reference for the following academic course.

Open Space Technology

Open space technology (OST) came to prominence in the 1980s, having been developed by Harrison Owen (2008). It has since has been applied in multiple circumstances worldwide, fundamentally in the field of organisational development and transformation.

OST invites large groups to work on a specific topic, which is divided into various issues. Groups are asked to offer ideas that can improve each issue. The information obtained permits the production of plans for improvement in each issue that is addressed.

The first step is a description of what the technique consists of, with an explanation that it permits work on various interrelated issues so that each participant can offer their ideas on each issue and a summary of the rules.

The principles for the technique are as follows:

- Whoever comes is the right people.
- What is happening is what the only thing that could have; the idea is to remain focused on what is happening now and not to worry about what could happen.
- The starting time is the right time, whenever it is.
- When something is over, it is over; time must not be wasted and discussions should be abandoned when they are not fruitful.
- The only "law" for the activity is "the law of two feet". If at any time a participant feels that they are not learning or contributing anything, they should use their feet and go to another session where they can learn or contribute. In fact, participants can assume any of the following roles: leader (with passion for the topic, taking charge of organising it), participant (anyone who is involved and wishes to remain for the whole time), bee (who moves from conversation to conversation) and butterfly (who is not willing to take part in any conversation).

Participants are then asked to choose the issues that they wish to work on regarding the framework of the proposed topic. Three or four issues will be chosen from among those that have been suggested. As many sessions will be initiated as there are issues to be worked upon, and a panel will usually be established with an announcer who encourages participants to offer ideas on the issue. The attendees decide which session to attend, and after thinking and exchanging positions with the rest, they write down the ideas that occur to them. After the established time for the session has passed – normally an hour and a half – there is a break during which the coordinators of the panels analyse the information that has been produced. A final phase involves presenting the main outcomes from each panel to all the participants.

Example

The professor Calles uses this technique to improve certain aspects of the Work and Organisational Psychology and Human Resource Management master's degree offered by UCM at the end of each academic year and with all the students who have completed the course. The outcomes enable on-going improvements to be made to the organisation, planning, content and methodology used on the master's programme.

INTERVENTION PROPOSALS

In the context of intervention and with the aim of development knowledge and competencies among university students, we propose the use of flipped-learning, gamification and peer-learning. These techniques are intended to provide more individualized and made-to-measure learning so as to cover students' current needs.

We examine how to use the methodology of action learning as a knowledge acquisition tool that enables students to engage in proactive conduct with respect to their own learning.

The third example of a process to increase learning is mentoring. This is an accompaniment model that, in the university context, allows students from one of the more advanced academic years (mentors) to hold a series of meetings with incoming students (mentees) to facilitate their integration into the university. We examine the characteristics that are necessary in order for a mentoring programme to work and to permit the development of knowledge and competencies among mentors and mentees. In the Spanish context, there are precedents that demonstrate the usefulness of the model.

Strategies to Increase Learning

We can no longer consider as we did in the past that teaching is an art and, as such, not susceptible to analysis or the imposition of rules. Even today, this way of thinking is engrained in the culture of many education processes, with the presumption that the participant's learning depends solely on the "art" of the teacher or lecturer and on the students' motivation or ability to allow that figure to teach them.

Moreover, we share the view of the teachers Alfredo Prieto and Miguel Valcárcel and of the educational philosopher John Dewey, who argue that on occasions teachers work within their comfort zones, repeating their classes year after year without considering alternatives that could improve student learning, as things have always been done in a particular way. Or, as Harvard physicist Eric Mazur put it in his lecture entitled "confessions of a converted lecturer" in 2009, the easiest and least demanding and stressful approach is usually for teachers to repeat what we have done before, but is this approach the best one for student learning?

In light of this, we consider that changes should be introduced to the way in which teaching is approached if we want students to involve themselves in their own learning and to enjoy themselves in the process.

In order to achieve this aim, a change of didactic methodology is necessary. We need to examine why we are teaching; that is, what we want our students to achieve. Students do not have to be able to reproduce what they are being taught, but rather must be able to understand it and apply it to situations that are practical and useful for them, that make sense, that involve them and that commit them to their own learning.

Within this framework, we propose the use of active and inductive methods based on flipped learning and gamification methodology, which we explain below. Both methods are characterised by permitting personalisation of the education offered to students based on their level of knowledge and skills.

What Is Flipped Learning?

As it is coherent with our understanding of and approach to the technique, we adopt the definition proposed by Flipped Learning Network (2014).

Flipped Learning is a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter (p. 1).

Methodologies of this type include Novak's just-in-time teaching (Novak, Patterson, Gavrin and Christian, 1999), Mazur's peer instruction (Mazur, 1997; Crouch and Mazur, 2001) and Michaelsen's team-based learning (Michaelsen, Sweet and Parmelee, 2011).

We shall focus specifically on just-in-time teaching (JITT) and peer learning; as these were, the first methodologies produced and have been subject to the largest number of studies. Those studies verified the high levels of effectiveness of the aforementioned methods in terms of improving student learning. This fact enables us to produce quantitative estimates regarding the objectives to be achieved when we develop our didactic proposals, since improvements have been recorded in terms of learning outcomes, reduced dropout rates, increased involvement in classes, student-teacher interactions and study habits (Crouch and Mazur, 2001, Marrs and Novak, 2004).

In order to check what is studied, JITT uses questionnaires that students complete prior to on-campus sessions, in which they report their difficulties when studying the matter at hand. The great advantage of this methodology is hence that it enables the teacher to be aware of their students' doubts or problems prior to class and to prepare the class based on those doubts or problems (Novak, Gavrin, Christian and Patterson, 1999; Marrs and Novak, 2004). Meanwhile, peer learning encourages the resolution of doubts by the peer group and the completion of collaborative tasks. The use of this methodology has given rise to results that may be described as spectacular, confirmed by the teachers Crouch and Mazur (2001) in a ten-year longitudinal study. As various authors note, however, it must not be forgotten that large degrees of motivation are necessary for students to follow this kind of methodology and that some of them will display resistance to traditional systems not being used.

This methodology implies students first prepare the theoretical contents of the subject out the classroom via articles, papers, videos and so on. After that different activities in the classroom are devised, as group discussions, problem-solving cases or peer resolution of doubts. These activities provide the opportunity for students to receive peer and teacher feedback. That's to say, student may correct wrong concepts, organize the new knowledge and self-evaluate his/her own learning (Swart, 2018) and thus achieve more effective and lasting learning. Therefore, flipped learning is a new way learning for students but it is also a new way of teaching for teachers.

This work methodology falls within the constructivist model of education, which affirms that it is the students who must construct the meaning of the knowledge, since it cannot simply be transferred (Weimer, 2013). This learning methodology allows the students to learn by themselves and to request for helping from peers about what they cannot learn on their own during group learning activities in the classroom (Swart, 2018). Therefore, flipped learning fosters curiosity and collaborative work, are fundamental aspects in any subject.

The advantages that the various studies conducted in the last few years have demonstrated in terms of the use of this methodology in the educational context (Toppo, 2011) have led to its implementation in both Europe and the United States. Though it is fundamentally being used for university studies, the methodology is easily transferrable to other training environments such as business, as has been seen in recent years.

However, it is not sufficient to order students to prepare content before a session. They must be motivated to do so and it is necessary to evaluate whether they have acquired the necessary knowledge and competencies, though avoiding their experiencing the negative sensation of being evaluated.

To address this situation, it is necessary to design a methodology that tests and ensures that the previous study has been carried out. The aim is to ensure that each and every one of the students has completed the prior study before the face-to-face session. Short questionnaires with open or closed questions can be used for this purpose, in addition to practical exercises.

If we wish to involve students in their own learning, they need to have challenges that they perceive to be worth achieving. But it is vital to take into account that the challenge set must have a level of difficulty that is in line with the students' level, avoiding it being so easy as to become boring or so difficult as to be demotivating, create "blockages" or even give rise to anxiety. The difficulty of a problem depends on (Prieto, Díaz and Santiago, 2014):

- The proportion between the information given and that which is needed to resolve the problem. For example, problems including manuals habitually provide all the information necessary for their resolution and nothing that is unnecessary, making the exercise considerably easier. Located at the other extreme are problems based on problem-based learning (PBL), which are designed so that it is for the student to complete the identification of the problems. The proportion of missing information naturally increases the difficult of the problem. In our case, the application of one extreme or another will depend on the group's degree of maturity and on its motivation to learn.
- The difficulty of accessing the information required to resolve the problem. Information can be given directly or provided when students realise what is needed and ask for it. Alternatively, students may be told where they can find the information. The difficulty of obtaining the information will vary depending on the strategy chosen.
- The facilitation strategy adopted by the teacher. If the teacher is proactive in providing assistance even before students feel that they are having difficulties, the solution to the problem will be easier as a result – although this approach reduces the student's level of independence.

Gamification

The game is part of our lives, what we can consider current is its application in different areas, in which we highlight for its importance to us, the educational context.

The use of the methodology of the game or 'gamification' owes its success to allowing activate the commitment of students in their own learning, being this learning deeper because they experience along the time (Kim, Song, Lockee and Burton, 2018).

Different definitions for gamification can be found, between the most important we can underline the one offer by Zicherman and Cunningham (2011, p.11) who refers to it as "a process related with the player´s thinking and the game technics to attract users and solve problems"

It is important to indicate that gamification (Hamari y Koivisto, 2013):

- It has as principal aim to influence the behavior of people in order that they solve problems, independently of other secondary aims as the amusement that it generates during the accomplishment of the game.

- It produces experiences and promotes the development of confidence feelings, self-assurance and autonomy, that are key aspects in every learning process.

It is considered, that across the utilization of own elements of the games as incentives or to reward in terms of attainment of points, levels, etc., the players, in our case students, increase their time of permanency in the game and their psychological predisposition to be kept in it. In addition, it is necessary that the student perceives that game supposes a challenge for him due to the importance that has for the player the sensation of being excelling itself and overcoming the requirements of the game.

Therefore, the aim of the gamification is to achieve an attitude change in the student's behavior, using elements of the game that turn out to be attractive and motivates him.

The key elements that usually are present in the educational context in this type of games are (adapted from Deterding, Dixon, Khaled and Nacke, 2011; Kapp, 2012; Zichermann and Cunningham, 2011):

- **The Base of the Game:** In it they find the keys of the game, the challenge, the procedure and the feedback that the students will receive during the same one.
- **The Rewards:** It promotes that the student wants to excel and his performance to be recognized, being able to be these rewards staggered.
- **The Aesthetics:** It must incorporate a visual attractive for the student.
- **Utility:** The student has to be able to play easily.
- **Players:** Key element and that will have to be taking into account during its design due to the profile diversity that can use it.
- **The Motivation:** Element that refers to the impulse of the people towards the action, in our case, taking part in the game, for what it is necessary to bear in mind the level of exigency that it will raise during its development to generate neither boredom nor frustration.
- **To Promote the Learning:** For what it will have to provide retro-information on successes and mistakes.
- **Resolution of Problems:** It is the final aim and implies solving a problem, to reach a goal, etc.

We consider that gamification is a powerful tool that can be used in any type of education, though; its utilization always must be tied to the fulfillment of the aims previously defined with its utilization

The ultimate goal of the strategies previously shown is to increase the learning of students. Though, it must be necessary to assess how much the objective have being fulfilled. Besides, the assessment affects the level of the learning acquired, communicate what it is important or not and. Influence in what, how and when study. A good assessment correctly applied will be a booster of learning (Bloxham, 2014). So, through the assessment a double objective can be achieved, first the summative evaluation and then the support and upgrade of such learning. To fulfil these objectives the assessment must allow that students put into practice the skills and competencies taught, students are involved in the assessment and students receive feedback continuously.

We want to highlight the value of feedback as it is considered a critical point to help students to know their strengths and weaknesses (Gibbs and Simpson, 2005). Just now, as Bloxham (2014) points out, it is important take into account the assessment among peers because when a student has to value the work of a classmate, he/she is also receiving feedback.

Mentoring: Roots to Fly

It is highly likely that all universities will want their graduates to be students who develop their potential as far as possible, who grow further than they thought possible, and who move on to enjoy outstanding careers. And in order to achieve this aim, they work to develop a high-quality study programme, to train their teachers and to obtain sufficient resources, among other things. They may also use personal development techniques that fit the needs of each student. One such technique is mentoring, which permits a high level of personalisation when communicating with students, attending to their needs, building individual programmes, offering supervision and feedback, and monitoring progress.

Mentoring and Other Accompanying Actions

Peer mentoring is a support process by way of which the more experienced students from higher academic years help incoming students to adapt more quickly to the university, under the supervision of a teacher who acts as coordinator.

Though it may appear clear, the concept is often distorted by the use of other terms that refer to different support processes. On occasions there may be a reference to tutoring, a term that implies the participation of a teacher rather than a student in the support process. On others, peer tutoring may be the term used – but these processes tend to relate to meetings held in academic contexts to improve knowledge of mathematics, physics or any other subject, in contrast to mentoring, which is directed at improving integration. Finally, some procedures are labelled welcome or induction processes, in which a series of introductions are made within a concentrated period of a few days with the purpose of ensuring social integration into the new environment. However, mentoring is a lengthier process that involves the mentee – the recipient of the mentoring – facing challenges, in order to acquire the knowledge and skills necessary to integrate within the university.

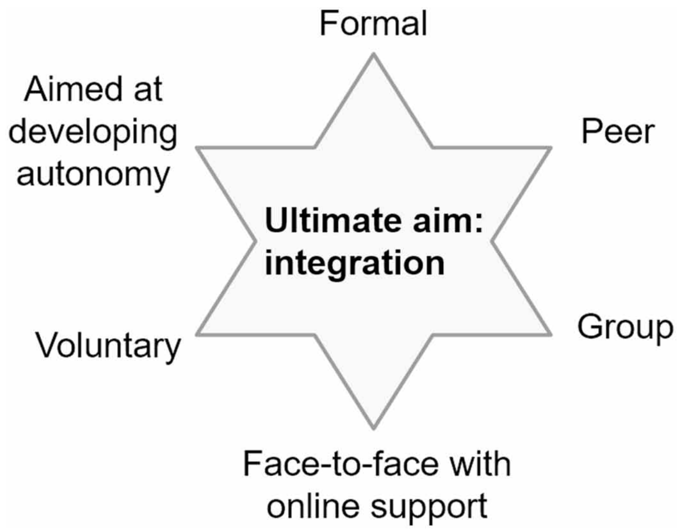
Characteristics of Successful Mentoring Programmes

Previous studies (Alonso, Castaño, Calles & Sánchez-Herrero, 2010; Alonso, Sánchez and Calles, 2011; Sánchez, 2010), have found that Spanish universities report higher levels of satisfaction in mentoring programmes that are formal (promoted by the university), between four and six months in duration, involve between five and seven meetings, where the first is conducted in the first week of the course and the last when the results have been issued for the examinations held in the first term (figure 1). The programmes are peer mentoring because the mentors of the incoming students are also students on the same course, and it is more important for them to be motivated to perform their role as mentor than for them to be students from the second, third or fourth year. The fact that they are group programmes makes it possible to attend to a larger number of students who would like a mentor, for those students to benefit from mutual feedback, for increased dynamism at meetings, to facilitate social relationships and to increase reference groups.

The mentoring programme must be voluntary for mentors and mentees. It is a resource that the university offers and students can decide whether or not to participate – but if they choose to do so, they must be asked to show the necessary commitment and involvement until the end of the programme.

The programmes are formal and are aimed at developing the independence of the mentee. This independence is expected to grow over the weeks as a result of progressive socialisation.

Figure 1. Features of university formal mentoring programmes
Source: Own elaboration



In order for mentoring relationships at university to be successful, it is necessary to follow a series of basic principles. One of these is trust between mentor and mentee, which is fundamental to the proper development of the relationship and is facilitated to a large degree by the peer element of the situation.

Another important aspect is for mentors to focus on the mentee's needs and to seek to cover them, always taking into account the objective: integration into the new environment.

As a practice-based learning technique, challenges work exceptionally well: they mobilise action and the subsequent analysis of what has been learned through experience.

Another effective technique is storytelling, in which the mentor shares their experiences with the mentee in order to pass on useful learning in an indirect manner. Mentor-mentee contact takes place in face-to-face meetings. The contents of these meetings are closely related to theories of university non-retention rates.

Peer mentoring at university can have impacts including producing a quicker and better integration of incoming students, increasing satisfaction with the centre of studies, improving class attendance and marks, raising levels of self-sufficiency, and reducing university dropout rates. University dropout rates are one of the problems that cause most concern to universities. To an extent, every dropout is interpreted as a failure. Mentoring can offer a valuable tool to combat high dropout rates.

Mentoring Meetings and Non-Retention Models

The main theoretical models explaining dropout rates are the adaptation model (which argues that drop-outs occur due to the student not sufficiently adapting to or integrating within the academic and social context of university education), the psycho-pedagogical model (which examines how to increase the likelihood of successful completion of studies), the structural model (focused on socio-economic stratum, occupation of parents, family income, labour market fluctuations, and so on) and the economics model (according to which dropouts are the result of the student's choice to invest time, energy and resources in an alternative way that may offer them future benefits in comparison with the costs of remaining at university).

Article by Cabrera et al. (2006) offer a general analysis of these models. The aforementioned authors argue that the causes of dropout are based on the individual characteristics of the student, their studies, the university and the social and family environment. These four major areas that are responsible for dropouts are examined below, with comments in each case as to how conversations between mentor and mentee can contribute to reducing dropout rates, as previous studies have already shown (e.g., Damkaci, Braun, & Gublo, 2017; Jackson, Smith, & Hill, 2003; Ward, Thomas, & Disch, 2014).

It is worth bearing in mind the mentor's functions with respect to the meetings: informing, supporting, guiding, motivating, offering alternatives, providing feedback, challenging, and recounting experiences.

The Social Environment

The social environment has changed in recent years. A larger number of universities have appeared, meaning a significant fall in the marks required to gain access to certain degree courses as a result of the increased number of available places. This results in students with lower learning capacity or less intense study habits entering universities; whatever the reason, they will find it more difficult to pass their subjects. One strategy to help pass rates was the implementation of the European Higher Education Area (EHEA), which established on-going assessments to break up examinations and make them easier to pass.

Other degrees, such as those relating to health sciences, are witnessing an increase in the number of student applications. This is having the opposite effect of increasing the marks required to access the degree. Many of the students who do not achieve the necessary marks can indirectly end up studying degrees that hold little attraction for them, causing demotivation and giving rise to the desire to drop out. Mentors are well aware of these aspects. From a motivational perspective, they can inform mentees of the situation and encourage them to make efforts to achieve the desired results.

The situation has also changed with regard to the labour market, after a number of years in which unemployment figures were very low and students could find internships without difficulties before completing their degrees. Now they encounter greater difficulties and the prospects of finding work upon completion of the degree are lower. To motivate them and offer a realistic vision, mentors can show mentees the subjects they will encounter beyond the first year and explain how those subjects are related with specific employment opportunities, which often differ from the occupational image that new students have of the professions. Mentors can broaden perspectives and this helps them generate new alternatives for work and career development.

On other occasions, on arrival at university students have to adapt not only to university life but also to a new city, which is often larger than their home town. Students can find it difficult to move around and to adapt to the number of people. They may be unaware of modes of transport, feel defenceless or even suffer high levels of anxiety. Mentors can help them in terms of providing advice on issues such as how to get about, the types of travel pass they need to obtain cheaper transport, how to resolve residential issues, or potential teething issues in halls of residence. The mentor's role is particularly important for students from outside the city or country where the university is located, since mentors can help such students to resolve urgent problems.

Additional aspects must be added within the environment. Students may have a perception that their parents are pressuring them to pass everything, especially in light of increased university fees and the financial difficulties faced by many families. Mentors can offer support by informing mentees of opportunities to apply for grants both within and outside the university, in addition to increasing their levels of awareness and helping them to focus on the present time and not to anticipate negative and stressful events that may never happen.

Students with family responsibilities in terms of the care of small children or who have to work and study also face more difficulties in reconciling these tasks with their studies. Here, mentors can work with them to set realistic goals, which may reduce the risk of dropout even if they result in planning aims that will increase the number of years taken to complete the degree.

Characteristics of Studies

The perception of pressure that many students experience when they arrive at university is due to their belief that they have too many subjects, an overload of content, little time to complete the academic tasks and work required of them and examinations concentrated over a short period of time. Mentors who have already passed through this situation can easily place themselves in the new student's shoes and offer guidelines on a wide range of issues.

Dropout models recommend carrying out various activities that have been proven to be useful when intervening to reduce dropout rates. Many of these activities are raised by mentors with their mentees in the conversations that take place during mentoring meetings, including the following:

- Mentor recommending the establishment of links involving cooperation with other peers when engaging in academic work, the creation of study groups, or carrying out leisure activities.
- When teacher-student relationships are positive, dropout rates fall. However, this is no simple matter. There are many kinds of teacher and student, and it is not always easy to match them up. Mentors can offer options to do better in the subject at hand and suggest strategies to ensure optimal teacher-student adaptation. For example, after consulting the teacher's guide to the subject, mentors may suggest asking certain questions in class, seeking support in specific handbooks if there are difficulties in understanding the subject, joining in with voluntary activities, or attending tutorials.
- Participating in different university activities also aids student retention. Mentors can propose that their mentees take part in associations or sporting and cultural activities, or sign up with university representative bodies.
- Making proper use of resources is also important for adaptation. With this in mind, mentors set challenges, offer information and provide help with relation to services such as libraries, IT resources, the dean's office, faculty secretaries, enrolment, academic credits, laboratories or means of transport.

Characteristics of Students and Dropout Rates

The student's individual characteristics have been studied to analyse their influence in university dropout rates. The psycho-pedagogical model places emphasis on how to increase the likelihood of students successfully completing their studies, and mentors carry out numerous actions with this target in mind.

Mentors help mentees to understand that it is necessary to properly manage certain emotions when interacting with teachers and that self-control is an important skill to develop. They motivate mentees to make repeated efforts to succeed after encountering failure (resilience), make comments to increase mentee self-efficacy (by highlighting and underlining what they have done correctly in order to help them pass), raise mentee expectations as to results by helping them to set credible goals, and foster mentee integrity by, for example, refusing to pass on work that they themselves completed during their first year.

Mentors also encourage conduct that reduces dropout rates, including increased levels of effort, staying up-to-date with subjects and attending class. They improve perceptions of the university environment by strengthening feelings of pride and belonging, increase satisfaction with the degree programme by making mentees feel better within their environment, and develop commitment to the university.

If students state their desire to drop out after the examinations at the end of the first term, mentors perform a key role by probing into the reasons. Failing exams should not in itself justify dropping out. Mentors can tell mentees of similar experiences that ended up with the successful obtaining of a degree through effort and dedication. On many occasions, this motivates mentees to continue until the end of the academic year and then to reassess their situation, and on many occasions, this results in the student being retained.

University Mentoring Model

When proposing a model, researchers have to pay attention to several criteria such as the non-retention rate among students participating in mentoring programmes (as opposed to non-participants), as well as other variables that explain the effectiveness of mentoring for the university, for mentors and for mentees. These include the acquisition of knowledge regarding the environment, satisfaction with the programme, levels of development of competencies, academic qualifications, levels of adaptation to the university (number of organisations and representative bodies in which students participate, number of academic tutorials attended, percentage attendance at classes during first time, and so on).

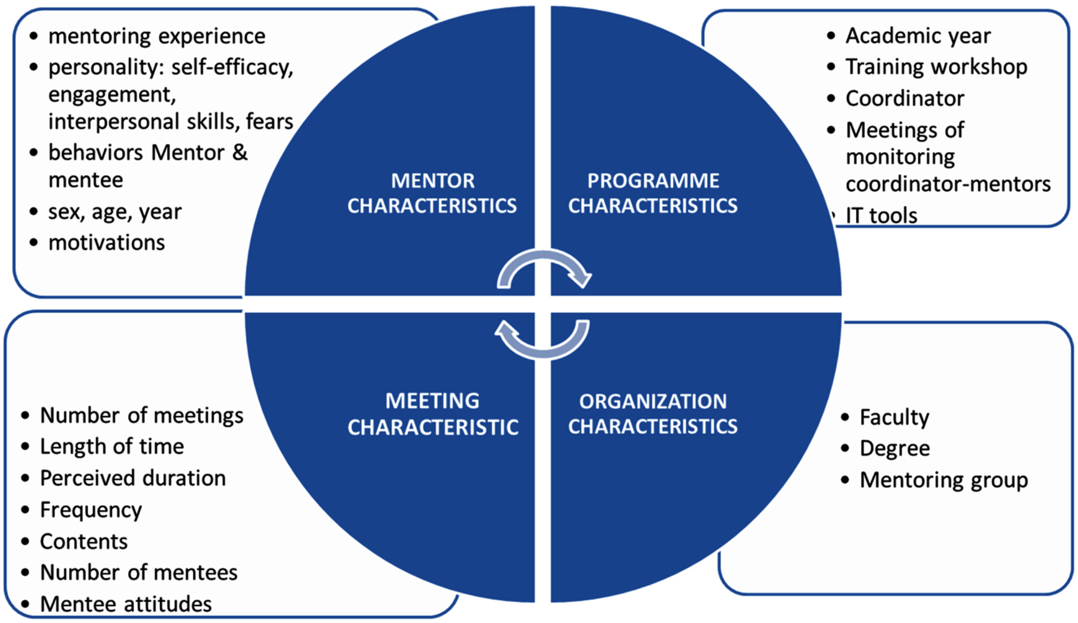
The proposed mentoring model addresses areas very similar to those addressed by dropout models, including characteristics of the university, the mentoring programme, mentoring meetings and the individual mentor (see Figure 2).

The development of each area permits the use of different predictive variables. The challenge is to identify which carry most weight in terms of the effectiveness of mentoring programmes and impact on university dropout rates. A multilevel analysis is appropriate, which would take into account individual data, mentoring group data, and data relating to each centre. This would permit a more in-depth understanding of the problems encountered and thereby enable identification of the most effective solutions.

Different variables that could have a significant impact on mentors completing their work successfully must be taken into account with respect to the mentor's characteristics. These variables include having previous experience as a mentor (or having previously had a mentor themselves), their personality traits (levels of self-efficacy, engagement, interpersonal skills, fears, and so on), their behaviour during meetings with mentees, their motivations, and other characteristics the impact of which remain to be researched (such as sex, age, or academic year).

The characteristics of the mentoring programme are also important to incoming students achieving good levels of integration. These characteristics include the existence of strong training programmes aimed at mentors and mentoring programme coordinators, meetings between the mentors and the coordinator that offer ample feedback, and availability of IT tools that facilitate post-session follow-up. Moreover, meetings should comply with the aforementioned criteria as they ensure that the mentoring programme will be based on processes and indicators that improve quality. Finally, the characteristics

Figure 2. University mentoring model
Source: Own elaboration



of the university are also important. The mentoring programme must fit these characteristics, with the adaptations that are suitable according to the faculty or school as well as the needs and idiosyncrasies of each mentoring group.

Mentoring can and must help to implement and maintain strategies to support and integrate students. These strategies characterised by their personalised nature and responding to specific needs, will help to reduce university dropout rates by integrating incoming students. What happens in mentor-mentee meetings is the key to understanding how this is achieved.

Mentoring helps students to develop roots in the university environment, to fuel their development of the knowledge and skills that will allow them to grow as professionals and as people. Those roots are underpinned by the personal relationships that they establish and by their commitment to the project of career development. Mentoring offers the roots, roots to fly.

CONCLUSION

Two aspects represent the key to learning: personalisation and commitment. The first of these concerns knowing the needs of each student and building made-to-measure action plans that increase the student's opportunities to develop their potential. From our perspective, this involves assessing the educational needs of students when they enter university, by means of interviews, discussion groups, and questionnaires to gather information from students and teachers. Subsequently, educational actions must be implemented to enable students to develop transversal competencies that will enable them to successfully cope with the majority of the tasks that they are faced with during their degree.

Commitment is obtained by involving the students and other members of the university community in the process of identifying aspects that can be improved, defining aims and goals, and implementing programmes in order to achieve those aims and goals. Methodologies such as Open Space Technology and "what you want to happen" involve the various actors, making them protagonists for the improvement of their own environment and giving them a voice and the opportunity to act.

In intervention, teachers are using new student-focused methodologies. The model of simply attending to be lectured is not sustainable. Students handle enormous amounts of information, meaning the teacher cannot be one more route by which it is transferred. Methodologies such as flipped learning again allow students to act as protagonists. They can attend class having acquired a considerable proportion of the knowledge and then during the face-to-face part, students can go into more depth, practise, learn and learn how to do. Learning is constructed and conducted on a made-to-measure basis (as the teacher is aware of the main issues before the class begins). It is even possible to personalise the learning for participants via gamification.

With respect to mentoring and other personal development techniques, peers are the true protagonists in sharing their learning and they do so effectively in a manner that achieves high levels of satisfaction and commitment, as well as alleviating issues that are harmful for society such as university dropout rates.

Now is the time to use assessment and development techniques that have been validated in organisational environments and apply them to educational contexts. Comparative studies about the efficacy of different strategies must be devised. It is time to identify the needs of groups and individuals and to develop made-to-measure action plans in order to increase their potential.

REFERENCES

Alonso, M. A., Berrocal, F., & Calles, A. (2012). *La utilización de técnicas de desarrollo participativas como estrategia de solución de problemas. Proyecto de Innovación y Mejora de la Calidad Docente 2011, Nº 110*. Madrid: Universidad Complutense.

Alonso, M. A., Castaño, G., Calles, A. M., & Sánchez-Herrero, S. (2010). Assessment of the Efficacy of a Peer Mentoring Program in a University Setting. *The Spanish Journal of Psychology*, *13*(2), 683–694. doi:10.1017/S1138741600002353 PMID:20977018

Alonso, M. A., Sánchez, C., & Calles, A. M. (2011). Satisfacción con el mentor. Diferencias por rol y sexo. *Revista Española de Pedagogía*, *250*, 485–50.

Beevers, K., & Rea, A. (2016). *Learning and Development Practice in the Workplace*. London: CIPD.

Berrocal, F., Alonso, M. A., Castaño, G., Sánchez-Herrero, S., & Calles, A. (2013). *Diseño de instrumentos de evaluación y desarrollo de competencias transversales para estudiantes de la UCM. Proyecto de innovación educativa y mejora de la docencia 254*. Madrid: Universidad Complutense de Madrid.

Bloxham, S. (2014) Assessing assessment: new developments in assessment design, feedback practices and marking in higher education. In H. Fry, S. Ketteridge, and S. Marshall (Eds.), *A handbook for teaching and learning in higher education: enhancing academic practice* (4th ed.; pp. 107-122). New York, NY: Taylor & Francis.

Cabrera, L., Bethencourt, J. T., Álvarez, P., & González, M. (2006). El problema del abandono de los estudios universitarios. *Relieve*, *12*(2), 105–127.

Crouch, C. H., & Mazur, E. (2001). Peer instruction: Ten years of experience and results. *American Journal of Physics*, *69*(9), 970–977. doi:10.1119/1.1374249

Damkaci, F., Braun, T. F., & Gublo, K. (2017). Peer Mentor Program for the General Chemistry Laboratory Designed to Improve Undergraduate STEM Retention. *Journal of Chemical Education*, *94*(12), 1873–1880. doi:10.1021/acs.jchemed.7b00340

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. E. (2011). From game design elements to gamefulness: defining gamification. In *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments* (pp. 9–15). New York: ACM Press. 10.1145/2181037.2181040

Flipped Learning Network. (2014). *The four pillars of F-L-I-P.* Retrieved from http://flippedlearning.org/wp-content/uploads/2016/07/FLIP_handout_FNL_Web.pdf

Gibbs, G., & Simpson, C. (2005). Conditions Under Which Assessment Supports Students' Learning. *Learning and Teaching in Higher Education*, (1), 3-31.

Gonzalez, J., & Wagenaar, R. (2003). *Tuning educational structures in Europe. Final report. Phaseone*. Bilbao: Deusto University.

Hamari, J., & Koivisto, J. (2013). Social motivations to use gamification: an empirical study of gamifying exercise. *Proceedings of the 21st European Conference on Information Systems*.

Hidalgo, A., & Castaño, G. (2011). El Proceso de evaluación del ajuste. In G. Castaño, G. López-Montalvo, & J. M. Prieto (Eds.), *Manual de buenas prácticas en reclutamiento y selección de personas* (pp. 129–164). Madrid: Colegio Oficial de Psicólogos de Madrid. Retrieved from http://www.copmadrid.org/web/publicaciones/manual-de-buenas-practicas-en-reclutamiento-y-seleccion-de-personal-rs

Honkanen, H., & Nyman, K. (2002). Handbook of good practice in personnel assessment. Helsinki: Psychologien Kustannus Oy.

ISO-10667. (2011). *Assessment service delivery: Procedures and methods to assess people in work and organizational settings.* International Organization for Standardization.

Jackson, A., Smith, S., & Hill, C. (2003). Academic persistence among Native American college students. *Journal of College Student Development*, *44*(4), 548–565. doi:10.1353/csd.2003.0039

Kapp, K. (2012). *The gamification of learning and instruction: game-based methods and strategies for training and education*. San Francisco, CA: John Wiley y Sons.

Kim, S., Song, K., Lockee, B., & Burton, J. (2018). *Gamification in learning and education. Enjoy learning like gaming*. Cham, Switzerland: Springer. doi:10.1007/978-3-319-47283-6

Marrs, K. A., & Novak, G. (2004). Just-in-time teaching in biology: Creating an active learner classroom using the internet. *Cell Biology Education*, *3*(1), 49–61. doi:10.1187/cbe.03-11-0022 PMID:22039345

Martinez-Clares, P & Gozález-Morga, N. (n.d.). Las competencias transversales en la universidad: propiedades psicométricas de un cuestionario. *Educación XXI, 21*(1), 231-262. doi:10.5944/educXX1.15662

Mazur, E. (1997). *Peer instruction: a user's manual*. Englewood Cliffs, NJ: Prentice Hall.

Mazur, E. (2009). *Confessions of a converted lecturer* [video file]. Retrieved from https://www.youtube.com/watch?v=WwslBPj8GgI

Michaelsen, L. K., Sweet, M., & Parmelee, D. X. (Eds.). (2011). *Team-based learning: Small group learning's next big step*. New York: Jossey-Bass.

Nikolaou, I., & Oostrom, J. (Eds.). (2015). *Employee recruitment, selection and assessment*. New York: Psychology Press.

Novak, G. M., Gavrin, A. D., Christian, W., & Patterson, E. T. (1999). *Just-in-time teaching blending active learning with web technology*. Upper Saddle River, NJ: Prentice Hall.

Owen, H. (2008). *Open space technology: A user's guide* (3rd ed.). Berrett- Koehler.

Prieto, A., Díaz, D., & Santiago, R. (2014). *Metodologías Inductivas: El desafío de enseñar mediante el cuestionamiento y los retos*. Madrid: Digital-text.

Robins, S., & Coultier, M. (2012). *Management* (11th ed.). Essex, UK: Pearson.

Sánchez, C. (2010). Red de mentoría en entornos universitarios españoles: Resultados de un análisis comparativo. *Revista de Mentoring & Coaching*, *3*, 13–29.

