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Using Applied Mathematical Models for Business Transformation

Antoine Trad and Damir Kalpić

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Using Applied Mathematical Models for Business Transformation

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Preface

Holism…Reason is immortal, all else mortal. Pythagoras, a Phoenician mathematician, to whom this book is dedicated.

It was during my engineering studies, in the beginning of the 80s, at the University of Zagreb, the capital of Croatia, precisely at the Department of applied mathematics of the Faculty of electrical engineering, that I discovered how challenging can be information and communication technology projects combined with architecture and applied mathematics… and decision making. There, I met my first good "friend", the programming language "FORTAN IV", which gave me the possibility to implement mathematical models (or algorithms) that ran on Information and Communication Technology (ICT) hosts/mainframes, to solve a specific business domain case (or problem). That was my first and crucial introduction to the three main fields of what today can be called the basics of holistic business engineering or transformational activities. I as the main author use the term *basics of holistic business engineering*, because projects need also a transversal structure that should be developed using modelling, design and architecture paradigms. In the early 80s, modelling, design and architecture where in their infancy age and were known under the name of Structured Analysis and Structured Design (SA/SD).

The author terminated his engineering studies working on the engineering thesis, that was tutored by Professor Dr. Damir Kalpić. The thesis coped with basic arithmetic/mathematical processors under the operating system Cromix (a Unix flavour on the microcomputer brand Cromemco); the thesis was entitled: "Building a multi-precise Arithmetic Processor (UNIX/C)". Dr. Damir Kalpić, who has been a fundamental support for the described works is also this book's co-author.

The author started working in Paris, France in 1986, developing telecommunication programs using C/C++ under the operating systems Microsoft Windows and various Unix flavours. Mainly to develop Praline telecommunication products, which were leading telecommunication products. These products were installed in many complex business infrastructures and needed a holistic structured approach that can be today considered as a basic technical architectures' approach. That influenced the main author to start and finalize his master's degree that was tutored by Professor Dr. Damir Kalpić. This degree's thesis coped with the risks of complex object-oriented business systems and was entitled: "Risk estimation in development of object-oriented information systems"

Advancing in his professional career, the main author worked as a consultant in software development and enterprise architect fields, where he has been continuously confronted with cross-functional integration problems that needed a holistic approach and that abstracted the use of: 1) Business Intelligence /Decision Making Systems/ mathematical models or algorithms; 2) Information and Communication Technology; 3) Modelling and design; and 4) Enterprise architecture. The vision of a holistic approach to solve complex problems, encouraged the author to start and finalize his doctorate degree that was tutored again by Professor Dr. Damir Kalpić and coped with building complex transformation and Enterprise Architectures Projects (EAP) and the thesis was entitled: "Auditing of risk and quality in information systems development". The thesis can be considered as the jumpstart for the research on business transformations and enterprise architecture.

Most of the author's technology architecture-related professional and academic works comprised business and structural transformation projects in which EAP frameworks like The Open Group's Architecture Framework, where used. It was in 1995 that the author started with Dr. Damir Kalpić developing cross-domain research articles combining the topics: 1) Decision making/Artificial Intelligence systems; 2) Mathematical models or algorithms based on heuristics; 3) Audit and risk management; 4) Information and Communication Technology; 5) Modelling and design; 6) Business transformation projects; and 4) EAPs. Together, they pioneered the use of a holistic based approach as a driving force behind the advancement of the mentioned research topics. That was the starting point that aimed to use a holistic Applied Mathematical Model (AMM) for business transformation and EAPs. The idea of a holistic AMM for *transformation project*s (from now on, the term *transformation project*, in italics will be used) has resulted with more than 100 articles and other research artefacts that are the skeleton of this book that is entitled "An Applied Mathematical Model for Business Transformations".

In 2009 the author started his second doctorate degree, a Doctorate of Business Administration (DBA) at the Grenoble School of Management in France. The chosen topic was managing Business Transformation Projects (BTP) that should have had a holistic approach. Business schools mainly used limited research methods; such approached an explain problems encountered in real-life situations, where such projects are managed by austere bookkeepers. Complex ICT projects and assets cannot be managed like primitive commodities, using damaging austerity procedures. These critical and warning statements are written to show why there are no actual methodologies to support BTPs. The actual approach is siloed and anti-holistic; in fact in project an aggressive commercial approach is used and that ruins BTPs. It is probably one of the fundamental reasons why *transformation project*s so often fail; knowing that most of such projects are managed by very young and inexperienced graduates of with bookkeeping background. Such tasks, should be delegated to quality engineering academic graduates with a long experience in various fields; to whom bookkeeping is just an auxiliary control structure and the main goal is a long term business sustainability for the enterprise and the nation to which is belongs.

Besides implementing *transformation project*s for various multinationals, the author has also lectured and managed research projects in Business, Finance, Information Technology at various universities. Today there are no books (or even methodologies) at hand that unify the mentioned topics, and none captures the integration of the mentioned three major fields. Each relevant book in these fields, has its merits, but most cover core topics that do not solve the essence of the problems of *transformation project*s. The notion of inspecting on how to integrate various fields using an AMM concluded its fundamental importance. For a long time, both authors have wanted to develop a book that provided definitive coverage of implementing a *transformation project* in the real-world. The opportunity to write for IGI Global, has provided an excellent occasion, and thus this book was born. The authors' goal in writing this book is to provide a complete guide for implementing *transformation project*s using a holistic AMM to avoid the high rate of failures.

The recent evolution of technologies and related methodologies have created complex business environments for Business Transformation Managers (BTM) who should be supported with a performant Business Transformation Framework (BTF) and underlying Decision Making Systems. The evoked hyper-evolution has sprung up traditional business environments, which have to be transformed and rearchitected. In a wider view, new business models and resultant opportunities have been created due to the unique fact of dynamic technologies that allow BTPs to set higher business goals for enterprises and meet the end-clients' expectations. The authors present not just an overview of isolated business, technology or architecture topics, but a detailed holistic overview of the evoked topics and propose a methodology in the form of a framework needed to support real-world transformations. The authors present the roles of design and integration processes for implementing BTPs; they also assume nothing about the readers' knowledge beyond a rudimentary understanding of AMMs, BTPs and EAPs. The only prerequisite is that the readers are business literate and have professional experiences. The authors provide the readers with the necessary resources and recommendations to be able to design and build complex *transformation project*s. Just as there is pleasure in well-implemented business solution, there is immense pleasure in well-designed *transformation project*s. With a holistic AMM, the reader gets to understand the *transformation project*'s structure and it is not recommended to implement isolated solutions but to implement holistic solutions using AMM using factors.

This book on *transformation project*s is a conclusion of more than 25 years of research, it proposes a set of related cross-functional Project's AMM and all its chapters are the result of a lifetime of research on business and technology transformations, applied mathematics, decision making systems, software modelling, business engineering, financial analysis and global EAPs; it is based on an authentic and proprietary mixed research method that is supported by an underlining qualitative holistic reasoning model. The reasoning model is based on neural network, an empirical process that is mainly based on the beam-search heuristic decision process. *The Project's AMM* can be used to implement any type of Research and Development (R&D) initiative that uses decision analytics and it can support complex inquiries. *The Project's AMM* components use a factors' driven research and reasoning concept that is supported by a behaviour driven development environment or a natural language programming that can be easily adopted by any of these environments; where *The Project's AMM* based framework offers such a high level of factors editing for their logic implementation environment, which can be used by any *transformation project* team member without any prior knowledge in Information and Communication Technology nor even advanced mathematics. *The Project's AMM* is a meta-model that can be used for any type of R&D project. The uniqueness of *The Project's AMM* is that the it promotes also the future *transformation project*'s unbundling and the alignment of various enterprise resources including services, architecture standards and strategies to support business transformation processes as the first step of any undertaking. Actual archaic *transformation project* R&D projects are managed as separate projects where their internal and external quantitative (sub)methods deliver recommendations. *The Project's AMM* uses a real-world research model that can be used in a large variety of research fields and topics, like: 1) BTPs; 2) business engineering; 3) decision making; 4) organisational engineering; and 3) enterprise architecture development of these research's components. This book's overall recommendation is to use the enterprise's Information and Communication Technology to implement a Decision Making System (or Systems) which in turn uses *The Project's AMM* to solve research questions (or problems) by offering credible solutions in the form of architecture, business operations, domain specific scientific or operational recommendations, for various fields. The proposed solutions can be applied by enterprise architects, business managers, business analysts and project engineers to enforce the implementation of a future business solution, which surpasses the business environment's actual archaic R&D activities. *The Project's AMM* is a model-first driven approach that is supported by this research's applicable framework that combines fields related to: 1) Knowledge Management (KM); 2) classical research approach; 3) enterprise architecture iterative concept; 4) heuristics/mathematical models; 5) technology management theories; 6) business transformation; and 7) business engineering fields. Building this research's component experiments based on a unique, innovative and holistic Mathematical Model (MM) is a pioneering undertaking and its results can be used as credible project solutions for the R&D topic that shows the mixed method or the unique method that inter-connects qualitative and quantitative methods. The valuable reader may have the impression to encounter repetitions in the book due to the fact that every chapter has been written to be read independently; it is a standard approach in complex frameworks, like TOGAF for example. Each chapter refers to the framework's standard approach but for a various topic and from a different angle. The book's chapters are categorized in parts and strongly inter-related.

This book's chapters, enable the implementation of cross-functional Decision Making Systems oriented R&D projects that are based on: 1) a qualitative research method; 2) a set of quantitative modules; and 3) an iterative heuristics tree that unifies the Decision Making System's algorithmic actions. The Decision Making System manages sets of factors that are known in classical R&D Projects (RDP), as dependent or independent variables. The authors based their unique R&D model mainly on intelligent heuristics neural networks, with specific calls to quantitative functions and supported by microartefacts-driven development models, where various disciplines, like decision making, enterprise architecture, applied mathematics and Information and Communication Technology are complementary, due to the use of many existing industry standards, like the Architecture Development Method (ADM) and its Archimate language. *The Project's Mathematical Model* is AMM driven and is agnostic to any specific RDP on business, EAP or technology environments, and is founded on a genuine R&D framework. *The Project's AMM* can be used to implement BTP, EA, Decision Making Systems or expert system solutions and to verify their feasibility to integrate in the enterprise's business and Information and Communication Technology environments. The uniqueness of *The Project's AMM* and its focus on the usage of a MM and an integrated Mathematical Language (ML), which promotes a holistic model to inspect the transformation initiatives, the possible alignment of various technology fields, enterprise architecture initiatives, the integration of a central Decision Making System to support *transformation project*s, which is this book's focus. This proposed framework's main aim is to deliver a skeleton to build RDPs that should be capable of delivering solutions in the form of applicable recommendations for solving project problems; this book's concept or methodology or applied research methodology is based on: 1) a multi-domain literature review; 2) a qualitative methodology; 3) a quantitative methodology; and 4) an engineering oriented Proof of Concept (PoC or a controlled experiment) for the related meta-hypotheses; the optimal research methodology can come from various fields that are presented in this book's organisation.

Each book's chapter proposes conclusions that can be synthesized and applied to define the alignment strategy and enrich the enterprise's microartefact libraries and areas, which in turn are modelled by an architecture formalism, like the ADM. The proposed framework supports such a complex formalism that combines various topics; in a unique holistic model. Unfortunately, the fact that most current frameworks are archaic and silo-built; in addition to an immense set of applied factors, influences negatively such complex R&D processes. The proposed framework is optimal for *transformation project*s' related R&D initiatives and can be applied to various types of topics and in each chapter the authors propose a set of recommendations on how a transformation framework should be implemented in form of a prototype for all the enterprise's business, technology and other areas.

The framework supports wide-spread standardized methods, like The Open Group's Architecture Framework's ADM and the Unified Modelling Language (UML), where each microartefact, goes through all of ADM phases. In this research, The Open Group Architecture Framework was selected and used, but any other architecture framework would fit in this generic book's concept or methodology proposal.

These ML microartefacts contain their private sets of Critical Success Factors (CSF) known as areas, where these CSF areas can be applied to: a) select the important CSFs; b) weight and rate the CSFs; c) estimate the book's concept or methodology's instance status using the Decision Making System's interface. The actual research article and the resultant experiment are also a part of the Selection management, Architecture-modelling, Control-monitoring, Decision-making, Training management, Project management, Finance management, Geopolitical management, Knowledge management, Research management and Implementation management Framework (SmAmCmDmTmPmFmGmKmRmImF, for simplification reasons, in further text the term Trad Kalpić Methodology and Framework (TKM&F) will be used). The TKM&F is not a black-box product to be applied as-is, it is rather an EAP strategy, recommendations and vision that each enterprise should implement by itself.

The TKM&F is composed of 11 modules, where the first one "Sm" can be applied for the selection and risk evaluation management of the BTP and EA team members profiles.

The remaining 10 modules can be applied to a BTP and EA undertakings, as follows:

- "Am": for the architecture and modelling strategy and risk evaluation.
- "Cm" for the control and monitoring strategy and risk evaluation.
- "Dm" for the decision-making strategy and risk.
- "Tm" for the training/education management and risk evaluation that can be applied to a BTP and EA projects.
- "Pm" for the project management strategy and risk evaluation.
- "Fm" for the financial management's and risk evaluation.
- "Gm" for the Geopolitical mind-mining, justification and risk evaluation.
- "Km" for Knowledge management and risk evaluation.
- "Im" for Implementation management and risk evaluation.
- "Lm" for Legal management and risk evaluation.
- "Rm" for Research management.

This book is based on a large set of articles, related to research methodologies, decision making, enterprise architecture and applied mathematics. An extensive literature review process was undertaken and has produced usable items, microartefacts and research artefacts. In this book's chapters, parts of previous works are reused for the better understanding of this complex iterative research topic and process. If everything were simply referenced, it would have been impossible to read and to understand this book's content. This book can be considered as a non-conventional and pioneering one, in the field of holistic *transformation project*s. Each book chapter can be read in independent manner and that is why the reader might have the impression that there were repetitions. This book's overall research question is: "Can an applied mathematical model be applied to implement business transformation projects, business engineering and enterprise architecture research projects?" That was developed after an extensive literature review, which produced the needed set of success factors.

The book's concept or methodology is based on Critical Success Areas (CSA) which are categories of sets of CSF where in turn, each CSF is a set of selected Key Performance Indicators (KPI), where: 1) each CSA corresponds to a BTP domain, like for example, finance; 2) each CSF corresponds to a set of project requirements, like for example, accounting balance sheet finalization; and 3) each KPI corresponds to a single transformation or architecture project requirement.

For an effective selection of the BTP's CSFs there is a need for an extensive literature review and very good knowledge of R&Ds. For each BTP research question or concrete problem, a researcher or a team engineer can define the initial set of CSFs. CSFs are important for the mapping between the project's requirements, microartefacts, organisational items to an instance of *The Project's AMM*. CSFs can express for example the project's requirements' evaluation that can be met and are defined in the project's goals and *The Project's AMM*'s limit constraints. The *Project's AMM*'s qualitative heuristic algorithms and punctual qualitative analysis can be used to evaluate for example the BTP's failure quota in each CSA, where CSFs can be internal or external; like: 1) the BTP's gap analysis is an internal CSF; and 2) client's purchase predictions is an external one. Once the BTP's initial set of CSFs have been selected, then the BTP's members can use the book's concept or methodology to query for possible credible research solutions.

A Decision Making Systems-based BTP concept is needed due to various resources and due to many problems in implementing complex project components. Research and related credible sources have proved that in many BTPs or EAs internal simplistic quantitative methods may cause failure. This book's RQs are complex when handling virtual global business organizations topics. A determinant factor in conducting a BTP and EA is the role of the applied MM. Such a project should be assisted with an efficient architecture framework (here the TKM&F) like The Open Group Architecture Framework that includes services and building blocks assembling concepts.

For complex BTPs, there is a need to build a concise MM, services and building block's composite model; shortly a "holistic brick". Holistic brick is a composite model, which can be used as a template for a variety of R&D projects. This research phase's focus is on the various technology and methods that can support a holistic BTP concept. The theory and concept of composite BTP suggests that implementers must be able to reuse proven components that emerge from the best practices, in order to solve generic R&D implementation requirements. Composite MM promotes the concept of services building and solution blocks. Absence of composite MM researchers would result in poor applying of research techniques; and that can result in failure of the target BTP to deliver.

The BTP's integration with the ADM, enables the automation and the auto-generation of the project's ML. These microartefacts management scripts, circulate throughout all the ADM phases and in various iterations. The ADM encloses cyclic processes that are managed by the TKM&F and its internal formalism is agnostic and is not dedicated to any specific R&D field. The ADM is controlled and monitored in real-time and supports the microartefacts' interactions using various types of tests for the BTP's MM and ML formalisms.

An ML microartefact is any microartefact that is a part of the TKM&F and which interacts with a multitude of other BTPs or external microartefacts in a coordinated manner. An ML microartefact uses the ADM to assist the *transformation project*s. The TKM&F includes various types of mechanisms that use ML/heuristics scenarios to make the *transformation project*'s integration more flexible and to avoid the simplistic quantitative research deductions. The TKM&F supports the *transformation project*, by offering ML microartefacts to handle various types of R&D methods. In this book, the authors present the optimal microartefact construct, where the majority of microartefacts are written in portable programming languages.

A set of ML microartefacts can be implemented in a software component written in any programming language. The usage of microartefacts provides some of the mechanisms needed to make *The Project's Mathematical Model* offer a pluggable component in the distributed ADM environment. *The Project's Mathematical Model* based Decision Making System is managed by the TKM&F, where any *transfor-*

mation project user can configure the types of ML microartefacts and CSFs to be used; the selected ML microartefacts are orchestrated by the TKM&F choreography engine. *The Project's Mathematical Model* based Decision Making System's actions map to the variety of the Information and Communication Technology systems' mechanisms to deliver the needed actions. *The Project's Mathematical Model* formalism manages the implementation of microartefacts that execute a set of actions. These actions can be modelled and managed by *The Project's Mathematical Model* that is implemented within an experiment or a PoC.

Today's *transformation project*s' dependency on automation and hence on Information and Communication Technology, requires that project teams establish a proactive Decision Making System, based on CSFs. Unfortunately, credible research sources seem to prove the opposite and such projects are often managed like simple quantitative research exercises. Traditional projects avoid a holistic approach and concentrate on simplistic quantitative samplings that are an insignificant topic and they avoid complexity needed to solve hard and very risky *transformation project*s. The possible application domains are: 1) BTPs; 2) applied mathematics; 3) Software modelling and implementation; 4) Business engineering and modelling; 5) Audit and risk management of technology components; 6) Global enterprise architecture; and 7) Legal and financial analysis.

In all the book chapters there is a PoC that is implemented using the TKM&F, which has been developed by the authors, using ML, Microsoft's Visual Studio .NET, C/C++ and Java Extended Edition (JEE). The PoC is based on *The Project's Mathematical Model* based Decision Making System and an internal set of CSFs' that are presented in CSA/CSF Tables. These CSFs have bindings to specific R&D resources. *The Project's Mathematical Model* based PoC processing model represents the relationships between this research's requirements, project ML generic and microartefacts (or building blocks), unique identifiers and the three defined CSAs.

In each of the book chapters, there is a set of recommendations proposed by the authors and a set of CSF tables that result from the PoC. The recommendations promote the use of a structured inter-relationship of ML microartefacts with application domains. The book's most important recommendation was that the business transformation manager must be an architect of adaptive business systems. By embarking on this BTP adventure, the reader puts himself in a position to be a leader and gets crucial recommendations in his organization's current or future transformation initiatives. This book was not written for a specific category of people who are seeking a career in mathematics, business administration or information systems alone. Rather, it was designed and written for the students, engineers, researchers, professors, various types of managers who want to transform their business by using a standard architecture, based on a mathematical model, to embrace and fully apply the capabilities of a methodology like the TKM&F.

The authors wanted to seize this opportunity to welcome the reader. Writing this book has been a lot of work and pleasure and the authors hope that the reader gets a lot of recommendations to support his *transformation project*s. The authors tried to be balanced in presenting both the advantages and disadvantages of *transformation project*s integration processes. The authors encourage the reader or future manager to adopt a similar path, like the TKM&F and to adopt an open and critical stance when reading this book. Please do inform your colleagues about this book and its content which we consider to be unique.

The authors' goal is to make this book accessible to the widest possible audience and we need your support in achieving this complex objective. The book and the used TKM&F, have the following unique characteristics and advantages:

- Placing *transformation project*s in their context, where they provide a proper perspective on the immense difficulties of such projects.
- Unique coverage of complex projects, where the covered topics are not found and analysed in literature. A concrete framework is provided.
- Holistic approach, where they rely on Information and Communication Technology, EAP, BTP disciplines. The authors propose the TKM&F to integrate these different perspectives to create an integrative overview of *transformation project*s.
- Success-Failure analysis, in adopting a balanced method of presentation, this book presents the realistic, both positive and negative aspects of such complex projects' implementation. In-depth case studies, taken from the real world, analyse major companies.
- Learning and communication objectives through the use of recommendations .
- PoCs or experiments: Thoughtful end-of-each-chapter PoC to direct readers, offering a concrete solution.
- Multi-domain flexibility, presented with a research and managerial focus, this book and resources can be utilized in various application domains.

The authors proposed framework is a leading environment and using the Scholar engine, in Google's search portal, in which the authors combined the previously mentioned keywords and key topics, the results have shown very clearly the uniqueness and the absolute lead of the authors' methodology, research and works. From this point of view and facts, the authors consider their works on the mentioned topics as successful and useful; so the main topics will be introduced.

We would like to thank the valuable readers for considering this book. We have worked hard to create a product hoped to be inspirational and that can create an excellent *transformation project* knowledge. The authors hope that the book's content and recommendations meet the readers' project needs. The TKM&F is optimal for research, development and management of *transformation project*s; it can be also used as learning tool in senior undergraduate programs.

The authors would like to thank the University of Zagreb and IGI Global for their support with the book and for the support of the proposed holistic approach which is unique and very probably is a vanguard approach. We would also like to thank the reviewers for their time and patience.

Best of all, it's written with pleasure.

Antoine Trad
IBISTM, France
November 2019

Acknowledgment

The inventions I have conceived in this way have always worked. In thirty years, there has not been a single exception… Nikola Tesla, a scientist and inventor.

In a work as large as this research project, technical, typographical, grammatical, or other kinds of errors are bound to be present. Ultimately, all mistakes are the authors' responsibility. Nevertheless, the authors encourage feedback from readers identifying errors in addition to comments on the work in general. It was our great pleasure to prepare this work. Now our greater hopes are for readers to receive some small measure of that pleasure.

In the beginning of the 80s, at the University of Zagreb in Croatia, precisely at the Department of applied mathematics of the Faculty of electrical engineering, Antoine Trad as the future first and main author of this book discovered how challenging architecture, information and communication technology projects can be, when combined with applied mathematics. Since then, he perused research and development projects in his fields of interest, which was strongly supported and enhanced by Prof. Dr. Damir Kalpić, now co-author of this book. The accomplishment of their combined effort is finalized now in this book on business transformations and enterprise architecture projects that are supported by a holistic mathematical model. Dr. Damir Kalpić has always been motivated and willing to support such ambitious and complex projects. He helped in directing the research and offered support in the approach to finalize this book. Added to that, Dr. Damir Kalpić is an innovative and open-minded person, who is also a good person. Without his encouragement and support, the first author would not have finished this book.

Furthermore, I would like to show my grateful feelings to the University of Zagreb, which has given me the needed skills and capability to develop the needed knowledge and knowhow to write this book.

The completion of this book would have been not possible if the author had missed the opportunity to work on international projects.

Thank you very much, Damir!

I would like to extend thanks to IGI Global editors, who have so generously provided us with opportunity to present our work in this book and enabled the emergence of an avantgarde framework.

The contents of this book are based upon the authors' opinions and their best knowledge, unless otherwise noted. This book is intended to share knowledge and information learned through research, experience, and discussions with others. The opinions of others, such as in the comments and the fora are their own and are not endorsed by the authors. The authors and publishers will not claim accountability, nor shall they be held liable for any loss that may result from our text. No expressed statement should be taken as intended offense but rather as authors' opinion which can be challenged in discussion.

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March 2019

Introduction

You have your way. I have my way. As for the right way, the correct way, and the only way, it does not exist… Friedrich Nietzsche, a German philosopher.

Business transformation projects are a combination of business techniques, information and communication technologies, methodologies, enterprise architecture, applied mathematical models and decision making systems that are combined and unified to manage transformation initiatives' risks. Business transformation projects are not just computer projects, the implementation of the information system is an important topic but not the only one; it is also about business architecture, enterprise architecture and many concordant subjects. Business transformation projects are complex and composite domain that understands and includes, information and communication technologies, applied mathematics, enterprise architecture, business engineering and educational support. A common holistic objective of this book on business transformation and enterprise architecture projects in these domains is to deliver solution patterns and recommendations by proposing a real world framework named the Trad Kalpić Methodology & Framework (*TKM&F*) who own the totality of copyright; where this book is an IGI Global copyright and these two objects are distinct and different. The book shows how to ensure the business transformation and enterprise architecture projects' feasibility, integrity and success in order to assure the business system's sustainability and serenity, so the concerned teams can use the future system without down-time and can access business information with acceptable response time.

Business process management, web technologies, modelling/architecture methodologies and mathematical models are greatly influencing business transformation and enterprise architecture projects. The vast majority of transformation initiatives, in major international corporations or small and medium enterprises, are globally inter-connected and networked in real-time to create a globalized business communities that are a set of macro economies. Business transformation and enterprise architecture project teams have become very linked and hence dependent on complex methodologies and information technology infrastructures; from various viewpoints of the transformation process that concerns from business process, architecture methodology, data communication, training and financial management, to audit and governing activities. Business transformation and enterprise architecture projects teams understand that today the global financial and economic infrastructure is extremely dependent on architecture methodologies and information communication technology, knowing that there is no assurance for a totally available and resilient business system. Business transformation and enterprise architecture projects are the most important domains that many professionals, are supposed to know of, unfortunately the majority might not be aware of the complexity and the possibilities of failures; and above all, the loss of the business' integrity. Many business system's users naively believe that their actual "hard stone fortress" ensures the company's protection, but they need to evolve their business advantage and not just protecting it. Business transformation and enterprise architecture projects are prone to various types of internal and external problems, like resistance, an immense volume of information to manage, a huge number of business and technical users, and other facts... There is also an increased exposure to security attacks, information espionage, and other types of malicious misdeeds. Business systems of international organizations need business transformation and enterprise architecture projects and at the same time are not prepared to manage them; neglecting the fact that such initiatives should be based on a decision making/artificial intelligence systems that are based on a holistic mathematical model. A decision making system, which is based on a holistic mathematical model which is connected to the enterprise's information and communication system, builds the enterprise's central nervous system. As a result, a decision making system's integration, is an important and even crucial activity for building the transformed business system. Business transformation and enterprise architecture projects' teams might not be aware of the important decision making system's central role; such teams do need to understand the decision making system's role and how to select the right critical success areas and factors, needed for the evaluation processes.

This book on business transformation and enterprise architecture projects, provides a valuable viewpoint on transformation initiatives and it analyses the major domains needed to implement them. Business transformation and enterprise architecture projects are critical for business to provide various models and underlying processes in order to support the decision making system's intelligent scenarios. These decision making systems can be tuned and configured with sets of critical success factors and related rules that are fed into the internal system. The applied architecture development methodology supports business transformation and enterprise architecture project team's activities, by directing the design and implementation processes. Such processes are software modules which contains libraries of microartefacts. The uniqueness of the business transformation and enterprise architecture projects' methodology or the *TKM&F* is today the framework of a possible salvation for transformation initiatives. Gartner Group declares, what seems to be obvious, that decision making systems and artificial intelligence, two terms for the same thing, are the most important innovations of the next decades. In order to ensure the business transformation and enterprise architecture projects' success, the authors have carried out, many research and development efforts; they have also devoted a lot of energy to review the existing literature to increase credibility of their unique research approach. Transformation and architecture initiatives are closely linked; when building a new business system's solution. The business transformation and enterprise architecture projects' teams need to consider the possible impacts on evolution and maintenance; and in the same time, not to neglect business security by proceeding to continuous simplistic risk assessment procedures. Business transformation and enterprise architecture projects' risk assessment is the most critical process to ensure the future business system's viability and can support the evaluation of the impact of unpredictable events that can cause failure. This book's main objective is not to try to eliminate all possible risks, but to introduce the strategy, framework and methodology that manages and controls such risks.

The main challenges in business transformation and enterprise architecture projects, are assuring success and managing complexity; which can be intellectually inspiring. The authors and the proposed research projects presents various themes with great enthusiasm, ambition, tenacity and hope to convince the reader to use the *TKM&F* for a future and successful implementation of business transformation and enterprise architecture projects. The authors provide solution patterns in the form of reusable components and recommendations. In these thrilling times of global interconnectivity and interdependence, it is necessary to provide concrete and experience based state-of-the of the art knowledge on business transformation and enterprise architecture projects; and even other generic project types.

This book's main and overall keywords are: 1) Business Engineering; 2) Enterprise Architecture; 3) Business Transformation Project; 4) Business Transformation Manager; 5) Applied Mathematical Model; 6) Neural Networks; 7) Holisms; 8) Risk Management; 9) Decision Making Systems; 10) Artificial Intelligence; 11) Knowledge Management Systems; and 12) Transformation and Innovation. Using the scholar engine, in Google's search portal, in which the authors combined the previously mentioned keywords and key topics; the results have shown very clearly the uniqueness and the absolute lead of the authors' methodology, research and works. From this point of view and facts the authors consider their works on the mentioned topics as successful and useful; so, the main topics will be introduced. This book also illustrates how transformation projects can insure the company's future business benefits and sustainability; by using a holistic approach and proposes an adequate research process.

The authors hope that this book could be an excellent introduction and support for transformation initiatives.

Best of all, it's written with pleasure.

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November 2019

Chapter 1
An Applied Mathematical Model for Business Transformation and Enterprise Architecture:
Introduction and Basics (Int&Bas)

ABSTRACT

The HMM-based framework offers such a high-level implementation environment that can be used by any transformation team member without any prior specific schooling or advanced mathematics models. The HMM can be used to implement and design enterprise architecture blueprints, business transformation projects or decision-making systems, mathematical models, algorithms, and it is supported by many real-life cases of various business domains. The uniqueness of this research is that the HMM promotes a holistic unbundling and the alignment of various enterprise architecture standards and strategies to support business transformation processes. Actual archaic business, information technology, and generic transformation processes are managed as separate black boxes in isolated silos, where their internal and external components create a messy hairball that is called the enterprise's information and communication system (ICS).

INTRODUCTION

…Reason is immortal, all else mortal, said Pythagoras (a Semite-Phoenician mathematician), everything can be explained using a holistic approach; that fact motivated this book and its framework, which are a conclusion of many years of research and development; it also proposes a Holistic Mathematical Model (HMM). This book's chapters on mathematical models, are the result of a lifetime of research on business transformations, applied mathematics, decision making systems, software modelling, business engineering, financial analysis and global enterprise architecture; it is based on an authentic and proprietary and unique mixed research method that is supported by an underlining qualitative holistic reasoning model module (Trad & Kalpić, 2017a, 2017b, 2017c, 2017d; Gunasekare, 2015). The proposed HMM formalism functions like the human brain, or more exactly its neural network(s) clone, are based on a process that is similar to the beam-search heuristic algorithm.