Swart, W. (2018). *Extending the principles of flipped learning to achieve measurable result: emerging research and opportunities*. Hershey, PA: IGI Global. doi:10.4018/978-1-5225-2984-2

Tejada Fernández, J. y Ruiz Bueno, C. (2016). Evaluación de competencias profesionales en Educación Superior: Retos e implicaciones. *Educación XX1*, *19*(1), 17-38. doi:10.5944/educXX1.12175

Toppo, G. (2011). Flipped classrooms' take advantage of technology. *USA Today*. Retrieved from http://usatoday30.usatoday.com/news/education/story/ 2011-10-06/flipped-classrooms-virtual-teaching/50681482/1

Ward, E. G., Thomas, E. E., & Disch, W. B. (2014). Mentor service themes emergent in a holistic, undergraduate peer-mentoring experience. *Journal of College Student Development*, *55*(6), 563–579. doi:10.1353/csd.2014.0058

Weimer, M. (2013). *Learner-centered teaching: Five key changes to practice*. San Francisco, CA: Jossey- Bass.

Zichermann, G., & Cunningham, C. (2011). *Gamification by Design: Implementing Game Mechanics in Web and Mobile Apps*. O'Reilly Media.

KEY TERMS AND DEFINITIONS

Flipped Learning: A pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter.

Gamification: Process related with the player´s thinking and the game technics to attract users and solve problems.

Identification of Training Needs: Training process that through different assessment techniques allows to detect the weaknesses or needs of workers (students) in order to play their role in an optimal way.

Mentoring: Peer mentoring is a support process by way of which the more experienced students from higher academic years help incoming students to adapt more quickly to the university, under the supervision of a teacher who acts as coordinator.

Open Space Technology: A technique that allows discussion of relevant issues in an open way. Facilitates the generation of new ideas and approaches to a topic. Panels are established with questions or aspects related to the topic to be discussed. A facilitator moderates every panel. The participants circulate freely through them, contributing their ideas and discussing about others' contributions. Although it can be applied in small groups, it is ideal for boosting large groups.

Transversal or Key Competences: Combination of knowledge, skills, and attitudes that all individuals need for their personal fulfillment and development, employability, social inclusion, and active citizenship. They can be acquired and developed throughout lifelong and through formal, non-formal, and informal learning.

What You Want to Happen: Technique for the development of people and organizations. This is an open and thought-provoking question, offering each individual a protagonist's role in terms of verbalizing the future that they desire.

Chapter 15
The Reconfiguration of Human Capital in Organizations:
The Relevant Competences in the Digital Natives in the Postgraduate Level

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ABSTRACT

The objective of the chapter is to describe the main competences to be developed in digital natives at the postgraduate level, based on the characteristics generated by information and communication technologies in the context of the fourth industrial revolution. From this perspective, individual knowledge, experience, initiative, and creativity are recognized as the unlimited resource of organizations and countries, so the talent of the people is the basis of the competitiveness and survival of organizations of any type. Three axes of training at the graduate level are identified: social competences, global competitions of investigation and innovation, and digital competitions with base in the inverted learning and gamification.

INTRODUCTION

Intellectual capital has become the intangible that generates value in companies and has an impact on the quality of higher education institutions, which has led to the need to establish processes that ensure proper management and measurement, aimed at increasing their production, protection and distribution. This situation is the result of the technological revolution and the globalization of markets, which have impacted society, government and the economy, where knowledge has been constituted as the strategic element to promote national and organizational development, which generates innovation in organizations (Arrieta, Gaviria & Consuegra, 2017 and Edvinsson & Sullivan, 1996).

In this way, the intellectual capital of an organization includes the intangible resources and assets that can be used to create value through its conversion into new processes, products and services. These intangibles are the knowledge, experience and intellectual capacity of their employees, as well as the resources of knowledge, processes, culture and philosophy of an organization. Therefore, the need to

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implement effective strategies to promote lifelong learning for all, to strengthen the ability to adapt and acquire new skills, which are the determining factor of long-term growth (OECD, 2012 and Ramírez, 1999). To achieve this, a new focus on the formation of human capital as a main component of intellectual capital is essential.

Consequently, the need to know, manage, store and disseminate knowledge as a means to cultivate the intellectual capital of organizations and countries will become more evident, especially as the conviction that the productivity of Knowledge and knowledge workers are the decisive factor in the global economy (Drucker, 1997).

Thus, in the framework in which the knowledge society is located, a world of continuous alterations is glimpsed, where science and technology are at the base of the economic competitiveness of the countries, where innovation plays a strategic role in the competition, for which they are forced to cover a series of requirements to compete successfully in an increasingly globalized economy, including high investments in both education and research. With respect to organizations and individuals, the knowledge society requires the acquisition of new qualities to adapt to the accelerated changes in the context, which implies continuous or permanent training. As long as countries, organizations or individuals fail to meet these requirements, they run the risk of being excluded from the knowledge society and, with it, from globalized economic competition.

In this sense, Anderson (2012), Jules (2017) and Peters (2017) argue that the fourth industrial revolution offers the following opportunities to be exploited that will allow in the different sectors of a country the following: 1) lower barriers between inventors and markets; 2) more active role for artificial intelligence; 3) integration of different techniques and domains (fusion); 4) improved quality of our lives (robotics) and, 5) connected life through the use of the Internet.

Based on the above, innovative technologies will integrate different disciplines, both scientific and technological. The key forces will come together in a fusion of technologies that is blurring the lines between the physical, digital and biological spheres, that is, artificial intelligence will equalize the reach of human intelligence and even exceed it due to continuous acceleration of information technologies (Schwab, 2015). This fusion of technologies goes beyond the combination because it creates new markets and new growth opportunities for each participant in innovation. In addition, the use of the Internet will allow the interconnection of networks of physical devices, which will impact on an advanced connectivity of devices, systems and services with a variety of applications. So it is expected that the interconnection of these integrated devices leads to automation in almost all areas, while generating advanced applications such as an intelligent network with the ability to expand to areas such as smart cities (Gershenfeld & Vasseur, 2014).

Thus, the Fourth Industrial Revolution is more than a change driven by technology because it is a phenomenon oriented towards innovation to positively impact the core sectors of a country such as education, health and business. Specifically, in the first, with the previous industrial revolutions, the focus changed; now in the Fourth Industrial Revolution, technologies expand in different ways the forms of training between the face and virtual, so it requires higher education to redefine its substantive functions considering new modes of curriculum and teaching, and therefore, consider the various forms of learning; which has led to the importance of designing alternative curricula (Jules, 2017).

Faced with this panorama, the massification of information and communication technologies (ICT) has caused that the generation of knowledge has a very high obsolescence, which is why human capital should be seen as a renewable resource, which requires updating and to renew permanently with the continuous learning, which will allow to endow it with flexibility and capacity of response before an environment in which the only permanent thing is the change. As mentioned by the OECD (1998, p.17): "investment in human capital is at the center of the strategies of countries to promote economic prosperity, full employment and social cohesion." Individuals, organizations and Nations increasingly recognize that high levels of knowledge, skills and competencies are essential to ensure a successful future."

In this way, the main objective of the chapter is to make a proposal for the training of human capital skills at the graduate level based on the characteristics of digital natives.

BACKGROUND

Over the past two decades a global movement has emerged that advocates a new learning model for the 21st century, mentioning the specific skills and competencies that are necessary to function effectively in that century and the pedagogy that is required to stimulate said capabilities. It has also been widely recognized that formal education must be transformed with a view to fostering new forms of learning necessary to face the complex global challenges that will allow future generations to solve them. In addition, as a result of growing concern about possible future economic and global crises, the question arises of identifying whether today's students have the combination of critical thinking, creativity, and collaboration and communication skills that are necessary to face the new unexpected situations.

In this sense, higher education is considered a transcendental component in the formation of human capital for this 21st century, oriented towards the production of knowledge and its transfer, which allows the positioning of a country in the international sphere (Arrieta, Gaviria & Consuegra, 2017).

From this perspective, individual knowledge, experience, initiative and creativity are recognized as the unlimited resource of organizations and countries, so the talent of the people is the basis of the competitiveness and survival of organizations of any type. Therefore, in the next millennium, efforts will be revitalized to generate and transfer knowledge, from the individual to the organizational level, which will result in a growth of the world economy.

This is explained by the fact that education plays a fundamental role in the development of a society, so that educational systems require considering their needs and demands, as well as the interests of citizens and the goals that as a country are intended to achieve. However, teachers face the challenge of educating people who are going to play in a society characterized by uncertainty, innovation and the circulation of information from the use of technological tools, which is why it is necessary to train the new one generations to live in this context (Bauman, 2008 and Leymonié, 2015).

Specifically, in higher education and with it the postgraduate has been forced to rethink itself, in order to accompany the dizzying changes that are taking place. In this way, it is expected that the formation of this level is focused on the development of basic and specific skills such as the ability to work as a team, the development of autonomous thinking and the disposition to lifelong learning (Leymonié, 2015). Similarly, Valencia (2005) established that investment in human capital in the country generates significant social benefits to the whole economy that exceeds those of individual type. These social benefits are related to the development of human capital and the development of new technologies that foster organizational innovations. In this sense, human capital comprises a diverse set of competencies that must be generated from postgraduate training, from which its graduates can achieve the advancement of the organization, whether public or private.

In addition, the education sector having a social purpose, whose mission is to train human talent with a set of core competencies that allow them to solve the various situations both work and individual they face, so it requires the formulation of a model that values the generation of human capital in the postgraduate course and thus cover with the criterion of quality that has been established as an accrediting element of educational programs both nationally and globally (Cardoso & Cerecedo, 2011).

This scenario has led economies to be transformed progressively considering high investments in education, training, research and development, as well as in information systems, where now, they are characterized by their outstanding use of new ICT, not only for communication between people, but also for the creation of new knowledge, which enables innovation. Organizations, communities and people have to acquire new qualities to be able to prosper in this world full of continuous alterations. This concerns the educational systems, labor markets, as well as the modes of organization of companies and markets.

Thus, the new educational framework in which the postgraduate level is located is characterized by giving priority not only to human capital but also to the management of new knowledge, innovation and the development of human capacities as sources of sustainable economic growth (CEPAL, 2008; Portnoi, Rust & Bagley, 2010).

Therefore, it is important to promote competencies oriented towards the administration, management and dissemination of knowledge as a means to cultivate the intellectual capital of organizations and countries, especially in the extent to which the conviction that the productivity of knowledge and Knowledge workers are the decisive factor in the world economy.

Against this background, higher education institutions through the implementation of their programs are the protagonists in the process of generation, dissemination and use of intellectual capital, so that the relevance of quality training for human capital has been acquired. context of economic globalization based on an educational approach based on competencies. This is due to the fact that higher education is considered a transcendental component in the formation of human capital oriented towards the production of knowledge and its transfer, which allows the positioning of a country in the international sphere (Arrieta, Gaviria & Consuegra, 2017).

In this way, preparing students for work, citizenship and life in the 21st century is a huge challenge because globalization, new technologies, migration, international competition, the evolution of markets and challenges environmental and political transnational are factors that govern the acquisition of skills and knowledge that students need to survive in this century.

Also, personalization, collaboration, communication, informal learning, productivity and the creation of knowledge are essential elements of the skills that people are expected to develop and the way in which these competences are imparted. These are fundamental elements in the general vision of 21st century learning (McLoughlin & Lee, 2008; Redecker & Punie, 2013). In addition, personal competences (initiative capacity, resilience, responsibility, risk taking and creativity), social competences (teamwork, networking, empathy and compassion) and learning competences (management, organization, metacognitive abilities and ability to turn difficulties into opportunities or to transform the perception of failure and the response to it) are key to achieving maximum levels of performance in the 21st century labor world (Learnovation, 2009).

THE POSTGRADUATE FORMATION OF THE COMPETENCES OF THE DIGITAL NATIVES AS THE HUMAN CAPITAL FUTURE

Based on the relevant characteristic that technological tools allow access to information immediately, it has given knowledge an important social value where mediation is carried out from virtual networks of a flexible, horizontal type and with various communication modes. In addition, the knowledge society has various alternatives to store information in digital format that enables it to process it more quickly to solve complex situations, so that the educational system of the countries faces a transformational change on teaching and learning.

This panorama had already been identified by Presnky (2001) when he indicated that he was facing individuals who had grown up under a technological environment that has been called as digital natives. These are people who were born and raised in scenarios based on technologies associated with computers such as the Internet, Twitter, YouTube, Facebook, among others, and mobile telephony, where this language based on ICT is their first language. Thus, educational institutions are mostly not prepared to face this challenge, which is why it is necessary to design management strategies to achieve it, where it is no longer the only place where knowledge can be found.

In this sense, digital natives have sophisticated technical skills and learning preferences for which traditional education is not ready. "Most of the students, in addition, are part of what we now describe as the Net generation, which acquires learning through participatory, sensory and experiential (physical or virtual) activities based on the use of computer media with a preference of to be doing instead of reading or listening, for what they prefer to discover instead of being told" (Becta Research Report, 2008, p. 13).

In this way, Prensky (2001) mentions that digital natives have the following characteristics:

- They receive the information in an agile and immediate way
- They are interested in multitasking and parallel processes
- Preference for graphics to texts
- They are inclined towards computer access
- They work better and perform better when working in a network
- They prefer to interact in a ludic way than in a rigorous way

Likewise, Obingler & Obingler (2005) established that the characteristics of this generation are the following: They possess a set of digital skills; they are visual communicators with the ability to integrate the virtual with the physical world; they learn by discovery, research and experience combined with their ability to perform multitasking activities.

While Benett, Maton & Kervin (2008) determined that the existence of a generation of digital natives focuses on two main features: 1) Young people of this generation possess sophisticated knowledge and skills with information technology and 2) As a result of their education and experiences with technology, digital natives have particular learning preferences or styles that differ from previous generations of students.

Meanwhile, Bringué, Sádaba & Tolsá (2011) indicated the importance of recognizing the new features of the generations in Latin America, which have a passion and attraction towards different technological tools and that are characterized by:

- **An Equipped Generation:** The network, the cell phone, video games and television are increasingly within reach.
- **The Screens and Their Multifunctional Use:** Use the television to entertain, the cell phone to communicate, video games to have fun and the internet to look for information.
- **A Multifunctional Generation:** They are characterized by performing simultaneously in front of diverse technological devices.

- **An Emancipated Generation:** The use of ICT allows them greater autonomy.

Thus, the digital natives represent a new group of citizens who for the first time in the history of humanity have knowledge that their parents or teachers were unaware of, mostly in the management and incorporation of ICT in the different facets of life (López, 2014). In this way, the differences between the native and the digital immigrant pose a challenge from the perspective of education, which faces its formation, since both parents and teachers are overcome in the handling of new technological means by the digital natives (Sábada & Bringué, 2010).

Consequently, these students are accustomed to handling information rapidly and in parallel because they are "multi-tasking" individuals because the images stimulate them more than the texts and prefer to work in networks together with the fact that they do not assume a passive role in the process of their learning so they require positive stimuli and continuous feedback mediated by emotional intelligence (OECD, 2003).

Recognizing that education plays a fundamental role in the development of a society, educational systems require considering their needs and demands, as well as the interests of citizens and the goals that as a country are intended to achieve. However, teachers face the challenge of educating people who are going to play in a society characterized by uncertainty, innovation and the circulation of information from the use of technological tools, which is why the formation of new generations to live in this context (Bauman, 2008 and Leymonié, 2015).

As the World Economic Forum (2018) pointed out: the relevant competences to be developed in the 21st century in individuals from basic education to higher education are the resolution of complex problems, critical thinking, creativity, collaboration and digital literacy, which are fundamental to allow people to remain flexible and adaptable to the changing needs of society and the labor market.

In this way, the educational sector having a social purpose, whose mission is to train human talent with a set of core competencies that allow them to solve the various situations both work and individual that they face, so the formulation of a model that values the generation of human capital in the post-graduate and thus cover with the criterion of quality that has been established as an accrediting element of educational programs both nationally and globally.

Likewise, the importance of personal competences, such as initiative capacity, resilience, responsibility, risk taking and creativity, is highlighted for the 21st century labor world; social competences, such as teamwork, networking, empathy and compassion; and learning competences, such as management, organization, metacognitive abilities and the ability to turn difficulties into opportunities.

Specifically, at the graduate level, their graduates constitute in any country the social group that accumulates a greater volume of human capital because it has been the longest in its training and has also required greater investment. These graduates provide the labor sector with a set of skills developed during their studies related to the capacity to generate innovation through the creation of new knowledge (Vila, Dávila & Ginés, 2010).

As a result of the continued use of digital and mobile technologies, most of today's students investigate, research and synthesize information in a natural way. These capacities can be used to a great extent in the classroom to encourage the participation of students. The technologies in which they are already skilled are an effective way to support independent and research-based learning and to allow for immediate and thoughtful forms of evaluation.

Therefore, the training of digital native skills at the graduate level focuses on the following areas of training:

1. **Social Competences:** These competences allow the person to interact effectively with others and relate to knowing when to listen and when to speak, as well as how to behave in a respectful and professional manner; it also involves knowing how to work effectively in diverse teams, respecting cultural differences and collaborating with people from different social and cultural backgrounds; also, be open to different ideas and values and use social and cultural differences to generate ideas, innovate and work better quality. To achieve this, students must explicitly confront opportunities for the development of emotional resilience and empathy (Leadbeater, 2008).

In the same way, it has been determined that one of the three main competences needed by 21st century human capital is adaptability, understood as the ability to change in the face of changing conditions in the economy and in the world of work and to dominate quickly new skills. Therefore, it is essential to promote flexibility in diverse labor and social contexts and show a capacity for initiative and inventiveness, particularly at a time when, increasingly, the expectations of the working world are changing rapidly. It is essential to encourage the mental agility and curiosity of the students, and for that there is a myriad of digital technologies (including social, mobile, audiovisual, playful and personalized portals). The use of informal learning resources facilitated by technology also allows those who work collaboratively to share and exchange knowledge easily and that self-taught people continue to learn for themselves (Herring, 2012).

2. **Global Research and Innovation Competences - Detection of Problems, Methodology and Dissemination:** People with global competence in research and innovation are able to take action in many ways, and tend to see themselves as global citizens rather than as citizens of their country or homeland. Learners with global competence use critical thinking skills to examine and carefully prioritize the various problems, determine possible solutions, evaluate options and plan actions based on empirical data (Mansilla & Jackson, 2011).

In this sense, research and innovation are key components in the development of knowledge, skills and attitudes that society demands, allowing different interest groups to use them as tools to eradicate poverty, promote sustainable development and progress for the country (UNESCO, 2009).

Thus, the ability of stakeholders to innovate depends on their ability to acquire knowledge and to apply it, that is, to manage it (Courvisanos, 2007 and Tidd, Bessant & Pavitt, 2005). Therefore, the relevant element of this management is to enable people to have access to higher education because it is the fundamental strategy for organizations to establish innovation processes (Rasiah, 2011 and Tejada & Navío). Likewise, the potential of innovation that the graduates contribute is a fundamental determinant both for the success in their professional career and for the total efficiency of the production systems in the different countries. Therefore, postgraduate studies contribute to the development of competences focused on generating new knowledge and taking decisions to put them into use, as well as for the mobilization of the resources of the organization.

As well, creativity and entrepreneurial thinking are fundamental competencies for the 21st century (Robinson, 2006). Having an entrepreneurial mentality (understood as the ability to recognize opportunities and act accordingly and willingness to take risks and responsibilities) allows individuals to create employment for themselves and for other people.

3. **Digital Competences:** The complexity of the current world makes it increasingly necessary the ability to know how to access information, evaluate it and use it (Trilling & Fadel, 2009). Information literacy has a truly transformative effect: it makes possible the acquisition of other fundamental competences for a prosperous life in the 21st century (Wan & Gut, 2011). According to P21 (2007), a person with basic knowledge about the media (digital literacy) is someone who uses information processing skills related to awareness, analysis, reflection and action to understand the nature of the messages transmitted by the media.

Digital literacy provides a framework of diverse forms of access, analysis, evaluation and creation of messages, gives rise to an understanding of the role played by the media in society and strengthens the fundamental skills of inquiry and self-expression. Digital literacy is not only limited to interpretation, it also includes the ability to create messages for self-expression and to influence and inform others (Redecker & Punie, 2013).

In this way, Cabra & Marciales (2009) mention that the understanding, use and appropriation of type technologies is required:

- Operational focused on the management of hardware and software;
- Relevant information that allows to find, select, process and evaluate information according to specific needs;
- Strategies related to the use of sources and means to achieve objectives that allow the exercise of citizenship in the short and long term.
- In addition, it considers having basic ICT knowledge oriented towards the ability to access, manage, integrate, evaluate and create information because technology alone cannot guarantee good results in the learning experience (Davies, Fidler & Gorbis, 2011).

The new learning styles include fluency in multiple media, valuing each one for the types of communication, activities, experiences and expressions for what learning is done from the collective search in order to synthesize experiences instead of locating and absorbing information from a single source, which implies frequent opportunities for reflection through associative networks (Dede, 2005a).

Thus, the current education system is not equipped to adapt to the changing needs of this new generation of students, which requires a transformation of teaching and learning processes in the postgraduate program. Therefore, "educational organizations are urged to make a modification of their support infrastructure and equipment, the use of ICT and the generation of professional development of teachers to face the characteristics of digital natives. This situation carried out by educational institutions will obtain a competitive advantage both to recruit the best students and to teach them effectively "(Dede, 2005b: 15).

In this way, the training strategies to be used at the graduate level would be based on the following:

In the first place, the teaching and learning link based on the diversity of profiles of the students who enter to study a postgraduate course from their academic career as work experience. In this sense, students who start this educational level already have a set of knowledge, skills, attitudes and experiences that is relevant to consider, so it is recommended to carry out a diagnostic assessment to obtain this information.

Secondly, the use of ICT as a fundamental element for the design and use of training strategies for digital natives because they already have a knowledge and interaction where they now have to focus on the consolidation of digital competence, which develops a set of capabilities such as creativity and innovation for the creation of products and processes. In addition, students use digital media and environments to communicate, work collaboratively and develop a global awareness. It also fosters the generation of teams in projects to solve problems based on research because they obtain, use and evaluate information. In this way, digital competence is not only oriented towards the management of ICT, but also includes the skills and attitudes to analyze, synthesize and evaluate the relevance and reliability of information in a productive way, which is why it is one of the fundamental elements on what the permanent formation of the individual is based and that should have a high priority within an educational program (OECD, 2003). Therefore, it is considered as a transversal competence that in today's society is fundamental for the learning of other competences and fields of study, for what has been constituted as an essential factor for new professionals and that companies demand within the characteristics of its employees (Larraz, Espuny & Gisbert, 2012).

Therefore, as stated by Larraz (2012), an integral formation of the digital competence organized by informational, technological, multimedia and communicative literacy is required. The first one oriented towards the identification, location, organization and evaluation of the information; the second towards hardware and software management; the third focused on the development and understanding of multimedia messages and the fourth, related to the presentation and dissemination of information to participate as a digital citizen.

Third, from recognizing the characteristics of digital natives as active subjects, it is necessary for strategies to encourage autonomous and collaborative learning through the investigation of topics. Thus, autonomous learning requires the existence of interest and the critical capacity to organize, analyze and synthesize information by the student. While collaborative learning involves recognizing and respecting the perspective of the other person when there are differences and reach the establishment of agreements.

Fourth, it implies a reconceptualization of the teacher's role where the main role of being the transmitter of knowledge is transformed into a mediator which is geared towards generating an atmosphere of trust and respect for students to make their contributions, for what communicative competence is a central element.

Fifth, the training strategies have to generate the possibility of transferring what has been learned to new situations and in different contexts, which, together with a collaborative work with their peers, will share experiences favoring attitudes of help whose result will be the formulation of solution strategies for situations in the workplace through discussion and common decision making.

In this sense, it is important to include that these didactic strategies consider elements based on inverted learning and gamification. On the other hand, invested learning is a didactic strategy, characterized by a teaching method that has changed the traditional model where the student is allowed to obtain information at a time and place that does not require the physical presence of the teacher for what constitutes an integral approach to increase your commitment and participation in order to build your own learning, socialize it and integrate it into your reality. The inverted classroom also provides the possibility for the teacher to perform a more individualized treatment covering all phases of the learning cycle.

In addition, the inverted classroom assumes the logic of the process of assimilation of the human being that considers the interaction between the orientation of the content (skills and knowledge), execution and control; and in this process are integrated the rational operations of thought, the skills of ICT and the content to be addressed in each learning. In this way, it is characterized by promoting independent work (execution of the self-study and of the practical tasks either face-to-face or of preparation to the face-to-face activity in the moments suggested in the inverted classroom), as well as in the control of the execution of the process. Students in this strategy are more independent and generate an acquisition of knowledge and skills, as well as their transfer to real life which leads to the achievement of professional skills.

Meanwhile, the gamification has the simultaneous purpose of rewarding the effort of the student who seeks with care and dedication the faithful fulfillment of the indicators of achievement coupled to penalize the lack of interest in learning. In this way, gamification as a quantifying parameter of learning within the university classroom, helps the teacher to measure the performance of each student, since the educator can visualize a scenario in which it is a mechanism to promote work in the classroom and retake an effective control of the academic performance of the students.

In this sense, the advantages of gamification are: 1) It seeks to reward and recognize the academic commitment that the student makes during the approach to their training process; 2) The use of gamification in the university class helps the student to easily identify their progress and progress of their own learning; 3) When the student does not put the dedication and enough effort to improve their academic performance, the gamification helps him to improve his performance by approaching technologies and integrating dynamics; 4) The gamification as a methodological strategy tries to propose to the student a clear route on how it can improve the comprehension of those academic subjects that are more difficult to him, due to the change of paradigm that supposes to develop gamified classes.

Thus, the utility provided by the gamification strategy applied to the postgraduate level of education allows a class to overcome the conjunction of linear theoretical knowledge to consolidate a class in a pleasant learning meeting, in which from the elements that are part of the structure of the game can create a connectivity that nourishes the interest and commitment of the student to learn.

Therefore, gamification offers a set of positive aspects that can be achieved in the graduate program, such as the following:

The teacher can generate a very fluid two-way communication with their students, creating a more closed interaction between student and teacher, allowing a better reflection of content, using the elements of the game to consolidate academic feedback frames.

The approach of content presented in the form of questions with response options gives the student a faster notification of the correct or incorrect answer, valuing their game strategies to continue reaching new materialized goals in knowledge, and get incorrect answers from experiences of change to improve at all times.

In the gamification, an immediate feedback is generated to encourage the student to continue participating and motivate him to deepen his actions in order to strengthen ties with the established learning goals. With the feedback inserted in the gamified class, a detection and timely solution of the problems of comprehension and collectivization of knowledge is presented, according to the difficulties that the students show during certain classes.

In this way, the gamification system involves most of the students, studying most of the topics seen in class, as it demands a prior study of the contents, which creates the ideal conditions for a quality interaction in person and highly interactive, where relevant information can be extracted from the students' learning mistakes so that the teacher can rethink how to use better methodologies and structure class time to obtain outstanding results in the evaluation of learning and thus avoid academic failure.

Therefore, the main factor to consider to promote sustainable growth and competitiveness in companies is the training of their human talent, which is also a generator of innovations so that training strategies at the graduate level need to focus in adaptability, contextualization and learning as axes of the management of the formation of human capital for organizations (Mejía & Jaramillo, 2006).

Also, consider the relevance of teamwork because it has been proven that it also influences the innovation capacity of the organization, so if in the postgraduate course this good practice is encouraged then in the companies it will lead to the generation of this activity combined with the fact that It allows the strengthening of links, which is an element that encourages innovation. Thus, if organizations establish collaboration links in particular with educational institutions so that their human capital can access their postgraduate educational programs, it will allow not only individual but organizational development that will result in an environment of learning and creativity (Smith, Courvisanos & Tuck, 2012).

Finally, organizations need to promote continuous learning of human capital based on the use of new technologies because it is the main mechanism that generates quality in this resource through education because the changing environment in which companies evolve continuously determines new demands in terms of knowledge, skills and abilities of its members to maintain and strengthen the positioning of the organization in the markets (Valencia, 2005).

Therefore, the new pedagogical proposals are aimed at digital natives as students commit themselves to their learning and become protagonists in their training, leaving aside the transmission of knowledge by teachers. In order to achieve this, the learning context is relevant in which ICT provides adequate tools for its construction in relation to the planning and implementation of didactic situations for the contents to be learned, as well as the ways to evaluate it and thus encourage the employee requires the knowledge society is an university graduate with a postgraduate education, highly trained that you can integrate equipment from different work, play various roles adapting quickly to changes and to manage a set competency social. Thus, the top having an impact on the development of society, education is necessary to focus on training people as change agents to formulate and implement strategies to address the situations of the labor sector.

FUTURE RESEARCH DIRECTIONS

The future studies to be carried out are the training of digital natives in postgraduate courses based on the area of knowledge to determine the acquisition of their essential competences from the use of ICT.

Likewise, implement a research on teaching strategies used by teachers to identify their level of transformation and innovation to meet the characteristics of digital natives at the graduate level. Also, the design of assessment instruments that collect, organize and systematize the information on the performance of digital natives as postgraduate students that allow to configure a strategic plan in order to improve the educational quality of this level.

CONCLUSION

The Fourth Industrial Revolution affects society and the economy in a variety of ways: First, the majority of the population around the world uses social networking platforms to connect, learn and change information. Second, a variety of innovative producers and competitors will have easy access to digital marketing, sales and distribution platforms, thus improving the quality and price of goods and services. Third, consumers will be more involved in the production and distribution chains. The main effect of this revolution in the business environment is the impact it will have on consumer expectations, product quality, progress towards innovation collaboration and innovations in organizational forms. The work and life environments of the 21st century demand much more than skills of thought and content knowledge. The ability to navigate through these complex environments in the globally competitive information age requires that digital natives develop, as they need them, the right competencies for life and work. The increasingly rapid pace at which changes appear will require that young people recognize quickly the importance of lifelong learning.

Therefore, schools must adopt curricula that are broad and flexible at the same time and focus on content that develops thinking and reasoning. Curricula are needed that are open to the contributions of those who learn, who have an interdisciplinary approach and combine formal and informal learning in an effective way. Problem solving, reflection, creativity, critical thinking, meta-knowledge, risk-taking, communication, collaboration, innovation and entrepreneurial skills have become fundamental competencies for life and work in the 21st century.

In addition, a dynamic 21st century curriculum that enriches these new competencies and skills is required, while reaffirming the importance of literacy forms and basic academic subjects where digital natives are more actors than viewers of their own. learning because they see themselves as participants in the creation of information and new ideas (Leadbeater, 2008).

Finally, digital natives are required to form an active and responsible citizenship that possesses the empowerment to exercise both their rights and responsibilities in the individual, community, regional, national and international spheres. This situation will be possible insofar as the postgraduate competences are developed focused on the location, access, evaluation and interpretation of the information that allow them to make informed choices that will enable the implementation of effective strategies.

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REFERENCES

P21. (2007). *The Intellectual and Policy Foundations of the 21 st Century Skills Framework*. Washington, DC: Partnership for 21st Century Skills.

Anderson, C. (2012). *Makers: The New Industrial Revolution*. New York: Crown Publishing.

Arrieta-Reales, N., Gaviria-García, G., & Consuegra-Machado, J. (2017). Papel del capital intelectual en la calidad de las Instituciones de Educación Superior en Colombia. *Education and Educators*, *20*(3), 419–433. doi:10.5294/edu.2017.20.3.5

Bauman, Z. (2008). *Los retos de la educación en la modernidad líquida*. Barcelona, Spain: Gedisa.

Becta. (2008). *Research report: Emerging technologies for learning*. Becta. Retrieved from http://webarchive.nationalarchives.gov.uk/20101017191925/http://partners.becta.org.uk/upload-dir/downloads/page_documents/research/emerging_technologies08-2.pdf

Benett, S., Maton, K., & Kervin, L. (2008). The 'Digital Natives' Debate: A Critical Review of the Evidence. *British Journal of Educational Technology*, *39*(5), 775–786. doi:10.1111/j.1467-8535.2007.00793.x

Bringué, X., Sádaba, C., & Tolsá, J. (2011). *La generación interactiva en Iberoamérica 2010. Niños adolescentes ante las pantallas*. Madrid, Spain: Colección Generaciones Interactivas – Fundación Telefónica.

Cabra, F., & Marciales, G. (2009). Nativos digitales: ¿ocultamiento de factores generadores de fracaso escolar? *Iberoamerican Journal of Education*, *50*, 113–130.

Cardoso, E., & Cerecedo, M. (2011). Propuesta de indicadores para evaluar la calidad de un programa de posgrado en educación. *Electronic Journal of Educational Research*, *13*(2), 68 – 82. Retrieved from http://redie.uabc.mx/vol13no2/contenido-cardosocerecedo.html

CEPAL. (2008). *Espacios Iberoamericanos: La economía del conocimiento*. Retrieved from http://www.cepal.org/publicaciones/xml/9/34459/EspacioIiberoIII.pdf

Courvisanos, J. (2007). The ontology of innovation: Human agency in the pursuit of novelty. *History of Economics Review*, *45*(1), 41–59. doi:10.1080/18386318.2007.11681236

Davies, A., Fidler, D., & Gorbis, M. (2011). *Future Work Skills 2020*. Palo Alto, CA: Instituto de Investigación de la Universidad de Phoenix.

Dede, C. (2005a). Planning for neomillennial learning styles. *EDUCAUSE Quarterly*, *28*(1), 7–12.

Dede, C. (2005b). Planning for neomillennial learning styles: implications for investments in technology and faculty. In D. Oblinger & J. Oblinger (Eds.), *Educating the Net generation* (pp. 15.1–15.22). Boulder, CO: EDUCAUSE. Retrieved from http://www.educause.edu/educatingthenetgen

Drucker, P. (1997). The Future that Has Already Happened. *Harvard Business Review*, *7*(49), 64–75.

Edvinsson, L., & Sullivan, P. (1996). Developing a model for managing intelectual capital. *European Management Journal*, *14*(4), 356–364. doi:10.1016/0263-2373(96)00022-9

Gershenfeld, N., & Vasseur, J. (2014). *As Objects Go Online: The Promise (and Pitfalls) of the Internet of Things*. Retrieved from https://www.foreignaffairs.com/articles/2014-02-12/objects-go-online

Herring, S. (2012). *Transforming the workplace: critical skills and learning methods for the successful 21st century worker. Bing Think*. Retrieved from http://bigthink.com/experts-corner/transforming-the-workplace-critical-skills-and-learning-methods-for-the-successful-21st-century-worker

Jules, T. (2017). *Public Policy and Governance. The Global Educational Policy Environment in the Fourth Industrial Revolution: Gate, Regulated and Governed*. Emerald Group Publishing Limited.

Larraz, V. (2012). *La competencia digital a la Universitat (PhD thesis)*. Andorra: Universitat d'Andorra.

Larraz, V., Espuny, C., & Gisbert, M. (2012). *La presencia de la competencia digital en la universidad.* Retrieved from www.virtualeduca.info/ponencias2011/138/

Leadbeater, C. (2008). *What's Next? 21 Ideas for 21 st Century Learning*. London: The Innovation Unit.

Learnovation. (2009). *Inspiring Young People to Become Lifelong Learners in 2025*. Brussels, Belgium: MENON.

Leymonié, J. (2015). Nativos e inmigrantes digitales: ¿cómo aprendemos y enseñamos? *Dixit*, *12*, 10–19.

López, M. (2014). *Aprendizaje, competencias y TIC*. Pearson.

Mansilla, V., & Jackson, A. (2011). *Global Competence: Preparing Our Youth to Engage the World*. New York: Asia Society.

Mc Loughlin, C., & Lee, M. (2008). The three p's of pedagogy for the networked society: Personalization, participation and productivity. *International Journal on Teaching and Learning in Higher Education*, *20*(1), 10–27.

Mejía, A., & Jaramillo, M. (2006). Formación del talento humano: factor estratégico para el desarrollo de la productividad y la competitividad sostenibles en las organizaciones. *Guillermo de Ockham Scientific Review*, *4*(1), 43 – 81. Retrieved from http://www.redalyc.org/pdf/1053/105316847004.pdf

Obingler, D., & Obingler, J. (2005). *Educating the Net Generation.* Retrieved from http://www.educause.edu/books/educatingthenetgen/5989

OECD. (1998). *Human Capital Investment. An International Comparison*. Paris, France: OECD.

OECD. (2003). *Los desafíos de las tecnologías de la información y las comunicaciones en la educación*. Madrid, Spain: Ministerio de Educación, Cultura y Deporte. doi:10.1787/9789264103429-es

OECD. (2003). *La comprensión del cerebro. Hacia una nueva ciencia del aprendizaje*. Santillana.

OECD. (2012). *Better Skills, Better Jobs, Better Lives: A Strategic Approach to Skills Policies*. Paris, France: OECD; doi:10.1787/9789264177338-

Peters, M. (2017). Technological Unemployment: Educating for the Fourth Industrial Revolution. *Journal of Self-Governnace and Management Economics*, *5*(1), 25–33. doi:10.22381/JSME5120172

Portnoi, L., Rust, V., & Bagley, S. (2010). *Higher education, policy and the global competition phenomenon*. New York: Palgrave MacMillan. doi:10.1057/9780230106130

Prensky, M. (2001). Digital Natives, Digital Inmigrants. On the Horizon, 9(5).

Ramírez, H. (1999). El capital intelectual, base de la capacidad competitiva de la organización. *Journal of Foreign Trade*, *289*(1), 1014–1060.

Rasiah, R. (2011). Epilogue: Implications from industrializing East Asia's innovation and learning experiencies. *Asia Pacific Business Review*, *17*(2), 257–262. doi:10.1080/13602381.2011.533500

Redecker, C., & Punie, Y. (2013). The future of learning 2025: Developing a vision for change. *Future Learning*, *1*, 3–17.

Robinson, K. (2006). *How schools kill creativity*. Paper presented at the Conference TED 2006, Monterrey, CA.

Sábada, C., & Bringué, X. (2010). Niños y adolescentes españoles ante las pantallas: Rasgos configuradores de una generación interactiva. *Educational Participation*, *15*, 86–104.

Schwab, K. (2015). *The Fourth Industrial Revolution: What It Means and How to Respond.* Retrieved from https://www.foreignaffairs.com/articles/2015-12-12/fourth-industrial-revolution

Smith, A., Courvisanos, J., & Tuck, J. (2012). *Building the capacity to innovate: the role of human capital*. National Centre for Vocational Education Research. Retrieved from https://files.eric.ed.gov/fulltext/ED529887.pdf

Tejada, J., & Navío, A. (2005). El desarrollo y la gestión de competencias profesionales: una mirada desde la formación. *Iberoamerican Journal of Education*, *37*(2), 1 – 14. Retrieved from http://www.rieoei.org/deloslectores/1089Tejada.pdf

Tidd, J., Bessant, J., & Pavitt, K. (2005). *Managin innovation: integrating technological, market and organizational change*. Chichester, UK: John Wiles & Sons.

Trilling, B., & Fadel, C. (2009). *21st Century Skills: Learning for Life in Our Times*. San Francisco, CA: Jossey-Bass/John Wiley & Sons, Inc.

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2009). Conferencia Mundial sobre la Educación Superior, 2009. La nueva dinámica de la educación superior y la investigación para el cambio social y el desarrollo. Paris, France: UNESCO.

Valencia, M. (2005). El capital humano, otro activo de su empresa. *Framework*, *1*(2), 20 – 33. Retrieved from http://www.redalyc.org/pdf/2654/265420471004.pdf

Vila, L., Dávila, D., & Ginés, J. (2010). Competencias para la innovación en las universidades de América Latina: un análisis empírico. *Iberoamerican Journal of Higher Education*, *1*(1), 5 – 23. Retrieved from https://ries.universia.net/article/view/30/competencias-innovacion-universidades-america-latina-analisis-empirico

Wan, G., & Gut, D. (2011). *Bringing Schools into the 21 st Century. In Explorations of Educational Purpose*. Dordrecht, The Netherlands: Springer. doi:10.1007/978-94-007-0268-4

World Economic Forum. (2018). *Temas claves de la agenda global*. Retrieved from https://toplink.weforum.org/knowledge/insight/a1Gb0000000LPFfEAO/explore/summary

ADDITIONAL READING

Aras, R. (2017). *Los nuevos aprendizajes del sujeto digital.* Argentina: Centro de Estudios en Diseño y Comunicación, Cuaderno 64, 107 – 121. Retrieved from http://www.scielo.org.ar/pdf/ccedce/n64/n64a08.pdf

Cabrales, O. (2016). Los nativos digitales y el cerebro digital un nuevo reto para la enseñanza. In: Instituto de Estudios Avanzados Universidad de Santiago de Chile Red de Integración Latinoamericana en Educación y Tecnologías (Ed.), *Utilizando tecnologías en la educación para fortalecer la práctica docente en América Latina* (pp. 145 – 168). Bogotá: Universidad Nacional Abierta y a Distancia. Retrieved from http://rilet.org/wp-content/uploads/2016/09/1447-2690-1-SM.pdf. 2016

Cabrales, O., & Díaz, V. (2017). El aprendizaje autónomo en los nativos digitales. *Conhecimiento & Diversidade*, 9 (17), 17 – 32. Retrieved from https://revistas.unilasalle.edu.br/index.php/conhecimento_diversidade/article/view/3473

Chávez, M. (2015). Cómo enseñar a las nuevas generaciones digitales. *Electronic Journal of Educational Research*, 17 (2), 1 – 4. Retrieved from https://redie.uabc.mx/redie/article/viewFile/876/1242

De la Torre, A. (2009). Nuevos perfiles en el alumnado: La creatividad en nativos digitales competentes y expertos rutinarios. *RUSC. Universities and Knowledge Society Journal*, *6*(1), 25–45.

Díaz, V., Pedraza, A., & Valdiri, L. (2014). Conceptos para el desarrollo de un modelo de formación en competencias tecnológicas para Colombia. *Findings*, 11 (22), 183 – 198. Retrieved from http://www.redalyc.org/pdf/4138/413834075010.pdf

García, F., Portillo, J., Romo, J., & Benito, M. (2007). Nativos digitales y modelos de aprendizaje. In SPDECE: Universidad de País Vasco / Euskal Herriko Unibertsitatea (UPV/EHU). Retrieved from http://ftp.informatik.rwth-aachen.de/Publications/CEUR-WS/Vol-318/Garcia.pdf. 2007

UNESCO. (2011). *Educación de calidad en la era digital: Una oportunidad de cooperación para UNESCO en América Latina y el Caribe*. Buenos Aires, Argentina: UNESCO. Retrieved from http://www.unesco.org/new/fileadmin/MULTIMEDIA/FIELD/Santiago/pdf/educacion-digital-Buenos-Aires.pdf

KEY TERMS AND DEFINITIONS

Assessment: Ongoing process which evaluates the quality of the object of study in their progress and achievements, identifying strengths and weaknesses in order to develop strategies for improvement.

Native Digital: Person who from an early age has interacted with new technologies (computers, video games, cell phones, among others) and new media that allows you to understand their reality.

Competence: Set of skills and attitudes to achieve in an individual.

ICT: Information and communication technologies cover all advanced technologies in manipulating and communicating information.

Performance-Based Assessment: Assessments rooted in the accomplishment of complex, authentic tasks within authentic settings.

Transcendent: A program is transcendent when it forms permanent and competence capable of generating their own learning coupled with the transfer of labor solution strategies.

Chapter 16
Evolution and Trends in Teaching and Learning of Cyberjournalism

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ABSTRACT

This chapter analyzes the formative aspects, trends, and initiatives that some faculties and schools are developing as an experimental part of a new educational ecosystem. It´s proposed to reflect on journalism, fundamentally, as a scientific discipline, whose teaching is endorsed and justified in the universities of world prestige where the realization of applied research of journalistic models with emerging technologies through medialabs is promoted. All this without prejudice to ethical principles, the use and contrast of sources, quality in writing and illustrations, created and produced in digital platforms and multimedia.

INTRODUCTION: CURRENT CONTEXTUALIZATION OF JOURNALISM

The evolutionary processes of society are demanding to the media more rigor and professionalism in their publications. The Technologies of Information and Communication (TIC) and, specifically, Internet and databases, which engulf the concept of "Big Data" and data journalism, provide a great ability to process, compare and analyze from a critical point of view all the welter of content of information.

It´s clear that we have entered an era of rapid change in all areas of information: from the sources to the public, from the traditional genres to new technologies. In the same time we attended to see how new media emerging, in a scenario where the protagonist is also the user as part of the emerging new audience. Blogs, wikis, applications for touch devices and social networks are giving way to a new communication model that revolutionizes the market paradigm of information and communication of the content industry.

In another order of ideas, transmedia storytelling, the mobile journalism, journalism and enterprise journalism data, all of them new journalism emerging environments, come to create a scenario where is

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necessary to propose and rebuild new training schemes in the faculties of communications. Those new journalism emerging environment doesn't affect the essential concept of new journalism.

With over two century of existence, journalism has been impacted by the Technologies of Information and Communications and modifies their structures. First, journalism is not the job that inculcated us in the practical exercise where anyone, with studies or not, could exercise in this field. Journalism is not a refuge for all the persons, who having studies a field of knowledge and professionally dedicated to it, in their spare time they also devoted to the "office" of journalist. Journalism should stop being this refuge. It is time to establish end create professional associations that defend the interest of thousands of graduates in this area of communications that spent a lot of years learning in university classrooms. It is possible that a graduate in journalism, professionally exercised, could devote in their free time to the office of attorney knowing only some laws, or to the office of doctor reading only a guide? Obviously, the answer of this question is no. So, what happens with journalism? Perhaps, the time spent studying by the lawyers, psychologist, sociologist and architect is not the same?

When a field of knowledge is recognized as a scientific discipline, we talk about an indicator of progress and cultural development of a society. In this context, Medicine, that began as an empirical practice that reached its greater knowledge in universities classrooms to become what is represent today, is just one example of this progress (Flores, 2014). Obviously, we cannot compare medical science studies to studies of Journalism and Communications.

As says Abdul Waheed Khan (2007)[1] in the foreword of the study titled "Model Curricula for Journalism Education", journalism has become one of the pillars of democracy. This is a fact that nobody doubts it, in the same time that we cannot ignore them:

Journalism and educational programs that enable people to use and improve their journalistic skills are essential tools to support key democratic principles that are vital to the development of all countries. (UNESCO, 2007)

In this context, it should discuss the current state of journalism studies and, specifically, the adequacy of the training implanted in the Faculty of Communications or the Journalism Schools. In additions to this, we must start form the fact that journalism is not a job, it is a regulated profession such us for example the lawyer, sociologist, philosopher or psychologist. Many people persist to assign it as a job because they do not know that UNESCO[2] has identified as a discipline of knowledge. In conclusion to this, it is necessary to adapt the "communicative recipe" of journalistic training to the paradigm shift as a result of the constant evolution of the Internet and other digital technologies. Contrary, we resign ourselves to get depressed. According to Felix Ortega (2013):[3]

Times have changed and the profession of communicator and journalist must adapt to changing consumer habits and new industry profitability derived from the information and communications technology. Renew and adapt, or languish and die.

This study is part of a broader analysis of research on training and developing services in the competitive project "Innovation and experimentation of New Narratives and Media with Disruptive Emerging Technologies"[4].

HYPOTHESIS AND OBJECTIVES

For a long time, more and more academic and professional voices stand to contradict the future of journalism as a profession, driven by the consequences of technological impact. Besides, there have been discussions about the adequacy of training schemes in communication skills, circumstances requiring a restructuring or a radical about-turn in the curriculum. In contrast, emerging professionals with new knowledge, acquired self-taught, who begin to design their own future, excited about projects that allow the profession to exist beyond the mainstream media.

In this context, the university has a fundamental and vital role in the training of the new profile journalist; a type of knowledge requires constant revision of the study plans. But, what are the contents of these study plans for the training of new professional profiles?

One first hypothesis that attempts to answer this variable is clear from the successful initiatives that are making prestigious institutions as Columbia University in New York, the City University of New York (CUNY), the News University at the Poynter Institute in Florida (EE .S.), the City University London and the University of Birmingham (GB), whose journalism schools have adopted structural changes in the training plans, incorporating subjects until recently unthinkable in journalism education. Although these reference institutions have introduced substantial changes, some questions arise such as: Is it enough the structural change in plans for training of students of journalism? What kind of knowledge is considered in the new structure of journalistic studies? How we adapt the characteristics of the culture of “Big data” transmedia storytelling or venture to the new media reality? Does the teacher has the skills needed to provide new training content? Who makes the trainer? Are teachers a part of the new training with multimedia tools and resources?

A second hypothesis is that the communication faculties fulfill and assume new roles in the training of journalists who demand, a global scale, a hyper connected society.

Therefore, the aim of this analysis includes not only study and describe the operation of the training plan and the roles they have to assume the powers of Spanish communication, but also propose content that involves new knowledge students that should have to grow professionally in the industry news organizations (Flores, 2011, p. 28).

METHODOLOGY

It´s proposed to reflection on journalism, fundamentally, as a scientific discipline, whose teaching is endorsed and justified in the universities of world prestige in where it´s promoted the realization of applied research of journalistic models with emerging technologies through medialabs. The methodology for this study is based on the emerging, although that it is still limited the reference on journalism training for an industry where information prevails as multimedia and digital. The bibliographical research is the stage where scientific research studying what has been written in the scientific community on a particular issue or problem: What to see and how we consult? This is the reason why we have chosen this technique. Second, no least, we rely on the results of the study conducted by the Poynter News University in innovation in training in communication, accessing the website of the US reference organization under the direct observation method.

The observation, as a scientific method, has to achieve an objective understanding of reality to ensure the collection of information from each and every one of the indicators of concepts. As a technical research, direct observation has broad scientific acceptance. The purpose use is manifold: allows the analyst to determine what is being done, as is being done, by whom, when carried out, how long it takes, where it is and why it is done. According Sierra Lombardy (1998), "The observation, such procedure can be used at different times of a more complex investigation. [...] In the course of the investigation procedure it can become the method used in testing the hypothesis.

At the end of the investigation, observation can predict trends and development of the phenomena of a higher order generalization". A third method used was the interview. To this end, it has resorted to the view expressed in the first place, by a professional in asset of a major newspaper that demands new professional profiles and secondly, interview with a teacher with over ten years experience in teaching in various faculties of Spanish and international media.

The results offer some thoughts on journalism training for a new society where citizens serve a different definition of past and consolidating new experiences as especially new, already known as the "new new media" (Levinson, 2012).

TOWARDS AN INNOVATION IN JOURNALISM TRAINING

Howard Finberg I (2013)[5], director of formation of Poynter Institute, makes a diagnosis of the situation of journalistic training in his article entitled "Rethinking the journalism. A call to innovation", published on the website of the Poynter, following the Report on the State of Education in Journalism[6] (2013):

What's scary is that a break does not know where it will go. Forty years ago, we did not realize that the first mobile phone call would lead to computers and smartphones. Twenty years ago, we did not realize that Amazon transformed retail shopping. Ten years ago, there was no Facebook, no Twitter. You just do not know where we will drive disruptive innovation. We do know, however, it is that the future of journalism education is in a critical situation.

Finberg (2013), points out two reasons to argue his reflection:

1. Time is running out. Disruption, driven by economics and technology, it is conducting much faster than most of the university system administrators.
2. The education in Journalism undergoes fundamental changes, especially in the way journalism is taught and who teaches. Those who do not innovate in the classroom will have fallen behind, like those who chose not to innovate in the newsroom.

For several years, they have sparked discussions about the future of journalism education in colleges. Academics and professionals are still debating about the future of education in journalism as well as the information professionals are discussing what is the future of journalism. The result of a survey by the Poynter News University held in spring 2012, stressed that "many may feel disappointed, but not surprised that the positions for both educators and professionals have not changed much in the last year". A new survey by the same institution (the end of that year) shows no change in the attitudes of both groups. With more than 1,800 responses, divided between practitioners and academics, there is still a great distance [more than 40 points] between the two groups of respondents.

Despite not expect to see a massive change in the views of respondents, itself it expected to see some movement, especially among academics. From the results of this survey Poynter, it stands out:

1. 96% of those who identify themselves as educators (teachers) think that journalism degree is very important. And, it is extremely important when it comes to understanding the value of journalism. This result is almost identical to the result of 2012. The professionals [editors, journalists and other related] have a less favorable opinion: 57% says that a degree is only valuable when it comes to understanding the value of journalism. This is the same percentage as in the 2012 survey.
2. In the gap between teachers and professionals no perceived changes in his view about the importance of a degree in journalism when it comes to "skills in news gathering, editing and presentation of news." Almost all the teachers (98%) say that a degree is extremely important when it comes to skills in news gathering.

Figure 1. The importance of a degree in journalism when it comes to understand the values of journalism
Source: Poynter News University (2013)

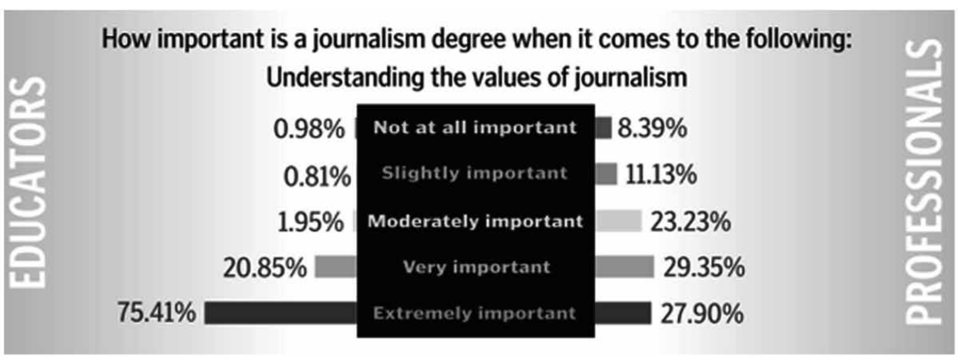
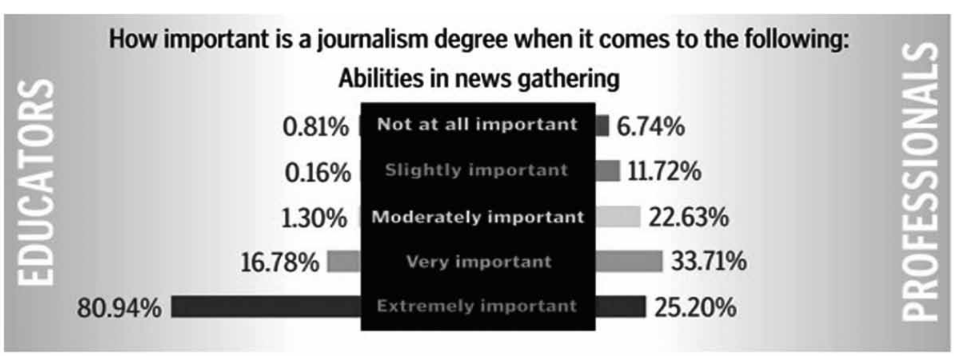


Figure 2. Importance of a degree in journalism for the teachers and professionals when it comes to collecting news
Source: Poynter News University (2013)



3. 39% percent of teachers said that education in journalism that seeks to keep up with industry changes nothing or very little. The leaders of newsrooms and staff are even more critical: 48% says that the academy is not current with the changes that journalism demands.
4. The gap between teachers and professionals is smaller when we speak of the value of a degree in journalism when it comes to getting a job. More than half [53%] of teachers think a degree in journalism is very important or extremely important to get a job. In contrast, only 41% of professionals shared that belief. But those who identify themselves as "self-employment" have an even lower opinion about a degree in journalism, and only 38% say that a journalism degree is very important or extremely important to get a job.

These results mean that, although that the attitudes have not changed since the 2012 survey, exist a perception of increased efforts to rethink journalism education.

A similar question had already been diagnosed in the "Model Journalism Education Report" ((Unesco, 2007), which states that one of the weaknesses of much of journalism education is a consequence of the failure to appreciate the extent to that the teaching of university disciplines constitutes (with media coverage and writing) the foundations of journalism. At the other end of this equation is the need for

Figure 3. Importance of journalism studies for the maintenance of industry changes
Source: Poynter News University (2013)

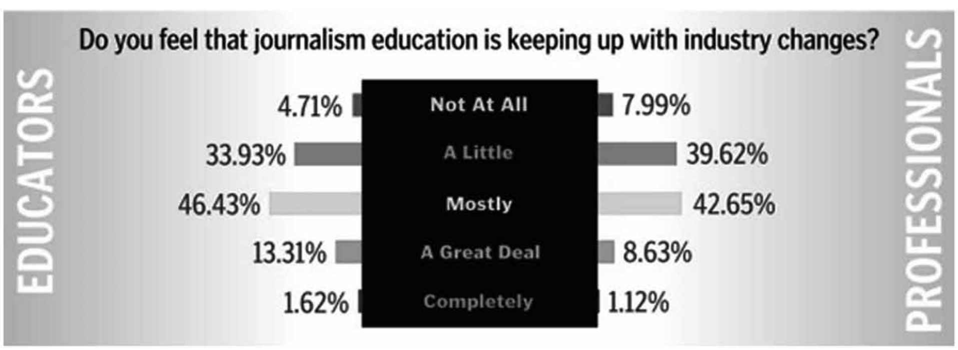
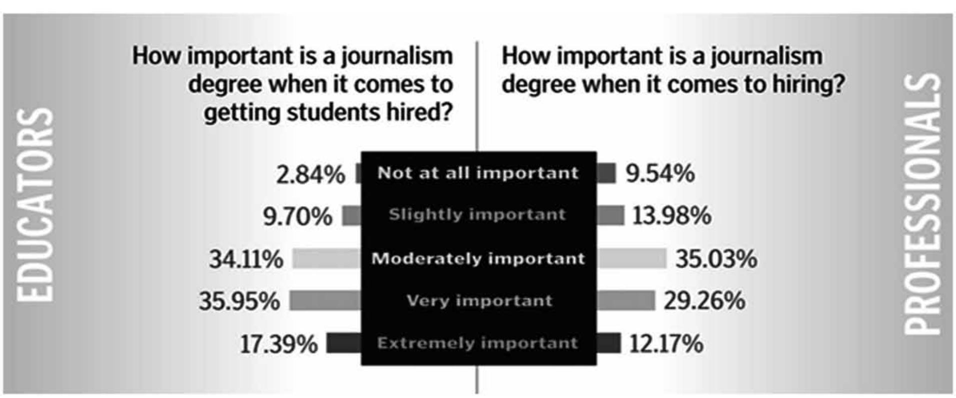


Figure 4. Importance of a degree in journalism for hiring professionals
Source: Poynter News University (2013)



journalism students receiving the training on journalism and on the use of technical equipment. These techniques are taught by competent practicing journalists, not only as teachers but also as guests promptly (and adequately compensated) respected faculty members. That is, a real synergy between the world of academia and the professional world. To enrich the practical side, in all journalism curricula should be including an internship (internship) in a medium of communication -u news organization, in the same time that would be necessary that schools will provide more collaboration agreements with local media.

In this context, cooperation agreements between news organizations and universities could consider, among other activities, workshops taught by professors of journalism in collaboration with renowned journalists and, most importantly, stay on media faculty members on business or exchanges and joint projects. The journalism schools can organize seminars at the headquarters of the media with which they maintain agreements in order to allow students access to technology and information services that are lacking in college. This collaboration can serve to bridge the gap between the study plans of journalism and the industry sector of the media.

The UNESCO report (2007) proposes to urge the mass media sector the time to study in universities or colleges and also to provide journalism educators the possibility to improve their professional skills.

The Adaptation to a Cyber Culture Change for the Formation of New Profiles

The Web 2.0 involves an era of change and transformation. The journalism and the mass media are the first affected by these rapid changes. In this context, changes to which reference is made in the faculties of communication, are a result of the impact that the Internet and other knowledge technologies have in media and journalism ecosystem. Under this scenario, the researchers at some universities work in order to implement new study plans in the training of journalist to new knowledge beyond the very concept of journalism and communication. All this, because of the concern they have about the perspective of constant technological innovation and acquisition of cyber culture network that grows in the media.

In the current state of journalism and the media, it is urgently needed an overhaul and review of the contents taught in colleges and schools of journalism. For decades, training and learning of journalism and communication in university classrooms has been a model that it was based on the contact sessions. Traditionally, the learning and knowledge in this discipline, has been transferred, through lectures by experts on communication. At present, the model of learning and teaching of journalism and communication remains the same, but at the traditional model are added the components that have erupted dramatically in just ten years of existence, models that impacting all areas of society and knowledge. These components or resources bearers Internet and other emerging technologies fully affect not only the context of journalism, also the form and substance of teaching and learning in this degree.

This new model of teaching and learning, which relies on the support of the virtual campus, not intended to replace face classes that are taught at the undergraduate or at the graduate. Mainly, the goal of this new model is to be a complement to the learning that results in the formation of the student as well as being a complementary support for the realization of more personalized and more responsive tutorials. Thus, the emerging technologies and the use of Internet are being studied and applied to teaching gradually. For example, in this context we can mention the use of blog platforms or wikis to generate interactivity and participation in network and mobile telephony with new communication codes.

The public or private institutions, the professional organizations and the companies strive to indicate that education in the information society must be a factor of social equality and personal development, a basic right and not just a market product. The high-risk groups in informational terms, those responsible for the digital divide, must be the objective for positives actions by the public authorities. For this reason, we should avoid that digital information technologies increase the social differences existing or create their own marginalized. But, are the universities prepared to face their fair share of this challenge? What should be the new educational model in journalism for faculties of this century? How to implement it in the classroom? What changes should be introduced in the classroom? How to train teachers to take on these challenges? What role does the Internet in the process of distance learning?

In the traditional industrial society, education was closely linked to the possibilities of social mobility. It would be easier to reach high positions in the social hierarchy with increasing levels of education. One of the main motivations for a person who wanted to study was in connection with the possible reward of social promotion. Today, reaching the dome of the education system does not imply access to the dome of the social system. In conclusion, having a college degree is not synonymous with fast access to a job.

Therefore, the environment teaching / learning cannot remain stagnant in the past, in the traditional way of teaching. This means a demand for new roles both teachers as well as students. For example, the traditional approach in higher education, for the teacher as the only source of information and wisdom and for the students as passive recipients, must give way to quite different roles with more active properties. Today, we can be achieved in the networks a lot of information and knowledge. Any college student can get more information than his teacher can provide him through the traditional channels. The mission of the teacher in rich environments of information is to be the counselor or guide appropriate about the sources of information, fostering in the same time among students creating habits and skills in the search, selection and processing of this information sources.

The faculties or schools of journalism have often been considered more modern professional schools than trade schools. As noted in other sections, for some mass media that have created their own schools or training centers, these are business units. The journalism schools must move firmly into the vocational school because the growing importance of journalism and its task of explaining to the public that the world becomes more complex and demanding. This includes the teachers, whose members must be professionals with experience in mass media or be active leaders in the profession, a level shown through his journalistic work, his teaching and his participation in public discourse. This would give students not only the entry-level job skills, but also a sense of the history of the profession and its importance to society and the state. This situation implies that journalism schools should be based on the resources available in their universities to give students the most powerful and possible set of tools, all those that help to transmit their knowledge to the public. The journalism schools are committed to the idea that the societies function is the best when citizens have access to the information that has been collected and presented by professionals highly trained, well-educated and honest. In conclusion, for intelligent people who have dedicated their life to a great profession such as journalism.

New Profile: Programmer Journalist

It is the time for future journalists. They need to know how to work with code, how to develop an application, how to create and design. It's time to innovate our study plans performing a 180 degrees, in the same time that we need to assume that it has been teaching at the journalism students the techniques of the past century.

But, learning specific software requires a continuing education (Briggs, 2007). Nobody can learn digital storytelling in a semester. For example, the domain of Dreamweaver, Flash or CMS[7], it is not complicated, but it is not possible to think that you learn "hastily", underestimating the extent of the knowledge of these applications. The intended to include learning in a course of online journalism as an optional subject can do more harm than good. The intended to include learning in a course of online journalism as an optional subject can do more harm than good. This means that we should be teaching the code in all the journalism degree courses (each semester, each year, until graduation).

Miranda Mulligan (2013), executive director of Knight News Innovation Lab at Northwestern University and former director of digital design of The Boston Globe says that journalists have to learn how to code if they want to be best (and most employable) narrators. Therefore, schools should teach students to have an open mind about your skills-and that means learning at least the basics of programming. The basic knowledge of programming can help journalists learn to create applications (mashups) to tell stories and also how to make presentations (views), in code form, with the current news. Never before it has been more urgent for the news industries understand the enough code to have meaningful conversations with technologists. In this context, one of the challenges that have the educators-teachers-trainers is to remove the fear of learning, to retrain, a notoriously common fear among the journalists. To a large extent we have seen this kind of debate and discussion a thousand times. But, now, not only the visual journalists complain about the stagnation of the narrative and online presentation. It is only one answer to this: journalists must learn more about the code. The idea to understand and comprehend the fear makes us better storytellers. For an industry that prides itself on being smart, tolerant, ignore Internet can lead to failure (Flores, 2012).

The offer of jobs for designers and journalists who can write code is growing exponentially. Therefore, we will tackle the problem of the training from all the point of view because, once detected the problem touches the solution. In other words: We need to teach students to be more literates from a technological point of view. We have to teach them how to learn and how to err, on the model of trial and error. It's not the same being a native digital that a digital alphabet. This does not mean that the editors and the publishers of content on blogs or websites, that have learned some programming, should to become a software engineer or web designer. Simply, not. The ultimate goal is not the fluency in programming software; it is the creativity in information content. However, there is an added value in understanding how browsers read and processed our stories.

Therefore, at the reporting and the writing a story we need to add the knowledge of writing some code (HTML, CSS, and JavaScript) and the programming of the complex applications and services. This fact makes the professional journalist has a profile with a collection of skills. A fundamental knowledge of code allows:

- Keep increasingly important conversations about the digital display.
- An understanding of the medium makes you better at your craft.
- Have a deeper and understanding thinking of data
- Learn more about what happens in the digital writing and the software programming taught to think in terms of abstractions, functions, parameters, components, frameworks, object classes, templates and much more.
- Ultimately leads to a better and more meaningful storytelling online.

The journalism needs qualified graduates that can create sophisticated visual presentations or applications using the programming code. At first, it may seem boring, emotionless and many students may feel intimidated when dealing with the use of code, but that apprehension disappears when they realize that it is not so difficult. It is a situation that surely many teachers have had-and have-all semesters during the practical subjects or multimedia content such as online journalism. In this context, they have to fight with HTML language, CCS or the use of CMS applications.

In this area and with this training approach, we can debunk the prevailing sentiment that exists in the fields of journalism and communication environment in which journalists still feel intimidated by digital technologies (Bradshaw, 2011). This feeling is also prevalent in communications schools where journalism is implanted. For example, at the multimedia classes, the author of this article has encountered students who maintain certain reluctance in using of HTML coding. Therefore, the work of teacher-researchers is to remove the fear of learning, a notoriously common fear among journalists. HTML is not magic. Writing code is not magic; it's just a hard work. Learning to program will not save the journalism and probably will not going to change the way we write our stories. However, it is a lot more fun to be a journalist on the web and see "how computers read and understand our content."

Learning to program provides not only a practical skill but also teaches solving problems. The students learn to be more precise, clarifying thought processes, so that the depth of their understanding of the information and data is growing up. In addition to this, visual journalists assume that the teaching code is the teaching of the information design.

The designers of the news and also the web designers assume the same responsibilities: organize the content in a rational way, illustrating the ideas to deepen the understanding of history and work within the limitations of the medium.

One of the most important tasks that a teacher should always do is to inspire students to have an open mind about your abilities. Nobody knows how will be the landscape of the narrative in two years and much less in a decade. An accessible and achievable question is to see and feel that students can become a digital journalist, for the role that we have as builders of learning. The graduates should be prepared with a set of skills that includes the ability to learn quickly and adapt to any environment and also to be open to new ideas and solutions, and take the initiative. This professional profile will never be bored and his knowledge will always be the weapon to fight unemployment. Our education and evangelization of the new journalism, based on new knowledge and skills, should inspire future digital journalists to continually grow and assume that constantly need to learn the tools that bring the new narratives and techniques, instilling so, that the learning process they are for all life. As affirmed in other sections, the practice of journalism should not be conceived as a simple hobby or profession, but as a career, whose knowledge is acquired in university classrooms. And, from a scientific perspective, we talk about a discipline of knowledge.

In this media ecosystem that is constantly changing, for the journalists and the universities, the greatest need in their training is how to create multimedia products (Flores, 2009). Secondly, it is also important how to write for the Internet and how to manage the online communities. Today, in a world of consumption and production of large-scale news, the journalism schools should study the technological, intellectual, artistic and literary possibilities of the journalism and carry out a constant expansion and improvement from the press capacity. The objective of those things is to inform the public about the importance and complexity of public affairs.

For all this, the training plans should be based on market needs information and what demand the societies from each country. The restructuring of the training plans in the faculties of journalism and communication must be done through a survey framework for professionals and academic researchers that respond about more technological training skills or knowledge.

Proposals to Reform the Journalism Studies

The detection of new profiles, forces to undertake new lines of training, for example in the field of social networks (Flores, 2009). To do this, we need an analysis of the current study plans of undergraduate and graduate with the objective to identify the unmet training needs. On the one hand, this calls a cross-conception: the aspects included in all subjects that they do not reference to social networks, and, on the other, a concept solely focused on social networks and that may appear in the title of the subject. The lines of training should be deeply in relation with the emerging professional profiles and they can be seen in the course of time. The professional profiles and the need for education to cover such unit are demanding a greater interaction (Flores and Salinas, 2012).

Recognizing this trend, the journalism programs at universities in different countries, including Spain, have been trying to renew their study plans, with the intention of offering courses that teach, for example, how to write for the Web or use of transmedia storytelling, trying in the same time to familiarize the students with software used in the multimedia area, such as Adobe Premiere Pro or Movie Maker environment (for video editing), Flash (for filing online video and create interactive presentations), HTML or XML (essential coding of algorithms) Dreamweaver (for building web sites) or increasingly used content Management Systems (CMS).