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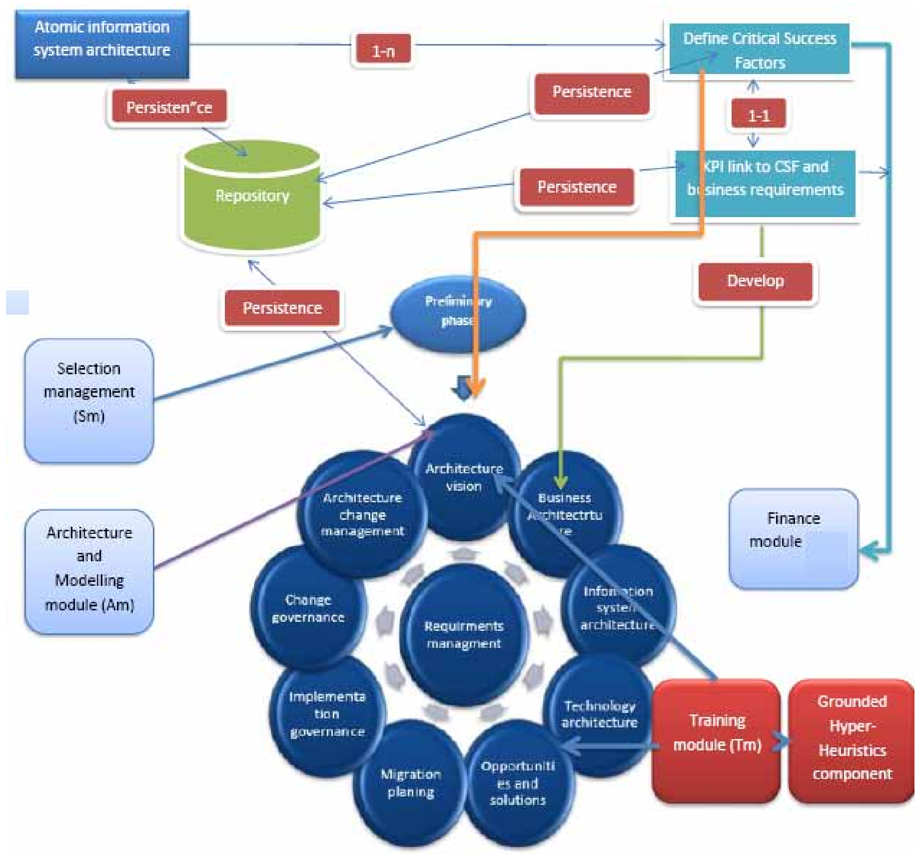
BACKGROUND

An HMM instance, can be used to implement a holistic decision-making system that can integrate in the enterprise's information and communication technology and business environments to form optimal enterprise and business architecture blueprints. The HMM uses a behaviour-driven development environment or a natural language programming that can be easily adopted by the project's development teams, who may not be computer scientists (Myers, Pane, & Ko, 2004; Kim & Kim, 1999; Della Croce & T'kindt, 2002). The HMM-based framework offers such a high level implementation environment that can be used by any transformation team member without any prior specific schooling or advanced mathematics models. The HMM can be used to implement and design enterprise architecture blueprints, business transformation projects or decision-making systems, mathematical models, algorithms and it is supported by many real-life cases of various business domains. The uniqueness of this research is that the HMM promotes a holistic unbundling and the alignment of various enterprise architecture standards and strategies to support business transformation processes (Farhoomand, 2004). Actual archaic business, information technology and generic transformation processes are managed as separate black-boxes in isolated silos, where their internal and external components create a messy hairball that is called the enterprise's Information and Communication System (ICS). The HMM is based on many real-life cases and uses a real-world model to be used in a large variety of fields like: 1) business transformation projects; 2) business engineering projects; 3) decision making projects; 4) organisational engineering; 5) asset and resources management; and 5) enterprise architecture development procedures. This book recommends that the ICS's Decision Making System (DMS) uses the HMM to solve problems by offering a set of possible solutions in the form of enterprise architecture, business operations, managerial and technical recommendations, for any type of problem in any business or generic field; where this book covers some fields, other fields like finance are covered in other authors' articles. The DMS' proposed solutions in the form of technical and managerial recommendations, can be applied by the business environment's architects, business managers, business analysts and project engineers to enforce the implementation of the business environment; and it surpasses the business environment's actual archaic decision making systems. Concerning the audience, holisitical approaches and multi-functional frameworks supports a wide range of audience and the authors would like to avoid a siloed approach of detailing the targets and audience ranges, because they estimate that the book would be on the levels of basics, like computer programming or excel editing…

The HMM is a Model First Driven (MFD) development approach that is supported by this research's applicable framework (IBM, 2001; Trad & Kalpić, 2018a, 2018b). This book's background combines Knowledge Management (KM), classical decision making systems' approach, enterprise architecture, heuristics/mathematical models, technology management, business transformation initiatives and business engineering fields (Tidd, Bessant, 2009). Building a DMS based on an HMM is today the major strategic goal of business companies, as shown in Figure 1 (Cearley, Walker, & Burke, 2016; Thomas, 2015; Ho, Xu, & Dey, 2010). The HMM enables the implementation of a generic and cross-functional business reasoning and decision-making engine that is based on: 1) a qualitative research method; and 2) a set of quantitative modules. The HMM structure manages sets of factors and can be applied to Business Transformation Project (BTP) and any other types of business projects. This book's author based his research model mainly on intelligent neural networks with calls to quantitative modules and is supported by information technology driven development models, where both disciplines, applied mathematics and information technology are complementary due to the use of many existing industry

Figure 1. This book's research framework (Trad, 2018a).



standards, like the Architecture Development Method (ADM) and Archimate (The Open Group, 2011a; Tidd & Bessant, 2009). This research project's main and overall keywords are: 1) Business Engineering; 2) Enterprise Architecture; 3) Business Transformation Project; 4) Business Transformation Manager; 5) Applied Mathematical Model; 6) Neural Networks; 7) Holisms; 8) Risk Management; 9) Decision Making Systems; 10) Artificial Intelligence; 11) Knowledge Management Systems; and 12) Transformation and Innovation. The HMM's concept is business-driven and is agnostic to a specific business environment, as shown in Figure 1, it is founded on a genuine research framework that in turn is based on tuneable heuristics and will be introduced (Johnson & Onwuegbuzie, 2004).

INTRODUCTION

This book's chapter is an introduction to an authentic framework, which proposes an applied HMM for BTPs and Enterprise Architecture (EA) projects (or simply *Projects*). The proposed framework is the result of a long research on business transformations, applied mathematics, software modelling, business engineering, financial analysis and global enterprise architecture. This ultimate research and development-oriented book is based on an authentic and proprietary mixed research method that is supported by an underlining mainly qualitative holistic reasoning model module (Trad & Kalpić, 2017a, 2017b, 2017c; 2017d; Gunasekare, 2015). The proposed HMM formalism, functions like the heuristics motor, which uses empirical processes that are mainly based on a decision making process. The HMM can be used to implement a DMS or an expert system that can integrate in the enterprise's business, information and communication technology environments.

The contents of this book are based upon the author's opinions and his best knowledge, unless otherwise noted. This book is intended to share knowledge and information learned through research, experience, and discussions with others. The opinions of others, such as in the comments and the fora are their own and are not endorsed by the author.

The author and publishers will not claim accountability, nor shall they be held liable for any loss that may result from our text. No expressed statement should be taken as intended offense but rather as author's opinion which can be challenged in discussion. While every attempt has been made to verify the accuracy of information provided in our book, neither the author nor the publishers are responsible for assuming liability for possible inaccuracies. The author and publishers disclaim any responsibility for the inaccuracy of the content, including but not limited to errors or omissions. The author cannot take any responsibility for loss of property, or any other damage that might appear to anyone as a direct or indirect consequence of the contents in our book.

The HMM uses an internal Natural Language Programming (NLP) environment that can be easily adapted by the project's development teams (Myers, Pane, & Ko, 2004). The HMM concept offers a high level implementation environment that can be used by any team member. The uniqueness and the focus of this research is that the HMM promotes a holistic unbundling process, the alignment of various enterprise architecture standards, a central decision-making system and transformation strategies to support business transformation projects which are this chapter's and book's focus (Farhoomand, 2004).

THIS CHAPTER'S AND BOOK'S FOCUS

This book's research proposal's main aim is to deliver a skeleton to build an DMS that is capable of delivering just-in-time solutions in the form of applicable actions or recommendations for solving *Project* or enterprise architecture problems and to achieve this precise goal, this book's applied research methodology is based on: 1) an adapted multi-domain literature review; 2) a qualitative methodology; 3) a quantitative methodology; and 4) an engineering oriented proof of concept (or a controlled experiment) for the related hypotheses; the optimal methodology applied in information technology and applied mathematics and engineering projects that are presented in this book's organisation.

The Book's Organization

The book is organized into five parts containing twenty-two chapters. A brief description of each of the chapters follows:

- Part 1 contains the introductory and common chapters. Some of this part's chapters globally introduce the book' topics and the rest are common chapters that deal with the research methodology, framework, keywords and other. This part introduces various topics related to *Project*s and EAs. In particular, this part identifies the global orientation of businesses transformations and the related problems with managing information technology and EA. It also identifies the importance of implementing a decision making system.

- Part 2 contains the human resources, information and communication technology, and enterprise architecture. This part's chapters introduce the holistic information and communication systems and related (and needed) skills set. They introduce also various topics related to *Project*s and especially the importance of implementing design and modelling blueprints. This part identifies the global EA-based *Project*s and the related problems with managing microartefacts. It also identifies the importance of implementing a decision-making system's microartefacts.
- Part 3 contains the intelligence based microartefacts, mathematical model's structure and implementation, neural language-like programming scripts, knowledge management systems, and decision making systems implementation. This part's chapters introduce advanced chapters, like, knowledge management and the HMM. This part introduces also various topics related to decision making and especially the importance of implementing decision making in EA. It identifies the global decision making based *Project*s and the related problems with decision making microartefacts.
- Part 4 contains the *Project* structure and its integration in the transformed enterprise. This part's chapters present various application domains in which this approach can be applied. This part introduces also various topics related to HMM based decision-making implementation and tuning. It identifies the benefits and the cross-functional characteristics of the proposed Trad-Kalpić Methodology & Framework *(TKM&F)*.
- Part 5 contains the Proof of Concept (PoC) and the results for an application field of resources and asset management; where they are combined in the form of an independent cluster. This part's chapters present various managerial and technical recommendations for various HMM application domains. This part introduces also various topics related to decision making implementation and tuning. It makes a conclusion and introduction to other book's chapters that share the same characteristics of its applied framework and research process.

THE RESEARCH PROCESS

The Research Cluster

The Research Cluster is a set of similar research fields aiming in parallel at a unique research question and goal (Cambridge University Press, 2018). This global research's main topic is related to *Project*s and their enterprise architecture implementation disciplines and the ultimate research question is: "Which business transformation manager characteristics and which type of support should be assured in the implementation phase of a business transformation and enterprise architecture project?" This research question and its analysis are genuine because of the immense gap in this field (Trad & Kalpić, 2011a).

The Research Gap

Today an important gap exists in the mentioned research areas (Cambridge University Press, 2018) and this research work project is pioneering work in the field; and it tries to link the MM to all levels of the enterprise architecture and to the underlying software components (Agievich, 2014). This is achieved by using a central qualitative engine that is based on beam-search heuristics (Kim & Kim, 1999; Della Croce & T'kindt, 2002). *Project*s are very risky and have a very high failure rate and one of the concrete reasons is that these projects lack a cross-functional and holistic coordination. That is why the author would like to contribute to enhance the success rate of such projects (Tidd & Bessant, 2018). In the mentioned research field, like already mentioned, there is a research gap and the author proposes a holistic approach that unifies the following:

- EA with other project's and external frameworks.
- Particular views in order to achieve a concrete manageable holistic project overview.
- All the project's components to be mapped into an applied mathematical model.
- A DMS as the kernel of the transformed business system.
- The Critical Success Areas (CSA) and Critical Success Factors (CSF) management.
- Implementation strategy for the development of microartefacts.
- The *Project*'s risk and audit management.

HMM based DMS uses CSFs, which are managed by this research's reasoning framework.

The Research Framework

The Business Transformation Manager (or simply the *Manager)* or the enterprise architects' *Project*s just-in-time made decisions are proposed by using the outputs from the enterprise's various support, project, knowledge and decision management areas. The HMM based DMS defines an alignment strategy of the enterprise's holistic architecture and overall resources that should manage and enrich the enterprise's microartefact libraries and areas that in turn are modelled by an architecture formalism like the ADM (Lankhorst, 2009). A global HMM concept is optimal for *Project*s (Daellenbach & McNickle, 2005) where the HMM supports the integration of a holistic architecture for the DMS and the whole *Project*. The HMM can be applied to various types of *Project*s and other general business projects and it is a part of the Decision making module (Dm) and the Architecture module (Am) that in turn are parts of the research framework. In this book the author proposes a set of HMM managerial and technical recommendations on how to implement and how to reuse in the real-world framework in the form of a prototype (Trad 2018a, 2018b, 2018c, 2018d). The HMM based DMS supports wide-spread standardized methods, like The Open Group's Architecture Framework's (TOGAF) architecture development method, where each *Project* microartefact circulates through all of its phases. In this research, TOGAF was selected and used, but any other architecture framework would fit in this book's proposal. The actual research book and the resultant experiments are also a part of the Selection management, Architecture-modelling, Control-monitoring, Decision-making, Training management, Project management, Finance management, Geopolitical management, Knowledge management and Implementation management Framework (SmAmCmDmTmPmFmGmKmImRmF, for simplification reasons, in further text the term *Framework* will be used). The *Framework* is not a black-box product to be applied as-is, it is rather an enterprise architecture strategy, recommendations and vision that each enterprise should implement by itself. The Framework or the *Trad Kalpić Methodology and Framework (TKM&F)* is composed of the following modules (that has already mentioned in the Preface chapter:

- "Sm": for the selection and risk evaluation management of the *Project* and EA projects team members.
- "Am": for the architecture and modelling strategy and risk evaluation that can be applied to a *Project* and EA projects.
- "Cm" for the control and monitoring strategy and risk evaluation that can be applied to a *Project* and EA projects.
- "Dm" for the decision-making strategy and risk evaluation that can be applied to a *Project* and EA projects.
- "Tm" for the training/education management and risk evaluation that can be applied to a *Project* and EA projects.
- "Pm" for the project management strategy and risk evaluation that can be applied to a *Project* and EA projects.
- "Fm" for the financial management's and risk evaluation that can be applied to a *Project* and EA projects.
- "Gm" for the Geopolitical mind-mining, justification and risk evaluation that can be applied to a *Project* and EA projects.
- "Km" for Knowledge management and risk evaluation that can be applied to a *Project* and EA projects.
- "Im" for Implementation management and risk evaluation that can be applied to a *Project* and EA projects.
- "Lm" for Legal management and risk evaluation that can be applied to a *Project* and EA projects.
- "Rm" for Research management and risk evaluation that can be applied to a *Project* and EA projects.

This chapter and book can be considered as a non-conventional and pioneering ones, in the field of holistic business transformation, applied mathematical models and enterprise architecture projects. This book's overall research question is: "Can an applied mathematical model, be used to implement business transformation and enterprise architecture projects?" That was developed after an extensive literature review.

The Research's Literature Review and Modelling

As already mentioned, this research project is focused on *Project*s and enterprise architecture; and it encompasses an extensive library containing major publications related to the research topics. For this research book, the literature review process was focused on the following subjects:

- Modelling enterprise architecture with the HMM-like approach.
- Modelling *Project*s with the HMM-like approach.
- Modelling a business enterprise with the HMM-like approach.
- The role of CSFs in the HMM approach.
- Integrating qualitative and quantitative methods in the HMM approach.
- Various business domains, like: marketing, resource management, human resources,…

The outcome is that very little scholarly or even general literature and research resources exist on the selected subject. The author considers his research works as pioneering ones; the most relevant works and components findings are:

- Models that provide abstractions of a real-world physical system should be used.
- Modelling is a descriptive design process which validates principles.
- Model-driven architecture has been defined by the Object Management Group (OMG).
- The gap between the adoption of transformation architecture and its usage is still huge today.
- A decision-making system is the base and finality of the end system.
- A mathematical model, the HMM approach is the skeleton of the end system.
- Multi-criteria or a multi-factor model is the fundament of the HMM, which in turn is the base of the decision-making system's processes.
- A modelling system should be able to model all possible types of problems and offer possible solutions in the form of recommendations.