In this context, several media professionals, according to academics, propose some initiatives to consider. Miravalls July (2014)[8] proposes to establish four distinct areas, in all of them the journalism student should demonstrating a knowledge and a training to complete an educational curriculum in the years established (whether four or five). These four areas are:

- **General Theoretical Knowledges:** Including the classic humanities subjects (geography, art, history, literature, religion and philosophy, history of journalism), the characteristics of the new culture (technology, science, cinema, sport ...), more legal basis, political theory, science economic, business administration, statistics, health and environment, political structure of Spain (or the corresponding country, if we talk about a broader approach) and international relations.
- **Specialized Theoretical Knowledge:** The developments in greater depth, with approaches of pure knowledge and of journalistic treatment of the most significant subjects to be selected as one or two specific options in the last period of the studies (one or two courses). The objective would be to prepare specializations, particularly, in areas of activity or knowledge through high-level seminars, workshops, a very elaborate work research and analysis.
- **Mindset:** The learning and intensive practice of intellectual processes that are not strictly based on theoretical knowledge (although using it intensively), oratory, mathematical language, logic, structural language, semantics, design, computer programming (this is a practical alternative that brings structure and language logic) and foreign languages (one required at the highest level and at least one, with a degree of understanding and basic capabilities of expression). It is about creating a habit of speech, an ability to understand (and avoid passing, innumeracy that blurs all kinds of information) and an automatic reaction (improvisation and reflection at a time) in any circumstance.
- **Drafting:** In the strictest and most literal sense of the word, the journalism student should pass along the race many hours of immersion (for example, not less than 300 per year on average) in a newsroom (or on the street, working for her), developing in the same time a dual activity of

theoretical learning and an professional practical exercise, as well as the medical students spend hours dissecting cadavers (doing or watching) and accompanying doctors visiting patients in real University Hospitals.

The proposal of Miravalls is to create an authentic newsroom, which would require to have the leadership of a few professionals with proven experience in the practice of journalism, to produce a daily news product (which may be available to the public via the web, or more restricted in internal networks of the University), with the requirement to manage professionally the present and the facts, working in real mode on the collection and evaluation of information, writing, layout (design, rundowns ...) and the publication.

Meanwhile, Felix Ortega (2014)[9] states that "we must adapt the communicative recipe" to the paradigm shift and its rapid evolution, or resign ourselves to languish. According to Ortega, times have changed and the profession of communicator and journalist must adapt to changing consumer habits and profitability of the new industry of information and communications technology. Renew and adapt, or languish and die.

Applied and Experimental Research Through Medialabs or Innovation Centers

For some years, they have begun to proliferate medialabs promoted by the universities and the mass media, focusing on the future of journalism and the media sphere, so it is up to observe what trends have been discovered in, by and for the profession . Various US, European and Spanish universities, are creating these research centers with similar objectives (Flores, 2012: 7).

This kind of initiatives is increasingly emerging. For example, we have the proposal made by the Nieman Foundation at Harvard University, reporting a WebSite which is called The Nieman Journalism Lab, whose motto is quite eloquent: "It is an attempt to help the journalists to decipher the future in the era of Internet ". In the same line of research on media, but with a global vision, is created MIT Medialab, that it defined itself as "the place where the future is lived, not imagined. In a world where technological advances are incorporated, Media Lab researchers are designing new technologies to help people create a better world". Frank Moss (2011) current director of MIT says that:

Over the last twenty years we have been pioneers in the design of digital lifestyle we enjoy today. But the best is yet to come: a globally connected digital society that makes for happier, healthier and more creative people. The laboratory is leading the technological research that aims to expand and extol the physical, cognitive and social abilities of people. The technology opens the door to creativity, innovation and helps to solve problems-particularly those of the young people that have born in the digital era, something that until now was impossible.

The researches by institutions and research centers such as MIT Medialab address the evolving of mass media and journalism that, as a discipline of knowledge and professional challenge, can provide solutions responding to different variables: How the new technologies help improve the forms of communication? Why the technology is beneficial for new professional journalists? What is the practical training required by journalists? Etc.

For Flores (2012: 9), the Medialabs are defined as collaborative environments from research and development of the convergence of new technologies. The Medialabs cover various fields of knowledge such as computers, communications, new information technologies, social sciences, economics or art - and are laboratories of ideas for public and for private institutions and agencies. Many of the innovations that have produced the medialabs have affected, directly or indirectly, to the profession of journalism. The journalistic Medialabs are forums, usually, about the convergences that affect the profession and what will be new technologies that will guide the action in the coming years.

Currently, each more and more media professionals and managers are joining the innovation culture that newspapers have historically had in the mediatic ecosystem, such as strategies in social media, new ways of consuming news through mobile, Google applications, audiovisual narratives, videogames or the improvement of the analysis of the writing as well as technical innovations in the field of fact checking.

In this scenario, there are several examples of development of digital and journalistic media where the Laboratory of Audiovisual Innovation of RTVE, the Vocento Media Lab, the journalistic innovation laboratory of the "Diario de Navarra" (Laboratory DN) and the CE Laboratory stand out of The Confidential. The complex situation of the media sector has a growth factor of journalistic organizations to look for innovative strategies, in the use of technological applications with opportunities for the future.

Model of Applied Research: Internet Media Lab

In the same line to the initiatives from the Nieman Lab, MIT Media Lab and BBC Lab, a research group at the Complutense University of Madrid, launches in 2012, at the headquarters of the School of Information Sciences, the Internet Media Lab. The laboratory aims to highlight the innovative efforts and tries to determine what makes or breaks into the mass media; seeks to implement good ideas that others might propose; aims to help the reporters and editors to fit their work online; aims to help the traditional news media to find a way to survive; aims to help the new entrepreneurs and the creation of new Internet-based companies.

The Internet Media Lab at the Complutense University of Madrid was born as a project-program in order to develop research, analysis, trends and prospects of the media and their adaptation to the new interactive forms that demand the Information Society. Based on research developed, the Internet Media Lab constitutes a test center of new media at the same time that develops specialized programs for professional journalists training in Spain and Latin America. The main objective of Internet Media Lab is to help students and journalists to develop self-sustained training programs that will raise the ethical, professional and technological standards of journalism, to thereby contribute to creating a culture of network and develop effectively in the new industry environments of information as a cornerstone in building the Information Society in Spain, Europe and Latin America.

The Internet Media Lab is defined as a center for a testing environment and learning practice of journalism on the Web (model trial and error). Another pillar of the laboratory is the development, research and analysis on media convergence which is already known as new media which results in new business models and the study of trends in the new digital audience.

Thus, the objectives of the Internet Media Lab are in complete harmony with the paths by institutions, companies and research centers that promote the development of the knowledge society that can be summarized as:

- Testing and analysis tools and technological resources of practical application for the convergence of media and communication enterprises. Expert training in the use and management of emerging, interactive and digital technologies.

- The design to methodologies and indicators for practical application to the study of the New Media.
- Preparation of studies and reports on trends, strategies and technology foresight in developing new business models for the media.
- Monitoring and surveillance technology of convergent journalism and online media.

The researchers of online journalism, online media and cyber culture, interested in working lines of Internet Media Lab may establish agreements and mechanisms for collaboration between departments and faculties of Economics and Business Administration, Law, Information Technology, Telecommunications, Statistics, Sociology and any other related field through research groups.

In this context, the Internet Media Lab's mission is a transversal and interdisciplinary study, in theoretical and experimental context, of the impact and incidents of the digital technology in the information professionals and the various media; and analyzes the emergence and development of new languages and codes of online communication.

CONCLUSION

Despite the failures of the university system, promptly detected, the training of professionals that occurs in the Spanish University allows them to compete in the global market of communication at the highest level. The professionals graduate with a good training, albeit with certain shortcomings demanded by today's information market.

Therefore, we must look for new learning environments of online journalism that would be a way to organize the process of classroom and distance learning which involves the use of technology. Although it is not limited only to this we must create an educational and methodological situation learner-centered that fosters self-learning, construction of knowledge and as part of this process, the development of critical and creative thinking. These aspects are essential in the process of teaching and learning of European Higher Education Area and applicable to all disciplines of knowledge, but still more in the discipline of journalism and communication.

Furthermore, in conjunction with the teaching aspect, research shows that the generation of network, based in university classrooms, not learns in a linear way and highlights the different learning styles, all valid, that has this generation. One of the challenges of online journalism that students present to their teachers is precisely the personal attention required. It requires the development of a number of professional, methodological, pedagogical and didactic skills to enable to the university to accomplish its mission to meet the demands of a generation with extraordinary potential.

The peculiarities of the emerging generation that expands increasingly seem intertwined with a formula (generational): "With the computer and internet, everything. Without it, virtually nothing". It is so easy or complex to meet and satisfy their needs for learning and growth, based on the model of trial and error that promotes research laboratories. The network generation wants to learn not the traditional ways, always using new technologies.

REFERENCES

Bradshaw, P., & Rohumaa, L. (2011). *The Online Journalism Handbook: Skills to Survive and Thrive in the Digital Age*. London, UK: Longman Practical Journalism Series.

Briggs, M. (2007). *Journalism 2.0.* Austin, TX: EE.UU. Edt. Knight Center of Texas University.

Cebrián, M. (2005). *The multimedia information. Supports, languages and business applications*. Madrid: Pearson Educación.

Finberg, H. (2013). *Rethinking journalism education: A Call for Innovation*. Poynter Institute. Retrieved from http://www.newsu.org/course_files/StateOfJournalismEducation2013.pdf

Flores, J. M. (2009). New models of communication, profiles and trends in social networks. *Comunicar*, *33*(33), 73–81. doi:10.3916/c33-2009-02-007

Flores, J. M. (Ed.). (2011). Reinventing the journalism and media. Madrid: Editorial Fragua.

Flores, J. M. (2012). The importance of medialabs for applied research with emerging technologies. Case Study: Creating mashups. In *Journalism in Network. Proceedings of the V International Congress of Journalism Network*. UCM.

Flores, J. M. (2014). The Journalism as Knowledge and Discipline, the academic value for a Quality Profession. *Prisma Social*, (12): 506–543.

Flores, J. M., & Salinas, C. (2012). Challenges of the Faculties of Communication: Training new profiles for journalists based on innovation and knowledge technologies. In *Journal of Knowledge Technology and Society*. USA Common Ground Publisher.

Grimm, J. (2010). Columbia's New Dual Degree Program Aims to Redefine Journalism As We Know it. Poynter Institute. Retrieved from http://www.poynter.org/how-tos/career-development/ask-the-recruiter/104901/columbias-new-dual-degree-program-aims-to-redefine-journalism-as-we-know-it/

Levinson, P. (2012). *New New Media* (2nd ed.). Penguin Academics.

Miravalls, J. (2014). The journalism, School of office. In Ciberperiodismo. Lima, Perú: Ed. USMP.

Ortega, F. (2014). Adapt the recipe to the paradigm shift. In Ciberperiodismo. Lima, Perú: Ed. USMP.

Poynter. (2013). *State of Journalism Education*. Poynter Institute. Retrieved from http://www.newsu.org/course_files/StateOfJournalismEducation2013.pdf

Unesco. (2007). *Model curricula for journalism education. Colección de la UNESCO sobre los estudios de Periodismo*. Retrieved from http://www.unesco.org/new/es/communication-and-information/resources/publications-and-communication-materials/publications/full-list/model-curricula-for-journalism-education/

KEY TERMS AND DEFINITIONS

Applied Research: Applied research is a methodology used to solve a specific, practical problem of an individual or group. The study and research is used in business, medicine, and education in order to find solutions that may cure diseases, solve scientific problems, or develop technology.

Cyberjournalism: A form of journalism in which news is published on the internet or in cyberspace. Also, it is a term coined after the merging of various traditional media brought about by the proliferation of media industries due to current influx of new technology and globalization.

Data Journalism: Is a journalism specialty reflecting the increased role that numerical data is used in the production and distribution of information in the digital era. It reflects the increased interaction between content producers (journalist) and several other fields such as design, computer science, and statistics.

Educational Ecosystem: An *ecosystem* can be described as a community network of interactions between organisms and their environment. Yes, this sounds like a slightly pompous way of describing networking, but what it highlights are the interactions that go to influence and nourish what actually happens in the classroom.

Innovation Journalism: Is journalism that covers innovation processes and innovation (eco)systems. Innovation journalism is a form of journalism that cuts across the traditional story areas. Instead of just being limited to writing about one field or area (i.e., politics, technology, celebrity, or sports), innovation journalism covers the whole story. Where traditional journalism relies on silos, innovation journalism eliminates them. Where traditional journalism sees various areas as unrelated and disjointed, innovation journalism sees them as corresponding and united.

MediaLabs: The objective of a MediaLab (multimedia lab) is to provide a confluence space for conducting training and production workshops, seminars, conferences, debates, concerts, meetings of different types of groups. The medialab centers are spaces for the open and collaborative exchange of ideas, knowledge, and experimentation processes through the means of documentation and communication provided by the center and optimized by the participants, also taking advantage of the best available means, such as the internet and the multimedia exchange.

Technological Evolution: A theory that describes the radical transformation of society through technological development. This theory originated with Czech philosopher Radovan Richta.

Technology Impact in Communication: Technology has improved communication. Communication is used for a number of purposes. Both society and organizations depend on communication to transfer information. People use technology to communicate with each other. Electronic media like radios, televisions, internet, social media have improved the way we exchange ideas which can develop our societies.

ENDNOTES

1 Abdul Waheed Khan is Assistant Director-General for Communication and Information, UNESCO.
2 United Nations Educational, Scientific and Cultural Organization.
3 Felix Ortega is professor of Audiovisual Communication at the University of Salamanca.
4 UCM-Santander. Convocatoria 2016. Referencia: PR26/16-20267.
5 Director of Training Partnerships and Alliances, the Poynter Institute for Media Studies.

[6] The State of Education in Journalism report is prepared annually by the Poynter Institute's News University. Florida, USA.

[7] CMS means Content Management System (content management system).

[8] Julio Miravalls has been deputy of ElMundo.es.

[9] Felix Ortega holds a degree in Economics and PhD in Communication and Culture from the University of Salamanca. Currently, he is professor of the Faculty of Social Sciences of the University of Salamanca, Spain.

Compilation of References

Abubakar, A., Kassim, S. H., & Yusoff, M. B. (2015). Financial development, human capital accumulation and economic growth: Empirical evidence from the economic community of West African States (ECOWAS). *Procedia: Social and Behavioral Sciences*, *172*, 96–103. doi:10.1016/j.sbspro.2015.01.341

Adalı, Z., & Yüksel, S. (2017). Causality relationship between foreign direct investments and economic improvement for developing economies. *Marmara İktisat Dergisi*, *1*(2), 109–118.

Adams, R. B. (2016). Women on boards: The superheroes of tomorrow? *The Leadership Quarterly*, *27*(3), 371–386. doi:10.1016/j.leaqua.2015.11.001

Adams, R. B., & Ferreira, D. (2009). Women in the boardroom and their impact on governance and performance. *Journal of Financial Economics*, *94*(2), 291–309. doi:10.1016/j.jfineco.2008.10.007

Adda, G., Azigwe, J. B., & Awuni, A. R. (2016). Business Ethics and Corporate Social Responsibility for Business Success and Growth. *European Journal of Business and Innovation Research*, *4*(6), 26–42.

Adhami, S., Giudici, G., & Martinazzi, S. (2018). Why do businesses go crypto? An empirical analysis of Initial Coin Offerings. *Journal of Economics and Business*. doi:10.1016/j.jeconbus.2018.04.001

Agrawal, A., Catalini, C., & Goldfarb, A. (2015). Crowdfunding: Geography, social networks, and the timing of investment decisions. *Journal of Economics & Management Strategy*, *24*(2), 253–274. doi:10.1111/jems.12093

Agrisani, L., Arpalia, P., Bonavolonta, F., & Lo Moriello, R. S. (2019). Academic FabLabs for industry 4.0: Experience at University of Naples Federico II. *IEEE Instrumentation & Measurement Magazine*, *21*(1), 6–13. doi:10.1109/MIM.2018.8278802

Ahlers, G., Cumming, D., Guenther, C., & Schweizer, A. (2015). Signaling in equity crowdfunding. *Entrepreneurship Theory and Practice*, *39*(4), 955–980. doi:10.1111/etap.12157

Ahmeda, E. (2017). Mobile Edge Computing: Opportunities, solutions, and challenges. *Future Generation Computer Systems*, *70*, 59–63. doi:10.1016/j.future.2016.09.015

Al Iriani, M. A., & Trabelsi, M. (2016). The economic impact of phasing out energy consumption subsidies in GCC countries. *Journal of Economics and Business*, *87*, 35–49. doi:10.1016/j.jeconbus.2016.04.004

Alam, M. S., & Paramati, S. R. (2016). The impact of tourism on income inequality in developing economies: Does Kuznets curve hypothesis exist? *Annals of Tourism Research*, *61*, 111–126. doi:10.1016/j.annals.2016.09.008

Alam, M. S., Paramati, S. R., Shahbaz, M., & Bhattacharya, M. (2017). Natural gas, trade and sustainable growth: Empirical evidence from the top gas consumers of the developing world. *Applied Economics*, *49*(7), 635–649. doi:10.1080/00036846.2016.1203064

Albee, G. (1985). The argument for primary prevention. *The Journal of Primary Prevention*, *5*(4), 213–219. doi:10.1007/BF01324537 PMID:24277528

Almada-Lobo, F. (2016). The Industry 4.0 revolution and the future of manufacturing execution systems (MES). *Journal of Innovation Management*, *3*(4), 16–21.

Alonso, M. A., Berrocal, F., & Calles, A. (2012). *La utilización de técnicas de desarrollo participativas como estrategia de solución de problemas. Proyecto de Innovación y Mejora de la Calidad Docente 2011, Nº 110*. Madrid: Universidad Complutense.

Alonso, M. A., Castaño, G., Calles, A. M., & Sánchez-Herrero, S. (2010). Assessment of the Efficacy of a Peer Mentoring Program in a University Setting. *The Spanish Journal of Psychology*, *13*(2), 683–694. doi:10.1017/S1138741600002353 PMID:20977018

Alonso, M. A., Sánchez, C., & Calles, A. M. (2011). Satisfacción con el mentor. Diferencias por rol y sexo. *Revista Española de Pedagogía*, *250*, 485–50.

Al-Shaer, H., & Zaman, M. (2016). Board gender diversity and sustainability reporting quality. *Journal of Contemporary Accounting and Economics*, *12*(3), 210–222. doi:10.1016/j.jcae.2016.09.001

Álvarez, N., González de Canales, F., & Puentes, M. (2013). Contextualizando lo digital reflexiones del taller Politics of Fabrication Laboratory de la Architectural Association y la Universidad Católica de Valparaíso. *Revista*, *180*(32), 30–35.

Anderson, C. (2012). *Makers: The New Industrial Revolution*. New York: Crown Publishing.

Andersson, F. O., & Helm, S. (2012). *Do Socially Entrepreneurial Nonprofits Perform Better: An Empirical Exploration.* Paper presented at New York University's Stern Conference on Social Entrepreneurship, New York, NY. Retrieved March 1, 2017, from http://bloch.umkc.edu/faculty-staff/documents/andersson-helm-conference.pdf

Ansoff, R. (1993). Finfing a home for a psychology of volition. *Theory ogy,* (3), 323-336.

Arena, M., Azzone, G., & Bengo, I. (2015). Performance Measurement for Social Enterprises. *Voluntas*, *26*(2), 649–672. doi:10.100711266-013-9436-8

Arner, D. W., Barberis, J. N., & Buckley, R. P. (2015). The evolution of Fintech: A new post-crisis paradigm? *Geo. J. Int'l L.*, *47*, 1271.

Arnold, C., Kiel, D., & Voigt, K. I. (2016). How the industrial internet of things changes business models in different manufacturing industries. *International Journal of Innovation Management*, *20*(08), 1640015. doi:10.1142/S1363919616400156

Arntz, M., Gregory, T., & Zierahn, U. (2017). *Revisiting the Risk of Automation.* ZEW. Retrieved from https://goo.gl/Es1JqM

Aronowitz, S., & DiFazio, W. (1995). *Jobless Future: Sci-Tech and the Dogma of Work*. University of Minnesota Press.

Arrieta-Reales, N., Gaviria-García, G., & Consuegra-Machado, J. (2017). Papel del capital intelectual en la calidad de las Instituciones de Educación Superior en Colombia. *Education and Educators*, *20*(3), 419–433. doi:10.5294/edu.2017.20.3.5

Arroyo, L., Murillo, D., & Val, E. (2017). *Confiados y confiables. La fabricación de la confianza en la era digital.* Instituto de Innovación Social (Esade). Retrieved December 23, 2017, from https://www.slideshare.net/ESADE/estudio-confiados-y-confiables-la-fabricacin-de-la-confianza-en-la-era-digital/1

Arroyo, L., Murillo, D., & Val, E. (2017). *Confiados y Confiables. La fabricación de la confianza en la era digital*. Barcelona: ESADE.

Arvanitis, S., & Loukis, E. N. (2009). Information and communication technologies, human capital, workplace organization and labour productivity: A comparative study based on firm-level data for Greece and Switzerland. *Information Economics and Policy*, *21*(1), 43–61. doi:10.1016/j.infoecopol.2008.09.002

Ashcraft, C., Mclain, B., & Eger, E. (2016). *Women in Tech: the Facts*. Retrieved from https://www.ncwit.org/sites/default/files/resources/ncwit_women-in-it_2016-full-report_final-web06012016.pdf

Asinari, L. (2015). Workshop FabAcademy. Ponencia en el Festival Internacional de Arquitectura EME3. Barcelona.

Astini, R., & Tafiprios, T. (2017). The Application of Three Orientation (Market, Technology and Entrepreneurship Orientation) and Global Mindset as Efforts to Increase the Growth and Export Performance: Evidence from Micro, Small and Medium Sized Industries of Teak Furniture in JAVA Island. *International Journal of Economic Perspectives*, *11*(1), 1731–1742.

Atehortúa, M. (2002). Resiliencia: Otra perspectiva de las experiencias sociales y personales dentro de la empresa. *Estudios Gerenciales.*, *18*(82), 47–55.

Atrostic, B. K., Boegh-Nielsen, P., Motohashi, K., & Nguyen, S. (2004). *IT, Productivity and Growth in Enterprises: Evidence from new international micro data*. The Economic Impact of ICT–Measurement, Evidence and Implications.

Austin, J., Stevenson, H., & Wei-Skillern, J. (2006). Social and Commercial Entrepreneurship: Same, Different, or Both? *Entrepreneurship Theory and Practice*, *30*(1), 1–22. doi:10.1111/j.1540-6520.2006.00107.x

Autor, D. (2015). Why Are There Still So Many Jobs? The History and Future of Workplace Automation. *The Journal of Economic Perspectives*, *29*(3), 3–30. doi:10.1257/jep.29.3.3

Autor, D., Katz, L., & Krueger, A. (1998). Computing Inequality: Have Computers Changed the Labor Market? *The Quarterly Journal of Economics*, *113*(4), 1169–1213. doi:10.1162/003355398555874

Autor, D., Levy, F., & Murnane, R. (2003). The Skill Content of Recent Technological Change: An Empirical Exploration. *The Quarterly Journal of Economics*, *118*(4), 1279–1333. doi:10.1162/003355303322552801

Avram, A., Avram, C. D., & Avram, V. (2014). Research and development expenditures between discretionary costs and source for economic growth. *Romanian Journal of Economics*, *39*(2), 49–66.

Aw, B. Y., Roberts, M. J., & Xu, D. Y. (2008). R&D investments, exporting, and the evolution of firm productivity. *The American Economic Review*, *98*(2), 451–456. doi:10.1257/aer.98.2.451

Aydın, M., & Malcıoğlu, G. (2016). Financial Development and Economic Growth Relationship: The Case of OECD Countries. *Journal of Applied Research in Finance and Economics*, *2*(1), 1–7.

Azevedo, F. (2018). *Online Reputation Management: Secrets from a Pro Ethical Hacker*. Independently Published.

Bacon, N., Faizullah, N., Mulgan, G., & Woodcraft, S. (2008). *Transformers: how local áreas innovate to address changing social needs*. London: NESTA.

Bacq, S., & Janssen, F. (2011). The multiple faces of social entrepreneurship: A review of definitional issues based on geographical and thematic criteria. *Entrepreneurship and Regional Development*, *23*(5-6), 373–403. doi:10.1080/08985626.2011.577242

Bagnoli, L., & Megali, C. (2011). Measuring Performance in Social Enterprises. *Nonprofit and Voluntary Sector Quarterly*, *40*(1), 149–165. doi:10.1177/0899764009351111

Bakirtas, T., & Akpolat, A. G. (2018). The Relationship between Energy Consumption, Urbanization, and Economic Growth in New Emerging-Market Countries. *Energy*, *147*, 110–121. doi:10.1016/j.energy.2018.01.011

Baldassarre, F., Ricciardi, F., & Campo, R. (2017). The Advent of Industry 4.0 in Manufacturing Industry: Literature Review and Growth Opportunities. In *DIEM: Dubrovnik International Economic Meeting* (Vol. 3, No. 1, pp. 632-643). Sveučilište u Dubrovniku.

Ballon, P. (2018). A Structural Equation Model of Female Empowerment. *The Journal of Development Studies*, *54*(8), 1303–1320. doi:10.1080/00220388.2017.1414189

Banesto Foundation. (2013). *Observatorio sobre el uso de las redes sociales en las PYMEs españolas*. Retrieved from http://www.slideshare.net/cink/segundo-observatorio-sobre-el-uso-de-las-redes-sociales-en-las-pym-es-espanolas

Bång, A., & Hell, J. (2015). *Digital Marketing Strategy: Social Media and its Contribution to Competitiveness*. Retrieved from https://www.divaportal.org/smash/get/diva2:824959/FULLTEXT01.pdf

Bank for International Settlements. (2014). *Trade finance: Developments and issues*. Retrieved September 1, 2017, from https://www.bis.org/publ/cgfs50.pdf

Barrett, H., Balloun, J. L., & Weinstein, A. (2005). The impact of creativity on performance in non-profits. *International Journal of Nonprofit and Voluntary Sector Marketing*, *10*(4), 213–223. doi:10.1002/nvsm.25

Bartlett, C. A., & Ghoshal, S. (1992). *Managing Businesses Abroad. A Transnational Solution* [Gerenciando empresas no exterior: a solução transnacional]. São Paulo, Brasil: Makron Books.

Baruah, T. D. (2012). Effectiveness of Social Media as a tool of communication & its potential for technology enabled connections: A micro-level study. *International Journal of Scientific & Research Publications*, *2*(5), 1–10.

Bass, C. (2014). Social Enterprise through Digital Desig. *Stanford Social Innovation Review*. Retrieved December 12, 2017, from https://ssir.org/podcasts/entry/social_enterprise_through_digital_design

Batabyal, A. A., & Yoo, S. J. (2017). On research and development in a model of Schumpeterian economic growth in a creative region. *Technological Forecasting and Social Change*, *115*, 69–74. doi:10.1016/j.techfore.2016.09.020

Battilana, J., & Dorado, S. (2010). Building sustainable hybrid organizations: The case of commercial microfinance organizations. *Academy of Management Journal*, *53*(6), 1419–1440. doi:10.5465/amj.2010.57318391

Battilana, J., Metin, S., Pache, A. C., & Model, J. (2015). Harnessing Productive Tensions in Hybrid Organizations: The Case of Work Integration Social Enterprises. *Academy of Management Journal*, *58*(6), 1658–1685. doi:10.5465/amj.2013.0903

Battistella, C., De Toni, A. F., & Pillon, R. (2015). The Extended Map methodology: Technology road mapping for SMES clusters. *Journal of Engineering and Technology Management*, *38*(4), 1–23. doi:10.1016/j.jengtecman.2015.05.006

Bauer, W., Hämmerle, M., Schlund, S., & Vocke, C. (2015). Transforming to a hyper-connected society and economy– towards an "Industry 4.0". *Procedia Manufacturing*, *3*, 417–424. doi:10.1016/j.promfg.2015.07.200

Bauman, Z. (2008). *Los retos de la educación en la modernidad líquida*. Barcelona, Spain: Gedisa.

Bayarcelik, E. B., & Taşel, F. (2012). Research and development: Source of economic growth. *Procedia: Social and Behavioral Sciences*, *58*, 744–753. doi:10.1016/j.sbspro.2012.09.1052

Beaudry, P., Green, D.A., & Sand, B.M. (2016). The great reversal in the demand for skill and cognitive tasks. *Journal of Labor Economics, 34*(1). Doi:10.1086/682347

Becker, K., Nobre, H., & Kanabar, V. (2013). Monitoring & protecting company & brand reputation on social networks: When sites are not enough. *Global Business & Economics Review*, *15*(2-3), 293–308. doi:10.1504/GBER.2013.053075

Becoña, E. (2006). Resiliencia: Definición, características y utilidad del concepto. *Revista de Psicopatología y Psicología Clínica*, *11*, 125–146.

Becta. (2008). *Research report: Emerging technologies for learning*. Becta. Retrieved from http://webarchive.nationalarchives.gov.uk/20101017191925/http://partners.becta.org.uk/upload-dir/downloads/page_documents/research/emerging_technologies08-2.pdf

Beer, L. A. (2015). *A Strategic and Tactical Approach to Global Business Ethics.* Business Expert Press.

Beevers, K., & Rea, A. (2016). *Learning and Development Practice in the Workplace*. London: CIPD.

Bell, B. (1996). *Skill-Biased Technological Change and Wages: Evidence from a Longitudinal Data Set*. Oxford, UK: Nuffield College. Retrieved from https://goo.gl/qGXJCM

Belleflamme, P., Lambert, T., & Schwienbacher, A. (2013a). Crowdfunding: Tapping the right crowd. *Journal of Business Venturing*, *29*(5), 585–609. doi:10.1016/j.jbusvent.2013.07.003

Belleflamme, P., Lambert, T., & Schwienbacher, A. (2013b). Individual crowdfunding practices. *Venture Capital*, *15*(4), 313–333. doi:10.1080/13691066.2013.785151

Benedikt Frey, C., & Osborne, M. A. (2016). The future of employment: How susceptible are jobs to computerisation? Oxford Martin School, University of Oxford.

Benett, S., Maton, K., & Kervin, L. (2008). The 'Digital Natives' Debate: A Critical Review of the Evidence. *British Journal of Educational Technology*, *39*(5), 775–786. doi:10.1111/j.1467-8535.2007.00793.x

Bergek, A., Jacobsson, S., Carlsson, B., Lindmarki, S., & Rickne, A. (2005). Analysing the Dynamics and Functionality of Sectoral Innovation Systems–A Manual. In 10 Year Anniversary DRUID Summer Conference, Copenhagen, Denmark.

Bernal-Conesa, J. A., Briones-Peñalver, A. J., & Nieves Nieto, C. (2017). CSR Strategy in Technology Companies: Its Influence on Performance, Competitiveness, and Sustainability. *Corporate Social Responsibility and Environmental Management*, *24*(2), 96–107. doi:10.1002/csr.1393

Bernard, B. (1999). Applications of resilience: possibilities and promise. In M. Glantz & J. Johnson (Eds.), *Resilience and Development: positive life adaptations* (pp. 269–277). Plenum Publishers.

Bernard, C. I. (1938). *The Functions of the Executive*. Boston, MA: Harvard University Press.

Bernasek, A., & Shwiff, S. (2001). Gender, risk, and retirement. *Journal of Economic Issues*, *35*(2), 345–356. doi:10.1080/00213624.2001.11506368

Berrocal, F., Alonso, M. A., Castaño, G., Sánchez-Herrero, S., & Calles, A. (2013). *Diseño de instrumentos de evaluación y desarrollo de competencias transversales para estudiantes de la UCM. Proyecto de innovación educativa y mejora de la docencia 254*. Madrid: Universidad Complutense de Madrid.

Bertoncello, M., & Wee, D. (2015). *Ten ways autonomous driving could redefine the automotive world*. McKinsey & Co.

Betts, B. (2010). Bringing The Factory Home. *Engineering & Technology*, *5*(8), 56–58. doi:10.1049/et.2010.0813

Beyers, R. N. (2010). Nurturing Creativity and Innovation Through FabKids: A Case Study. *Journal of Science Education and Technology*, *19*(5), 447–455. doi:10.100710956-010-9212-0

Bhuian, S. N., Menguc, B., & Bell, S. J. (2005). Just entrepreneurial enough: The moderating effect of entrepreneurship on the relationship between market orientation and performance. *Journal of Business Research*, *58*(1), 9–17. doi:10.1016/S0148-2963(03)00074-2

Biao, W. A. N. G., Zhao, J. Y., Wan, Z. G., Hong, L. I., & Jian, M. A. (2016). Lean Intelligent Production System and Value Stream Practice. *DEStech Transactions on Economics, Business and Management*.

BioAcademany. (2016). *How To Grow Almost Anything - BioAcademany*. Retrieved January 31, 2017, from http://bio.academany.org

Blanchet, M., Rinn, T., & Dujin, A. (2016). The Industrie 4.0 transition quantified. *Roland Berger Strategy Consultants GmbH. München.* Retrieved from: https://www.rolandberger.com/en/Publications/pub_the_industrie_4_0_transition_quantified.html

Blanchet, M., Rinn, T., Von Thaden, G., & De Thieulloy, G. (2014). Industry 4.0: The new industrial revolution - How Europe will succeed. *Roland Berger Strategy Consultants GmbH. München.* Retrieved from: http://www. rolandberger.com/media/pdf/Roland_Berger_TAB_Industry_4_0_2014 0403. pdf

Blanco, L. R., Gu, J., & Prieger, J. E. (2016). The impact of research and development on economic growth and productivity in the US states. *Southern Economic Journal*, *82*(3), 914–934. doi:10.1002oej.12107

Blikstein, P., & Krannich, D. (2013). The Makers' Movement and FabLabs in Education: Experiences, Technologies, and Research. *Proceedings of the 12th International Conference on Interaction Design and Children. IDC '13*, 613–616. 10.1145/2485760.2485884

Bloomberg, L. P. (2018). *Bloomberg Professional Services* [computer software]. Madrid: Universidad CEU San Pablo.

Bloxham, S. (2014) Assessing assessment: new developments in assessment design, feedback practices and marking in higher education. In H. Fry, S. Ketteridge, and S. Marshall (Eds.), A handbook for teaching and learning in higher education: enhancing academic practice (4th ed.; pp. 107-122). New York, NY: Taylor & Francis.

Bohn, R. B., Messina, J., Liu, L., Tong, J., & Mao, J. (2011). NIST Cloud Computing Reference Architecture. *IEEE World Congress on Services, IEEE*, *7*, 594-596. http://ieeexplore.ieee.org/document/6012797/

Bojnec, Š., & Fertő, I. (2014). Research and development spending and export performance by the technological intensity of the products. *Ekonomický časopis*. *Journal of Economics*, *62*(10).

Bonin, H., Gregory, T., & Zierahn, U. (2015). Übertragung der Studie von Frey/Osborne (2013) auf Deutschland. *ZEW Kurzexpertise*, No. 57. Retrieved from https://goo.gl/cuCx3G

Bosqué, C. (2013). FabLabs: La démocratie du design. *AA; l'Architecture d'Aujourd'Hui*, *398*, 70–77.

Bosua, R., Kurnia, S., Gloet, M., & Moza, A. (2017). Telework Impact on Productivity and Well-Being. *Social Inclusion and Usability of ICT-Enabled Services*, 201.

Bouvier-Patron, P. (2015). FabLab et extension de la forme réseau : Vers une nouvelle dynamique industrielle? *Innovations*, *47*(2), 165–188. doi:10.3917/inno.047.0165

Bowen, H. R. (1953). *Social Responsibilities for the Businessman*. New York: Harper.

Boyd, D. M., & Ellison, N. B. (2008). Social Network Sites: Definition, History, & Scholarship. *Journal of Computer-Mediated Communication*, *13*(1), 210–230. doi:10.1111/j.1083-6101.2007.00393.x

Boyd, D., Golder, S., & Lotan, G. (2010). Tweet, tweet, retweet: Conversational aspects of retweeting on twitter. In *Proceedings of the 43rd Hawaii International Conference on Social Systems (HICSS)*. IEEE. 10.1109/HICSS.2010.412

Bradford, C.S. (2012). Crowdfunding and the federal securities laws. *Columbia Business Law Review*, *2012*(1), 1-150.

Bradshaw, P., & Rohumaa, L. (2011). *The Online Journalism Handbook: Skills to Survive and Thrive in the Digital Age*. London, UK: Longman Practical Journalism Series.

Brem, A., & Wolfram, P. (2014). Research and development from the bottom up-introduction of terminologies for new product development in emerging markets. *Journal of Innovation and Entrepreneurship*, *3*(1), 9. doi:10.1186/2192-5372-3-9

Bresnahan, T. F., & Trajtenberg, M. (1995). General purpose technologies 'Engines of growth'? *Journal of Econometrics*, *65*(1), 83–108. doi:10.1016/0304-4076(94)01598-T

Bresnahan, T., Brynjolfsson, E., & Hitt, L. (2002). Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-Level Evidence. *The Quarterly Journal of Economics, MIT Press*, *117*(1), 339–376. doi:10.1162/003355302753399526

Brian, F., Sestini, F., Gascó, M., Baeck, P., Halpin, H., Almirall, E., & Kresin, F. (2015). *Growing a digital social innovation ecosistem for Europe: DSI Final Report.* Brussels: European Commission. Retrieved March 2, 2018, from https://www.nesta.org.uk/sites/default/files/dsireport.pdf

Briggs, M. (2007). *Journalism 2.0.* Austin, TX: EE.UU. Edt. Knight Center of Texas University.

Bringué, X., Sádaba, C., & Tolsá, J. (2011). *La generación interactiva en Iberoamérica 2010. Niños adolescentes ante las pantallas*. Madrid, Spain: Colección Generaciones Interactivas – Fundación Telefónica.

Briones-Peñalver, A. J., Nieves Nieto, C., & Bernal-Conesa, J. A. (2018). Analysis of Corporate Social Responsibility in Spanish Agribusiness and its Influence on Innovation and Performance. *Corporate Social Responsibility and Environmental Management*, *25*(2), 182–193. doi:10.1002/csr.1448

Brito, J., & Castillo, A. (2013). *Bitcoin: A premier for policy makers*. Retrieved January 10, 2018, from https://www.mercatus.org/system/files/Brito_BitcoinPrimer.pdf

Bronfenbrenner, U. (1979). *Ecology of human development*. Boston: Harvard University Press.

Brooks, R. B., Goldstein, S., & Bueno, B. (2004). *El poder de la resiliencia: cómo lograr el equilibrio, la seguridad y la fuerza interior necesarios para vivir en paz*. Paidós.

Brown, R. (2015). *Introducing R3 Corda™: A distributed ledger designed for financial services*. Retrieved January 10, 2018, from https://www.r3cev.com/blog/2016/4/4/introducing-r3-corda-a-distributed-ledger-designed-for-financial-services

Bruneel, J., Moray, N., Stevens, R., & Fassin, Y. (2016). Balancing Competing Logics in For-Profit Social Enterprises: A Need for Hybrid Governance. *Journal of Social Entrepreneurship*, *7*(3), 263–288. doi:10.1080/19420676.2016.1166147

Brunswicker, S., Bertino, E., & Matei, S. (2015). Big Data for Open Digital Innovation - A Research Roadmap. *Big Data ResearchVolume*, *2*(2), 53–58. doi:10.1016/j.bdr.2015.01.008

Bryer, A., Carrier, J. G., Cooper, C., & Ferández, M. ª I., Goddard, V., & Kasmir, S. (2012). *Las políticas de la economía social desde una perspectiva antropológica.* Madrid, Spain: Fundación EOI. Retrieved February 14, 2018, from https://www.eoi.es/es/savia/publicaciones/19615/las-politicas-de-la-economia-social-desde-una-perspectiva-antropologica

Brynjolfsson, E., & McAfee, A. (2014). *The second machine age. Work, progress, and prosperity in a time of brilliant technologies*. New York: W.W. Norton & Company.

Buching, C., Walter-Herrmann, J., & Schelhowe, H. (2012). The C-Model of Interaction between humans and Digital Media in learning environments. *2012 15th International Conference on Interactive Collaborative Learning (ICL),* 1–7. 10.1109/ICL.2012.6402152

Buckland, H., & Murillo, D. (2013a). *Vías hacia el cambio sistémico.* Instituto de Innovación Social (Esade). Retrieved October 14, 2017, from http://itemsweb.esade.es/wi/research/iis/publicacions/2013-04_Antenna-cast.pdf

Buckland, H., & Murillo, D. (2013b). *La Innovación Social en América Latina. Marco conceptual y agentes*. Instituto de Innovación Social (Esade). Retrieved October 18, 2017, from https://www.slideshare.net/ESADE/informe-la-innovacin-social-en-amrica-latina-45162162

Buckland, H., & Murillo, D. (2015). *The Quest for precision. Antenna for Social Innovation. Instituto de Innovación Social*. Esade.

Bureau van Dijk. (2018). Osiris [Data file]. Available from: https://www.bvdinfo.com/en-gb/our-products/data/international/osiris

Burgueño, P. (2009). *Clasificación de redes sociales.* Retrieved from http://www.pabloburgueno.com/2009/03/clasificacion-de-redes-sociales

Burmeister, C., Lüttgens, D., & Piller, F. T. (2015). Business Model Innovation for Industrie 4.0. *Why the Industrial Internet Mandates a New Perspective on Innovation.*, *0*, 1–31.

Byoun, S., Chang, K., & Kim, Y. S. (2016). Does corporate board diversity affect corporate payout policy? *Asia-Pacific Journal of Financial Studies*, *45*(1), 48–101. doi:10.1111/ajfs.12119

Cabra, F., & Marciales, G. (2009). Nativos digitales: ¿ocultamiento de factores generadores de fracaso escolar? *Iberoamerican Journal of Education*, *50*, 113–130.

Cabrera, L., Bethencourt, J. T., Álvarez, P., & González, M. (2006). El problema del abandono de los estudios universitarios. *Relieve*, *12*(2), 105–127.

Calvo, P. (2014). Business Ethics, Social Responsibility, and Communicative Goods [Ética Empresarial, Responsabilidad Social y Bienes Comunicativos]. *Tópicos. Revista de Filosofía*, *47*, 199–232.

Capdevila, I. (2014). Coworking Spaces and the Localized Dynamics of Innovation. The Case of Barcelona. *International Journal of Innovation Management*, *19*(3), 1540004. doi:10.1142/S1363919615400046

Carayannis, E. G., & Campbell, D. F. J. (2009). 'Mode 3' and ¿Quadruple Helix': Toward a 21st Century Fractal Innovation Ecosystem. *International Journal of Technology Management*, *46*(3/4), 201–234. doi:10.1504/IJTM.2009.023374

Carboni, O. A., & Medda, G. (2018). R&D, export and investment decision: Evidence from European firms. *Applied Economics*, *50*(2), 187–201. doi:10.1080/00036846.2017.1332747

Cardona, M., Kretschmer, T., & Strobel, T. (2013). ICT and productivity: Conclusions from the empirical literature. *Information Economics and Policy*, *25*(3), 109–125. doi:10.1016/j.infoecopol.2012.12.002

Cardoso, E., & Cerecedo, M. (2011). Propuesta de indicadores para evaluar la calidad de un programa de posgrado en educación. *Electronic Journal of Educational Research*, *13*(2), 68 – 82. Retrieved from http://redie.uabc.mx/vol13no2/contenido-cardosocerecedo.html

Carlsson, B., Jacobsson, S., Holmén, M., & Rickne, A. (2002). Innovation Systems: Analytical and Methodological Issues. *Research Policy*, *31*(2), 233–245. doi:10.1016/S0048-7333(01)00138-X

Carlsson, B., & Stankiewicz, R. (1991). On Nature, Function, and Composition of Technological Systems. *Journal of Evolutionary Economics*, *1*(2), 93–118. doi:10.1007/BF01224915

Carroll, A. B. (1979). A Three-Dimensional Conceptual Model of Corporate Performance. *Academy of Management Review*, *4*(4), 497–505. doi:10.5465/amr.1979.4498296

Carroll, A. B. (1991). The Pyramid of Corporate Social Responsibility: Toward the Moral Management of Organizational Stakeholders. *Business Horizons*, *34*(4), 39–48. doi:10.1016/0007-6813(91)90005-G

Carta Europea de Principios de la Economía Social. (2002). Déclaration finale commune des organisations européennes de l´Économie Sociale, CEP-CMAF, 20 juin 2002.

Carter, D. A., D'Souza, F., Simkins, B. J., & Simpson, W. G. (2010). The gender and ethnic diversity of US boards and board committees and firm financial performance. *Corporate Governance*, *18*(5), 396–414. doi:10.1111/j.1467-8683.2010.00809.x

Carter, D. A., Simkins, B. J., & Simpson, W. G. (2003). Corporate governance, board diversity, and firm value. *Financial Review*, *38*(1), 33–53. doi:10.1111/1540-6288.00034

Caruana, A., Ewing, M. T., & Ramaseshan, B. (2002). Effects of some Environmental Challenges and Centralization on the Entrepreneurial Orientation and Performance of Public Sector Entities. *Service Industries Journal*, *22*(2), 43–58. doi:10.1080/714005076

Cavalcanti, G. (2013). *Is it a Hackerspace, Makerspace, TechShop, or FabLab?* Retrieved from https://makezine.com/2013/05/22/the-difference-between-hackerspaces-makerspaces-techshops-and-fablabs/

CEBR (Centre for Economics and Business Research). (2015). *World Economic League Table 2016 Highlights*. Author.

Cebrián, M. (2005). *The multimedia information. Supports, languages and business applications*. Madrid: Pearson Educación.

Celaya, J. (2000, 2001, 2012). La empresa en la Web 2.0: el impacto de las redes sociales y las nuevas formas de comunicación on-line en la estrategia empresarial. Barcelona.

CEPAL. (2008). *Espacios Iberoamericanos: La economía del conocimiento*. Retrieved from http://www.cepal.org/publicaciones/xml/9/34459/EspacioIiberoIII.pdf

Chaffey, D., & Patron, M. (2012). From web analytics to digital marketing optimization: Increasing the commercial value of digital analytics. *Journal of Direct*. *Data and Digital Marketing Practice*, *14*(1), 30–45. doi:10.1057/dddmp.2012.20

Chaffey, D., & Wood, S. (2005). *Business Information Management. Improving Performance Using Information Systems*. Business Information Management.

Chen, H. L., & Hsu, C.-H. (2013). Entrepreneurial orientation and firm performance in non-profit service organizations: Contingent effect of market orientation. *Service Industries Journal*, *33*(5), 445–466. doi:10.1080/02642069.2011.622372

Chen, R. C. Y., & Lee, C. (2017). Assessing Whether Corporate Social Responsibility Influence Corporate Value. *Applied Economics*, *49*(54), 5547–5557. doi:10.1080/00036846.2017.1313949

Chen, T., & Tsai, H.-R. (2017). Ubiquitous Manufacturing: Current Practices, Challenges, and Opportunities. *Robotics and Computer-integrated Manufacturing*, *45*, 126–132. doi:10.1016/j.rcim.2016.01.001

Chen, Y., & Fang, Z. (2017). Industrial electricity consumption, human capital investment and economic growth in Chinese cities. *Economic Modelling*.

Cheong, H., & Lee, H. (2017). Technology and policy strategies in the era of CPS (cyber physical system) and automated driving. *Procedia Computer Science*, *122*, 102–105. doi:10.1016/j.procs.2017.11.347

Chesbrough, H. (2003, Spring). The era of Open Innovation. *MIT Sloan School of Management*, 35-41.

Chigora, F. (2016). Social Media & Brand Equity: Reality for Small to Medium Enterprises in Zimbabwe Tourism Industry. *International Journal of Innovative Research and Development*, *5*(4).

Chishti, S., & Barberis, J. (2016). *The FinTech book: The financial technology handbook for investors, entrepreneurs and visionaries*. Chichester, UK: John Wiley & Sons Ltd. doi:10.1002/9781119218906

Cho, Park, Son, & Lee. (2016). R&D Support Services for Small and Medium-Sized Enterprises: The different Perspectives of Clients and Service Providers, and the Roles of Intermediaries. *Journal of Science and Public Policy*, *43*(6), 859–871.

Chohan, U. W. (2017). *Cryptocurrencies: A brief thematic review*. Retrieved February 15, 2018, from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3024330

Chung, N., Tyan, I., & Chung, H. C. (2017). Social support & commitment within Social Networking Site in Tourism Experience. *Sustainability*, *9*(11), 2102. doi:10.3390u9112102

Chusseau, N., & Hellier, J. (2008). Social policies and R&D subsidies: Impact on inequality, unemployment, growth and the tax burden. *International Journal of Manpower*, *29*(3), 239–262. doi:10.1108/01437720810878905

CitizenLab. (2018). *Civic engagement made really easy.* Retrieved March 20, 2018, from https://www.citizenlab.co/

Cohoon, J. M. (2011). Which Gender Differences Matter for High Tech Entrepreneurship? *Open Source Business Resource*. Retrieved July 1, 2017, from https://ssrn.com/abstract=2577124

Conferencia de Helsinki. (2006). *Manifiesto de Helsinki*. Retrieved February 2, 2018, from elivinglab.org/files/Helsinki_Manifesto_201106.pdf

Connor, K. M., & Davidson, J. R. (2003). *Development of a new resilience scale*: The Connor - Davidson Resilience Scale (CD-RISC). *Depression and Anxiety*, *18*(2), 76–82. doi:10.1002/da.10113 PMID:12964174

Coombes, S. M. T., Morris, M. H., Allen, J. A., & Webb, J. W. (2011). Behavioural Orientations of Non-Profit Boards as a Factor in Entrepreneurial Performance: Does Governance Matter? *Journal of Management Studies*, *48*(4), 829–856. doi:10.1111/j.1467-6486.2010.00956.x

Costa, M., & López, M. (2006). *Manual para la vida Psicológica. Dar Poder Vivir. Más allá del counseling*. Madrid: Pirámide.

Costa-Sánchez, C., & Fontela Baró, B. (2016). Public Relations and Social Media. Spanish companies proactivity in the audiovisual social networks. *Revista Internacional de Relaciones Públicas*, *6*(11), 235–254.

Courvisanos, J. (2007). The ontology of innovation: Human agency in the pursuit of novelty. *History of Economics Review*, *45*(1), 41–59. doi:10.1080/18386318.2007.11681236

Covin, J. G., & Slevin, D. P. (1989). Strategic Management of Small Firms in Hostile and Benign Environments. *Strategic Management Journal*, *10*(1), 75–87. doi:10.1002mj.4250100107

Crouch, C. H., & Mazur, E. (2001). Peer instruction: Ten years of experience and results. *American Journal of Physics*, *69*(9), 970–977. doi:10.1119/1.1374249

Cubillos, R., Quintero, A. I. C., & Valencia, M. A. (2017). *Colección académica de ciencias sociales. ROAD*. Retrieved March 22, 2018, from http://road.issn.org/issn/2422-0477-coleccion-academica-de-ciencias-sociales

Cutler, L. (2000). Creativity: Essential to technological innovation. *Research Technology Management*, *43*(6), 29–30. doi:10.1080/08956308.2000.11671391

Cyrulnik, B. (2001). *La maravilla del dolor*. Barcelona: Granica.

D'aveni, R. (1994). *Hypercompetition. Managing the dynamics of strategic maneuvering*. New York: Free Press.

Dacin, P. A., Dacin, M. T., & Matear, M. (2010). Social Entrepreneurship: Why We Don't Need a New Theory and How We Move Forward from Here. *The Academy of Management Perspectives*, *24*(3), 37–57.

Damkaci, F., Braun, T. F., & Gublo, K. (2017). Peer Mentor Program for the General Chemistry Laboratory Designed to Improve Undergraduate STEM Retention. *Journal of Chemical Education*, *94*(12), 1873–1880. doi:10.1021/acs.jchemed.7b00340

David Reinsel, D., Gantz, J., & Rydning, J. (2017). *Data Age 2025: The evolution of Data to Life-Critical. Seagate*. Retrieved from https://www.seagate.com/files/www-content/our-story/trends/files/Seagate-WP-DataAge2025-March-2017.pdf

David, B. (2017). Computer technology and probable job destructions in Japan: An evaluation. *Journal of the Japanese and International Economies*, *43*, 77–87. doi:10.1016/j.jjie.2017.01.001

Davidson, R. (Ed.). (2012). The psychobiology of consciousness. Springer Science and Business Media.

Davies, R. (2015). Industry 4.0. Digitalisation for productivity and growth. *European Parliamentary Research Service, Briefing*.

Davies, A., Fidler, D., & Gorbis, M. (2011). *Future Work Skills 2020*. Palo Alto, CA: Instituto de Investigación de la Universidad de Phoenix.

Davis, J. A., Marino, L. D., Aaron, J. R., & Tolbert, C. L. (2011). An Examination of Entrepreneurial Orientation, Environmental Scanning, and Market Strategies of Nonprofit and For-Profit Nursing Home Administrators. *Nonprofit and Voluntary Sector Quarterly*, *40*(1), 197–211. doi:10.1177/0899764009351112

Davis, K. (1960). Can Business Afford to Ignore Social Responsibilities? *California Management Review*, *11*(3), 70–76. doi:10.2307/41166246

Davis, K. (1967). Understanding the Social Responsibility Puzzle: What Does the Businessman Owe to Society? *Business Horizons*, *10*(4), 45–50. doi:10.1016/0007-6813(67)90007-9

Davos Economic Forum. (2016). *El futuro del empleo. ManpowerGroup. Business & Talent Paper #1.* Retrieved June 13, 2016, from https://drive.google.com/file/d/0BwktW2X_nhxqeGxUc0plTkxRdTg/view

de Boer, J. (2015). The business case of FryskLab, Europe's first mobile library FabLab. *Library Hi Tech*, *33*(4), 505–518. doi:10.1108/LHT-06-2015-0059

de la Mata, G. (2018a). *Manual de la Innovación Social: de la Idea al Proyecto.* Retrieved December 10, 2017, from http://innovationforsocialchange.org/buy-ebooks/

de la Mata, G. (2018b). *The top 10 Social Innovation Practices*. Retrieved February 20, 2018, from http://innovationforsocialchange.org/downloads/top-10-social-innovation-practices/

de la Mata, G. (2018c). *Labs for Change*. Retrieved March 5, 2018, from http://innovationforsocialchange.org/metodologias-2/nuestra-metodologia-de-cambio-labs-for-change/

De Sousa Jabbour, A. B. L., Jabbour, C. J. C., Godinho Filho, M., & Roubaud, D. (2018). Industry 4.0 and the circular economy: A proposed research agenda and original roadmap for sustainable operations. *Annals of Operations Research*, 1–14.

Decreuse, B., & Maarek, P. (2015). FDI and the labor share in developing countries: A theory and some evidence. *Annals of Economics and Statistics*. *Annales d'Economie et de Statistique*, (119/120), 289–319. doi:10.15609/annaeconstat2009.119-120.289

Dede, C. (2005a). Planning for neomillennial learning styles. *EDUCAUSE Quarterly*, *28*(1), 7–12.

Dede, C. (2005b). Planning for neomillennial learning styles: implications for investments in technology and faculty. In D. Oblinger & J. Oblinger (Eds.), *Educating the Net generation* (pp. 15.1–15.22). Boulder, CO: EDUCAUSE. Retrieved from http://www.educause.edu/educatingthenetgen

Dees, J. G. (1998). *The Meaning of Social Entrepreneurship*. Retrieved 15 February, 2017, from http://www.sosyalinovasyonmerkezi.com.tr/yayin/2020010002.pdf

Dees, J. G., & Anderson, B. B. (2003). For-Profit Social Ventures. *International Journal of Entrepreneurship Education*, *2*, 1–26.

Defourny, J., & Nyssens, M. (2010). Conceptions of Social Enterprise and Social Entrepreneurship in Europe and the United States: Convergences and Divergences. *Journal of Social Entrepreneurship*, *1*(1), 32–53. doi:10.1080/19420670903442053

Del Águila, R. (2000). *Comercio Electrónico y Estrategia Empresarial: Modelos de Negocio en Internet*. Daccach T., J. C.

Deloitte. (2016). *Disaggregating FinTech: Brighter shades of disruption*. Retrieved December 14, 2017, from https://www2.deloitte.com/us/en/pages/financial-services/articles/disaggregating-the-impact-of-fintech.html#

Dess, G. G., & Beard, D. (1984). Dimensions of organizational task environment. *Administrative Science Quarterly, 29.*

Destek, M. A., & Aslan, A. (2017). Renewable and non-renewable energy consumption and economic growth in emerging economies: Evidence from bootstrap panel causality. *Renewable Energy*, *111*, 757–763. doi:10.1016/j.renene.2017.05.008

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. E. (2011). From game design elements to gamefulness: defining gamification. In *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments* (pp. 9–15). New York: ACM Press. 10.1145/2181037.2181040

Diamond, D. W. (1984). Financial intermediation and delegated monitoring. *The Review of Economic Studies*, *51*(3), 393–414.

Diamond, D. W., & Rajan, R. G. (2001). Liquidity risk, liquidity creation, and financial fragility: A theory of banking. *Journal of Political Economy*, *109*(2), 287–327. doi:10.1086/319552

Dietz, M., Khanna, S., Olanrewaju, T., & Rajgopal, K. (2016). *Cutting through the noise around financial technology*. Retrieved February 15, 2018, from https://www.mckinsey.com/industries/financial-services/our-insights/cutting-through-the-noise-around-financial-technology

Diez, T. (2012). Personal Fabrication: FabLabs as Platforms for Citizen-Based Innovation, from Microcontrollers to Cities. *Nexus Network Journal*, *14*(3), 457–468. doi:10.100700004-012-0131-7

Digital Social Innovation. (2018). *About DSI4EU*. Retrieved 15 March, 2018, from https://digitalsocial.eu/about-the-project

Dijkmans, C., Kerkhof, P., & Beukeboom, C. J. (2015). A stage to engage: Social Media use and corporate reputation. *Tourism Management*, *47*, 58–67. doi:10.1016/j.tourman.2014.09.005

Dilling-Hansen, M., & Smith, V. (2014). R&D, export and productivity: Testing the Bustos model on Danish data. *Applied Economics Letters*, *21*(11), 733–737. doi:10.1080/13504851.2014.884695

Dinçer, H., Yüksel, S., & Adalı, Z. (2017). Identifying Causality Relationship between Energy Consumption and Economic Growth in Developed Countries. *International Business and Accounting Research Journal*, *1*(2), 71–81. doi:10.15294/ibarj.v1i2.9

Dinçer, H., Yuksel, S., & Adalı, Z. (2018). Relationship Between Non-Performing Loans, Industry, and Economic Growth of the African Economies and Policy Recommendations for Global Growth. In *Globalization and Trade Integration in Developing Countries* (pp. 203–228). IGI Global. doi:10.4018/978-1-5225-4032-8.ch009

Dogan, E., Sebri, M., & Turkekul, B. (2016). Exploring the relationship between agricultural electricity consumption and output: New evidence from Turkish regional data. *Energy Policy*, *95*, 370–377. doi:10.1016/j.enpol.2016.05.018

Dogru, T., & Bulut, U. (2017). Is tourism an engine for economic recovery? Theory and empirical evidence. *Tourism Management*.

Drath, R., & Horch, A. (2014). Industrie 4.0: Hit or hype? *IEEE Industrial Electronics Magazine*, *8*(2), 56–58. doi:10.1109/MIE.2014.2312079

Drucker, P. (1997). The Future that Has Already Happened. *Harvard Business Review*, *7*(49), 64–75.

DSI EU. (2018a). *About the DSI4EU Project. Digital Social Innovation*. European Union. Retrieved January 20, 2018, from https://digitalsocial.eu/es/about-the-project

Dumitrescu, E. I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic Modelling*, *29*(4), 1450–1460. doi:10.1016/j.econmod.2012.02.014

Durkin, M., McGowan, P., & McKeown, N. (2013). Exploring Social Media adoption in Small to Medium-Sized Enterprises in Ireland. *Journal of Small Business and Enterprise Development*, *20*(4), 716–734. doi:10.1108/JSBED-08-2012-0094

Dutot, V., & Bergeron, F. (2016). From strategic orientation to Social Media orientation: Improving SMEs' performance on Social Media. *Journal of Small Business and Enterprise Development*, *23*(4), 1165–1190. doi:10.1108/JSBED-11-2015-0160

Duvnäs, H., Stenholm, P., Brännback, M., & Carsrud, A. L. (2012). What are the Outcomes of Innovativeness within Social Entrepreneurship? The Relationship Between Innovative Orientation and Social Enterprise Economic Performance. *Journal of Strategic Innovation and Sustainability*, *8*(1), 68–80.

Dyer, J., Gregersen, H., & Christensen, C. (2011). *The Innovator's DNA: Mastering the Five Skills of Disruptive Innovators*. Boston, MA: Harvard Business Review Press.

Edquist, C. (2005). Systems of Innovation: Perspectives and Challenges. In J. Fagerberg, D. C. Mowery, & R. R. Nelson (Eds.), *The Oxford Handbook of Innovation* (pp. 181–208). New York: Oxford University Press.

Edvinsson, L., & Sullivan, P. (1996). Developing a model for managing intelectual capital. *European Management Journal*, *14*(4), 356–364. doi:10.1016/0263-2373(96)00022-9

El Marrakchi, M., Bellafkih, M., & Bensaid, H. (2015). Towards reputation measurement in online social networks. In Intelligent Systems & Computer Vision (ISCV) (pp. 1-8). IEEE. doi:10.1109/ISACV.2015.7105540

El Marrakchi, M., Bensaid, H., & Bellafkih, M. (2016). Intelligent reputation scoring in social networks: Use case of brands of smartphones. In *Intelligent Systems: Theories & Applications (SITA), 2016 11th International Conference on* (pp. 1-6). IEEE.

El Wawy, O. A., & Pereira, F. (2013). *Business Modelling in the Dynamic Digital Space An Ecosystem Approach*. Kindle Edition. doi:10.1007/978-3-642-31765-1

El-Rabbany, A. (2002). *Introduction to GPS: the global positioning system*. Artech house.

Empodera. (2018). Trazando el mapa de la Innovación Social Digital en Europa. *Empodera*. Retrieved February 25, 2018, from http://empodera.org/trazando-el-mapa-de-la-innovacion-social-digital-en-europa/

Erol, S., Schumacher, A., & Sihn, W. (2016). Strategic guidance towards Industry 4.0–a three-stage process model. *International conference on competitive manufacturing*.

Ersin, İ., & Eti, S. (2017). Measuring the Waste-Conscious and Saving Habits of the Youth in Turkey: The Sample of Istanbul Medipol University. *International Journal of Islamic Economics and Finance Studies*, *3*(3), 41–49.

Esteban, V. A., Villardón, M. P. G., & Sánchez, I. M. G. (2017). Cultural Values on CSR Patterns and Evolution: A Study from the Biplot Representation. *Ecological Indicators*, *81*, 18–29. doi:10.1016/j.ecolind.2017.05.051

European Network of Living Labs. (2006). Retrieved January 12, 2018, from http://www.openlivinglabs.eu/

European Social Innovation Research. (2013). *Measuring and Mapping Social Innovation: About the Discussion.* Retrieved November 16, 2017, from https://www.socialinnovationexchange.org/insights/measuring-and-mapping-social-innovation-about-discussion

EY. (2017). *EY FinTech adoption index 2017.* Retrieved June 30, 2018, from https://www.ey.com/Publication/vwLUAssets/ey-fintech-adoption-index-2017/$FILE/ey-fintech-adoption-index-2017.pdf

Eychenne, F. (2012). FabLabs Overview. *The Fing (Fondation Internet Nouvelle Generation*). Retrieved from http://fing.org/?Fab-Labs-overview

Eychenne, F. (2015). *Simone Amber: "FabLab Connect produces collaboration between labs."* Retrieved from http://www.makery.info/en/2015/03/09/simone-amber-fab-lab-connect-produit-de-la-collaboration-entre-labs/

FabAcademy. (2016). *Fab Academy*. Retrieved January 31, 2017, from: http://fabacademy.org/

FabFolk. (n.d.). *Fabfolk, a global network of creators.* Retrieved January 31, 2017, from: https://www.fabfolk.com

FabFoundation. (2015). *FabFoundation: FabLabs*. Retrieved January 31, 2017, from: https://fabfoundation.org

FabLabs.io. (n.d.). *FabLabs.io.* Retrieved January 31, 2017, from: https://www.fablabs.io/

Fama, E., & Jensen, M. (1983). Separation of Ownership and Control. *The Journal of Law & Economics*, *26*(2), 301–325. doi:10.1086/467037

Fernández, R. M., & Campero, S. (2012). *Gender Sorting and the Glass Ceiling in High Tech.* MIT Sloan Research Paper No. 4989-12. Retrieved July 1, 2017, from https://ssrn.com/abstract=2067102

Finberg, H. (2013). *Rethinking journalism education: A Call for Innovation*. Poynter Institute. Retrieved from http://www.newsu.org/course_files/StateOfJournalismEducation2013.pdf

Finextra. (2017). *Banking on blockchain: Charting the progress of distributed ledger technology in financial services*. Retrieved February 15, 2018, from https://www.ingwb.com/media/1609652/banking-on-blockchain.pdf

Finquelievich, S. (2007). Innovación, tecnología y prácticas sociales en las ciudades: hacia los laboratorios vivientes. *Revista. Iberoamericana de Ciencia, Tecnología y sociedad, 3*(9), 135-152.

Flipped Learning Network. (2014). *The four pillars of F-L-I-P.* Retrieved from http://flippedlearning.org/wp-content/uploads/2016/07/FLIP_handout_FNL_Web.pdf

Flores, J. M. (2012). The importance of medialabs for applied research with emerging technologies. Case Study: Creating mashups. In *Journalism in Network. Proceedings of the V International Congress of Journalism Network*. UCM.

Flores, J. M. (Ed.). (2011). Reinventing the journalism and media. Madrid: Editorial Fragua.

Flores, C. (2018). Problem-based science, a constructionist approach to science literacy in middle school. *Interantional Journal of Child-Computer Interaction*, *16*, 25–30. doi:10.1016/j.ijcci.2017.11.001

Flores, J. M. (2009). New models of communication, profiles and trends in social networks. *Comunicar*, *33*(33), 73–81. doi:10.3916/c33-2009-02-007

Flores, J. M. (2014). The Journalism as Knowledge and Discipline, the academic value for a Quality Profession. *Prisma Social*, (12): 506–543.

Flores, J. M., & Salinas, C. (2012). Challenges of the Faculties of Communication: Training new profiles for journalists based on innovation and knowledge technologies. In *Journal of Knowledge Technology and Society*. USA Common Ground Publisher.

Fombrun, C. J., & Van Riel, C. B. (2004). *Fame & fortune: How successful companies build winning reputations*. FT Press.

Ford, M. (2015). *Rise of the Robots: Technology and the Threat of a Jobless Future*. Kindle Edition.

Foust-Cummings, H., Sabattini, L., & Carter, N. (2008). *Women in technology: Maximizing talent, minimizing barriers*. Retrieved from http://www.catalyst.org/system/files/Women_in_Technology_Maximizing_Talent_Minimizing_Barriers.pdf

Fowler, A. (2000). NGDOs as a moment in history: Beyond aid to social entrepreneurship or civic innovation? *Third World Quarterly*, *21*(4), 637–654. doi:10.1080/713701063

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden-&-build theory of positive emotions. *The American Psychologist*, *56*(3), 218–226. doi:10.1037/0003-066X.56.3.218 PMID:11315248

Freimane, R., & Bāliņa, S. (2016). Research and development expenditures and economic growth in the EU: A panel data analysis. *Economics and Business*, *29*(1), 5–11. doi:10.1515/eb-2016-0016

Frey, C. B., & Osborne, M. (2013). *The Future of Employment: How Susceptible are jobs to Computerisation?* Retrieved from https://goo.gl/UvLsSg

Friborg, O., Hjemdal, O., Rosenvinge, J. H., & Martinussen, M. (2001). A new rating scale for adult resilience: What are the central protective resources behind healthy adjustment? *International Journal of Methods in Psychiatric Research*, *12*(2), 65–76. doi:10.1002/mpr.143 PMID:12830300

Fundación Schwab. (2013). *El rompimiento del pensamiento binario: guía de políticas para extender la innovación social*. Fundación Schwab para la Iniciativa Empresarial Social. Retrieved March 4, 2018, from http://www.esade.edu/esocialhub/centro-de-conocimiento/recursos/el-rompimiento-del-pensamiento-binario-gu%C3%ADa-de-pol%C3%ADticas-para

Furuoka, F. (2015). Financial development and energy consumption: Evidence from a heterogeneous panel of Asian countries. *Renewable & Sustainable Energy Reviews*, *52*, 430–444. doi:10.1016/j.rser.2015.07.120

Furuoka, F. (2017). Renewable electricity consumption and economic development: New findings from the Baltic countries. *Renewable & Sustainable Energy Reviews*, *71*, 450–463. doi:10.1016/j.rser.2016.12.074

Gabriel, M., & Pessl, E. (2016). Industry 4.0 and sustainability impacts: Critical discussion of sustainability aspects with a special focus on future of work and ecological consequences. *Annals of the Faculty of Engineering Hunedoara*, *14*(2), 131.

Gamble, E. N., & Moroz, P. W. (2014). Unpacking Not-for-profit Performance. *Journal of Social Entrepreneurship*, *5*(1), 77–106. doi:10.1080/19420676.2013.834457

Gamerzy, N., & Masten, A. S. (1986). Stress, competence and resilience: Common frontiers for therapist and psychologist. *Behavior Therapy*, *17*(5), 500–521. doi:10.1016/S0005-7894(86)80091-0

Gao, Y., Wu, J., & Hafsi, T. (2017). The Inverted U-Shaped Relationship between Corporate Philanthropy and Spending on Research and Development: A Case of Complementarity and Competition Moderated by Firm Size and Visibility. *Corporate Social Responsibility and Environmental Management*, *24*(6), 465–477. doi:10.1002/csr.1420

García, M., Carrillo-Durán, M. V., & Tato-Jiménez, J. L. (2017). Online corporate communications: Website usability & content. *Journal of Communication Management*, *21*(2), 140–154. doi:10.1108/JCOM-08-2016-0069

García-Meca, E., García-Sánchez, I., & Martínez-Ferrero, J. (2015). Board diversity and its effects on bank performance: An international analysis. *Journal of Banking & Finance*, *53*, 202–214. doi:10.1016/j.jbankfin.2014.12.002

García-Ruiz, M.E., & Lena-Acebo, F. J. (2016). Cartografía de las ecologías colaborativas. *Economía industrial, 402*, 97-106.