A modelling system should be able to model all possible types of requirements, factors, problems and to offer possible and real solutions. Therefore, the author considers his work as a pioneering and original research project; and the most relevant references found in literature are the following topics:

- Models provide abstractions of a real-world physical system, like the enterprise's ICS. A model allows engineers to brainstorm the ICS issues, by filtering unneeded details and to focus on its fundaments. All of the engineering fields use models to understand complex, real-world systems. Modelling is the process of describing relevant characteristics of a business domain in a well-defined language or diagram. A modelling language codifies the microartefacts of which a model consists (Hinkelmann, 2016).
- Modelling is a descriptive design process which validates principles and explores the system's structure. Modelling artefacts comprises the design and testing of a business system using a Proof of Concept (PoC) (Sankaralingam, Ferris, Nowatzki, Estan, Wood, & Vaish, 2013).
- Model-driven architecture is defined by the Object Management Group (OMG). It is a design paradigm as a way to organize and manage enterprise architectures that are supported by automated tools, microartefacts and services. It supports the development of a model and it facilitates the transformations between different types of models, using the ADM and an iterative global software design (D'Emilia & Galar, 2018; Hinkelmann, 2016).
- The gap, in *Project*s and EA projects, is defined as the difference between their adoption and their implementation's iterations; and the gap of EA usage is still huge today. What is the reason that EA methodologies are not used extensively to gain a sustainable business system, achieve a greater level of organizational alignment, improved decision-making, and improved performance, remains unclear...?
- A decision-making system should include CSFs in its processes in the form of a structured mathematical model where CSF sets are used to represent relationships among a set of many interrelated (dependent or independent) variables. For an effective selection of the *Project*'s CSFs, there is the need for an extensive literature review and very good knowledge of the *Project*s (Nilda Tri & Yusof, 2009).

- A mathematical model can be used in an enterprise transformation to resolve various types of dependencies that can appear because of the use of a huge set of project resources. The lack of interdependencies management can result in silo projects and the use of a holistic methodology can insure success. A mathematical model can be used to represent relations between the *Project*'s modules and resources. A mathematical model facilitates a dynamic possibility to generate a feasible *Project* plan. A holistic mathematical model can support a decision-making system that offers solutions to *Project* problems. A *Project* plan is generated by the DMS's heuristics engine to realize enterprise transformation (Kim & Kim, 1999).
- An applied mathematical model is the description of a business system using mathematical concepts and language; these models are applied in natural sciences and engineering fields like computer science, ... (Sankaralingam, Ferris, Nowatzki, Estan, Wood, & Vaish, 2013).
- Multi-criteria or a multi-factor model for decision making needs a mixed method, based on qualitative and quantitative criteria. Qualitative analysis is used for judgment in imprecise situations that are known as subjective conclusions. Quantitative criteria and analyses are applied for precise and objective measurements; these criteria sets can be input as numerical sequences, where these sequences can be timestamped to become precise data sets. The HMM aggregates the qualitative and quantitative data stream in a heuristic multi-criteria model (Kim & Kim, 1999).
- A holistic modelling system should be able to model all possible types of problems and to offer just-in-time solutions, using a natural formalism that can be applied in various situations. In enterprise architecture and DMSs, mechanistic models can be used (Sankaralingam, Ferris, Nowatzki, Estan, Wood, & Vaish, 2013). As already mentioned, this book uses a mixed methods research that can be considered as a natural complement to traditional qualitative and quantitative research, in order to deliver an authentic empirical engineering research model (Easterbrook, Singer, Storey, & Damian, 2008).

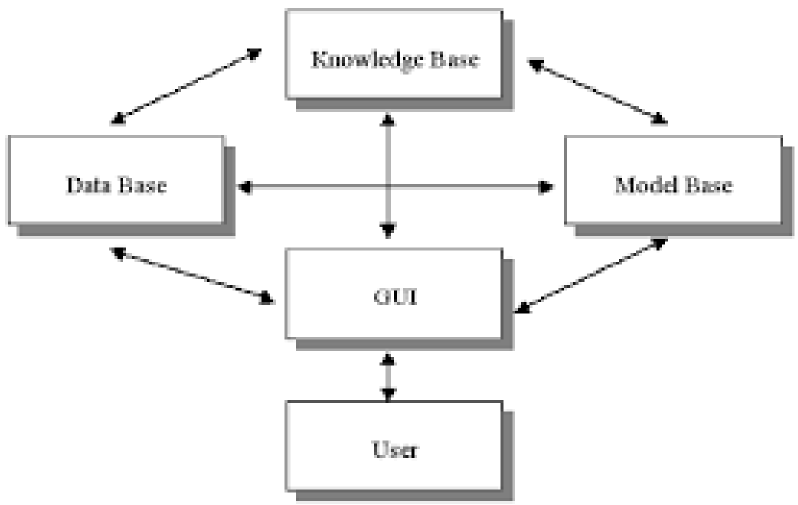
Empirical Engineering Research Model

Business, societal transformations and technology evolution lead the society and business enterprises to optimize various factors of the underlying structure and micro-environments and to enhance/automate the relations between various actors/delimiters. In *Project*, the development depends on a process that involves synchronization between all its domains and levels, and the possibility to fail could be translated into incapacity to be transformed. This research book is based on an empirical engineering research approach (Johnson & Onwuegbuzie, 2004; Easterbrook, Singer, Storey, & Damian, 2008). This research book is an empirical research and it includes a proof of concept and uses action research (Easterbrook, Singer, Storey, & Damian, 2008).

In business transformation and architecture development projects, there are today high levels of pressure to move always faster and to become more agile and at the same time be capable of insuring for the transformed business system, high levels of: 1) performance; 2) security; 3) availability; and 4) reliability. The mentioned immense pressure is the main cause that project's like *Project*s fail or are simply cancelled (Kornilova, 2017); and that is this research's focus.

This research article is based on an empirical engineering research approach because of the following facts (Johnson & Onwuegbuzie, 2004; Easterbrook, Singer, Storey, & Damian, 2008):

Figure 2. The decision-making interaction (Trad, 2018a).



- It uses an authentic mixed method (where mixed research is a simplistic synonym) that can be considered as a natural complement to conventional qualitative and quantitative research methodologies, to deliver empirical pragmatism concepts as a possible holistic approach for mixed methods research. Such a holistic approach provides an authentic framework for designing and implementing long term mixed methods research.
- Today we have five classes of research methods that are the most relevant to applied mathematics in engineering fields: 1) controlled experiments or proof of concepts; 2) building case studies; 3) survey research; 4) ethnographies; and 5) action research.

Engineering and applied mathematics researchers usually do not excel at making theories and related research explicit, because most of engineering fields are complex and large projects, which cannot be simply proven using basic statistics. Many of such empirical studies, developed in the last few decades, failed to relate data collected in the research to the underlying research theory. The clear results are hard to obtain, and final findings are difficult to interpret and apply, while various resultant studies are incomparable.

- Positivism argues that a project's knowledge must be founded on logical reasoning from a well-defined set of observable facts that are presented as CSFs. Positivists are known to be reductionist, because they research a set of phenomena by unbundling them into smaller distinct components, in this research they are labelled microartefacts. For positivists, scientific knowledge and recommendations are built iteratively from verifiable factors, and inferences are based on these CSFs. Positivists promote methods that start with precise theories from which verifiable hypotheses can be extracted and proofed separately. Hence, positivism is most closely associated with controlled experiment or a Proof of Concept (PoC). Nevertheless, quantitative survey research and case studies are also used to verify a positivist instance in a precise period of time.
- This research considers that qualitative research is a huge set of quantitative analysis schemas that are used to verify a precise hypothesis, using precise constraints and it is variable in time.

- This research uses Action Research (AR) which helps the researchers to solve a real *Project* problem and also it stores the gained knowledge and experience of solving the problem; this is known as the knowledge item (Berger & Rose, 2015). Most empirical research methods try to analyse the world as it is, qualitative action researchers try to offer recommendations for specific *Project* situations, with the explicit goal to enhance the *Project*. AR is applied in education, where transformations in educational fields cannot be analysed without implementing them, where implementation of a transformation process implies a long-term engagement, because the recommendations may have immense influence. AR has also been adopted in information science's research and development processes; *Project*s may require many years to be implemented. In the presented fields, AR is a new discipline, and there are many initiatives on finding the appropriate methodology, and there are even many debates on the validity of AR as an empirical method. That is why the author proposes a research method that fills the gaps and insures its empirical validity.
- Empirical validity checks whether the research work is acceptable as a contribution to existing scientific knowledge, this article's researchers want to convince the valuable readers that this article's recommendations and the related PoC are valid.
- A controlled experiment or a PoC is a software prototype of a testable hypothesis where one or more CSFs (or independent variables) are processed to evaluate their influence on the model's dependent variables. Controlled experiments or proof of concepts permit to evaluate with precision the CSFs and if they are related, whether the cause–effect relationship exists between these CSFs.

This research article is an empirical research and it includes a proof of concept and uses action research (Easterbrook, Singer, Storey, & Damian, 2008). The proposed HMM based DMS is a business-driven model which is based on three areas of research that represent separate sets of CSFs:

- The mathematical model with its artefacts.
- The mathematical model's integration in the information and communication technology system.
- The holistic management of the decision-making system, using a mathematical model.

THE BOOK'S AND FRAMEWORK'S BUILDING BLOCKS

In the past four decades, various important business and technical developments have brought business innovation and transformation aspects to the forefront. The most important development is the fact of increased dependence of business organizations on information and communication technologies and hence on automated processes, not only for crucial business operational goals but also for insuring strategic substantial business advantage. A second important evolution, influenced by the development of information and communication technologies, is that the holistic business model and its integration need a realistic business transformation project. In the past, business organizations focused on specific geographical areas to drive their business and economical eco-systems. Today, business organizations are becoming virtual and geographically independent. They feel handicapped if depending on a geographical location. The consequence of the hyper-evolution of information and communication technologies and the virtualization of business organizations have increased the importance of data and information. Technology, data and information architecture supports the business organizations to realize their strategic business objectives and it supports managers to make adequate decisions, using a central and holistic decision/knowledge management system. The business organizations' traditional business model, where its enterprise technology, data and information architecture models have to be transformed and made accessible to a virtual world, has to be secured and protected against external misconduct; at the same time, the business transformation process must insure robustness and availability. A successful enterprise architecture ensures that the previously managed information, which was usually processed in a fixed central location to be unified and virtualized. This is improving performance and ensuring acceptable response time, while the enterprise data content and form maintain their integrity. Access rights and privileges remain under control. In fact, maintaining confidentiality, integrity and availability were the main tenants for managing security. Today, business organizations, due to the evident fact of the technology evolution, have to conduct transformational processes to deliver a decision making system-based enterprise architecture blueprint, to be used to automate and drive the business organizations' ICS and businesses. Tackling such subjects and especially holistics and failures rates, may cause an snowball of critics, which are more than welcomed, because they enhance the quality of the proposed framework… In real world projects, business transformation managers face important resistance and they must be resilient… Anyway the future is in such multi-functional frameworks and this book proposes a methodology that drives business transformation project's management (Trad, 2013a).

Business Transformation Project's Management

Ever changing structures of business organizations, hyper-advances in ICS and the crucial dependencies of business organizations on instant data and information imply a hazardous set of challenges for achieving a substantial business advantage. In the last few years, many business organizations have failed to transform and to implement adequate innovation policies to manage continuous change. Many credible sources have proved failure of *Project*s because of the extreme complexity of encountered problems and the simplicity in their attempted solutions. There seems to exist a fatalistic attitude and at the same time expressed willingness to implement *Project*s. This has been proven by many sources and also it reflects in the incapability of *Project* managers to implement adequate actions to solve *Project* problems. A classic case of a *Project* problem is the case of Randal Shwartz where an ICS has encountered various types of technical problems, like the illicit use of ICS resources was interpreted by Shwartz as an ICS crime (Dhillon & Phukan, 2000). The hyper-evolution of ICS-based systems and their inter-connections using e-technologies, known as the Cloud has inducted another type of *Project* problems for business organizations like ICS security and change management (Dhillon, 1999). In a problem of ICS security, an enterprise employee was convicted under the UK Computer Misuse Act after he activated for himself a 70% discount while the regular staff of the wholesaler were engaged otherwise. To prevent and even predict various types of *Project* problems, the *Project* architects and management teams must define the basic unit of work.

The Model's Unit of Work

A holistic alignment and classification of all the *Project*'s resources must be done, so that the unbundling process can start. A holistic alignment needs also to define the HMM Unit of Work (UoW) or a basic microartefact. Using the "1:1" mapping concept, the microartefact is represented with a class diagram and can be represented also by an extensible Mark-up Language (XML) model, like in the services-based unbundling and naming conventions. Such a mapping concept is based on an automated naming convention that can link all the *Project*'s resources. The mapping concept supports the interoperability between all the *Project*'s modules and enables the use of ML microartefacts that include the needed knowledge and intelligence support (Mehra, Grundy, & Hosking, 2005; Scherer & Schapke, 2011). To prevent and even predict various types of *Project* problems, the *Project* architects and management teams need a functional development environment.

Functional Development Environment

The *Framework's* internal functional development tool and its mathematical choreography/language can be used for various application domains and which concept is similar to the Behaviour Driven Development (BDD) or Neuro Linguistic Programming (NLP) that are used in general for hard systems' thinking. The HMM uses BDD and NLP like scripts that are interpreted and executed in real-time; these scripts can be implemented and maintained by business professionals with no prior computer science or mathematical background. That is why the author recommends the use of an interpretable NLP-based HMM formalism for building a DMS (Moore, 2014; North, 2010). The HMM based DMS is business-driven and is founded on a genuine research framework that in turn is based on a ML to manage heuristics, enterprise architecture and information and communication artefacts (The Open Group, 2011a). The complexity lies in how to integrate the HMM and its programming ML in the enterprise's existing information and communication technology system. To prevent and even predict various types of *Project* problems, the *Project* architects and management teams must build a central holistic decision-making system (Trad & Kalpić, 2018c).

Decision Making System

Unfortunately, the actual archaic DMSs are not in an advanced stage and are silos-like and cannot support an agile transformation process, which in theory may drive the business company to participate in dynamic microartefacts development, operations, choreography and maintenance phases. Today's extreme dependency of business enterprise on automation and hence on ICS, forces *Project* teams to establish a proactive *Project* concept, based on a DMS and established on the approach of CSF. Unfortunately, credible research sources seem to prove the prevailing of opposite practices and such *Project*s are managed like simple ICS silo projects. Based on survey results Adam & Haslam (2001) suggest that no adequate actions are being implemented on crucial subjects like data management. Traditional *Project* managers avoid a holistic approach and concentrate on simplistic financial and budget aspects that are an insignificant topic and avoid complexity to solve complex and very risky problems by putting the blame on team members and using various behavioural explanations (Trad & Kalpić, 2017a, 2017b, 2017c, 2017d; Gunasekare, 2015).

Complexity and Failure

Project problems and ICS have become very complex to solve and simplistic attempt to solve them needs advanced knowledge from various domains that in this research book and project are classified into various Critical Success Areas (CSA) existing in *Project*s. Such problem types can be classified into the following initial areas; where these areas can be modified or extended:

- The complexity of implementing successful *Project* management and architecture practices in a virtual and diverse global environment and being capable to control business and ICS operations.
- The complexity of implementing successful *Project* DMS structures of responsibility, given the complex structuring of organizations and information processing activities.
- The complexity of implementing successful *Project* holistic integration policies.
- The complexity of implementing successful *Project* ICS and security actions, policies and procedures that adequately implement the business organization's enterprise architecture vision and objectives, using new business processes.

Enterprise Architecture

A DMS-based Enterprise Architecture (EA) is needed relying on various resources (for a summary and review see Mikko Siponen's article, besides Dhillon et al, 1996; Dhillon, 1997) and have proven that there are problems in implementing complex ICS actions and policies with frequent encounter of the behaviour and resistance of the business organizations' employees. Research and related credible sources have proved that in many *Project*s internal employees may cause their failure because of their intention to avoid existing controls and gain substantial advantage, essentially because an opportunity exists (Backhouse & Dhillon, 1995). Many *Project* problems are very complex when handling virtual global business organizations and it becomes risky for the DMS to propose optimal project actions. This was evidenced in the case of Nick Lesson, who analysed the downfall of Barings Bank in Singapore. Barings had collapsed because it relied on ICS; Leeson was able to successfully point out real reasons and losses from the Barings executive management, internal and external auditors, and regulatory bodies in Singapore and the Bank of England. Leeson's case presents weaknesses of control, trust, confidence, and deviations from conventional accounting methods or expectations. A determinant factor in transforming a traditional business environment into an innovative and lean architecture blueprint is the role of the applied patterns, services and building blocks. Such a transformation should be assisted by an efficient transformation and architecture framework like TOGAF that includes patterns, services and building blocks assembling concept. There such concepts can change the transformation project's outcomes and make the architectures transcendent. The enterprise architect's role is crucial for the finalization of the implementation phase of a very complex business transformation project. During this phase, the enterprise architect's knowledge is determinant to design and implement the end-system. There is a need to build a concise patterns, services and a building block's composite model; shortly a "holistic brick". A holistic brick is the composite model, which can be used as a template for a variety of architecture transformation projects, using methods like Archimate. This research phase's focus is on the various technologies and methods that can support a holistic architecture. The theory and concept of composite patterns suggest that implementers must be able to reuse proven components that emerge from the best *architecture & modelling* practices in order to solve generic architecture implementation requirements. Composite patterns promote the concept of design patterns, services building and solution blocks. Without the use of composite patterns, enterprise architects, business analysts, designers and implementers, would be poorly applying *architecture & modelling* techniques; and that can result in the target business system failing to deliver (Trad & Kalpić, 2016a).