Gardberg, N. A. (2017). Corporate Reputation: Fashion, Fad, or Phenomenon? *Corporate Reputation Review*, *20*(3-4), 177–180. doi:10.105741299-017-0033-4

Garofalo, A., Rycx, F., & Paolo Vinci, C. (2008). Unemployment, innovation and R&D: Introduction. *International Journal of Manpower*, *29*(3), 192–197. doi:10.1108/01437720810878879

Garrido-Moreno, A., & Lockett, N. (2016). Social Media use in European hotels: Benefits and main challenges. *Tourism & Management Studies*, *12*(1), 172–179. doi:10.18089/tms.2016.12118

Geissbauer, R., Schrauf, S., Koch, V., & Kuge, S. (2014). Industry 4.0 – Opportunities and Challenges of the Industrial Internet. *Survey by PWC*, 1-52.

Gennari, R., Melonio, A., Rizvi, M., & Bonani, A. (2017). Design of IoT tangibles for primary schools: a case study. *Proceedings of the 12th Biannual Conference on Italian SIGCHI*. 10.1145/3125571.3125591

George-Williams, S. C. (2015). If You Build It Will They Come?: Building a FabLab in the University of Texas @ Arlington Libraries and Building Faculty Partnerships for Its Use. *122nd ASEE Annual Conference & Exposition*. 10.18260/p.24219

Georgiou, M. N. (2010). *R&D, Government Debt and Unemployment: An Empirical Analysis for Europe (1998-2007)*. Some Comments.

Germann, F., Lilien, G., & Rangaswamy, A. (2013). Performance implications of deploying marketing analytics. *International Journal of Research in Marketing*, *30*(2), 114–128. doi:10.1016/j.ijresmar.2012.10.001

Gerometta, J., Haussermann, H., & Longo, G. (2005). Social Innovation and Civil Society in Urban Governance: Strategies for an Inclusive City. *Urban Studies (Edinburgh, Scotland)*, *42*(11), 2007–2021. doi:10.1080/00420980500279851

Gershenfeld, N., & Prakash, M. (2004). Personal communication fabrication. *The Lyngen Alps. Telektronikk, 3*, 22–26.

Gershenfeld, N., & Vasseur, J. (2014). *As Objects Go Online: The Promise (and Pitfalls) of the Internet of Things*. Retrieved from https://www.foreignaffairs.com/articles/2014-02-12/objects-go-online

Gershenfeld, N. (2005). *Fab: The Coming Revolution on Your Desktop. From Personal Computers to Personal Fabrication*. Cambridge, UK: Basic Books.

Gershenfeld, N. (2012). How to Make Almost Anything: The Digital Fabrication Revolution. *Foreign Affairs*, *91*(6), 43–57.

Gibbs, G., & Simpson, C. (2005). Conditions Under Which Assessment Supports Students' Learning. *Learning and Teaching in Higher Education*, (1), 3-31.

Gilchrist, A. (2016). *Industry 4.0: the industrial internet of things.* A press.

Gilchrist, S., Gurbaxani, V., & Town, R. (2001). *Productivity and the PC Revolution.* Center for Research on Information Technology and Organizations Working paper, University of California.

Girma, S., Görg, H., & Hanley, A. (2008). R&D and exporting: A comparison of British and Irish firms. *Review of World Economics*, *144*(4), 750–773. doi:10.100710290-008-0168-6

Gjengedal, A. (2010). Industrial clusters and establishment of MIT FabLab at Furuflaten, Norway. In *INEER (International Network for Engineering Education and Research) 9th International Conference on Engineering Education.* INEER.

Glass, J. L., Sassler, S., Levitte, Y., & Michelmore, K. M. (2013). What's so special about STEM? A comparison of women's retention in STEM and professional occupations. *Social Forces*, *92*(2), 723–756. doi:10.1093fot092 PMID:25554713

Go, A. W., Sutanto, S., Zullaikah, S., Ismadji, S., & Ju, Y. H. (2016). A new approach in maximizing and direct utilization of whole Jatropha curcas L. kernels in biodiesel production–Technological improvement. *Renewable Energy*, *85*, 759–765. doi:10.1016/j.renene.2015.06.073

Godin, S. (1995). Emarketing: Reaping profits on the information highway. New York: Perigree Books.

González, A. López, F. N., & Valdez, M. J. (2013). Resiliencia: Diferencias por edad en hombres y mujeres mexicanos. *Acta de Investigación Psicológica - Psychological Research Records, 3*(1), 941-956.

Gonzalez, J., & Wagenaar, R. (2003). *Tuning educational structures in Europe. Final report. Phaseone*. Bilbao: Deusto University.

González, P. E. (2013). *Fenómeno de la Resiliencia en el Bienestar y el Rendimiento Laboral (Máster en Prevención de Riesgos Laborales)*. Universidad Oviedo.

Goos, M., & Manning, A. (2003). *Lousy and Lovely Jobs: the Rising Polarization of Work in Britain*. Centre for Economic Performance.

Gordon, L. (2011). Rapid prototyping for the masses. *Machine Design*, *83*(10), 20.

Gorecky, D., Schmitt, M., Loskyll, M., & Zühlke, D. (2014). Human-machine-interaction in the industry 4.0 era. In *Industrial Informatics (INDIN), 2014 12th IEEE International Conference on* (pp. 289-294). IEEE.

Götz, M., & Jankowska, B. (2017). Clusters and Industry 4.0 – Do They Fit Together? *European Planning Studies*, *25*(9), 1633–1653. doi:10.1080/09654313.2017.1327037

Gough, J. (2017). Measuring the Impact of the Internet on Retailing. *World Economy*, *18*(4), 211–236.

Grazzi, M., & Jung, J. (2015). *ICT, innovation and productivity: evidence from Latin American firms*. Google Scholar.

Grimm, J. (2010). Columbia's New Dual Degree Program Aims to Redefine Journalism As We Know it. Poynter Institute. Retrieved from http://www.poynter.org/how-tos/career-development/ask-the-recruiter/104901/columbias-new-dual-degree-program-aims-to-redefine-journalism-as-we-know-it/

Grotberg, E. (1996). *Guía de promoción de la resiliencia in los niños para fortalecer el espíritu humano. Holanda: La Haya*. Fundación Bernard van Leer.

Grotberg, E. (1998). I Am, I Have, I Can: What Families Worldwide Taught Us about Resilience. *Reaching Today's Youth*. *The Community Circle of Caring Journal*, *2*(3), 36–39.

Grotberg, E. (2001). *Nuevas tendencias en resiliencia. Resiliencia: Descubriendo las propias fortalezas*. Buenos Aires: Paidos.

Grotberg, E. (2003). Resiliencia, descubriendo las propias fortalezas. *Recuperado el*, *3*(5), 11.

Guarascio, D., Pianta, M., & Bogliacino, F. (2017). Export, R&D and New Products: A Model and a Test on European Industries. In *Foundations of Economic Change* (pp. 393–432). Cham: Springer. doi:10.1007/978-3-319-62009-1_17

Guerra, A., & Sánchez de Gómez, L. (2016). From a FabLab towards a Social Entrepreneurship and Business Lab. *Journal of Cases on Information Technology*, *18*(4), 1–21. doi:10.4018/JCIT.2016100101

Guerra, A., & Sánchez, L. (2016). Social Entreperneuship Taxonomy: Extremadura Case (Spain). In *Handbook of Research on Social Entrepreneurship and Solidarity Economics*. IGI Global. doi:10.4018/978-1-5225-0097-1.ch019

Guía, I. S. (2018). *Guía de la innovación social.* European Commission (UE). Gobierno de Asturias. Retrieved December 15, 2017, from http://movil.asturias.es/Asturias/descargas/PDF_TEMAS/Asuntos%20Sociales/guia_innovacion_social.pdf

Gulamhussen, M. A., & Santa, S. F. (2015). Female directors in bank boardrooms and their influence on performance and risk-taking. *Global Finance Journal*, *28*, 10–23. doi:10.1016/j.gfj.2015.11.002

Guloglu, B., & Tekin, R. B. (2012). A panel causality analysis of the relationship among research and development, innovation, and economic growth in high-income OECD countries. *Eurasian Economic Review*, *2*(1), 32–47.

Hagel, J. (2015). The power of platforms. In E. Kelly (Ed.), *Business Ecosystems Come of Age*. Deloitte University Press.

Hager, G., & Wellein, G. (2011). *Introduction to High Performance Computing for Scientists and Engineers*. Boca Raton, FL: CRC Press Taylor & Francis Group.

Halpern, J., & Pignataro, C. (2015). Service Function Chaining (SFC) Architecture. *Internet Engineering Task Force (IETF), Informational*, 1-32.

Hamari, J., & Koivisto, J. (2013). Social motivations to use gamification: an empirical study of gamifying exercise. *Proceedings of the 21st European Conference on Information Systems*.

Handel, M. J. (2003). *Implications of Information Technology for Employment, Skills and Wages: A Review of Recent Research.* SRI International. Retrieved from https://goo.gl/EcSRz7

Harbers, M., Van Waart, P., & Visser, E. (2015). Value Sensitive Design of Smart Cities. *5th Decennial Aarhus Conference*, Aarhus, Denmark.

Harjoto, M., Laksmana, I., & Lee, R. (2015). Board diversity and corporate social responsibility. *Journal of Business Ethics*, *132*(4), 641–660. doi:10.100710551-014-2343-0

Harvey, W. S., Morris, T., & Müller Santos, M. (2017). Reputation and identity conflict in management consulting. *Human Relations*, *70*(1), 92–118. doi:10.1177/0018726716641747

Hasanov, F., Bulut, C., & Suleymanov, E. (2017). Review of energy-growth nexus: A panel analysis for ten Eurasian oil exporting countries. *Renewable & Sustainable Energy Reviews*, *73*, 369–386. doi:10.1016/j.rser.2017.01.140

Heiskala, R. (2007). Social innovations: structural and power perspectives. In T. Hämäläinen & R. Heiskala (Eds.), *Social innovations, institutional change and economic performance. Making sense of structural adjustment processes in industrial sectors, regions and societies*. SITRA. doi:10.4337/9781847206992.00009

Hellier, J., & Chusseau, N. (2008). *Social Policies and R&D Subsidies: Impact on Inequality*. Unemployment and Growth.

Helm, S. T., & Andersson, F. O. (2010). Beyond taxonomy- An empirical validation of social entrepreneurship in the nonprofit sector. *Nonprofit Management & Leadership*, *20*(3), 259–276. doi:10.1002/nml.253

Henderson, N., & Milstein, M. M. (2003). *Resiliencia en la escuela*. Buenos Aires: Paidós.

Hernández-Nicolás, C. M., Martín-Ugedo, J. F., & Mínguez-Vera, A. (2015). The influence of gender on financial decisions: Evidence from small start-up firms in Spain. *E+M. Ekonomie a Management*, *18*(4), 93–107. doi:10.15240/tul/001/2015-4-007

Herrera, P. C. (2012). Perspectivas en los Laboratorios de Fabricación Digital en Latinoamérica. Sigradi. In *Proceedings XVI Conference of Iberoamerican Society of Digital Graphics* (pp. 285-289). Fortaleza, BR: SIGRADI 2012.

Herring, S. (2012). *Transforming the workplace: critical skills and learning methods for the successful 21st century worker. Bing Think*. Retrieved from http://bigthink.com/experts-corner/transforming-the-workplace-critical-skills-and-learning-methods-for-the-successful-21st-century-worker

Heunks, F., & Roos, H. (1992). Entrepreneurs in a changing cultural context. In Transnational Business in Europe, Economic and Social Perspectives. Tilburg, The Netherlands: Tilburg University Press.

Hidalgo, A., & Castaño, G. (2011). El Proceso de evaluación del ajuste. In G. Castaño, G. López-Montalvo, & J. M. Prieto (Eds.), *Manual de buenas prácticas en reclutamiento y selección de personas* (pp. 129–164). Madrid: Colegio Oficial de Psicólogos de Madrid. Retrieved from http://www.copmadrid.org/web/publicaciones/manual-de-buenas-practicas-en-reclutamiento-y-seleccion-de-personal-rs

Hidalgo, A., Chaparro, J., Hernández, Á., Iglesias, S., Pascual, F., Agudo, Á. F., ... Feria, V. H. (2010). *Economía Digital*. Madrid, Spain: Fundación EOI.

Hielscher, S. (2014). *Examining web-based materials A snapshot of UK FabLabs and Hacker- spaces*. Proyect Report. CIED, STEPS Centre, Grassroots Innovations.

Hielscher, S., Smith, A., & Fressoli, M. (2015). WP4 Case Study Report: FabLabs. Report for the TRANSIT FP7 Project. Brighton.

Hill, T. L., Kothari, T. H., & Shea, M. (2010). Patterns of Meaning in the Social Entrepreneurship Literature: A Research Platform. *Journal of Social Entrepreneurship*, *1*(1), 5–31. doi:10.1080/19420670903442079

Hines, F. (2005). Viable social enterprise: An evaluation of business support to social enterprises. *Social Enterprise Journal*, *1*(1), 13–28. doi:10.1108/17508610580000704

Hirsch-Kreinsen, H., Weyer, J., & Wilkesmann, J. D. M. (2016). *"Industry 4.0" as Promising Technology: Emergence, Semantics and Ambivalent Character*. Universitätsbibliothek Dortmund. Retrieved from: https://www.wiwi.tu-dortmund.de/wiwi/de/forschung/gebiete/fphirschkreinsen/forschung/soz_arbeitspapiere/AP-SOZ-48.pdf

Hirsch-Kreinsen, H. (2016). Digitization of industrial work: development paths and prospects/Digitalisierung industrieller Arbeit: Entwicklungspfade und Perspektiven. *Journal for Labour Market Research*, *49*(1), 1–14. doi:10.100712651-016-0200-6

Hofmann, E., & Rüsch, M. (2017). Industry 4.0 and the Current Status as Well as Future Prospects on Logistics. *Computers in Industry*, *89*, 23–34. doi:10.1016/j.compind.2017.04.002

Honeycutt, C., & Herring, S. C. (2009). Beyond microblogging: Conversation and collaboration via Twitter. *42nd Hawaii International Conference on System Sciences*, 1-10.

Hong, J. H., & Cho, D. H. (2012). The Effects of Market Orientation, Entrepreneurial Orientation and Social Networks on the Social Performance of Non-profit Organizations. In *Computer Applications for Web, Human Computer Interaction, Signal and Image Processing, and Pattern Recognition. Communications in Computer and Information Science* (pp. 240–248). Berlin: Springer. doi:10.1007/978-3-642-35270-6_33

Honkanen, H., & Nyman, K. (2002). Handbook of good practice in personnel assessment. Helsinki: Psychologien Kustannus Oy.

Hou, D., Li, G., & Nathanail, P. (2018). An emerging market for groundwater remediation in China: Policies, statistics, and future outlook. *Frontiers of Environmental Science & Engineering*, *12*(1), 16. doi:10.100711783-018-1027-x

Hunady, J., & Orviska, M. (2014). Determinants of Foreign Direct Investment in EU Countries–Do Corporate Taxes Really Matter? *Procedia Economics and Finance*, *12*, 243–250. doi:10.1016/S2212-5671(14)00341-4

Hu, Y., Li, J., & Holloway, L. E. (2008). *Towards modeling of resilience dynamics in manufacturing enterprises: Literature review and problem formulation*. Automation Science and Engineering.

Hu, Y., & Pang, X. (2013). Social Entrepreneurial Orientation and Performance of Nonprofit Organizations: An Empirical Study in China. *Journal of Applied Sciences (Faisalabad)*, *13*(19), 3989–3994. doi:10.3923/jas.2013.3989.3994

Huybrechts, B., & Nicholls, A. (2012). Social Entrepreneurship: Definitions, Drivers and Challenges. In *Social Entrepreneurship and Social Business: An Introduction and Discussion with Case Studies* (pp. 31–48). Wiesbaden: Springer-Gabler. doi:10.1007/978-3-8349-7093-0_2

Iansiti, M., & Lakhani, K. R. (2017, January). The truth about blockchain: It will take years to transform business, but the journey begins now. *Harvard Business Review*, 118–127.

Ikeda, G., Ferranty, M. L., & Mendes, F. (2015). CSR Strategy on Multinationals. Dilemma between Local Adaptation and Internationalization [Estratégia em RSC em Multinacionais: Dilema entre Adaptação Local e Internacionalização]. *Pensamento & Realidade*, *30*(4), 1–20.

ILO. (2016a). *The rise of the "just-in-time workforce": On-demand work, crowdwork and labour protection in the "gig economy"*. Conditions of work and employment Series No. 71. Retrieved from https://goo.gl/RQrykV

ILO. (2016b). *Income security in the on-demand economy: Findings and policy lessons from a survey of crowdworkers.* Conditions of work and employment Series No. 74. Retrieved from https://goo.gl/o1YPt4

ILO. (2017). *Employment in industry (% of total employment).* ILOSTAT database. Retrieved from: https://data.worldbank.org/indicator/SL.IND.EMPL.ZS

Infante, F. (1997). *Acciones específicas que los jóvenes y los agentes de salud toman para promover la resiliencia en los primeros. Tesis para postular al título de Psicóloga de la Universidad Diego Portales*. Santiago de Chile.

Informe, O. C. D. E. (2002). *Measuring the Information Economy*. Retrieved January 15, 2018, from https://www.oecd.org/sti/ieconomy/1835738.pdf

Inglehart, R. (2016). Inequality and Modernization: Why Equality Is Likely to Make a Comeback. *Foreign Affairs*, *95*, 2.

Innovation Union initiative. (2010). *Innovation Union*. Retrieved November 12, 2017, from http://ec.europa.eu/growth/industry/innovation/policy/social_es

Insights, C. B. (2017). *Blockchain investment trends in review*. Retrieved July 1, 2018, from https://www.cbinsights.com/research/report/blockchain-trends-opportunities/

International Chamber of Commerce (2017). *2017 rethinking trade & finance*. An ICC Private Sector Development Perspective.

International FabLab Association. (n.d.). *The International FabLab Association Website*. Retrieved from http://empty-ice-3260.herokuapp.com/refinery/

Isidro, H., & Sobral, M. (2015). The effects of women on corporate boards on firm value, financial performance, and ethical and social compliance. *Journal of Business Ethics*, *132*(1), 1–19. doi:10.100710551-014-2302-9

Ismail, S., Malone, M. S., & Van Geest, Y. (2014). *Exponential Organizations: Why new organizations are ten times better, faster, and cheaper than yours (and what to do about it)*. Kindle Edition.

ISO-10667. (2011). *Assessment service delivery: Procedures and methods to assess people in work and organizational settings.* International Organization for Standardization.

Jackson, A., Smith, S., & Hill, C. (2003). Academic persistence among Native American college students. *Journal of College Student Development*, *44*(4), 548–565. doi:10.1353/csd.2003.0039

Jaimovich, N., & Siu, H. E. (2012). *The trend is the cycle: Job polarization and jobless recoveries.* NBER Working Paper No. 18334. Retrieved from https://goo.gl/vuwCKP

Jamali, D., Karam, C., Yin, J., & Soundararajan, V. (2017). CSR Logics in Developing Countries: Translation, Adaptation and Stalled Development. *Journal of World Business*, *52*(3), 343–359. doi:10.1016/j.jwb.2017.02.001

Jamali, D., Lund-Thomsen, P., & Jeppesen, S. (2017). SMEs and CSR in Developing Countries. *Business & Society*, *56*(1), 11–22. doi:10.1177/0007650315571258

Jangraiz, K. H. A. N. (2015). The role of research and development in economic growth: A review. *Journal of Economics Bibliography*, *2*(3), 128.

Järvinen, J., & Karjaluoto, H. (2015). The use of Web analytics for digital marketing performance measurement. *Industrial Marketing Management*, *50*, 117–127. doi:10.1016/j.indmarman.2015.04.009

Jayaram, J., Manrai, K., & Manrai, S. (2015). Effective use of marketing technology in Eastern Europe: Web analytics, social media, customer analytics, digital campaigns and mobile applications. *Journal of Economics, Finance and Administrative Science*, *20*(39), 118–132. doi:10.1016/j.jefas.2015.07.001

Jazdi, N. (2014). Cyber physical systems in the context of Industry 4.0. In *Automation, Quality and Testing, Robotics, 2014 IEEE International Conference* (pp. 1-4). IEEE.

Jha, S., Qiu, J., Luckow, A., Mantha, P., & Fox, G. C. (2014). A Tale of Two Data-Intensive Paradigms: Applications, Abstractions, and Architectures. In *Big Data (BigData Congress), IEEE International Congress on.* (pp. 1-8). IEEE.

Jin, X., Wah, B. W., Cheng, X., & Wang, Y. (2015). Significance and Challenges of Big Data Research. *Big Data Research*, *2*(2), 59–64. doi:10.1016/j.bdr.2015.01.006

Ji, Y. G., Li, C., North, M., & Liu, J. (2017). Staking reputation on stakeholders: How does stakeholders' Facebook engagement help or ruin a company's reputation? *Public Relations Review*, *43*(1), 201–210. doi:10.1016/j.pubrev.2016.12.004

John, A., Qadeer, F., Shahzadi, G., & Jia, F. (2017). Corporate Social Responsibility and Employee's Desire: A Social Influence Perspective. *Service Industries Journal*, *37*(13-14), 819–832. doi:10.1080/02642069.2017.1353081

Jules, T. (2017). *Public Policy and Governance. The Global Educational Policy Environment in the Fourth Industrial Revolution: Gate, Regulated and Governed*. Emerald Group Publishing Limited.

Jung, H. J., Na, K. Y., & Yoon, C. H. (2013). The role of ICT in Korea's economic growth: Productivity changes across industries since the 1990s. *Telecommunications Policy*, *37*(4-5), 292–310. doi:10.1016/j.telpol.2012.06.006

Kagermann, H. (2015). Change through digitization—Value creation in the age of Industry 4.0. In *Management of permanent change* (pp. 23–45). Wiesbaden, Germany: Springer Gabler. doi:10.1007/978-3-658-05014-6_2

Kahia, M., Aïssa, M. S. B., & Lanouar, C. (2017). Renewable and non-renewable energy use-economic growth nexus: The case of MENA Net Oil Importing Countries. *Renewable & Sustainable Energy Reviews*, *71*, 127–140. doi:10.1016/j.rser.2017.01.010

Kano, L. (2017). (in press). Global Value Chain Governance: A Relational Perspective. *Journal of International Business Studies*.

Kaplan, H. P. (1999). Toward an understanding of resilience. A critical review of definitions and models. In M.D. Glantz & J. L. Johnson (Eds.), Resilience and development. Positive life adaptations. Kluwer Academic/Plenum Press.

Kapp, K. (2012). *The gamification of learning and instruction: game-based methods and strategies for training and education*. San Francisco, CA: John Wiley y Sons.

Karabarbounis, L., & Neiman, B. (2013). *The Global Decline of the Labor Share*. NBER Working Paper No. 19136. Doi:10.3386/w19136

Karami, S., & Naghibi, H. S. (2014). Social Media Marketing (SMM) Strategies for Small to Medium Enterprises (SMEs). *International Journal of Sales & Marketing Management Research & Development*, *4*(4), 11–20.

Kaushik, A. (2009). *Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity*. Academic Press.

Keane, T., Caffin, B., Soto, M., Chauhan, A., Krishnaswamy, R., van Dijk, G., & Wadhawan, M. (2014). *DIY - Development Impact and You: Practical Tools to Trigger and Support Social Innovation*. Nesta – Rockefeller Foundation. Retrieved March 15, 2018, from http://www.esade.edu/esocialhub/centro-de-conocimiento/recursos/the-open-book-social-innovation

Kent, M. L., Carr, B. J., Husted, R. A., & Pop, R. A. (2011). Learning web analytics: A tool for strategic communication. *Public Relations Review*, *37*(5), 536–543. doi:10.1016/j.pubrev.2011.09.011

Kerlin, J. A. (2006). Social Enterprise in the United States and Europe: Understanding and Learning from the Differences. *Voluntas*, *17*(3), 247–263. doi:10.100711266-006-9016-2

Keynes, J. M. (1963). *Essays in Persuasion*. New York: W.W. Norton & Co.

Khan, H. U. R., Zaman, K., Khan, A., & Islam, T. (2017). Quadrilateral Relationship Between Information and Communications Technology, Patent Applications, Research and Development Expenditures, and Growth Factors: Evidence from the Group of Seven (G-7) Countries. *Social Indicators Research*, *133*(3), 1165–1191. doi:10.100711205-016-1402-6

Khan, S., & Digout, J. (2018). The Corporate Reputation Reporting Framework (CRRF). *Corporate Reputation Review*, *21*(1), 22–36. doi:10.105741299-017-0041-4

Kilic, C. (2015). Effects of Globalization on Economic Growth: Panel Data Analysis for Developing Countries. *Petroleum-Gas University of Ploiesti Bulletin, Technical Series, 67*(1).

Kim, S., Song, K., Lockee, B., & Burton, J. (2018). *Gamification in learning and education. Enjoy learning like gaming*. Cham, Switzerland: Springer. doi:10.1007/978-3-319-47283-6

Kiviat, T. I. (2015). Beyond bitcoin: Issues in regulating blockchain transactions. *Duke Law Journal*, *65*, 569.

Koeppl, T. V., & Kronick, J. (2017). *Blockchain technology–What's in store for Canada's economy and financial markets?* Retrieved February 15, 2018, from https://www.cdhowe.org/sites/default/files/attachments/research_papers/mixed/Commentary_468_0.pdf

Kohtala, C. (2013). Shaping Sustainability in FabLabs. In Participatory Innovation Conference PIN-C 2013 (pp. 287–290). Lappeenranta University of Technology.

Kohtala, C., & Bosqué, C. (2013). The Story of MIT-Fablab Norway: Community Embedding of Peer Production. *Journal of Peer Production, 5*. Retrieved from http://peerproduction.net/issues/issue-5-shared-machine-shops/peer-reviewed-articles/the-story-of-mit-fablab-norway-community-embedding-of-peer-production/

Komal, R., & Abbas, F. (2015). Linking financial development, economic growth and energy consumption in Pakistan. *Renewable & Sustainable Energy Reviews*, *44*, 211–220. doi:10.1016/j.rser.2014.12.015

Kotler, A. E. (2006). *Principles Of Marketing.* Academic Internet Publisher.

Kotler, P. (1986). The Prosumer Movement: A New Challenge for Marketers. *Advances in Consumer Research. Association for Consumer Research (U. S.)*, *13*(1), 510–513.

Kotler, P., & Gertner, D. (2002). Country as brand, product, and beyond: A place marketing and brand management perspective. *Journal of Brand Management*, *9*(4), 249–261. doi:10.1057/palgrave.bm.2540076

Kotliarenco, M. A., Cáceres, I., & Fontecilla, M. (1997). *Estado del arte en resiliencia*. Washington, DC: Organización Panamericana de la salud.

KPMG. (2017a). *Forging the future: How financial institutions are embracing FinTech to evolve and grow.* Retrieved December 1, 2017, from https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2017/10/forging-the-future-global-fintech-study.pdf

KPMG. (2017b). *Think like a start-up: How to grow in a disruptive market.* Retrieved January 10, 2018, from https://home.kpmg.com/xx/en/home/insights/2017/06/top-of-mind-survey-2017.html

Krannich, D., Robben, B., & Wilske, S. (2012). Digital fabrication for educational contexts. In *Proceedings of the 11th International Conference on Interaction Design and Children*. New York, NY: ACM.

Kreps, T. J. (1940). Measurement of the Social Performance of Business. *The Annals of the American Academy of Political and Social Science*, *343*(1), 20–31. doi:10.1177/000271626234300104

Kucuk, S., & Sandeep, K. (2007). An Analysis of Consumer Power on the Internet. *Technovation*, *27*(1-2), 47–56. doi:10.1016/j.technovation.2006.05.002

Kuljic, T. (2016). Altruism, Philanthropy, and Humanism–The Conceptual-Historical Aspects of Solidarity. *Sociologija*, *58*(4), 525–551. doi:10.2298/SOC1604525K

Kumpfer, K. L. (1999). Factors and processes contributing to resilience: The resilience framework. In M. D. Glantz & J. L. Johnson (Eds.), *Resilience and development. Positive life adaptations. Nueva* (pp. 179–224). Kluwer Academic/Plenum Press.

Lamoneda, D. I. (2016). The Economy of the Common Good and New Economies. A New Scale of CSR? [Economía del Bien Común y Nuevas Economías. ¿Una Nueva Escala de la RSC?]. *Tiempo de Paz*, *122*, 61–67.

Larraz, V., Espuny, C., & Gisbert, M. (2012). *La presencia de la competencia digital en la universidad.* Retrieved from www.virtualeduca.info/ponencias2011/138/

Larraz, V. (2012). *La competencia digital a la Universitat (PhD thesis)*. Andorra: Universitat d'Andorra.

Lasi, H., Fettke, P., Kemper, H. G., Feld, T., & Hoffmann, M. (2014). Industry 4.0. *Business & Information Systems Engineering*, *6*(4), 239–242. doi:10.100712599-014-0334-4

Latif, Z., Latif, S., Ximei, L., Pathan, Z. H., Salam, S., & Jianqiu, Z. (2017). The dynamics of ICT, foreign direct investment, globalization and economic growth: Panel estimation robust to heterogeneity and cross-sectional dependence. *Telematics and Informatics*.

Laverde, V. G., & Rivera, R. H. (2017). La disrupción: El punto de partida de la resiliencia o del fracaso empresarial (Reflexiones desde ingeniería). *Espacios*, *38*(7), 5.

Leadbeater, C. (2008). *What's Next? 21 Ideas for 21 st Century Learning*. London: The Innovation Unit.

Learnovation. (2009). *Inspiring Young People to Become Lifelong Learners in 2025*. Brussels, Belgium: MENON.

Leeflang, P., Verhoef, P., Dahsltröm, P., & Freundt, T. (2014). Challengues and solutions for marketing in a digital era. *European Management Journal*, *32*(1), 1–12. doi:10.1016/j.emj.2013.12.001

Lee, G. (2010). Death of 'last click wins': Media attribution and the expanding use of media data. *Journal of Direct. Data and Digital Marketing Practice*, *12*(1), 16–26. doi:10.1057/dddmp.2010.14

Lee, J., Bagheri, B., & Kao, H. A. (2015). A cyber-physical systems architecture for industry 4.0-based manufacturing systems. *Manufacturing Letters*, *3*, 18–23. doi:10.1016/j.mfglet.2014.12.001

Lee, J., Kao, H. A., & Yang, S. (2014). Service innovation and smart analytics for industry 4.0 and big data environment. *Procedia Cirp*, *16*, 3–8. doi:10.1016/j.procir.2014.02.001

Lehner, O. M. (2013). Crowdfunding social ventures: A model and research agenda. *Venture Capital*, *15*(4), 289–311. doi:10.1080/13691066.2013.782624

Leil, T. A., & Bertz, R. (2014). Quantitative systems pharmacology can reduce attrition and improve productivity in pharmaceutical research and development. *Frontiers in Pharmacology*, *5*, 247. doi:10.3389/fphar.2014.00247 PMID:25426074

Lekhanya, L. M. (2013). The Use of Social Media & Social Networks as the Promotional Tool for Rural Small, Medium & Micro Enterprises in KwaZulu-Natal. *International Journal of Scientific & Research Publications, 3*(7).

Lenskold, J. (2002). Marketing ROI: Playing to win. *Journal of Marketing Management*.

Levin, D. Z., & Cross, R. (2004). The strength of weak ties you can trust: The mediating role of trust in effective knowledge transfer. *Management Science*, *50*(11), 1477–1490. doi:10.1287/mnsc.1030.0136

Levinson, P. (2012). *New New Media* (2nd ed.). Penguin Academics.

Levy, D. (2017). Risk and the Cosmopolitanization of Solidarities. *Journal of Risk Research*.

Leymonié, J. (2015). Nativos e inmigrantes digitales: ¿cómo aprendemos y enseñamos? *Dixit*, *12*, 10–19.

Liao, Y., Deschamps, F., Loures, E. D. F. R., & Ramos, L. F. P. (2017). Past, present and future of Industry 4.0-a systematic literature review and research agenda proposal. *International Journal of Production Research*, *55*(12), 3609–3629. doi:10.1080/00207543.2017.1308576

Liietz, C., & Strength, M. (2011). Stories of successful reunification: A narrative study of family resilience in child welfare. *Families in Society*, *92*(2), 203–210. doi:10.1606/1044-3894.4102

Lim, J. S., & Greenwood, C. A. (2017). Communicating Corporate Social Responsibility (CSR): Stakeholder Responsiveness and Engagement Strategy to Achieve CSR Goals. *Public Relations Review*, *43*(4), 768–776. doi:10.1016/j.pubrev.2017.06.007

Lin, Y., Fang, C., & Hsu, C. (2014). Determining Uses and Gratifications for Mobile Phone Apps. *Lecture Notes in Electrical Engineering Future Information Technology*, 661-668. doi:10.1007/978-3-642-55038-6_103

Lindberg, M., Lindgren, M., & Packendorff, J. (2014). Quadruple Helix as a Way to Bridge the Gender Gap in Entrepreneurship: The Case of an Innovation System Project in the Baltic Sea Region. *Journal of Knowledge Economy*, *5*(1), 94–113. doi:10.100713132-012-0098-3

Ling-Yee, L. (2011). Marketing metrics' usage: Its predictors and implications for customer relationship management. *Industrial Marketing Management*, *40*(1), 139–148. doi:10.1016/j.indmarman.2010.09.002

Liu, C. (2018). Finance strategies for medium-sized enterprises: FinTech as the game changer. In M. Vemic (Ed.), *Strategic Optimization of Medium-Sized Enterprises in the Global Market* (pp. 162–184). Hershey, PA: IGI Global.

Liu, Y., & Shrum, L. J. (2002). What is interactivity & is it always such a good thing? Implications of definition, person, & situation for the influence of interactivity on advertising effectiveness. *Journal of Advertising*, *31*(4), 53–64. doi:10.1080/00913367.2002.10673685

Liu, Y., Wei, Z., & Xie, F. (2014). Do women directors improve firm performance in China? *Journal of Corporate Finance*, *28*, 169–184. doi:10.1016/j.jcorpfin.2013.11.016

Llorente, J. I., & Amador, S. (2010). *Análisis de estados económicos-financieros*. Madrid: Centro de Estudios Financieros.

López, M. (2014). *Aprendizaje, competencias y TIC*. Pearson.

Lorenz, M., Rüßmann, M., Strack, R., Lueth, K. L., & Bolle, M. (2015). *Man and machine in Industry 4.0: How will technology transform the industrial workforce through 2025.* The Boston Consulting Group. Retrieved from: https:// www. bcgperspectives. com/content/articles/technology-business-transformationengineered-products-infrastructure-man-machine-industry-4

Losada, A. V., & Latour, M. I. (2013). Resilience. Conceptualization and research in Argentina. *Revista Latinoamericana De Ciencia Psicológica*, *4*(2), 84–97.

Lösel, F., Bliesener, T., & Koferl, P. (1989). *On the concept of invulnerability: Evaluation and first results of the Bielefeld project. In Children and risk: Assessment, longitudinal research, and intervention* (pp. 186–219). New York: Walther de Gruyter.

Lozano, J., & Peris, J. (2012). Businesses and Human Development. The Potential of the Multinational Companies for Human Development [Empresas y desarrollo humano: El potencial de las compañías trasnacionales para el desarrollo humano]. In *Responsabilidad Social Empresarial*. Pearson.

Lu, C., Gao, L., Li, X., & Xiao, S. (2017). A hybrid multi-objective grey wolf optimizer for dynamic scheduling in a real-world welding industry. *Engineering Applications of Artificial Intelligence*, *57*(1), 61–79. doi:10.1016/j.engappai.2016.10.013

Lucas, R. E. Jr. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, *22*(1), 3–42. doi:10.1016/0304-3932(88)90168-7

Lucas, R. E. Jr. (1993). Making a miracle. *Econometrica*, *61*(2), 251–272. doi:10.2307/2951551

Lumpkin, G. T., & Dess, G. G. (1996). Clarifying the Entrepreneurial Orientation Construct and Linking It to Performance. *Academy of Management Review*, *21*(1), 135–172. doi:10.5465/amr.1996.9602161568

Lumpkin, G. T., Moss, T. W., Gras, D. M., Kato, S., & Amezcua, A. S. (2013). Entrepreneurial processes in social contexts: How are they different, if at all? *Small Business Economics*, *40*(3), 761–783. doi:10.100711187-011-9399-3

Lurtz, K., & Kreutzer, K. (2017). Entrepreneurial Orientation and Social Venture Creation in Nonprofit Organizations: The Pivotal Role of Social Risk Taking and Collaboration. *Nonprofit and Voluntary Sector Quarterly*, *46*(1), 92–115. doi:10.1177/0899764016654221

Luthar, S. S. (2006). *Resilience in development: A synthesis of research across five decades*. Academic Press.

Luthar, S. S., Cicchetti, D., & Becker, B. (2000). The construct of resilience: A critical evaluation and guidelines for future work. *Child Development*, *71*(3), 543–562. doi:10.1111/1467-8624.00164 PMID:10953923

Luthar, S., & Cushing, G. (1999). The construct of resilience: Implications for interventions and social policy. *Development and Psychopathology*, *26*(2), 353–372.

Lu, Y. (2017). Industry 4.0: A Survey on Technologies, Applications, and Open Research Issues. *Journal of Industrial Information Integration*, *6*, 1–10. doi:10.1016/j.jii.2017.04.005

Maarof & Mahmud. (2016). A Review of Contributing Factors and Challenges in Implementing Kaizen in Small and Medium Enterprises. *Procedia Economics and Finance*, *35*(2), 522–531.

Määttä, A., & Troxler, P. (2011). Developing open & distributed tools for Fablab project documentation. *CEUR Workshop Proceedings*, 739.

Magalhães, M., & Afonso, Ó. (2017). A multi-sector growth model with technology diffusion and networks. *Research Policy*, *46*(7), 1340–1359. doi:10.1016/j.respol.2017.05.004

Maier, E. (2016). Supply and demand on crowdlending platforms: Connecting small and medium-sized enterprise borrowers and consumer investors. *Journal of Retailing and Consumer Services*, *33*, 143–153. doi:10.1016/j.jretconser.2016.08.004

Mair, J., & Marti, I. (2006). Social entrepreneurship research: A source of explanation, prediction, and delight. *Journal of World Business*, *41*(1), 36–44. doi:10.1016/j.jwb.2005.09.002

Manciaux, M. (2004). *La resiliencia: resistir y rehacerse*. Barcelona: Gedisa.

Manciaux, M., Vanistendael, S., Lecomte, J., & Cyrulnik, B. (2003). La resiliencia: estado de la cuestión. In *La resiliencia: Resistir y rehacerse* (pp. 17–27). Barcelona: Gedisa.

Mansilla, V., & Jackson, A. (2011). *Global Competence: Preparing Our Youth to Engage the World*. New York: Asia Society.

Manual de Oslo. (2005). *Manual de Oslo. Directrices para la recogida e interpretación de información relativa a innovación* (3rd ed.). OEDC/European Communities. Retrieved November 16, 2017, from www.madrid.org/bvirtual/BVCM001708.pdf

Manyika, J., Chui, M., Bughin, J., Dobbs, R., Bisson, P., & Marrs, A. (2013). *Disruptive technologies: Advances that will transform life, business and the global economy.* McKinsey Global Institute. Retrieved from https://goo.gl/qPTLV7

Marica, M. E. (2018). Hoeworking/teleworking. Atypical forms of employment: between usefulness and precariousness. *Juridical Tribune/Tribuna Juridica, 8*(1).

Marinova, J., Plantenga, J., & Remery, C. (2016). Gender diversity and firm performance: Evidence from Dutch and Danish boardrooms. *International Journal of Human Resource Management*, *27*(15), 1777–1790. doi:10.1080/09585192.2015.1079229

Marrano, M. G., Haskel, J., & Wallis, G. (2009). What happened to the knowledge economy? ICT, intangible investment, and Britain's productivity record revisited. *Review of Income and Wealth*, *55*(3), 686–716. doi:10.1111/j.1475-4991.2009.00344.x

Marrs, K. A., & Novak, G. (2004). Just-in-time teaching in biology: Creating an active learner classroom using the internet. *Cell Biology Education*, *3*(1), 49–61. doi:10.1187/cbe.03-11-0022 PMID:22039345

Marsteller, B. (2010). *Global Social Media Check Up White Paper*. Retrieved from https://www.slideshare.net/webconomia/burson-marsteller-2010-global-social-media-check-up-white-paper-3368506

Martin, R. L. & Osberg, S. (2007). Social entrepreneurship: the case for definition. *Stanford Social Innovation Review, 5*(2).

Martinez-Clares, P & Gozález-Morga, N. (n.d.). Las competencias transversales en la universidad: propiedades psicométricas de un cuestionario. *Educación XXI, 21*(1), 231-262. doi:10.5944/educXX1.15662

Masiero, G., Ogasavara, M. H., Jussani, A. C., & Risso, M. L. (2017). The global value chain of electric vehicles: A review of the Japanese, South Korean and Brazilian cases. *Renewable & Sustainable Energy Reviews*, *80*, 290–296. doi:10.1016/j.rser.2017.05.148

Masten, A. S., & Garmezy, N. (1985). Risk, vulnerability, and protective factors in developmental psychopathology. Advances in Clinical Child Psychology, (8), 1-52. doi:10.1007/978-1-4613-9820-2_1

Masten, A. S. (2001). Resilience come of age: Reflections on the past and outlooks for the next generation of researchers. In M. Glantz & J. Johnson (Eds.), *Resilience and Development: positive life adaptations, Nueva York* (pp. 281–296). Plenum Publishers.

Masten, A. S. (2007). Resilience in developing systems: Progress and promise as the fourth wave rises. *Development and Psychopathology*, *19*(3), 921–930. doi:10.1017/S0954579407000442 PMID:17705908

Mavridis, T., & Symeonidis, A. L. (2015). Identifying valid search engine ranking factors in a Web 2.0 and Web 3.0 context for building efficient SEO mechanisms. *Engineering Applications of Artificial Intelligence*, *41*, 75–91. doi:10.1016/j.engappai.2015.02.002

Mayberry, C. L. (2011) *Social entrepreneurs: the role of entrepreneurial orientation and leadership style in non-profit organizations* (Unpublished doctoral dissertation). The University of British Columbia, Vancouver, Canada.

Maynard, A. D. (2015). Navigating the fourth industrial revolution. *Nature Nanotechnology*, *10*(12), 1005–1006. doi:10.1038/nnano.2015.286 PMID:26632281

Mazur, E. (2009). *Confessions of a converted lecturer* [video file]. Retrieved from https://www.youtube.com/watch?v=WwslBPj8GgI

Mazur, E. (1997). *Peer instruction: a user's manual*. Englewood Cliffs, NJ: Prentice Hall.

Mazzella, F., & Sundararajan, A. (2016). *Entering the Trust Age.* Francia: BlaBlaCar.

Mc Loughlin, C., & Lee, M. (2008). The three p's of pedagogy for the networked society: Personalization, participation and productivity. *International Journal on Teaching and Learning in Higher Education*, *20*(1), 10–27.

McElwain, M. A., Zhang, R. Y., Drmanac, R., & Peters, B. A. (2017). Long Fragment Read (LFR) Technology: Cost-Effective, High-Quality Genome-Wide Molecular Haplotyping. *Haplotyping: Methods and Protocols*, 191-205.

McKinsey. (2015). *Supply-chain finance: The emergence of a new competitive landscape*. Retrieved September 1, 2017, from https://www.mckinsey.com/industries/financial-services/our-insights/supply-chain-finance-the-emergence-of-a-new-competitive-landscape

McMichael, P. (2011). *Development and social change: A global perspective: A global perspective*. Sage Publications.

Meadows, M., & Pike, M. (2010). Performance Management for Social Enterprises. *Systemic Practice and Action Research*, *23*(2), 127–141. doi:10.100711213-009-9149-5

Mejía, A., & Jaramillo, M. (2006). Formación del talento humano: factor estratégico para el desarrollo de la productividad y la competitividad sostenibles en las organizaciones. *Guillermo de Ockham Scientific Review*, *4*(1), 43 – 81. Retrieved from http://www.redalyc.org/pdf/1053/105316847004.pdf

Melewar, T. C., Nguyen, B., Alwi, S. S., & Navare, J. (2017). Guest Editors' Introduction: The State of the Art on Corporate Reputation: A Special Section. *International Studies of Management & Organization*, *47*(3), 217–219. doi:10.1080/00208825.2017.1318016

Melillo, A., Suárez, O., & Rodríguez, D. (2004). *Resiliencia y subjetividad. Los ciclos de la vida*. Buenos Aires: Paidós.

Mell, P., & Grance, T. (2011). *The NIST Definition of Cloud Computing*. Retrieved from https://csrc.nist.gov/publications/detail/sp/800-145/final

Mendizábal, G., & Tufiño, B. (2015). Challenges of the CSR in Face of Workers' Human Rights. The Case of Mexico [Desafíos de la responsabilidad social corporativa (RSC) frente a los derechos humanos de los trabajos: El ejemplo mexicano]. *Alegatos. Revista Jurídica de la Universidad Autónoma Metropolitana*, *91*, 591–610.

Men, L. R., & Tsai, W. H. S. (2015). Infusing Social Media with humanity: Corporate character, public engagement, & relational outcomes. *Public Relations Review*, *41*(3), 395–403.

Michaelidou, N., Siamagka, N. T., & Christodoulides, G. (2011). Usage, barriers & measurement of Social Media marketing: An exploratory investigation of small & medium B2B brands. *Industrial Marketing Management*, *40*(7), 1153–1159. doi:10.1016/j.indmarman.2011.09.009

Michaelsen, L. K., Sweet, M., & Parmelee, D. X. (Eds.). (2011). *Team-based learning: Small group learning's next big step*. New York: Jossey-Bass.

Mikulic, I. M., Crespi, M., Cassullo, G. L., Fernández, G. L., Caruso, A., García, L. L., … Sosa, P. (2008). Estudio de las Fuentes de Resiliencia: Percepción de Factores de Riesgo y Protección Ante Distintos Sucesos Estresantes. *XV Jornadas de Investigación y Cuarto Encuentro de Investigadores en Psicología del Mercosur.* Facultad de Psicología - Universidad de Buenos Aires, Buenos Aires, UBACyT.

Miles, M. P., Verreynne, M.-L., Luke, B. G., Eversole, R., & Barraket, J. (2013). The Relationship of Entrepreneurial Orientation, Vineentian Values and Economie and Social Performance in Social Enterprise. *St John's University- Review of Business*, *33*(2), 91–102.

Milian, L. (2015). *CSR. Origin and Evolution in the Spanish and European Business Environment* [Responsabilidad Social Corporativa. Origen y Evolución en el Entorno Empresarial Europeo y Español]. Madrid, Spain: Pontifical University of Comillas.

Miller, D. (1983). The correlates of entrepreneurship in three types of firms. *Management Science*, *29*(7), 770–791. doi:10.1287/mnsc.29.7.770

Miller, D., & Friesen, P. H. (1983). Strategy-Making and Environment: The Third Link. *Strategic Management Journal*, *4*(3), 221–235. doi:10.1002mj.4250040304

Miller, R. (2015). *The Complete Guide To Online Reputation For Small & Local Business: Everything You Must Know About Managing Your Online Reputation*. MDM-Publishing.

Miravalls, J. (2014). The journalism, School of office. In Ciberperiodismo. Lima, Perú: Ed. USMP.

MIT Technology Review. (2018). Retrieved from https://www.technologyreview.com/lists/technologies/2018/

Miyamoto, H. (2010). R&D, unemployment, and labor market policies. *Japan and the World Economy*, *22*(3), 198–205. doi:10.1016/j.japwor.2010.03.006

Mollick, E. (2014). The dynamics of crowdfunding: An exploratory study. *Journal of Business Venturing*, *29*(1), 1–16. doi:10.1016/j.jbusvent.2013.06.005

Money, K., Saraeva, A., Garnelo-Gomez, I., Pain, S., & Hillenbrand, C. (2017). Corporate Reputation Past & Future: A Review & Integration of Existing Literature & a Framework for Future Research. *Corporate Reputation Review*, *20*(3-4), 193–211. doi:10.105741299-017-0034-3

Monroy, C. B., & Palacios, C. L. (2011). Resiliencia: ¿Es posible medirla e influir en ella? *Salud Mental, 34*(3), 237-246. Recuperado en 02 de agosto de 2017, de http://www.scielo.org.mx/scielo.php?script=sci_arttextandpid=S0185-33252011000300007andlng=esandtlng=es

Monzón, J. L., & Chaves, R. (2012). *La Economía Social en la Unión Europea. Comité Económico y Social Europeo (CESE)*. Unión Europea. Bruxelles, Belgique: Unidad de visitas y publicaciones.

Monzón, J. L., Antuñano, I., & Marco, F. (2010). *Sectores de la Nueva Economía 20+20. Economía Social*. Madrid, Spain: Fundación EOI.

Moreno, J. B., González, J. L., & Garrosa, E. (2001). Desgaste profesional (burnout), personalidad y salud percibida. In J. Buendía & F. Ramos (Eds.), *Empleo, estrés y salud* (pp. 59–83). Madrid: Pirámide.

Moreno, J., Tejeda, A., Porcel, C., Fujita, H., & Viedma, E. (2015). A system to enrich marketing customers acquisition and retention campaigns using social media information. *Journal of Service Research*, *80*, 163–179. doi:10.1016/j.knosys.2014.12.033

Morón, J. A., Pérez, M. P., & Pedrero, P. G. (2016). *Educación para la salud y prevención de riesgos psicosociales: En adolescentes y jóvenes*. Madrid: Narcea S. A. Ediciones.

Morris, M. H., Coombes, S., Schindehutte, M., & Allen, J. (2007). Antecedents and Outcomes of Entrepreneurial and Market Orientations in a Non-profit Context: Theoretical and Empirical Insights. *Journal of Leadership & Organizational Studies*, *13*(4), 12–39. doi:10.1177/10717919070130040401

Morris, M. H., & Joyce, M. L. (1998). On the measurement of entrepreneurial behavior in Not--for--profit organizations: Implications for social marketing. *Social Marketing Quarterly*, *4*(4), 93–104. doi:10.1080/15245004.1998.9961027

Morris, M. H., & Sexton, D. L. (1996). The concept of entrepreneurial intensity: Implications for company performance. *Journal of Business Research*, *36*(1), 5–13. doi:10.1016/0148-2963(95)00158-1

Morris, M. H., Webb, J. W., & Franklin, R. J. (2011). Understanding the Manifestation of Entrepreneurial Orientation in the Nonprofit Context. *Entrepreneurship Theory and Practice*, *35*(5), 947–971. doi:10.1111/j.1540-6520.2011.00453.x

Mort, G. S., Weerawardena, J., & Carnegie, K. (2003). Social entrepreneurship: Towards conceptualization. *International Journal of Nonprofit and Voluntary Sector Marketing*, *8*(1), 76–88. doi:10.1002/nvsm.202

Morton, N. A., & Hu, Q. (2008). Implications of the fit between organizational structure and ERP: A structural contingency theory perspective. *International Journal of Information Management*, *28*(5), 391–402. doi:10.1016/j.ijinfomgt.2008.01.008

Mostert-Van Der Sar, M., Mulder, I., & Remijn, L. (2013). *Fablabs in Design Education*. Paper presented at International conference on engineering and product design education, Dublin Institute of Technology, Dublin, Ireland.

Mrazek, P. J., & Mrazek, D. (1987). Resilience in children at high risk for psychological disorder. *Journal of Pediatric Psychology*, *12*(3), 3–23. PMID:3572675

Mulgan, G. (2017). *Big Mind: How Collective Intelligence Can Change Our World*. Princeton University Press.

Mulgan, G., Ali, R., Halkett, R., & Sanders, B. (2007a). *In and out of sync: The challenge of growing social innovations*. London: Nesta.

Mulgan, G., Tucker, S., Ali, R., & Sanders, B. (2007b). *Social Innovation: What it is, why it matters and how it can be accelerated. Oxford Said Business School*. London: Skoll Centre for Entrepreneurship.

Muntinga, D. G., Moorman, M., & Smit, E. G. (2011). Introducing COBRAs: Exploring motivations for brand-related social media use. *International Journal of Advertising*, *30*(1), 13–46. doi:10.2501/IJA-30-1-013-046

Murray, R., Caulier, J., & Mulgan, G. (2010). *The open book of social innovation*. The Young Foundation – Nesta. Retrieved March 3, 2018, from http://www.esade.edu/esocialhub/centro-de-conocimiento/recursos/the-open-book-social-innovation

Murrin, J. M., Johnson, P. E., McPherson, J. M., Fahs, A., & Gerstle, G. (2011). *Liberty, equality, power: a history of the American people*. Cengage Learning.

Musa, H., Rahim, N.A., Azmi, F. R., Shibghatullah, A S., & Othman, N.A. (2016). Social Media marketing & online small and medium enterprises performance: Perspective of Malaysian small & medium enterprises. *International Review of Management & Marketing*, *6*(7S).

Nabout, A., Skiera, B., & Stepanchuk, T. (2012). Return on Quality Improvements in Search Engine Marketing. *Journal of Interactive Marketing*, *26*(3), 141–154. doi:10.1016/j.intmar.2011.11.001

Narváez, G. A., & Montalvo, E. (2014). Best Practice in the Use of Social Networks Marketing Strategy as in SMEs. *Procedia: Social and Behavioral Sciences*, *148*, 533–542. doi:10.1016/j.sbspro.2014.07.076

Nathan Saraiva de Sousa, F., Danny Lachos Perez, A., Raphael Rosa, V., & Mateus Santos, A. S., & Rothenberg. (2018). Network Service Orchestration: A Survey. *IEEE Communications Surveys and Tutorials*, 1–30.

Navaretti, G. B., Calzolari, G., Mansilla-Fernandez, J., & Pozzolo, A. F. (2018). Fintech and Banking. Friends or Foes? *European Economy*, (2), 9-39.

Nesta. (2017a). *Stories of digital social innovation: Migration*. Retrieved March 15, 2018, from https://www.nesta.org.uk/blog/stories-digital-social-innovation-migration

Nesta. (2017b). *Stories of digital social innovation: Environment*. Retrieved March 15, 2018, from https://www.nesta.org.uk/blog/stories-digital-social-innovation-environment

Nesta. (2017c). *Stories of digital social innovation: Healthcare*. Retrieved March 15, 2018, from https://www.nesta.org.uk/blog/stories-digital-social-innovation-healthcare

Nesta. (2017d). *Stories of digital social innovation: Democracy*. Retrieved March 15, 2018, from https://www.nesta.org.uk/blog/stories-digital-social-innovation-democracy

Nesta. (2017e). *Stories of digital social innovation: Accountability and transparency*. Retrieved March 15, 2018, from https://www.nesta.org.uk/blog/stories-digital-social-innovation-accountability-and-transparency

Nesta. (2017f). *Stories of digital social innovation: Education, work and skills*. Retrieved March 15, 2018, from https://www.nesta.org.uk/blog/stories-digital-social-innovation-education-work-and-skills

Nesta. (2018). *Why are we doing this?* Retrieved March 1, 2018, from https://www.nesta.org.uk/project/digital-social-innovation

Newbold, P., Carlson, W. L., & Thorne, B. (2007). *Statistics for business and economics*. London: Pearson Education, Inc.

Nicholls, A. (2006). Introduction. In A. Nicholls (Ed.), *Social Entrepreneurship. New Models of Sustainable Social Change* (pp. 1–35). Oxford, UK: Oxford University Press.

Nicholls, A., & Cho, A. N. (2006). Social entrepreneurship. The structuration of a field. In A. Nicholls (Ed.), *Social Entrepreneurship. New Models of Sustainable Social Change* (pp. 99–118). Oxford, UK: Oxford University Press.

Nicholls, A., Simon, J., & Gabriel, M. (2015). *New Frontiers in Social Innovation Research*. London, UK: Palgrave Macmillan. doi:10.1057/9781137506801

Nielsen, S., & Huse, M. (2010). The contribution of women on boards of directors: Going beyond the surface. *Corporate Governance*, *18*(2), 136–148. doi:10.1111/j.1467-8683.2010.00784.x

Nikolaou, I., & Oostrom, J. (Eds.). (2015). *Employee recruitment, selection and assessment*. New York: Psychology Press.

Noble, D. (2017). *Forces of production: A social history of industrial automation*. Routledge.

Nobre, H., & Silva, D. (2014). Social Network Marketing Strategy & SME Strategy Benefits. *Journal of Transnational Management*, *19*(2), 138–151. doi:10.1080/15475778.2014.904658

Novak, G. M., Gavrin, A. D., Christian, W., & Patterson, E. T. (1999). *Just-in-time teaching blending active learning with web technology*. Upper Saddle River, NJ: Prentice Hall.

O' Dougherty Wright, M., Masten, A. S., & Narayan, A. J. (2013). Resilience processes in development: Four waves of research on positive adaptation in the context of adversity. In M. Gauvain & M. Cole (Eds.), *Handbook of resilience in children* (pp. 15–37). New York: Springer.

O'Reilly, T. (2005). *What is Web 2.0*. Madrid: Design Patterns and Bussiness Models for the Next Generation of Software.

Obinata, T. (2016). The Contribution of Research and Development Investments by Sectors to GDP Growth (No. CIRJE-J-279). CIRJE, Faculty of Economics, University of Tokyo. (in Japanese)

Obingler, D., & Obingler, J. (2005). *Educating the Net Generation.* Retrieved from http://www.educause.edu/books/educatingthenetgen/5989

OCDE. (2014). The digital economy, new business models and key features. In *Addressing the Tax Challenges of the Digital Economy*. Paris, France: OECD Publishing.

OECD. (1998). *Human Capital Investment. An International Comparison*. Paris, France: OECD.

OECD. (2003). *La comprensión del cerebro. Hacia una nueva ciencia del aprendizaje*. Santillana.

OECD. (2003). *Los desafíos de las tecnologías de la información y las comunicaciones en la educación*. Madrid, Spain: Ministerio de Educación, Cultura y Deporte. doi:10.1787/9789264103429-es

OECD. (2012). *Better Skills, Better Jobs, Better Lives: A Strategic Approach to Skills Policies*. Paris, France: OECD; doi:10.1787/9789264177338-

OECD. (2016). *New forms of work in the digital economy.* OECD Digital Economy Papers No. 260. Retrieved from https://goo.gl/v35PgF

Ofem, B. (2014) *Entrepreneurial orientation, collaborative networks, and nonprofit performance* (Unpublished doctoral dissertation). University of Kentucky, Lexington, KY.

Okazaki, S., & Hirose, M. (2009). Does gender affect media choice in travel information search? On the use of mobile Internet. *Tourism Management*, *30*(6), 794–804. doi:10.1016/j.tourman.2008.12.012

Ortega, F. (2014). Adapt the recipe to the paradigm shift. In Ciberperiodismo. Lima, Perú: Ed. USMP.

Osawa, J. (2015). *Tencent's WeChat App to Offer Personal Loans in Minutes*. Retrieved September 1, 2017, from http://www.wsj.com/articles/tencent-to-add-personal-loan-feature-to-wechat-app-1441952556

Osborn, A. (1994). *Resiliencia y estrategias de intervención*. Ginebra: BICE.

Owen, H. (2008). *Open space technology: A user's guide* (3rd ed.). Berrett- Koehler.

P21. (2007). *The Intellectual and Policy Foundations of the 21 st Century Skills Framework*. Washington, DC: Partnership for 21st Century Skills.

Paio, A., Eloy, S., Rato, V. M., Resende, R., & de Oliveira, M. J. J. (2012). Prototyping Vitruvius, New Challenges: Digital Education, Research and Practice. *Nexus Network Journal*, *14*(3), 409–429. doi:10.100700004-012-0124-6

Palomar, L. J., & Gómez, Valdez, G. N. (2010). Desarrollo De Una Escala De Medición De La Resiliencia Con Mexicanos (Resi-M) Construction of A Measurement Scale of Resilience in Mexicans (Resi-M). *Interdisciplinaria*, *27*(1), 7–22.

Palos-Sanchez, P. R., & Saura, J. R. (2018). The Effect of Internet Searches on Afforestation: The Case of a Green Search Engine. *Forest*, *9*(2), 51. doi:10.3390/f9020051

Palos-Sanchez, P. R., Saura, J. R., & Debasa, F. (2018). *The influence of social networks on the development of recruitment actions that favor user interface design and conversions in mobile applications powered by linked data*. Mobile Information Systems. doi:10.1155/2018/5047017

Pamburai, H. H., Chamisa, E., Abdulla, C., & Smith, C. (2015). An analysis of corporate governance and company performance: A South African perspective. *South African Journal of Accounting Research*, *29*(2), 115–131. doi:10.1080/10291954.2015.1006482

Panagiotopoulos, P., Shan, L. C., Barnett, J., Regan, Á., & McConnon, Á. (2015). A framework of social media engagement: Case studies with food & consumer organisations in the UK and Ireland. *International Journal of Information Management*, *35*(4), 394–402. doi:10.1016/j.ijinfomgt.2015.02.006

Papaioannou, S. K., & Dimelis, S. P. (2007). Information technology as a factor of economic development: Evidence from developed and developing countries. *Economics of Innovation and New Technology*, *16*(3), 179–194. doi:10.1080/10438590600661889

Paramati, S. R., Alam, M. S., & Chen, C. F. (2017). The effects of tourism on economic growth and CO2 emissions: A comparison between developed and developing economies. *Journal of Travel Research*, *56*(6), 712–724. doi:10.1177/0047287516667848

Paramati, S. R., Ummalla, M., & Apergis, N. (2016). The effect of foreign direct investment and stock market growth on clean energy use across a panel of emerging market economies. *Energy Economics*, *56*, 29–41. doi:10.1016/j.eneco.2016.02.008

Pauli, G. (2011). *The Blue Economy* [La Economía Azul]. Barcelona, Spain: Tusquets.

Pavlinek, P. (2017). Research and Development. In *Dependent Growth: Foreign Investment and the Development of the Automotive Industry in East-Central Europe* (pp. 107–147). Cham: Springer. doi:10.1007/978-3-319-53955-3_4

Pearce, J. A. II, Fritz, D. A., & Davis, P. S. (2010). Entrepreneurial orientation and the performance of religious congregations as predicted by rational choice theory. *Entrepreneurship Theory and Practice*, *34*(1), 219–248. doi:10.1111/j.1540-6520.2009.00315.x

Peters, M. (2017). Technological Unemployment: Educating for the Fourth Industrial Revolution. *Journal of Self-Governnace and Management Economics*, *5*(1), 25–33. doi:10.22381/JSME5120172

Phills, J. A. Jr, Deiglmeier, K., & Miller, D. T. (2008). Rediscovering Social Innovation. *Stanford Social Innovation Review*. Retrieved from https://ssir.org/articles/entry/rediscovering_social_innovation

Pilat, D., & Lee, F. C. (2001). *Productivity Growth in ICT-producing and ICT-using Industries*. Academic Press.

Pisani, N., Kourula, A., Kolk, A., & Meijer, R. (2017). How global is international CSR research? Insights and Recommendations from a Systematic Review. *Journal of World Business*, *52*(5), 591–614. doi:10.1016/j.jwb.2017.05.003

Podmetina, D., Smirnova, M., Väätänen, J., & Torkkeli, M. (2009). Innovativeness and international operations: Case of Russian R&D companies. *International Journal of Innovation Management*, *13*(2), 295–317. doi:10.1142/S1363919609002303

Podnar, K., & Golob, U. (2017). The Quest for the Corporate Reputation Definition: Lessons from the Interconnection Model of Identity, Image, & Reputation. *Corporate Reputation Review*, *20*(3-4), 186–192.

Pollard, D., Chuo, S., & Lee, B. (2016). Strategies for mass customization. *Journal of Business & Economics Research (Online)*, *14*(3), 101.

Pomerantz, M. (2003). The Business of Social Entrepreneurship in a "Down Economy". *Business (Atlanta, Ga.)*, *25*(2), 25.

Porter, M. E., & Heppelmann, J. E. (2015). How smart, connected products are transforming companies. *Harvard Business Review*, *93*(10), 96–114.

Portnoi, L., Rust, V., & Bagley, S. (2010). *Higher education, policy and the global competition phenomenon*. New York: Palgrave MacMillan. doi:10.1057/9780230106130

Posch, I., & Fitzpatrick, G. (2012). First steps in the FabLab. In *Proceedings of the 24th Australian Computer-Human Interaction Conference on - OzCHI '12* (pp. 497–500). New York. ACM. 10.1145/2414536.2414612

Posch, I., Ogawa, H., Lindinger, C., Haring, R., & Hörtner, H. (2010). Introducing the FabLab as interactive exhibition space. In *Proceedings of the 9th International Conference on Interaction Design and Children* (pp. 254–257). New York: ACM. 10.1145/1810543.1810584

Post, C., & Byron, K. (2015). Women on boards and firm financial performance: A meta-analysis. *Academy of Management Journal*, *58*(5), 1546–1571. doi:10.5465/amj.2013.0319

Pownall, C. (2015). *Managing Online Reputation: How to Protect Your Company on Social Media*. Springer.

Poynter. (2013). *State of Journalism Education*. Poynter Institute. Retrieved from http://www.newsu.org/course_files/StateOfJournalismEducation2013.pdf

Prandi, M., & Cano, J. A. (2015). *Coinnovación social.* Esade (Insitituto de Innovación Social) – Fundación Abertis. Retrieved January 12, 2018, from https://www.slideshare.net/ESADE/coinnovacin-social-claves-para-connotar-desde-la-colaboracin

Pratt, G. A. (2015). Is a Cambrian Explosion Coming for Robotics? *The Journal of Economic Perspectives*, *29*(3), 51–60. doi:10.1257/jep.29.3.51

Prensky, M. (2001). Digital Natives, Digital Inmigrants. On the Horizon, 9(5).

Prieto, A., Díaz, D., & Santiago, R. (2014). *Metodologías Inductivas: El desafío de enseñar mediante el cuestionamiento y los retos*. Madrid: Digital-text.

Pucci, E. L., & Mulder, I. (2015). Star(t) to Shine: Unlocking Hidden Talents Through Sharing and Making. In Lecture Notes in Computer Science: Vol. 9189. *Distributed, Ambient, and Pervasive Interactions. DAPI 2015* (pp. 85–96). Cham: Springer. doi:10.1007/978-3-319-20804-6_8

PWC (PriceWaterhouseCoopers). (2017). *The Long View. How will the global economic order change by 2050?* London: PWC.

Qin, J., Liu, Y., & Grosvenor, R. (2016). A categorical framework of manufacturing for industry 4.0 and beyond. *Procedia Cirp*, *52*, 173–178. doi:10.1016/j.procir.2016.08.005

Raj, E. D., & Babu, L. D. (2017). An enhanced trust prediction strategy for online social networks using probabilistic reputation features. *Neurocomputing*, *219*, 412–421. doi:10.1016/j.neucom.2016.09.036

Ramírez, D. N. (2013). *The Social Mortgage* [La Hipoteca Social]. McGraw-Hill.

Ramírez, H. (1999). El capital intelectual, base de la capacidad competitiva de la organización. *Journal of Foreign Trade*, *289*(1), 1014–1060.

Ranga, M., & Etzkowitz, H. (2013). Triple Helix Systems: An Analytical Framework for Innovation Policy and Practice in the Knowledge Society. *Industry and Higher Education*, *27*(4), 237–262. doi:10.5367/ihe.2013.0165

Rashid, M. A. A., Othman, M. N. A., Othman, M. Z., & Salleh, K. (2016, July). Exploring Employees' Social Media Engagement & Corporate Reputation of a Malaysian Public Enterprise. *3rd European Conference on Social M di R h Media Research EM Normandie*, 332.

Rasiah, R. (2011). Epilogue: Implications from industrializing East Asia's innovation and learning experiencies. *Asia Pacific Business Review*, *17*(2), 257–262. doi:10.1080/13602381.2011.533500

Ratajczak, P., & Szutowski, D. (2016). Exploring the Relationship between CSR and Innovation. *Sustainability, Accounting, Management, and Policy Journal*, *7*(2), 295–318. doi:10.1108/SAMPJ-07-2015-0058

Rauch, A., Wiklund, J., Lumpkin, G. T., & Frese, M. (2009). Entrepreneurial Orientation and Business Performance: An Assessment of Past Research and Suggestions for the Future. *Entrepreneurship Theory and Practice*, *33*(3), 761–787. doi:10.1111/j.1540-6520.2009.00308.x

Rauschnabel, P. A., Kammerlander, N., & Ivens, B. S. (2016). Collaborative brand attacks in social media: Exploring the antecedents, characteristics, and consequences of a new form of brand crises. *Journal of Marketing Theory and Practice*, *24*(4), 381–410. doi:10.1080/10696679.2016.1205452

Rayman-Bacchus, L., & Molina, A. (2001). Internet-based tourism services: Business issues and trends. *Futures*, *33*(7), 589–605. doi:10.1016/S0016-3287(01)00003-9

Real Academia Española. (2017). *Diccionario de la lengua española* [Dictionary of the Spanish Language] (24th ed.). Madrid, Spain: Author.

Reddy, P. (1997). New trends in globalization of corporate R&D and implications for innovation capability in host countries: A survey from India. *World Development*, *25*(11), 1821–1837. doi:10.1016/S0305-750X(97)00079-X

Redecker, C., & Punie, Y. (2013). The future of learning 2025: Developing a vision for change. *Future Learning*, *1*, 3–17.

Ren, S., Eisingerich, A. B., & Tsai, H. T. (2015). How do marketing, research and development capabilities, and degree of internationalization synergistically affect the innovation performance of small and medium-sized enterprises (SMEs)? A panel data study of Chinese SMEs. *International Business Review*, *24*(4), 642–651. doi:10.1016/j.ibusrev.2014.11.006

Reputation Institute. (2014). *Playing to Win in the Reputation Economy 2014. Annual Reputation Leaders Study*. Retrieved from https://www.reputationinstitute.com/research/reputation-leaders-study

Rezazadeh, A., & Nobari, N. (2018). Antecedents and Consequences of Cooperative Entrepreneurship: A Conceptual Model and Empirical Investigation. *The International Entrepreneurship and Management Journal*, *14*(2), 479–507. doi:10.100711365-017-0470-7

Rifkin, J. (1995). *The End of Work. The decline of the Global Labor Force and the Dawn of the Post-Market Era*. Tarcher/Putnam.