Law and Finance

*Project*s face the challenge of implementing appropriate legal policies and financial audit procedures that adequately support the organizational context and transformed business processes. These challenges understand two levels: 1) internal or enterprise organizational level; 2) external or partners from the business ecosystem that become difficult to rely on traditional business legal policies to regulate various types of domains. To include a business transformation project or an enterprise architecture project in the enterprise's business and financial strategic planning process and to prepare this enterprise to integrate the local and the global economy in a sustainable way, the integration of financial engineering-related risk and legal controls is necessary and is even the most fundamental action. Actually, these finance-related risk and legal standards and automation procedures are not mature and are even chaotic, so these facts can damage the business transformation project or an enterprise architecture project and that may disable the traditional business environments to become a part of the networked global economy (Trad & Kalpić, 2014a). An important factor in frequent business transformation projects' changes and implementation iterations are the roles of the business transformation manager, finance analysts and enterprise architect(s) who should be supported by the optimal business transformation framework, like the *TKM&F,* which should include holistic financial control mechanisms. These HMM holistic mechanisms, should be also capable of supporting the business environment's financial engineering risk management, legal control and integration in a complex block-chain globalized environment. To achieve this financial engineering risk and legal integration, critical success areas and critical success factors must be used to evaluate legal pitfalls, risk, audit, assert, govern, automate, trace, monitor and control the business transformation project's financial budget. The business transformation project or an enterprise's architecture project critical success factors can be configured to manage the complexities in managing asynchronous financial flows of (e)business local and international financial environments. Transformed business environments must have built-in automated block-chain controls, capable of recognizing fraud, black swan effects (Taleb, 2007), bad investments, business transformation project budget slips, loss of (e)transactions, illegal activities and tax evasions (Trad & Kalpić, 2017f).

Geopolitical Analysis

World leaders claim that supporting the societal transformation happenings is the top objective for geopolitical events and origins. Political leaders and executive managers can learn how a specific geopolitical events can be analysed and recommend how to deliver detailed analysis, justification and/or how to execute a successful discovery of a concrete event (Gartner, 2013a). This implies that business and societal transformation projects are crucial for future of any geopolitical change and hence an adequate risk analysis strategy must be established. The business and societal transformation manager must ensure: 1) An analytic approach that unites all domains in the society or origin to improve or explain events, in order to make the societal transformation project viable; and 2) that he/she has the analytical skills to analyse the complete solution, and equally important, also require skills to ensure consensus between all affected geopolitical stakeholders (Uppal & Rahman, 2013).

Application Domains

The *TKM&F* can be applied in the following domains:

- Business transformations.
- Applied mathematics.
- Software modelling and implementation.
- Business engineering and modelling.
- Financial analysis.
- Audit and risk management of technology components.
- Global enterprise architecture.

THE BOOK'S AND FRAMEWORK'S SOLUTION PROVISION

Solutions to the *Project* problems in the current period of time enabled the shifting of emphasis from unique technology to business and societal process. Although many research projects have promoted such an orientation, in practice over-formalized and over-emphasized, archaic approaches and solutions designed in a reactive manner, still are dominant. In many *Project*s, badly conceived solutions note the beginning of a disastrous EA and ICS implementation with an inadequate consideration of its underlying DMS.

Critical Success Factors and Areas

Establishing formalized rules is one step that could lead towards a solution for managing information security. Such formalized rules may take the form of security policies that help in facilitating bureaucratic functions in order to resolve ambiguities and misunderstandings within organizations. Both academics and practitioners have made numerous calls for formulating security policies and many of these calls have stopped at just that. Although security policies are essential for laying down rules of conduct, success of security policies is clearly a function of the level of their integration with the strategic vision. If we accept that a secure environment is an enabling condition for the smooth running of an enterprise, then security considerations are a strategic issue and there is a need to configure them for maintaining the consistency and coherence of organizational operations (Trad & Kalpić, 2016d).

Types of Problems, Related to Critical Success Factors

The types of problems correspond to the CSF, where each CSF corresponds to a type of problem. The TKM&F offers the possibility to estimate the risks of possible important problems that could cause major problems or even make the *Project* fail. The *TKM&F* or the Framework must sense the risks through the use of tractable events and not just have the capability to forecast an event that could cause a major *Project* problem. This research cluster proposes optimal approaches to prediction, prognostication, and risk management; that are the basic structures of business and organizational engineering that need a specific Framework or in our case the TKM&F. Even if modern business environments may have immense technological knowledge, unfortunately the lack of holistic approach makes unpredictable problems for *Project*. The *TKM&F* data architecture and modelling concept structures, serve many functional domains and in this proof of concept the functional domain covers information analysis and decision making for *Project* problems (Taleb, 2012; Trad & Kalpić, 2017b; Trad & Kalpić, 2017c).

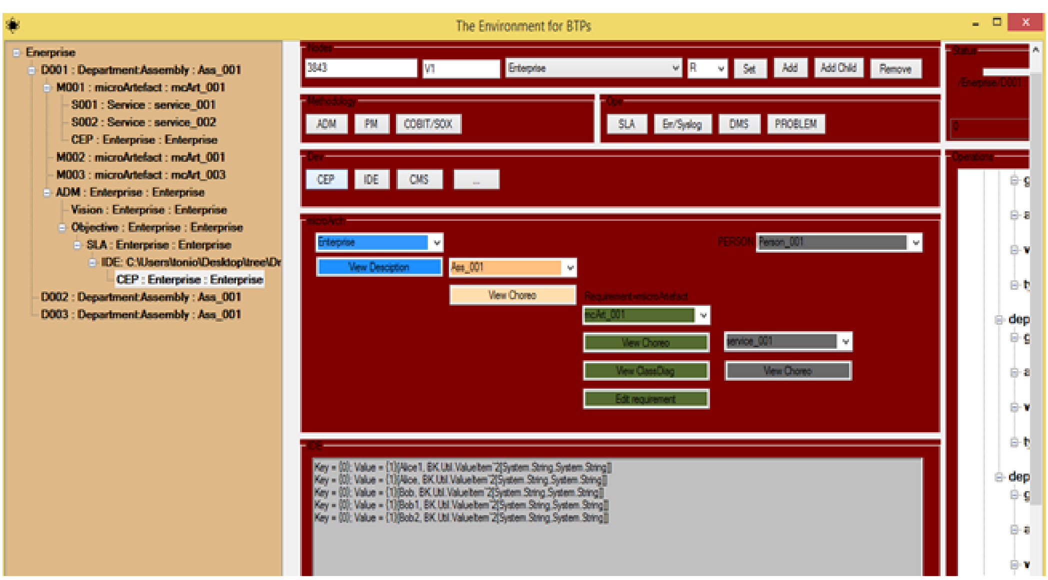
THE RESEARCH'S IMPLEMENTATION

The Design First Approach and Process

Defining a ML microartefact granularity and responsibility for a *Project* is a complex undertaking in the holistic implementation of the *Project*; added to that, there is the complexity in implementing the "1:1" mapping and classification of the discovered *Project* microartefacts in the development of the business environments which have in general limited resources and financing. The applied software design concept uses standard design methodologies, like the TOGAF's ADM and/or the Unified Modelling Language (UML). Mapping of a requirement's Use Case (UC) to a mathematical (or standard) microartefact in the form of a class diagram and/or communication diagram, is done through various HMM's capabilities that can be used and deployed using the HMM ML. This proposed design and mapping concepts are supported by a set of the *Framework's* microartefacts where its internal HMM ML consists of implementing microartefacts to dynamically evaluate compound expressions, according to the HMM principles. The HMM formalism uses the internal mathematical model to encode the *Project*'s requirements and to deliver microartefacts. As shown in Figure 3, the HMM based DMS offers a graphical user interface to manage the automated and auto-generated build and deploy formalism, where a ML microartefact maps to a UML class diagram (or communication diagram) and has a Global Unique IDentifier (GUID). The GUID identifies a specialized class that contains information for the auto-generated ML microartefact's operations. This auto-generation can be modelled by the *Framework's* ML.

The HMM formalism expresses a holistic structural concept or schema for the *Project*'s DMS's capabilities; the HMM formalism is a schema that can be used to automate ML microartefacts' implementation in various ADM cycles. It has an interface. The HMM formalism describes the common structure for a general microartefacts automation problem within the *Project* implementation phases by using the "1:1" concept; that makes the HMM holistic. The HMM formalism is a set of idioms and activities, where an

Figure 3. The graphical user interface for development and operation client interface.



idiom is a basic automation activity that is generic and not specific to any ICS implementation environment. An idiom describes the aspects of an artefact and its relationships with other *Project* artefacts, where the HMM formalism refers to automation scripts that are used to deploy a set of microartefact modules using an enterprise agile implementation methodology used in a business case.

The Business Case

This chapter's PoC implementation (which is in the same time this research's project experiment and the proof of its consistency) that is used throughout all the book's chapters, uses the default demo application named Handle Claim Process case study that comes with the Archi Archimate tool (Beauvoir & Sarrodie, 2018), as the experiment's *Project*'s and EA's case. The current Research and Development Project's (RDP) demo application is an insurance claims management system that has a Client Relationship Management (CRM) system, a transactional mainframe host system, claim data-oriented services subsystem, customer oriented services subsystem. This RDP's demo application manages, registers, accepts, valuates and invoices claims activities. The RDP's demo application uses the model's resources as a business case and shows the possibility to integrate EA artefacts for the PoC (Beauvoir & Sarrodie, 2018).

The Proof of Concept

Also already presented, the HMM RDP (or research experiment/PoC) was implemented using the research's cluster framework known as the *TKM&F* that had been developed by the author, using the RDP's Mathematical Language (ML), Microsoft's Visual Studio .NET, C/C++ and Java Extended Edition (JEE), as shown in Figure 4. The PoC is based on the HMM-based DMS and an internal set of CSFs' that are presented in CSA/CSF tables. These CSFs have bindings to specific research resources, where the HMM formalism was designed using an ML microartefacts, and object oriented enterprise architecture methodologies and tools. The HMM-based DMS processing model represents the relationships between this research's requirements, project ML generic WHAT? and microartefacts (or building blocks), unique identifiers and the three defined CSAs. The proof of concept was achieved using the development environment and the research framework that is shown in Figure 4. The development setup interface that is shown in Figure 26, can be launched from the frontend.

Once the development setup interface is activated, the RDP ML interface can be launched to implement the needed microartefact scripts to process the defined research item CSAs/CSFs. These scripts make up the kernel knowledge system and the HMM set of actions are processed in the background. The HMM uses a knowledge database that automatically generates decision making actions which make calls to DMS. This research's instance of the HMM and its related CSFs were selected as demonstrated previously, as shown in Figure 5.

The *TKM&F* and hence the RDP's main constraint is that CSAs/CSFs for simple research components, having an average result below the level defined by the *Manager;* and will be ignored. In the case of complex items like the HMM's holistic implementation an average result below 6.5 will be ignored.

Figure 4. The TKM&F's interaction and interfaces.

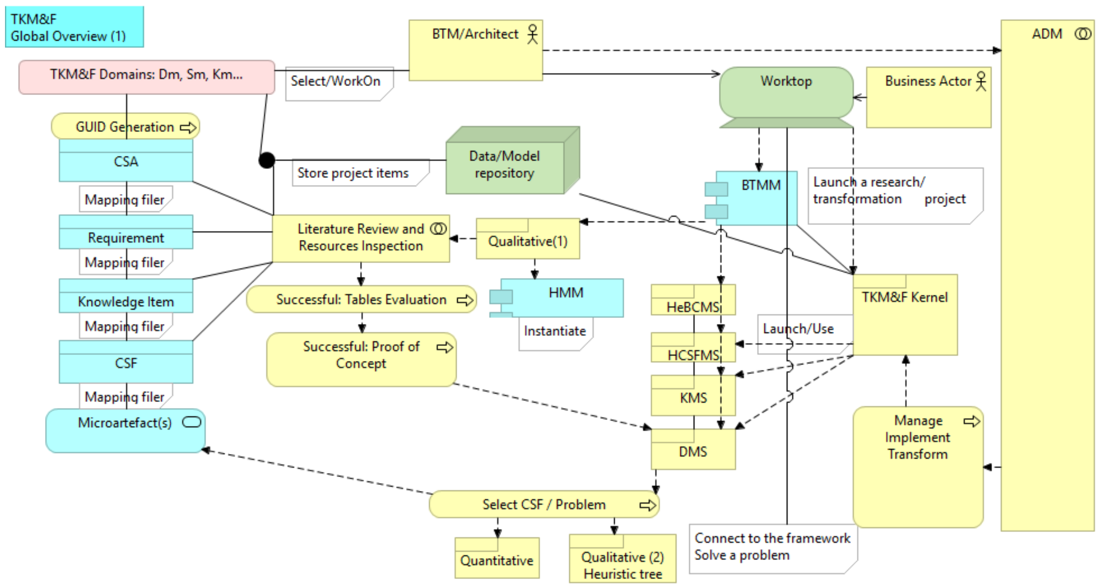
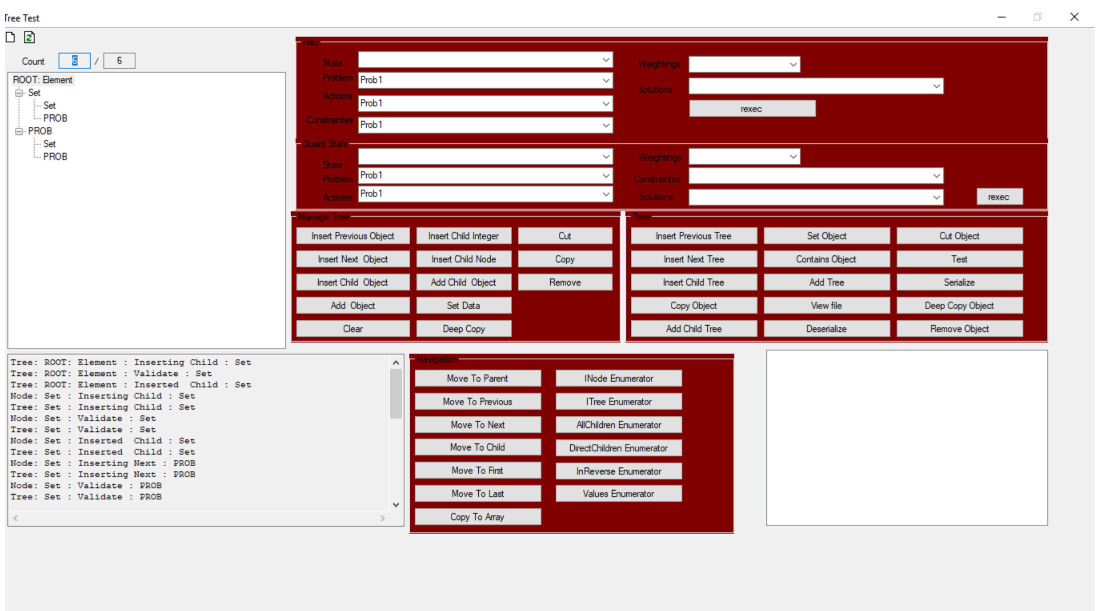


Figure 5. The heuristics tree interface.



SOLUTION AND RECOMMENDATIONS

In this book that is related to the HMM transformation initiatives and projects, the author will propose a whole set of business, transformation, architecture and technical recommendations, the resultant RDP tables can prove, by using the HMM implementation, the feasibility of the research project. Such implementation tends to be complex and very risky and should be simplified by the structured use of enterprise architecture, decision system and knowledge management systems. Some of the possible resultant technical and managerial recommendations that can be offered are:

- Unbundle the enterprise system to deliver the needed microartefacts library.
- Build an information system based on the HMM-like concept.
- On top implement a DMS.