Ritzer, G., Dean, P., & Jurgenson, N. (2012). The Coming of Age of the Prosumer. *The American Behavioral Scientist*, *56*(4), 379–398. doi:10.1177/0002764211429368

Rivera, R. H. (2010). Cambio estratégico para entornos Turbulentos. *Facultad de Ciencias económicas*. *Investigación y Reflexión*, *18*(1), 87–117.

Robinson, K. (2006). *How schools kill creativity*. Paper presented at the Conference TED 2006, Monterrey, CA.

Robinson, G., & Dechant, K. (1997). Building a business case for diversity. *The Academy of Management Executive*, *11*(3), 21–31. Retrieved from https://www.jstor.org/stable/4165408?seq=1#page_scan_tab_contents

Robins, S., & Coultier, M. (2012). *Management* (11th ed.). Essex, UK: Pearson.

Rodríguez, B., Pérez-Bustamante, D. & Saura, J.R. (2017). Information classification on social networks. Content analysis of e-commerce companies on Twitter. Clasificación de información en redes sociales. Análisis de contenido en Twitter de empresas de comercio electrónico. *Revista Espacios*, *38*(52).

Rodríguez, E., Carreras, I., & Sureda, M. (2012). *Innovar para el cambio social.* Programa Esade-PwC de Liderazgo Social 2011-2012. Esade (Instituto de Innovación Social) – U. Ramon Llull. Retrieved February 5, 2018, from http://itemsweb.esade.es/wi/research/iis/publicacions/2012-InnovarParaCambioSocial-web.pdf

Rodríguez-Domínguez, L., García-Sánchez, I., & Gallego-Álvarez, I. (2012). Explanatory factors of the relationship between gender diversity and corporate performance. *European Journal of Law and Economics*, *33*(3), 603–620. doi:10.100710657-010-9144-4

Rodríguez-Ruiz, Ó., Rodríguez-Duarte, A., & Gómez-Martínez, L. (2016). Does a balanced gender ratio improve performance? The case of Spanish banks (1999-2010). *Personnel Review*, *45*(1), 103–120. doi:10.1108/PR-07-2014-0143

Rodrik, D. (2014). The past, present, and future of economic growth. *Challenge*, *57*(3), 5–39. doi:10.2753/0577-5132570301

Rollins, M., Rodriguez-Franco, C., Haan, T., & Conard, S. (2017). *Research and Development wildland fire and fuels accomplishments and outcomes. FS-1086*. Washington, DC: US Department of Agriculture, Forest Service.

Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, *94*(5), 1002–1037. doi:10.1086/261420

Rossheim, B. N., Kim, P. S., & Ruchelman, L. (1995). Managerial Roles and Entrepreneurship in Nonprofit Urban Arts Agencies in Virginia. *Nonprofit and Voluntary Sector Quarterly*, *24*(2), 143–166. doi:10.1177/089976409502400205

Rüßmann, M., Lorenz, M., Gerbert, P., Waldner, M., Justus, J., Engel, P., & Harnisch, M. (2015). Industry 4.0: The future of productivity and growth in manufacturing industries. Boston Consulting Group, 9.

Rutter, M. (1991). *Resilience: Some conceptual considerations*. Trabajo presentado en Initiatives Conferences on Fostering Resilience, Washington, DC.

Rutter, M. (1993). Resilience: Some conceptual considerations. *The Journal of Adolescent Health*, *14*(8), 626–631. doi:10.1016/1054-139X(93)90196-V PMID:8130234

Rutter, M., & Rutter, M. (1992). *Developing Minds: Challenge and Continuity across the Life Span*. London: Penguin Books.

Ryan, D., & Jones, C. (2009). *Understanding digital marketing: marketing strategies for engaging the digital generation*. Kogan Page.

Rycx, F., Garofalo, A., & Vinci, C. P. (2008). *Unemployment, innovation and R&D* (No. 2013/6589). ULB--Universite Libre de Bruxelles.

Saavedra, E. (2005). Resiliencia: La historia de Ana y Luis. Liberabit. *Revista de Psicología*, *11*, 91–101.

Saavedra, G. E., & Villalta, P. M. (2008). Measurement of the resilient characteristics, a comparative study in people between 15 and 65 years old. *Liberabit. Revista de Psicología*, *14*, 31–40.

Sábada, C., & Bringué, X. (2010). Niños y adolescentes españoles ante las pantallas: Rasgos configuradores de una generación interactiva. *Educational Participation*, *15*, 86–104.

Sachs, J. D., Benzell, S. G., & LaGarda, G. (2015). *Robots: Curse of blessing? A basic framework*. NBER Working Paper 21091. Doi:10.3386/w21091

Saito, K., Nakano, R., & Kimura, M. (2008). Prediction of information diffusion probabilities for independent cascade model. In *Knowledge-Based Intelligent Information and Engineering Systems* (pp. 67–75). Springer. doi:10.1007/978-3-540-85567-5_9

Saiz-Álvarez, J. M. (2017a). Entrepreneurial ICT-based Skills and Leadership for Business Ethics in Higher Education. In Handbook of Research on Technology-Centric Strategies in Higher Education Administration. Hershey, PA: Information Science Reference.

Saiz-Álvarez, J. M. (2017b). *Mexico and the European Energy Source Shift.* Monterrey, Mexico: EGADE Business School-Tecnológico de Monterrey.

Saiz-Álvarez, J. M., & García-Ochoa, M. (2008). Outsourcing and Strategic Alliances in the New Knowledge Economy [Externalización de Servicios y Alianzas Estratégicas en la Nueva Economía del Conocimiento]. *Economía Industrial*, *370*, 135–141.

Sajardo, A. (2009). *CSR* [La Responsabilidad Social de las Empresas]. Valencia, Spain: Tirant lo Blanch.

Salahuddin, M., & Alam, K. (2016). Information and Communication Technology, electricity consumption and economic growth in OECD countries: A panel data analysis. *International Journal of Electrical Power & Energy Systems*, *76*, 185–193. doi:10.1016/j.ijepes.2015.11.005

Salgado, A. C. (2005). Métodos para medir la resiliencia: Una alternativa Peruana [Methods of measurement of resilience: A Peruvian alternative]. *Liberalit*. *Revista de Psicología*, *11*, 41–48.

Sánchez, C. (2010). Red de mentoría en entornos universitarios españoles: Resultados de un análisis comparativo. *Revista de Mentoring & Coaching*, *3*, 13–29.

Sanchis, R., & Poler, R. (2014). Enterprise resilience assessment: a categorization framework of disruptions. *Dirección y organización, 54*, 45-53.

Saunders, A. (2014). *Financial markets and institutions*. McGraw-Hill Higher Education.

Saura, J. R., Palos-Sanchez, P. R., & Rios-Martin, M. A. (2018). Attitudes to environmental factors in the tourism sector expressed in online comments: An exploratory study. *International Journal of Environmental Research and Public Health*, *15*(3), 553. doi:10.3390/ijerph15030553 PMID:29562724

Saura, J. R., Palos-Sánchez, P., & Suárez, L. M. (2017). Understanding the Digital Marketing Environment with KPIs and Web Analytics. *Future Internet*, *9*(4), 76. doi:10.3390/fi9040076

Saxton, G. D., & Waters, R. D. (2014). What do stakeholders like on Facebook? Examining public reactions to nonprofit organizations' informational, promotional, and community-building messages. *Journal of Public Relations Research*, *26*(3), 280–299. doi:10.1080/1062726X.2014.908721

Schlechtendahl, J., Keinert, M., Kretschmer, F., Lechler, A., & Verl, A. (2015). Making existing production systems Industry 4.0-ready. *Production Engineering*, *9*(1), 143–148. doi:10.100711740-014-0586-3

Schueffel, P. (2016). Taming the beast: A scientific definition of FinTech. *Journal of Innovation Management*, *4*(4), 32–54.

Schumpeter, J. (1992). *Capitalism, Socialism and Democracy*. London: Routledge.

Schwab, K. (2015). *The Fourth Industrial Revolution: What It Means and How to Respond.* Retrieved from https://www.foreignaffairs.com/articles/2015-12-12/fourth-industrial-revolution

Schwab, K. (2016). The 4th industrial revolution. In *World Economic Forum.* New York: Crown Business.

Schwab, K. (2016). *The Fourth Industrial Revolution*. London: Crown Business.

Schwartz, M. S., & Carroll, A. B. (2003). Corporate Social Responsibility: A Three-Domain Approach. *Business Ethics Quarterly*, *13*(4), 503–530. doi:10.5840/beq200313435

ScienceNews. (2018). *Magazine of the Society for Science & the Public*. Retrieved from https://www.sciencenews.org/editors-picks/2017-top-10

Serrano, P. D., Garrido, A. M., Notario, P. B., Bartolomé, G. R., Solera, M. M., & Martínez, V. V. (2012). Validez de la escala de resiliencia de Connor-Davidson (10 ítems) en una población de mayores no institucionalizados. *Enfermeria Clinica*, *23*(1), 14–21.

Seyedali, Mohammad, & Lewisa. (2014). Grey Wolf Optimizer. *Advances in Engineering Software*, *69*(1), 46–61.

Sheffi, Y., & Rice, J. B. Jr. (2005). A supply chain view of the resilient enterprise. *MIT Sloan Management Review*, *47*(1), 41.

Shelvia, S., & Sulasmiyati, S. (2017). Affecting Factors of Foreign Direct Investment: Export and Gross Domestic Expenditure on Research and Development in Human Capital Concept (a Study in Indonesia Period 2009-2016). *Jurnal Administrasi Bisnis*, *50*(4), 123–130.

Shi, W., Cao, J., Zhang, Q., Li, Y., & Xu, L. (2016). Edge Computing: Vision and Challenges. *IEEE Internet of Things Journal*, *3*(5), 637–646. doi:10.1109/JIOT.2016.2579198

Shi, W., & Dustdar, S. (2016). The Promise of Edge Computing. *Journal of Computers*, *49*(5), 78–81.

Silaghi, M. I. P., Alexa, D., Jude, C., & Litan, C. (2014). Do business and public sector research and development expenditures contribute to economic growth in Central and Eastern European Countries? A dynamic panel estimation. *Economic Modelling*, *36*, 108–119. doi:10.1016/j.econmod.2013.08.035

Silva, H. C., & Lima, F. (2017). Technology, employment and skills: A look into job duration. *Research Policy*, *46*(8), 1519–1530. doi:10.1016/j.respol.2017.07.007

Simard, C., Henderson, A. D., Gilmartin, S., Schiebinger, L., & Whitney, T. (2008). *Climbing the technical ladder: Obstacles and solutions for mid-level women in technology*. Retrieved from http://anitaborg.org/wp-content/uploads/2013/12/Climbing_the_ Technical_Ladder.pdf

Šimleša, D., Bušljeta Tonković, A., & Puđak, J. (2016). Društveno poduzetništvo u Hrvatskoj: Od prepoznavanja do primjene. *Revija za Sociologiju*, *46*(3), 271–295.

Šimleša, D., Puđak, J., Majetić, F., & Bušljeta Tonković, A. (2015). *Mapping New Horizons. Report on the state of social entrepreneurship in Croatia 2015*. Zagreb: Institute of Social Sciences Ivo Pilar.

Simon, J., Millard, J., Keller, J. R., Carpenter, G., Schimpf, G., & Leszek, P. (2014). *Doing Social Innovation. A Guide for Practitioners.* Social Innovation Europe. Retrieved November 24, 2018, from http://www.esade.edu/esocialhub/centro-de-conocimiento/recursos/doing-social-innovation-guide-practitioners

Simonis, K., Gloy, Y. S., & Gries, T. (2016, July). INDUSTRIE 4.0-Automation in weft knitting technology. *IOP Conference Series. Materials Science and Engineering*, *141*(1), 012014. doi:10.1088/1757-899X/141/1/012014

Slager, R. (2017). The Discursive Construction of Corruption Risk. *Journal of Management Inquiry*, *26*(4), 366–382. doi:10.1177/1056492616686839

Small Business Service. (2005). *Social Enterprise Survey Across the UK*. Retrieved on 16 January 2018 from www.dti.gov.uk/socialenterprise

Smith, N. (2017, October 18). Who Has the World's No. 1 Economy? Not the U.S. *Bloomberg*.

Smith, A., Courvisanos, J., & Tuck, J. (2012). *Building the capacity to innovate: the role of human capital*. National Centre for Vocational Education Research. Retrieved from https://files.eric.ed.gov/fulltext/ED529887.pdf

Social Innovation Exchange. (2018). Retrieved November 18, 2017, from https://www.socialinnovationexchange.org/about-us

Social Investment Package. (2013). *Employment, Social Affairs & Inclusion (EaSI).* Retrieved November 12, 2017, from http://ec.europa.eu/growth/industry/innovation/policy/social_es

Spencer, R., Brueckner, M., Wise, G., & Marika, B. (2016). Australian indigenous social enterprise: Measuring performance. *Journal of Enterprising Communities: People and Places in the Global Economy*, *10*(4), 397–424. doi:10.1108/JEC-10-2015-0050

Stager, G. S. (2013). Papert's Prison FabLab: Implications for the maker movement and education design. In *IDC '13 Proceedings of the 12th International Conference on Interaction* (pp. 487–490). New York: ACM.

Stahel, W. R. (2016). The circular economy. *NATNews*, *531*(7595), 435. PMID:27008952

Standford Graduate School of Education. (2013). Transformative Learning Technologies Lab. *FabLab@School.* Retrieved July 16, 2014, from https://tltl.stanford.edu/

Stanford. (2018). *Defining Social Innovation*. Center for Social Innovation. Stanford Graduate School of Business. Retrieved December 21, 2017, from https://www.gsb.stanford.edu/faculty-research/centers-initiatives/csi/defining-social-innovation

Stankovska, I., Josimovski, S., & Edwards, C. (2016). Digital channels diminish SME barriers: The case of the UK. *Economic Research-Ekonomska Istraživanja*, *29*(1), 217–232. doi:10.1080/1331677X.2016.1164926

Staudinger, U. M., Marsiske, M., & Baltes, P. B. (1993). Resilience and levels of reserve capacity in later adulthood: Perspectives from life-span theory. *Development and Psychopathology, 5*(4), 541-566. doi 101017/S0954579400006155

Steijn, B. (2017). ICT, organisations and labour in the information society. In *The Future of Work in Europe* (pp. 45–62). Routledge.

Stemp-Morlock, G. (2010). Personal Fabrication. *Communications of the ACM*, *53*(10), 14–15. doi:10.1145/1831407.1831414

Stokes, M., & Baeck, P. (2017). Number of European 'tech for good' projects doubles in two years. *Financial Times*. Retrieved January 25, 2018, from https://www.ft.com/content/6dc79e0e-8db1-11e7-9580-c651950d3672

Stokes, M., Baeck, P., & Baker, T. (2017). *What next for Digital Social Innovation?* European Union. Eddie Copeland. Retrieved January 18, 2018, from https://www.nesta.org.uk/publications/what-next-digital-social-innovation-realising-potential-people-and-technology-tackle-social-challenges

Stokes, M., Baeck, P., & Baker, T. (2017). *What Next for Digital Social Innovation?* European Union. Retrieved January 4, 2018, from https://www.nesta.org.uk/publications/what-next-digital-social-innovation-realising-potential-people-and-technology-tackle-social-challenges

Suárez, N. (2004). *Resiliencia, tendencias y perspectivas*. Unla.

Suárez, O. N., Barna, R., Kotliarenco, M., & Munist, M. (2009). *Resiliencia: proyectos e investigaciones*. Universidad Nacional de Lanús. Colección Salud Comunitaria.

Susskind, R., & Susskind, D. (2015). *The Future of Professions How technology will transform the work of human experts*. Kindle Edition.

Swart, W. (2018). *Extending the principles of flipped learning to achieve measurable result: emerging research and opportunities*. Hershey, PA: IGI Global. doi:10.4018/978-1-5225-2984-2

Synnes, E. L., & Welo, T. (2016). Bridging the Gap between High and Low-volume Production through Enhancement of Integrative Capabilities. *Procedia Manufacturing*, *5*, 26–40. doi:10.1016/j.promfg.2016.08.006

Taylor, M., & Kent, M. L. (2014). Dialogic engagement: Clarifying foundational concepts. *Journal of Public Relations Research*, *26*(5), 384–398. doi:10.1080/1062726X.2014.956106

Tejada Fernández, J. y Ruiz Bueno, C. (2016). Evaluación de competencias profesionales en Educación Superior: Retos e implicaciones. *Educación XX1*, *19*(1), 17-38. doi:10.5944/educXX1.12175

Tejada, J., & Navío, A. (2005). El desarrollo y la gestión de competencias profesionales: una mirada desde la formación. *Iberoamerican Journal of Education*, *37*(2), 1 – 14. Retrieved from http://www.rieoei.org/deloslectores/1089Tejada.pdf

Terjesen, S., Couto, E. B., & Francisco, P. M. (2016). Does the presence of independent and female directors impact firm performance? A multi-country study of board diversity. *The Journal of Management and Governance*, *20*(3), 447–483. doi:10.100710997-014-9307-8

Terreberry, S. (1968). The Evolution of Organizational environments. *Administrative Science Quarterly*, *12*(4), 590–613. doi:10.2307/2391535

Thanki, S., Govindan, K., & Thakkar, J. (2016). An investigation on lean-green implementation practices in Indian SMEs using analytical hierarchy process (AHP) approach. *Journal of Cleaner Production*, *135*(2), 284–298. doi:10.1016/j.jclepro.2016.06.105

The Government of the Republic of Croatia. (2015). Strategy for the Development of Social Entrepreneurship in the Republic of Croatia for the period 2015-2020. Zagreb, Croatia: Author.

The Millennium Project. (2018). Retrieved from http://www.millennium-project.org

The World Bank Group. (2018). World Development Indicators [Data file]. Retrieved from http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators

Tiala, S. (2011). FabLabs: Re-envisioning Innovation and “Entrepreneering”. *ASQ Higher Education Brief*, *4*(5). University of Wisconsin. Stout.

Tidd, J., Bessant, J., & Pavitt, K. (2005). *Managin innovation: integrating technological, market and organizational change*. Chichester, UK: John Wiles & Sons.

Tonkovic, M. P., & Hussain, S. A. (2017). Residential and non-residential electricity dynamics. *Energy Economics*, *64*, 262–271. doi:10.1016/j.eneco.2017.04.003

Toppo, G. (2011). Flipped classrooms’ take advantage of technology. *USA Today*. Retrieved from http://usatoday30.usatoday.com/news/education/story/ 2011-10-06/flipped-classrooms-virtual-teaching/50681482/1

Torchia, M., Calabrò, A., & Huse, M. (2011). Women Directors on Corporate Boards: From Tokenism to Critical Mass. *Journal of Business Ethics*, *102*(2), 299–317. doi:10.100710551-011-0815-z

Transparency International. (2018). *Corruptions Perceptions Index*. Retrieved from https://www.transparency.org/research/cpi/overview

Trilling, B., & Fadel, C. (2009). *21st Century Skills: Learning for Life in Our Times*. San Francisco, CA: Jossey-Bass/John Wiley & Sons, Inc.

Troxler, P. (2009). Open Content in the Creative Industries: A Source for Service Innovation? In *Supporting service innovation through knowledge management*. Swiss Knowledge Management Forum.

Troxler, P. (2010). *Commons-based Peer-Production of Physical Goods Is there Room for a Hybrid Innovation Ecology?* Paper presented at 3rd Free Culture Research Conference, Berlin, Germany. 10.2139srn.1692617

Troxler, P. (2014). FabLabs Forked: A Grassroots Insurgency inside the Next Industrial Revolution From a Book Programmes National. *Journal of Peer Production, 5*. Retrieved January 31, 2017, from http://peerproduction.net/issues/issue-5-shared-machine-shops/editorial-section/fab-labs-forked-a-grassroots-insurgency-inside-the-next-industrial-revolution/

Troxler, P., & Wolf, P. (2010). *Bending the Rules: The FabLab Innovation Ecology*. Paper presented at the 11th International CINet Conference, Zurich Switzerland.

Troxler, P., & Schweikert, S. (2010). Developing a Business Model for Concurrent Enterprising at the FabLab. *2010 IEEE International Technology Management Conference (ICE)*, 1–8.

Tsai, S. B. (2018). Using the DEMATEL model to explore the job satisfaction of research and development professionals in china’s photovoltaic cell industry. *Renewable & Sustainable Energy Reviews*, *81*, 62–68. doi:10.1016/j.rser.2017.07.014

Turi, A., Mocan, M., Ivascu, L., Goncalves, G., & Maistor, S. (2015, May). From Fordism to Lean management: Main shifts in automotive industry evolution within the last century. In *MakeLearn International Scientific Conference on Management of Knowledge and Learning* (pp. 25-27). Academic Press.

Turk, J. V., Jin, Y., Stewart, S., Kim, J., & Hipple, J. R. (2012). Examining the interplay of an organization’s prior reputation, CEO’s visibility, and immediate response to a crisis. *Public Relations Review*, *38*(4), 574–583.

Tyler. (2016). *Mechanics of Online Reputation Management: Repair and Control Your Name or Brand Reputation Online*. CreateSpace Independent Publishing Platform.

Uncapher, P. C. (2013) *The Relationship between Entrepreneurial Orientation and Organizational Effectiveness: An Analysis of How Entrepreneurial Orientation is Manifested in the Nonprofit Context* (Unpublished doctoral dissertation). St. John Fisher College, Rochester, NY.

Unesco. (2007). *Model curricula for journalism education. Colección de la UNESCO sobre los estudios de Periodismo*. Retrieved from http://www.unesco.org/new/es/communication-and-information/resources/publications-and-communication-materials/publications/full-list/model-curricula-for-journalism-education/

United Nations Educational, Scientific and Cultural Organization (UNESCO). (2009). Conferencia Mundial sobre la Educación Superior, 2009. La nueva dinámica de la educación superior y la investigación para el cambio social y el desarrollo. Paris, France: UNESCO.

Valencia, M. (2005). El capital humano, otro activo de su empresa. *Framework*, *1*(2), 20 – 33. Retrieved from http://www.redalyc.org/pdf/2654/265420471004.pdf

Valor, C., & Merino, A. (2007). Firms and Poverty. The Role of CSR [Empresa y Pobreza. El Papel de la Responsabilidad Social Corporativa] (Unpublished document). Madrid: Madrid City Hall.

van Noort, G., & Willemsen, L. M. (2012). Online damage control: The effects of proactive versus reactive webcare interventions in consumer-generated and brand-generated platforms. *Journal of Interactive Marketing*, *26*(3), 131–140. doi:10.1016/j.intmar.2011.07.001

Vanistendael, S. (1994). *Cómo crecer superando los percances. Resiliencia: capitalizar las fuerzas del individuo*. Ginebra: BICE.

Vanistendael, S. (1997). *Resiliencia. In Conferencia presentada en el Seminario: Los aportes del concepto de resiliencia en los programas de intervención psicosocial*. Santiago, Chile: Pontificia Universidad Católica de Chile.

Vanistendael, S., & Lecomte, J. (2002). *La felicidad es posible. Despertar en niños maltratados la confianza en sí mismos: construir la resiliencia*. Barcelona: Gedisa.

Vargas, J. G. (2013). Sustentabilidad organizacional y capital social organizacional para el desarrollo ambiental y económico. El caso de las micro y pequeñas empresas en la explotación del tule Typha spp de la Laguna de Zapotlán. *Revista de Formación Gerencial*, *12*(1), 292–326.

Velasco, R., Brakke, A. P., & Chavarro, D. (2015). Computer-Aided Architectural Design Futures. The Next City - New Technologies and the Future of the Built Environment. In *16th International Conference, CAAD Futures 2015* (*vol. 527*, pp. 172–191). Berlin: Springer-Verlag.

Verma, R., Stock, D., & Mccarthy, L. (2012). Customer Preferences for Online, Social Media, and Mobile Innovations in the Hospitality Industry. *Cornell Hospitality Quarterly*, *53*(3), 183–186. doi:10.1177/1938965512445161

Viana, W., & Andrade, R. M. C. (2008). XMobile: A MB-UID environment for semiautomatic generation of adaptive applications for mobile devices. *Journal of Systems and Software*, *81*(3), 382–394. doi:10.1016/j.jss.2007.04.045

Vila, L., Dávila, D., & Ginés, J. (2010). Competencias para la innovación en las universidades de América Latina: un análisis empírico. *Iberoamerican Journal of Higher Education*, *1*(1), 5 – 23. Retrieved from https://ries.universia.net/article/view/30/competencias-innovacion-universidades-america-latina-analisis-empirico

Villalba, Q. C. (2004). *El concepto de resiliencia. Aplicaciones en la intervención social*. Sevilla: Universidad Pablo de Olvide.

Vives, X. (2017). The Impact of Fintech on Banking. *European Economy*, (2), 97-105.

Voss, Z. G., Voss, G. B., & Moorman, C. (2005). An empirical examination of the complex relationships between entrepreneurial orientation and stakeholder support. *European Journal of Marketing*, *39*(9/10), 1132–1150. doi:10.1108/03090560510610761

Walker, K. (2010). A systematic review of the corporate reputation literature: Definition, measurement, and theory. *Corporate Reputation Review*, *12*(4), 357–387. doi:10.1057/crr.2009.26

Walter-Herrmann, J., & Büching, C. (2013). *FabLab: Of Machines, Makers and Inventors*. Wetzlar: Transcript-Verlag. doi:10.14361/transcript.9783839423820

Wan, G., & Gut, D. (2011). *Bringing Schools into the 21 st Century. In Explorations of Educational Purpose*. Dordrecht, The Netherlands: Springer. doi:10.1007/978-94-007-0268-4

Wang, D., Park, S., & Fesenmaier, D. R. (2012). The role of smartphones in mediating the touristic experience. *Journal of Travel Research*, *51*(4), 371–387. doi:10.1177/0047287511426341

Wang, K. (2016). Intelligent predictive maintenance (IPdM) system–Industry 4.0 scenario. *WIT Transactions on Engineering Sciences*, *113*, 259–268.

Wang, R., Kim, J., Xiao, A., & Jung, Y. J. (2017). Networked narratives on Humans of New York: A content analysis of social media engagement on Facebook. *Computers in Human Behavior*, *66*, 149–153. doi:10.1016/j.chb.2016.09.042

Wang, S., Wan, J., Zhang, D., Li, D., & Zhang, C. (2016). Towards smart factory for industry 4.0: A self-organized multi-agent system with big data based feedback and coordination. *Computer Networks*, *101*, 158–168. doi:10.1016/j.comnet.2015.12.017

Wan, J., Cai, H., & Zhou, K. (2015, January). Industrie 4.0: enabling technologies. In *2014 International Conference on Intelligent Computing and Internet of Things (ICIT)*, (pp. 135-140). IEEE. 10.1109/ICAIOT.2015.7111555

Ward, E. G., Thomas, E. E., & Disch, W. B. (2014). Mentor service themes emergent in a holistic, undergraduate peer-mentoring experience. *Journal of College Student Development*, *55*(6), 563–579. doi:10.1353/csd.2014.0058

Warf, B., & Stewart, S. (2016). Latin American Corruption in Geographic Perspective. *Journal of Latin American Geography*, *15*(1), 133–155. doi:10.1353/lag.2016.0006

Web of Science. (2018). *Database Information*. Retrieved from https://apps.webofknowledge.com/select_databases.do?highlighted_tab=select_databases&product=UA&SID=F3LBJ8MFntCrg5hnKVH&last_prod=UA&cacheurl=no

Weimer, M. (2013). *Learner-centered teaching: Five key changes to practice*. San Francisco, CA: Jossey- Bass.

Welling, R., & White, L. (2006). Web site performance measurement: Promise and reality. *Managing Service Quality*, *16*(6), 654–670. doi:10.1108/09604520610711954

Werner, E. E., & Smith, R. S. (1992). *Vulnerable but invincible. A study of resilient children*. New York: Cornell University Press.

Willemaerts, C., Dewulf, W., Lambaerts, M., Boeykens, S., Abeele, V. V., Van Aken, J., ... Lauwers, B. (2011). Introducing Engineering Students to Manufacturing in a Fabrication Laboratory (FabLab). *Proceedings of the 1st World Engineering Education Flash Week*, 72–79.

Williams, G., Gunn, D., Roma, E., & Bansal, B. (2016). *Distributed Ledgers in Payments: Beyond the Bitcoin Hype*. Retrieved January 10, 2018, from http://www.bain.com/publications/articles/distributed-ledgers-in-payments-beyond-bitcoin-hype.aspx

Williams, J. C. (2014). *Hacking tech's diversity program*. Retrieved from https://hbr.org/2014/10/hacking-techs-diversity-problem

Willmott, H. (2015). Why institutional theory cannot be critical. *Journal of Management Inquiry*, *24*(1), 105–111. doi:10.1177/1056492614545306

Wilson, R. D. (2004). Using web traffic analysis for customer acquisition and retention programs in marketing. *Services Marketing Quarterly*, *26*(2), 1–22. doi:10.1300/J396v26n02_01

Wilson, R. F., & Pettijohn, J. B. (2008). Affiliate management software: A premier. *Journal of Website Promotion*, *3*(1/2), 118–130. doi:10.1080/15533610802052894

Wilson, T., Wiebe, J., & Hoffmann, P. (2005). Recognizing contextual polarity in phrase-level sentiment analysis. *Proceedings of the conference on human language technology and empirical methods in natural language processing*. 10.3115/1220575.1220619

Windelband, L. (2017). Work Requirements and Qualifications in Maintenance 4.0. In *Advances in Ergonomic Design of Systems, Products and Processes* (pp. 89–102). Berlin: Springer. doi:10.1007/978-3-662-53305-5_6

Wolf, P., Troxler, P., Kocher, P., Harboe, J., & Gaudenz, U. (2013). Sharing is Sparing : Open Knowledge Sharing in FabLabs. *Journal of Peer Production, 5*. Retrieved January 31, 2017, from http://peerproduction.net/issues/issue-5-shared-machine-shops/peer-reviewed-articles/sharing-is-sparing-open-knowledge-sharing-in-fab-labs/

Wollschlaeger, M., Sauter, T., & Jasperneite, J. (2017). The future of industrial communication: Automation networks in the era of the internet of things and industry 4.0. *IEEE Industrial Electronics Magazine*, *11*(1), 17–27. doi:10.1109/MIE.2017.2649104

World Bank. (2018a). *Research and Development Expenditure (% of GDP).* Retrieved from https://data.worldbank.org/indicator/gb.xpd.rsdv.gd.zs

World Bank. (2018b). *The World Bank*. Retrieved from http://www.worldbank.org/

World Economic Forum. (2015). *The future of FinTech: A paradigm shift in small business finance*. Retrieved January 10, 2018, from http://www3.weforum.org/docs/IP/2015/FS/GAC15_The_Future_of_FinTech_Paradigm_Shift_Small_Business_Finance_report_2015.pdf

World Economic Forum. (2018). *Temas claves de la agenda global*. Retrieved from https://toplink.weforum.org/knowledge/insight/a1Gb0000000LPFfEAO/explore/summary

Xu, Z., Frankwick, G. L., & Ramirez, E. (2016). Effects of big data analytics and traditional marketing analytics on new product success: A knowledge fusion perspective. *Journal of Business Research*, *69*(5), 1562–1566. doi:10.1016/j.jbusres.2015.10.017

Yao, K., Zweig, G., Hwang, M.-Y., Shi, Y., & Yu, D. (2013). *Recurrent Neural Networks for Language Understanding*. Interspeech.

Yeh, C. M., & Trejos, B. (2015). The influence of governance on tourism firm performance. *Current Issues in Tourism*, *18*(4), 299–314. doi:10.1080/13683500.2013.820258

Yermack, D. (2017). Corporate governance and blockchains. *Review of Finance*, 7–31.

Yin, J., & Jamali, D. (2016). Strategic Corporate Social Responsibility of Multinational Companies Subsidiaries in Emerging Markets: Evidence from China. *Long Range Planning*, *49*(5), 541–558. doi:10.1016/j.lrp.2015.12.024

Young, D. R., & Kim, C. (2015). Can social enterprises remain sustainable and mission focused? Applying resiliency theory. *Social Enterprise Journal*, *11*(3), 233–259. doi:10.1108/SEJ-02-2015-0005

Yüksel, S. (2017). The impacts of research and development expenses on export and economic growth. *International Business and Accounting Research Journal*, *1*(1), 1–8. doi:10.15294/ibarj.v1i1.1

Zahra, S. A., Gedajlovic, E., Neubaum, D. O., & Shulman, J. M. (2009). A typology of social entrepreneurs: Motives, search processes and ethical challenges. *Journal of Business Venturing*, *24*(5), 519–532. doi:10.1016/j.jbusvent.2008.04.007

Zaman, K., Shahbaz, M., Loganathan, N., & Raza, S. A. (2016). Tourism development, energy consumption and Environmental Kuznets Curve: Trivariate analysis in the panel of developed and developing countries. *Tourism Management*, *54*, 275–283. doi:10.1016/j.tourman.2015.12.001

Zenelaj, B., Gambarov, V., & Bilge, F. A. (2016). Using Social Media Communication as a Marketing Strategy to Generate Corporate Reputation: A Study in the Telecommunication Industry. In *Central & Eastern Europe in the Changing Business Environment* (pp. 356–370). Prague: University of Economics.

Zhang, K., Yun, X., Liang, J., Zhang, X.-y., Li, C., & Tian, B. (2016). Retweeting behavior prediction using probabilistic matrix factorization. *Computers and Communication (ISCC), IEEE Symposium on*, 1185–1192. 10.1109/ISCC.2016.7543897

Zhang, C., Zhou, K., Yang, S., & Shao, Z. (2017). On electricity consumption and economic growth in China. *Renewable & Sustainable Energy Reviews*, *76*, 353–368. doi:10.1016/j.rser.2017.03.071

Zheng, P., Sang, Z., Zhong, R. Y., Liu, Y., Liu, C., Mubarok, K., ... Xu, X. (2018). Smart manufacturing systems for Industry 4.0: Conceptual framework, scenarios, and future perspectives. *Frontiers of Mechanical Engineering*, 1–14.

Zhu, J., Xiong, F., Piao, D., Liu, Y., & Zhang, Y. (2011). Statistically modeling the effectiveness of disaster information in social media. *Global Humanitarian Technology Conference (GHTC)*, 431–436. 10.1109/GHTC.2011.48

Zhuofan, Y., Shib, Y., & Wang, B. (2015). Search Engine Marketing, Financing Ability and Firm Performance in E-commerce. *JMR, Journal of Marketing Research*, *55*, 1106–1112. doi:10.1016/j.procs.2015.07.078

Zichermann, G., & Cunningham, C. (2011). *Gamification by Design: Implementing Game Mechanics in Web and Mobile Apps*. O'Reilly Media.

Żur, A. (2013). Entrepreneurial Orientation and Firm Performance - Challenges for Research and Practice. *Entrepreneurial Business and Economics Review*, *1*(2), 7–28. doi:10.15678/EBER.2013.010202

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