FUTURE RESEARCH DIRECTIONS

The *TKM&F* future research efforts will focus on the various decision-making system like on automated tests in transformational initiatives in a cross-functional environment; in fields like financial crime.

CONCLUSION

This research book is part of a series of publications related to *Project*s, information systems, decision making systems and enterprise architectures. This book research is based on mixed action research model; where critical success factors and areas are offered to help *Project* architects to diminish the chances of failure when building development and operation systems. In this book, the focus is on the HMM's formalism that supports in defining a structured inter-relationship of microartefacts decision making fields. HMM decision making engineering concepts are an important factor for the business information system's evolution. The most important managerial recommendation that was generated by the previous research phases, was that the business transformation manager must be an architect of adaptive business systems.

The PoCs are based on the CSFs' binding to specific research resources and the internal reasoning model that represents the relationships between this research's concepts, requirements, microartefacts and CSFs. The final results clearly should prove that a decision-making engineering attempt for transformation is dangerously prone to failure; and that the HMM should support such a process. To avoid such a costly scenario, the author recommends performing the *Project* operations through multiple independent sub-projects, where the priority is to transform the information system, structure a mathematical model, decision making system and global architecture.

The advantages of the *TKM&F* are:

- A holistic decision-making concept.
- A cohesive and holistic enterprise architecture implementation methodology.
- Support to organisational engineering.
- Cohabitation with existing methodology and tools.
- Being an applicable concept and not a tool, so there is no notions of being locked-in.
- Ease of use by non-ICS personnel.
- Simplicity and not being complex like TOGAF.
- Coming out from academic and deliberated practices.

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KEY TERMS AND DEFINITIONS

ADM: Architecture development method.

CSF: Critical success factors; can be used to manage the statuses and gaps in various project plans and gives the projects the capacity to proactively and automatically recognize erroneous building blocks and to just-in-time reschedule the project plan(s).

DMP: Decision-making process.

DMS: Decision-making system.

EA: Enterprise architecture; aims to simplify the information systems (IS) of a company, and to reduce the cost of IS development and evolution.

EMS: Enterprise knowledge management.

HMM: Holistic mathematical model.

ICS: Information and communication system.

JEE: Java extended edition.

KMS: Knowledge management system.

Manager: Business transformation manager, in this research and framework.

MFD: Model first-driven.

ML: Mathematical language.

MM: Mathematical model.

NLP: Natural language programming.

Project: Business transformation project.

RDP: Research and development project.

TOGAF: The Open Group's architecture framework.

Chapter 2
An Applied Mathematical Model for Business Transformation and Enterprise Architecture:
The Applied Case Study (ACS)

ABSTRACT

This chapter presents an applied case study (ACS) that is supported by a proof of concept (PoC) that is implemented in each of this book's chapters to prove the feasibility of the chapter's and hence the book's HMM approach. The ACS/PoC are used to present the research's framework on how to support business transformation projects (BTP) and enterprise architecture projects (EAP) (or simply projects). The ACS/PoC is supported mainly by an adopted fictive case from the insurance domain. The uniqueness of the proposed HMM promotes a holistic enterprise architecture and an implementation model that supports complex case studies.

BACKGROUND

This book on transformation projects is a conclusion of many years of research and development that proposes a set of related cross-business domain Holistic Mathematical Model (HMM) for business transformation initiatives. This book's chapter presents the HMM that is the result of research on business case studies, business transformations, applied mathematics, software modelling, business engineering, financial analysis and global enterprise architecture. This ultimate research project is based on an authentic and proprietary mixed research method that is supported by an underlining mainly qualitative holistic reasoning module (Trad & Kalpić, 2017a, 2017b, 2017c, 2017d; Gunasekare, 2015). The proposed HMM formalism attempts to abstract some functions of the human empirical behaviour, which uses empirical processes and actions; which are mainly based on the beam-search, like heuristic decision-making process. The HMM can be used to implement a business/technical/transformation process, decision making system or an artificial intelligence based expert system that can integrate into the enterprise's business, information and communication technology environments. The HMM uses a behaviour driven

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development environment or a natural language environment that can be easily adopted by the project's development teams (Myers, Pane, & Ko, 2004; Kim & Kim, 1999; Della Croce & T'kindt, 2002). This chapter presents an Applied Case Study (ACS) that is supported by a Proof of Concept (PoC) that is implemented in each of this book's chapters to prove the feasibility of the chapter's and hence the book's HMM approach. The ACS/PoC are used to present the research's framework on how to support Business Transformation Projects (BTP) and Enterprise Architecture Projects (EAP) (or simply *Projects*). The ACS/PoC is supported mainly by an adopted fictive case from the insurance domain (Jonkers, Band, & Quartel, 2012a). The uniqueness of the proposed HMM promotes a holistic enterprise architecture and an implementation model that supports complex case studies (Farhoomand, 2004).

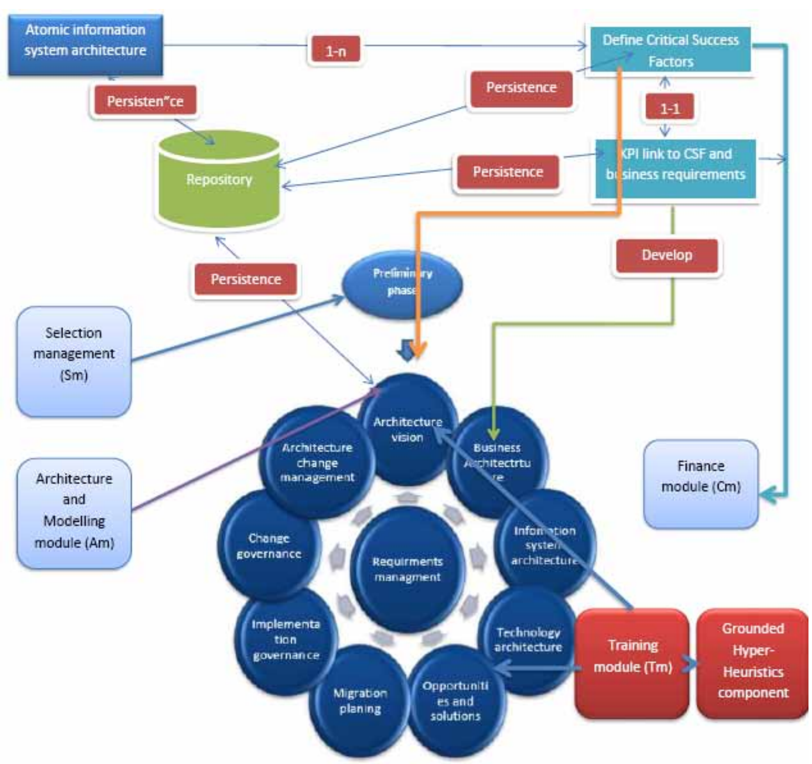
INTRODUCTION

Actual archaic *Project*s are managed as separate black-boxes that are isolated silos where their internal and external components create a messy hairball that is called the enterprise's Information and Communication System (ICS) (Desmond, 2013). The ACS/PoC can be used to present the feasibility of the implementation of the HMM for *Project*s in a variety of application fields, like: 1) *Projects*; 2) business engineering projects; 3) EAPs; and 4) other ... This book's chapter recommends that the resultant ICS's Decision Making System (DMS) uses the HMM instance to solve ACS problems by offering a set of possible solutions in the form of architecture, managerial and technical recommendations or blueprints. The ACS's proposed solutions, which have the form of technical and managerial recommendations, can be applied by the business environment's architects, business managers, business analysts and project engineers to enforce the implementation of the *Project*s. Such projects should surpass the in business environment currently used archaic PoCs. This book chapter's authors based their research model mainly on intelligent neural networks which can execute specific calls to quantitative modules and is supported by ICS driven development models, where both disciplines, applied mathematics and ICS models are complementary, due to the use of many existing industry standards, like for example the Architecture Development Method (ADM) (The Open Group, 2011a; Tidd & Bessant, 2009). The HMM holistic concept is mainly business driven and is agnostic to a specific business environment's technical internals. As shown in Figure 1, it has been decided by the authors that this genuine research framework should be founded on artificial intelligent artefacts that in turn are based on existing technology standards (Johnson & Onwuegbuzie, 2004).

The Business Transformation Manager (BTM) or an enterprise architect (simply the *Manager*) can integrate an HMM based DMS in the ACS/PoC to support recommendations (Trad & Kalpić, 2017b, 2017c, 2018a, 2018b; Tidd, 2006). To achieve this precise goal, the applied research methodology that is applied in this book's chapter is based on a specific mixed methodology (Easterbrook, Singer, Storey & Damian, 2008). For a successful integration of the ACS/PoC, the role of the *Project* team is crucial to select and evaluate the right Critical Success Factors (CSF) that are essential for the *Project* implementation. Selecting a huge set of possible CSFs, can negatively influence such *Project*s. A holistic system approach is the optimal choice to implement an ACS/PoC (Simonin, Bertin, Traon, Jezequel, & Crespi 2010; Daellenbach, & McNickle, 2005; Trad & Kalpić, 2017d). The proposed framework interacts with business users by means of a graphical user interface in order to manage the CSFs and launch the reasoning process, as shown in Figure 2.

Figure 1. Technology Trends (Cearley, Walker & Burke, 2016).

Figure 2. The research framework's concept (Trad & Kalpić, 2017d).



Building an ACS based PoC and the related set of heterogeneous project modules can be very complex and problematic; the main problem can arise due to the ACS's technical complexity, based on a jungle of used gadgets. The current book's chapters try to prove, using an ACS/PoC, the credibility of the chapter's Research Question (RQ). As shown in Figure 3, an adapted PoC development and iterative process is used, to support a research process.

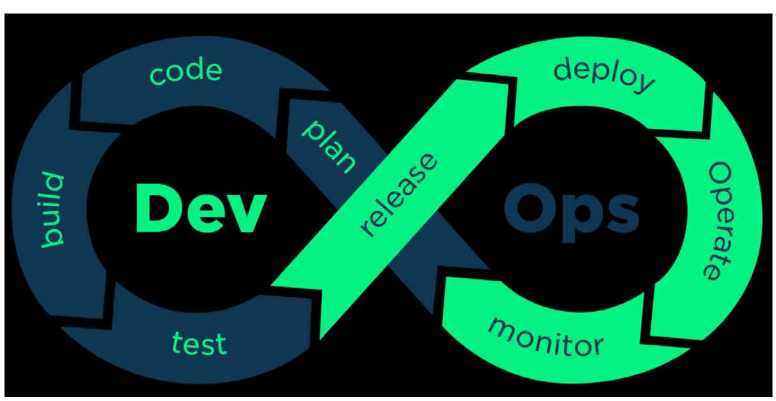
THE RESEARCH PROCESS

Today an important gap exists in this research area and this research is a pioneering work in the field. It tries to link the Mathematical Model (MM) to all levels of the *Project* and to the underlying ICS and testing its feasibility by using an ACS/PoC. Which is used in this book (Agievich, 2014). This is achieved by using an ACS, which is based on a fictive study. *Projects* are very risky and have a very high failure rate and one of the concrete reasons is that these *Projects* lack a cross-functional and holistic coordination. That is why the authors would like to contribute to enhance the success rate of such projects by presenting a methodology and an applied research framework (Tidd & Bessant, 2018).

The Applied Research Framework

The HMM based DMS defines an alignment strategy of the *Project* that should manage and enrich the enterprise's microartefact libraries and areas that in turn are modelled by an architecture formalism like the ADM (Lankhorst, 2009). The proposed ACS adapts to the research framework and supports such a complex formalism that combines enterprise architecture, decision making and various implementation standards with an HMM. The HMM can be applied to various types of *Project*s and other general projects and it is a part of the Research management module (Rm) and the Architecture module (Am), that in turn are parts of the research framework. In this book's chapter, the authors propose a set of HMM managerial and technical recommendations on how a reusable real-world framework should be implemented in form of a PoC (Trad 2018a; 2018b; 2018c; 2018d). The actual research book's chapter and the resultant experiment are also a part of the Selection management, Architecture-modelling, Control-monitoring, Decision-making, Training management, Project management, Finance management, Geopolitical man-

Figure 3. The agilization process (Kornilova, 2017).



agement, Knowledge management, Implementation management and Research management Framework (SmAmCmDmTmPmFmGmKmImRmF), for simplification reasons, in further text the term Trad Kalpic Methodology & Framework (*TKM&F*) will be used. *TKM&F* is not a black-box product to be applied as-is, it is rather an enterprise architecture strategy, recommendations and vision that each enterprise should implement by itself; that had been developed by the authors, using the Microsoft Visual Studio .NET, C/C++, Microsoft Office and Java development environments. This book's chapter's Research Question (RQ) is: "Can the selected case study and the applied proof of concept be used to prove the feasibility of the proposed business transformation project and applicability of the future enterprise architecture components?".

A common holistic objective of this book on business transformation and enterprise architecture projects in these domains is to deliver solution patterns and recommendations by proposing the already mentioned real world framework *TKM&F*. The named authors own the totality of rights, while IGI Global owns the copyright of this book. These two rights are distinct and different. The research process' first phase is the literature review phase, which verifies if the PoC would make sense or not.

The Research's Literature Review

The already mentioned RQ is focused on *Project*s' ACSs and PoCs that are covered by a literature review that tried to find publications related to the research topic. The outcome is that very little scholar or even general literature and research resources exist on the selected subject. Therefore, the authors consider their work as a pioneering one; the most relevant information found in literature was that there is a gap, in *Project*s and EA PoCs. The reason that EA methodologies are not used extensively to gain a sustainable business system, achieve a greater level of organizational alignment, improved decision making, and improved performance; it is unclear…(Syynimaa, 2015).

Empirical Engineering Research Model

This research book's chapter is based on an empirical engineering research approach (Johnson & Onwuegbuzie, 2004; Easterbrook, Singer, Storey, & Damian, 2008). It uses an authentic mixed method (where mixed research is a simplistic synonym) that can be considered as a natural complement to conventional qualitative and quantitative research methodologies, to deliver empirical pragmatic concepts as a possible holistic approach for mixed methods research. Empirical validity checks are performed, whether this research work is acceptable as a contribution to existing scientific knowledge. The researchers in this chapter wish to convince the valuable readers that recommendations in this chapter and the related PoC are valid. A controlled experiment or a PoC is a software prototype of a testable hypothesis where one or more CSFs (or independent variables) are processed to evaluate their influence on the model's dependent variables. Controlled experiments or proof of concepts permit to evaluate with precision the CSFs, and if related, whether a cause–effect relationship exists between these CSFs; which are used in the ACS.

THE APPLIED CASE STUDY'S BASICS

ACS is a fictive case study that has been developed by the Open Group as a reference study and that is why the authors have decided to use it. The Open Group's case study presents the possibilities to implement

*Project*s; using ArchiMate's modelling language (The Open Group, 2011a, 2011b). The ACS is related to a fictive insurance company named ArchiSurance. ArchiSurance has supposedly resulted from the merger of three independent insurance companies, situated in different metropolitan areas. ACS describes the *Project* and a set of transformation scenarios. This ACS is used throughout the book's chapters as the basis of a PoC. This book's ACS illustrates the realistic use of the ArchiMate in the context of The Open Group's Architecture Framework's (TOGAF). This ACS presents the *Project*'s baseline business, application, data, and technology architectures, making use of the appropriate ArchiMate viewpoints that are incorporated in the *TKM&F*. The ACS presents also two transformation scenarios: 1) The first scenario provides an implementation of views presenting the *Project* implementation cycle; showing the *Project*'s vision, business goals, principles and requirements, the transformed business, application, data, and technology architecture; and 2) the second transformation adopts the transformed environment from the first scenario as the new transformation (or a *Project* iteration), where the end clients gain direct access to their e-insurance contracts (Jonkers, Band, & Quartel, 2012).

The Merger, a Transformation Process

The ACS describes a merger of three independent insurance companies and the transformed company consists of three divisions and headquarters. The ACS was designed to take advantage of synergies between the three organizations. The three pre-merger insurance companies sold different types of insurance policies, but they had similar Business Models (BM). All three companies offered insurance policies through the Internet-related technologies including e-mail, telephone, and postal mail channels. Geographically in different locations, with specific customer groups, all the three companies were privately owned by investors. The principal investors had launched a merger transformation to improve competitivity. A larger, unified company should optimize its costs, improve customer satisfaction, invest in *Project*s to become more automated. The merger transformation took 18 months and the new company is offering all the insurance products of the three merged companies. The merger *Project* has demanded many integration and alignment initiatives for the reengineering of Business Processes and ICS' integration. The *Project* results are visible in the unified company's baseline business, application, data, and technology architecture (Jonkers, Band, & Quartel, 2012).

The Architecture Modelling Language

Figure 5 shows ArchiMate layers of intervention and it provides a standardized representation for *Project* models to support the *Project* cycles (Beauvoir & Sarrodie, 2018). It understands core language that can be used to describe the actual situation (business, information systems, and technology architectures, as well as their mapping-relationships) that are used in the ADM.

The Architecture Development Method

Figure 6 shows the ADM's most important phases that can be used to define viewpoints and communicate different characteristics of a *Project* model. The ADM implements *Project* architectures, while ArchiMate focuses on a language to implement microartefacts (The Open Group, 2011a; The Open Group, 2011b).

Figure 7 shows how the core language is linked to the ADM that can be used to define viewpoints and communicate different characteristics of a *Project* model.

Figure 4. The result of merger of three insurance companies (Jonkers, Band, & Quartel, 2012).

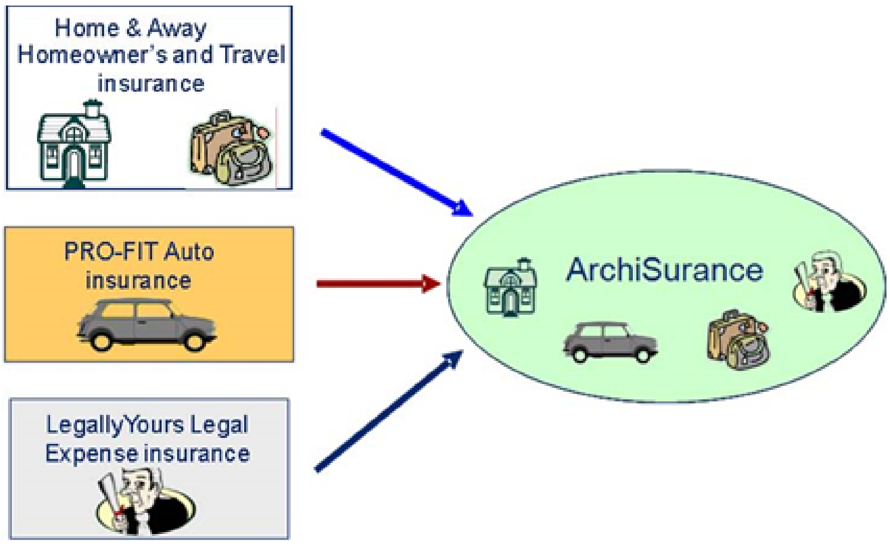
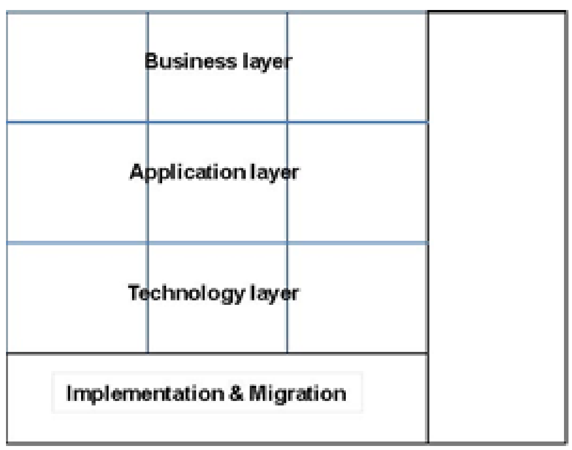


Figure 5. The ArchiMate levels of usage (Jonkers, Band, & Quartel, 2012).



But first, the TOGAF ADM Preliminary Phase establishes a motivational context for these challenges.

The Applied Case Study's Critical Success Factors

For a successful integration of the HMM in *Project*s, the BTM's profile and role are crucial and his or her (for simplicity, in further text – his) decisions are supported by the selection and implementation of Critical Success Factors (CSF) that are essential for the *Project* development process. Selecting a huge set of possible CSFs, can negatively influence such DMSs. Examples of sets of CSFs can be the following: a) *Project* risks; b) enterprise architecture evaluation; c) enterprise tangible and intangible resources management; d) employee skills and human management; e) evaluation of engineering and

Figure 6. The methods phases (Jonkers, Band, & Quartel, 2012).

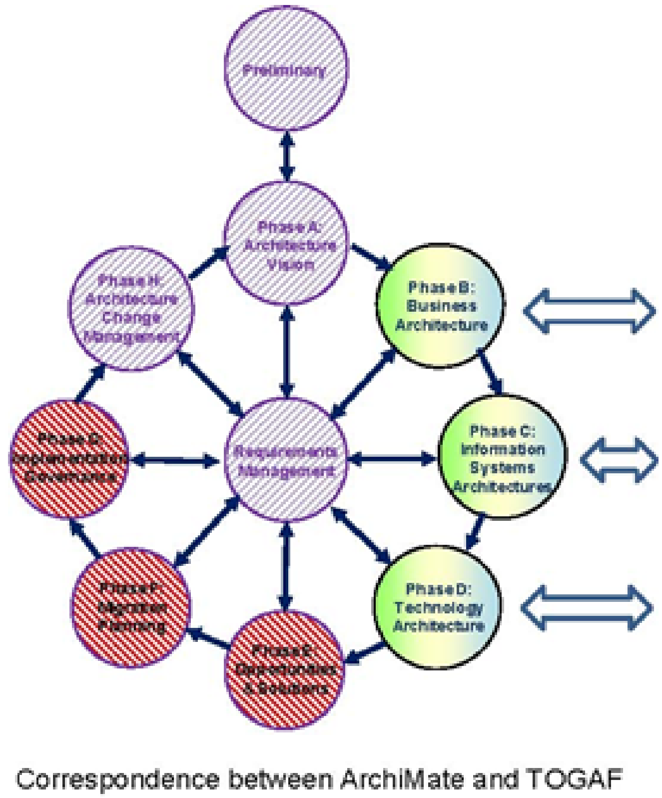


Figure 7. The ArchiMate and methods interaction (Jonkers, Band, & Quartel, 2012).

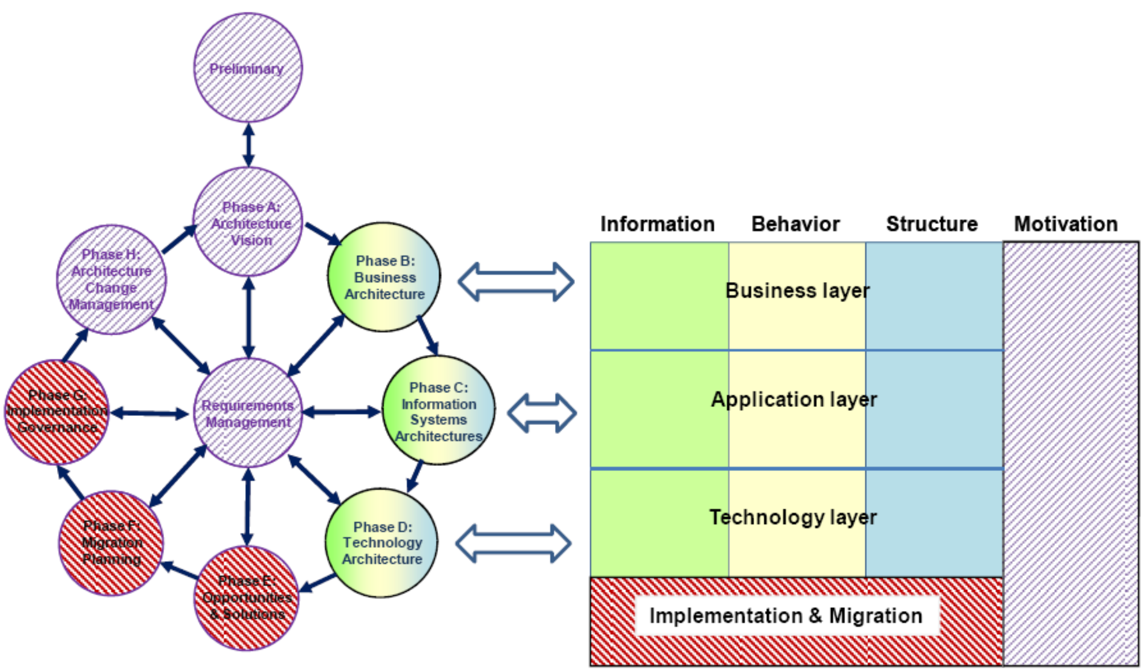
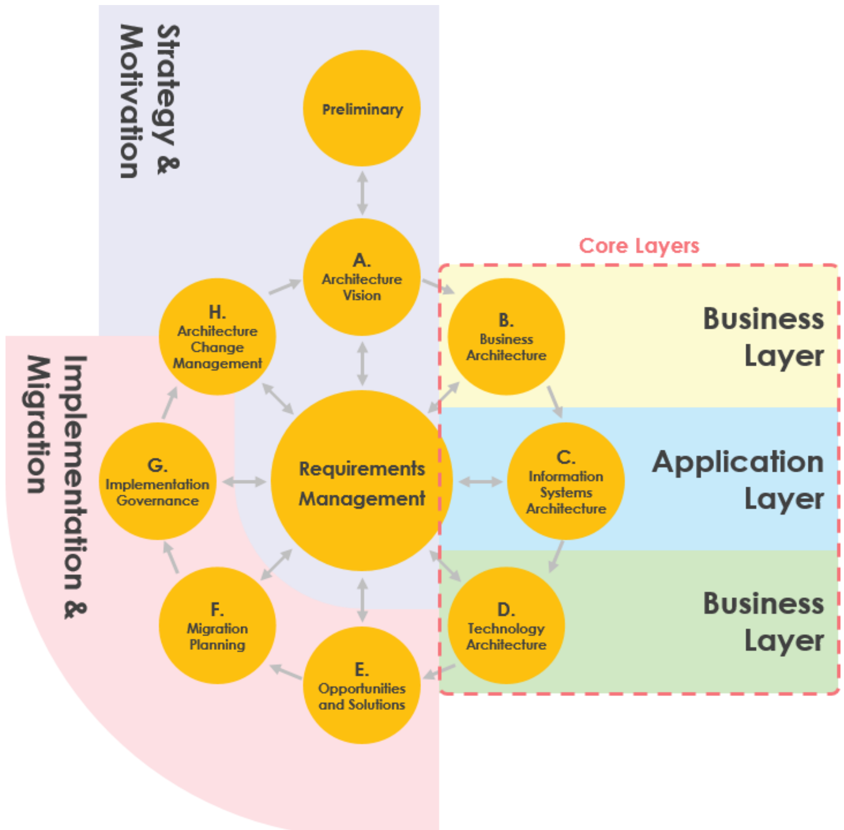


Figure 8. The architecture development method phases (Visual Paradigm, 2019).



infrastructure technological statuses; f) implementation tests and qualification environments; g) risk management mechanisms; h) enterprise control and monitoring mechanisms; i) project status; and j) enterprise financial accounting and audit. A holistic system approach is the optimal choice to integrate an HMM based DMS in the *Project* (Simonin, Bertin, Traon, Jezequel, & Crespi 2010; Daellenbach & McNickle, 2005; Trad & Kalpić, 2017d). The DMS interacts with business users by means of a graphical user interface in order to manage the CSFs and launch the reasoning process. Based on the literature review and related evaluation processes, the most important ACS's CSFs that are used and evaluated. The evaluation is done respecting the following rules:

- References should be credible and is estimated by the authors, the notions of ranking is less important because of the ego-concentration of closed circles of influence. By references it is meant the origins found in various types of literature and other resources, while the credibility of these references is estimated by Key Performance Indicators (KPI): 1) the authors' experiences that is 20% of the estimation value; 2) statistical checkers like Gartner that is 20% of the estimation value; 3) various company's and specialists surveying that is 20% of the estimation value; 4) code/application sources that is 20% of the estimation value; and 5) simulation in the proof of concept and frequency that is 20% of the estimation value.

- Merger is the result of organisational changes in the company aiming that former separate entities start behaving like a single organisation with consolidated resources and interests. Whether it was successful is measured by the references presented in the previous point.
- Modelling language should be limited in order to make it manageable and not too complex for use. Whether it is usable can be estimated from literature or from own working experience or firm references like Gartner.
- The ADM is considered to be mature if it has been in use for more than ten years and that it has been reported successful; the interest in using TOGAF is very high and its ADM kernel is about 90% (Alm & Wissotzki, 2015; Kotusev, 2018). Unfortunately that does not mean that the transformation projects are successful and in fact their success rate is low, some publications speak about less than 10% success rate (Mintzberg, 1994). The ADM is appropriate for any project's local conditions.

As shown in Table 1, the result's aim is to prove or justify that the ACS can be used with ArchiMate and ADM for proof evaluating of *Project*s that are enforced by using the *TKM&F*. The next CSA to be analysed is the integration of HMM category.

THE APPLIED MATHEMATICAL MODEL'S USAGE

Quantitative Research Model

The *TKM&F* qualitative research module enables a holistic systematic approach to researching a problem, RQ, factor or phenomenon in given *Project* environment situation (Gast, 2010). It offers an research process capacities to recommend actions and solutions (Lincoln & Guba, 1985). A problem, RQ, factor or phenomenon are examined in iterations relating breadth and depth, using heuristics/beam search, which is specialized for unknown problems or the ones are in a preliminary phase or first iterations (Babbie, 1989). The solutions or recommendations are offered in the form of reports of professional or academic experiences (Capaldi & Procter, 2005). The qualitative research module processed solutions or recommendations are generated by experiments/PoCs, specialists interviews, direct professional observations, processing and analysis of *Project* artefacts, credible documents from for example Gartner or Forster and reference records, visual materials or personal mixed experiences (Denzin & Lincoln, 1994). The solutions or recommendations are delivered with the aim of formulating hypotheses outcomes.

Table 1. The applied case study's critical success factors that have an average weighting of 9.25

Critical Success Factors	**KPIs**	**Weightings**
CSF_ACS_References	Credible	From 1 to 10. 10 **Selected**
CSF_ACS_Merger	Successful	From 1 to 10. **10 Selected**
CSF_ACS_ModellingLanguage	LimitedButUssuable	From 1 to 10. 8 **Selected**
CSF_ACS_ArchitectureDevelopmentMethod	Mature	From 1 to 10. 9 **Selected**

Qualitative Research Model

The *TKM&F* qualitative research module enables a specific quantitative analysis and a precise focus on proving or disproving RQ, problem or hypotheses in a cause-effect manner by applying a detailed and precise processing of pre-defined variables; CSFs in the research process (Shuttleworth, 2008). The *TKM&F* qualitative research module input data streams(s) consists of sets of numbers that are collected from sets generated by using designed/structured and approved/validated data object-collection modules and statistically processes. The *TKM&F* qualitative research module results are used to generalized for a given qualitative node and can be applied to other qualitative tree node that gives the ability to analyse the cause and effect; as well as offering solutions or recommendations, even make proactive estimations (Leung, 2015). The *TKM&F* qualitative research module input data streams(s) can be fed from experiments/PoCs, surveys, interviews with precise questions (Kelley, Clark, Brown, & Sitzia, 2003).

The Model's Basics

The *Project* has a major precondition that the traditional business environment must undergo a total and successful HMM based unbundling process, before the transformation activities start. The unbundling insures that the ICS microartefacts are ready to be used. This research offers the HMM that is an abstract model containing a Mathematical Language (ML) that can be used to describe, transform and implement the behaviour of any business system and its ICS (Goikoetxea, 2004). The HMM that is based on related Research and Development, conducted by many authors and development works, can be used in natural sciences, social sciences and engineering fields; where managers, engineers, computer scientists, and economists can use HMM to solve various project problems and model their kernel enterprise architectures. The HMM that is presented in Figure 9, in a simplified form, to be easily understood on the cost of a holistic formulation of the architecture's vision. The HMM's instance is used to solve a *Project* problem.

As shown in Figure 9, the abbreviation "mc" stands for mirco.

Figure 9. The applied mathematical model's nomenclature (Trad, & Kalpić, 2017a).

AMM4BT

rncRequirement	= KP I	(1)
CSF	= Σ KPI	(2)
CSA	= Σ CSF	(3)
Requirement	= $\underline{\cup}$ rncRequirement	(4)
(e)neuron	= action+ rncInteligenceArtefact	(5)
mcArtefact	= $\underline{\cup}$ (e)neurons	(6)
rncEnterprise	= $\underline{\cup}$ mcArtefact	(7)
(e)Ellterprise	= $\underline{\cup}$ rncEnterprise	(8)
mcArtefactScenario	= $\underline{\cup}$ mcArtefactDecisionMaking	(9)
IntelligenceComponent	= $\underline{\cup}$ mcArtefactScenario	(10)
OrganisationalIntelligence	= $\underline{\cup}$ InteligenceComponent	(11)
AMM4BT	= ADM+ OrganisationalIntelligence	(12)

The symbol ∑ indicates summation of weightings/ratings, denoting the relative importance of the set members selected as relevant. Weightings as integers range in ascending importance from 1 to 10.

The symbol U indicates sets union.

The proposed HMM enables the possibility to define *Project*s as a model; using CSFs weightings and ratings.

The selected corresponding weightings to: CSF ϵ { 1 … 10 }; are integer values.

The selected corresponding ratings to: CSF ϵ { 0.00% … 100.00% } are floating point percentage values.

The Applied Mathematical Model's Structure

A holistic HMM for *Projects* has a composite structure that can be viewed as follows:

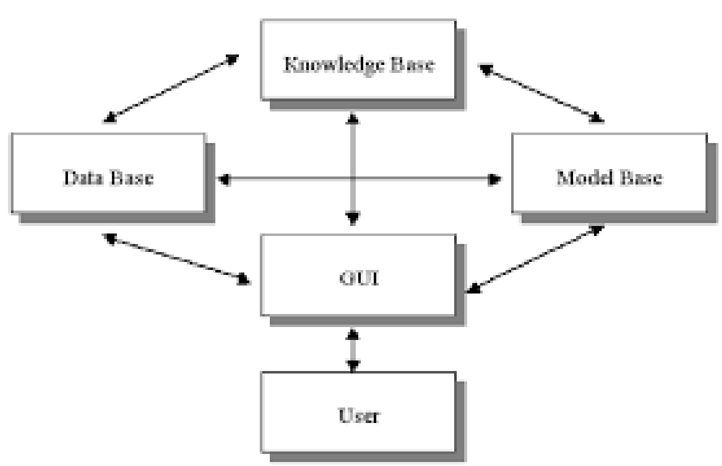
- The static view, has a similar static structure like the relational model's structure that includes sets of CSAs/CSFs that map to tables and the ability to create them and apply actions on these tables; in the case of HMM it is (e)Business microartefacts and not tables (Lockwood, 2018).
- The behavioural view, These actions are designed using set of mathematics nomenclature, the implementation of the HMM is the internal scripting language; used also to tune CSFs (Lazar, Motogna, & Parv, 2010).

Is the skeleton of the *TKM&F* that uses (e)Business microartefacts' scenarios to support just-in-time *Projects* requests.

The Applied Transformation Mathematical Model

A holistic HMM is a part of the *TKM&F* that uses microartefacts to support just-in-time DMS that can be called from the graphical user interface. The DMS components and interfaces, as shown in Figure 10, are based on a light version of the ADM.

Figure 10. The decision making system's components



The transformation is the combination of an enterprise architecture methodology like TOGAF and the HMM that can be modelled after the following formula for the Transformation Mathematical Model (TMM) that abstracts the *Project*:

(HMM): The Applied Mathematical Model

(AMM) = Weigthing_1 * AMM_Qualitative + Weigthing_2 * AMM_Quantitative (1).

HMM = $\sum$ AMM for an enterprise architecture's instance (2).

(TMM):

TMM = $\sum$ HMM instances (3).

The objective function of the TMM's formula can be optimized by using constraints and with extra variables that need to be tuned using the HMM. The variable for maximization or minimization can be, for example, the *Project* success, costs or other (Dantzig, 1949; Sankaralingam, Ferris, Nowatzki, Estan, Wood, & Vaish, 2013). For a detailed explanation of the formulas, the reader should refer to the book's chapter related to the mathematical model. For this PoC, the success will be the main and only constraint and success is quantified as a binary 0 or 1. Where the objective function definition will be:

Minimize risk for TMM (4).

The HMM instance is based on a concurrent and synchronized *TKM&F*, which uses concurrent threads that can make various HMMs run in parallel and manage information through the use of the HMM's mathematical choreography/language. The TMM is the combination of an EAP, *Project* methodologies and a holistic mathematical model that integrates the enterprise organisational concept, information and communication technologies that must be formalized using a functional development environment.

Functional Development *TKM&F*

The *TKM&F's* internal functional development tool and its mathematical choreography/language can be used for various application domains, which concept is similar to the Behaviour Driven Development or Neuro Linguistic Programming (NLP) that are used in general for hard systems' thinking. The HMM uses Behaviour Driven Development and NLP like scripts that are interpreted and executed in real-time; these scripts can be implemented and maintained by business professionals with no prior computer science or mathematical background. That is why the authors recommend the use of an interpretable NLP based HMM as the fundament of a framework (Moore, 2014).

Framework and the Applied Mathematical Model

A generic *Project* model and its kernel ADM are the base of this Research and Development and they are the basics of its *TKM&F.* The authors want to propose a mathematical model to represent the *Proj-*

ect's global architecture and solve its problems. The literature review process, has shown that existing research resources on EA, as a mathematical model, are practically inexistent. This pioneering research work is cross-functional and links all the *Project*'s microartefacts to *Project*s and enterprise architecture method (Agievich, 2014).

The Mathematical Model's Integration Critical Success Factors

Based on the literature review process, the most important mathematical model's CSFs that are used are evaluated in the following table:

As shown in Table 2, the result's aim is to prove or justify that it is complex but possible to implement a mathematical model as the base structure of *Project*. Today, the proposed model is stable and totally applicable. The next CSA to be analysed is the holistic management of the ICS category.

THE CASE STUDY'S INTEGRATION INTO THE INFORMATION AND COMMUNICATION TECHNOLOGY SYSTEM

Today many technology standards exist, and their related tooling and development environments are supposed to support the iterative *Project* unbundling process of a traditional business and its ICT environments, through the execution of an agile ADM (Tidd & Bessant, 2009). Unfortunately, the actual archaic methodologies and ICT infrastructures are not in an advanced synchronized stage and are silos-like and cannot support an agile *Project* that in theory may drive the business company to participate in dynamic microartefacts development, operations, choreography and maintenance phases.

Development, Choreography and Maintenance

Actual architecture, modelling, development, operations, integration and transformation tools/environments are skeletons that should enclose various automated ML and generic microartefacts building capabilities, needed in a holistic and unified implementation strategy for a *Project*. The *TKM&F* offers a high level interpreted microartefacts implementation environment, which includes the instantiation of HMM composite objects that can be used to enable fast *Project* development, operations, integration and testing iterations and to support its future maintenance. The HMM formalism is based on existing proven standard design and architectures that are based on service oriented architecture to support internal process choreography.

Table 2. The critical success factors that have an average of 9.33

Critical Success Factors	KPIs	Weightings
CSF_MM_Integration	Feasible	From 1 to 10. **9 Selected**
CSF_MM_TMM	VerifiedModel	From 1 to 10. **10 Selected**
CSF_MM_ADM	Synchronized	From 1 to 10. **9 Selected**

The Design First Process

Defining a microartefact granularity and responsibility for a *Project*s is a complex process; added to that, there is the complexity in implementing the "1:1" mapping and classification of the discovered microartefacts. The applied design concept uses standard design methodologies like the TOGAF's ADM and/or the Unified Modelling Language. Mapping of a requirement's Use Case to a ML (or standard) microartefact in the form of a class diagram and/or communication diagram, is done through various HMM's capabilities that can be used and deployed using the HMM's MLs. This proposed design and mapping concepts are supported by a set of the *TKM&F's* microartefacts where its internal HMM ML consists of implementing microartefacts to dynamically evaluate compound expressions, according to the HMM principles (Neumann, 2002).

Integration Lifecycle with Existing Rapid Application Development

HMM needs a real world, technically agnostic development tool like the enterprise's Rapid Application Development (RAD) environments; by agnostic, the authors would like to point out the importance of abstracting the software implementation processes. So instead of engineering HMM solutions, JEE or other RAD engineers, preferre spending weeks searching for and then integrating tools or gadgets that could have been developed in-house in a shorter time, what additionally complicates the adoption of a stress tests.

Holistic Tests

The major problem that causes a *Project* to be stopped or to fail, is the performance problem, which in general in business enterprises is translated and justified by the human behavioural aspects; that is the major reason for the emergence of the saviour's new mirage, Microservices and astonishingly again with the same mammoth approach, JEE…

Figure 11 shows that actual development and operations for decision making systems is still in an infancy age and enterprises are losing a lot of energy on putting *Project*s together. JEE RAD and hyper comfort natural implementation environments are still confronted with serious project issues. These problems show that RAD tools are still immature for large enterprise intelligent applications and hence *Project*s (Gartner, 2016).

The Information and Communication Technology's Critical Success Factors

Based on the literature review process, the most important ICT's CSFs that are used are evaluated to the following:

As shown in Table 3, the result's aim is to prove or justify that it is complex but possible to implement an ACS and the ICT system. The next CSA to be analysed is the holistic management of the ADM.

Figure 11. The expected decision making based systems' evolution (Gartner, 2016)

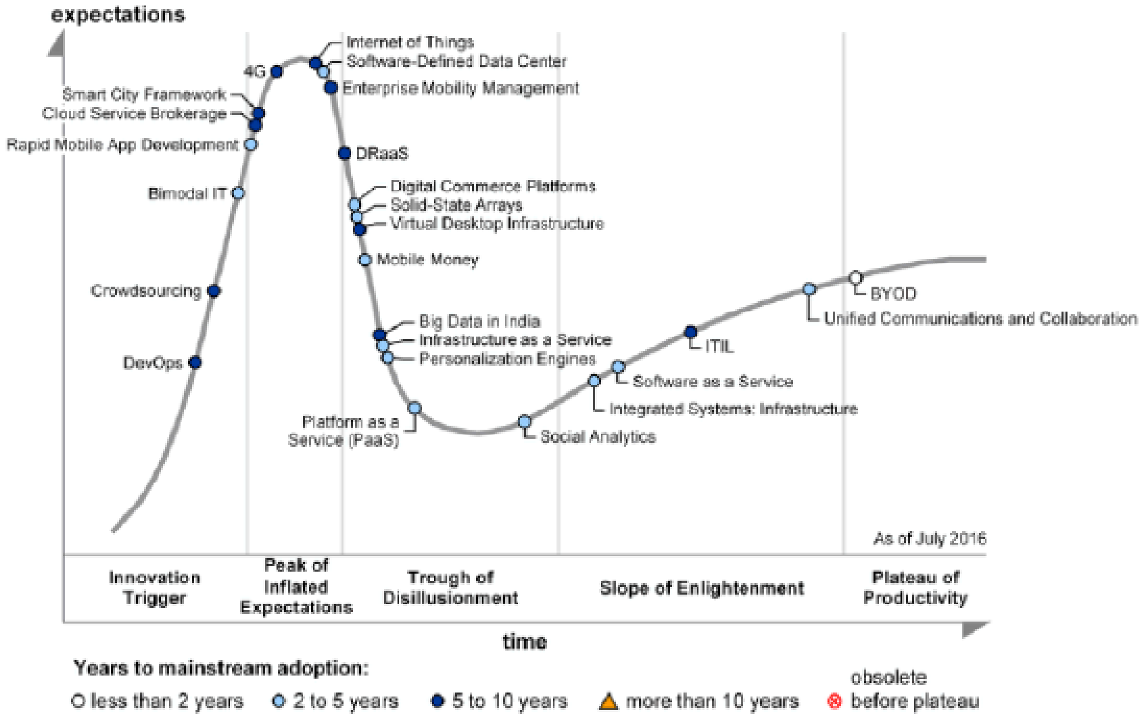


Table 3. The critical success factors that have an average of 9.2

Critical Success Factors	AHMM enhances: KPIs	Weightings
CSF_ICT_IntegrationProcesses	Supported	From 1 to 10. **9 Selected**
CSF_ICT_Operations&Choreography	CanBeAutomated	From 1 to 10. **8 Selected**
CSF_ICT_DesignProcess	Supported	From 1 to 10. **9 Selected**
CSF_ICT_McLifecycle	ExistingProcedures	From 1 to 10. **10 Selected**
CSF_ICT_RAD	ExistingEnvironments	From 1 to 10. **10 Selected**
CSF_ICT_Tests	ExistingTests	From 1 to 10. **10 Selected**

THE CASE STUDY'S INTEGRATION WITH THE ARCHITECTURE DEVELOPMENT METHOD

The HMM's integration with the ADM, enables the automation and the auto-generation of the project's ML and other generic microartefacts. These microartefacts management scripts circulate throughout all the ADM phases and in various iterations. This circulation process is synchronized and managed by their identifiers. The ADM encloses cyclic processes that are managed by *Project* iterations; where information about all ML microartefacts is logged in ICS tracing subsystem. The ADM is a generic method and recommends a set of phases and iterations to develop *Project*; it designs parts of the transformed system interfaces other deliverables from other frameworks. In this section, the authors present ADM's phases and the ACS/PoCs implications on the *Project* (Visual Paradigm, 2019).

The Preliminary Phase

Preliminary activities prepare the business enterprise for a successful *Project*; Figure 12 shows such a figure that identifies two stakeholders of the ArchiSurance board of directors and their main requirements that are modelled as project drivers. Customer satisfaction is an objective and a main requirement; another objective is stakeholder's satisfaction (Jonkers, Band, & Quartel, 2012).

The ArchiMate principles viewpoint, is shown in Figure 12, presents the principles and their dependencies. The principles viewpoint allows architects to model the principles that are important from the *Project* point of view (Jonkers, Band, & Quartel, 2012).

The transformed business environment consists of the major business requirements/objectives that are translated to a set of CSFs that in turn are linked to the major business goals and *Project* principles. The most relevant business goals and principles for the ACS/PoC are shown in Figure 14.

Architecture Vision and Business Architecture

Architecture Vision and Business Architecture models the scope, constraints and objectives for the *Project*; validates the business capabilities and creates the Statement of Architecture Work. As shown in Figure 15 and on Figure 16, representing the organizational view following the merger, ArchiSurance

Figure 12. Fragment of a stakeholder view (Jonkers, Band, & Quartel, 2012)

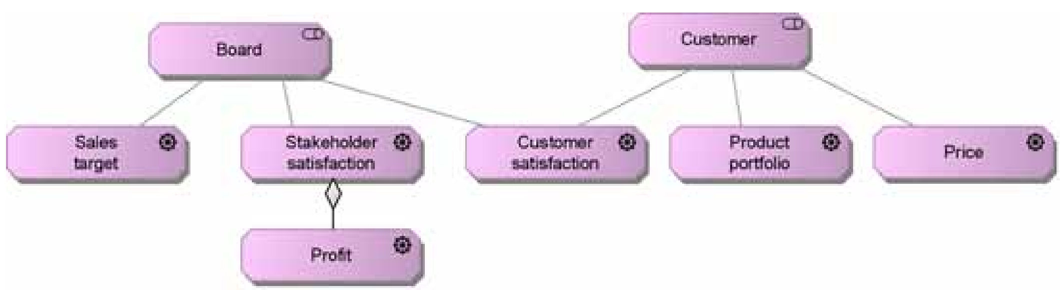


Figure 13. Principles view (Jonkers, Band, & Quartel, 2012)

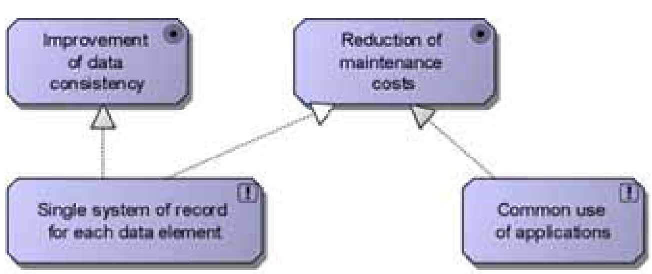
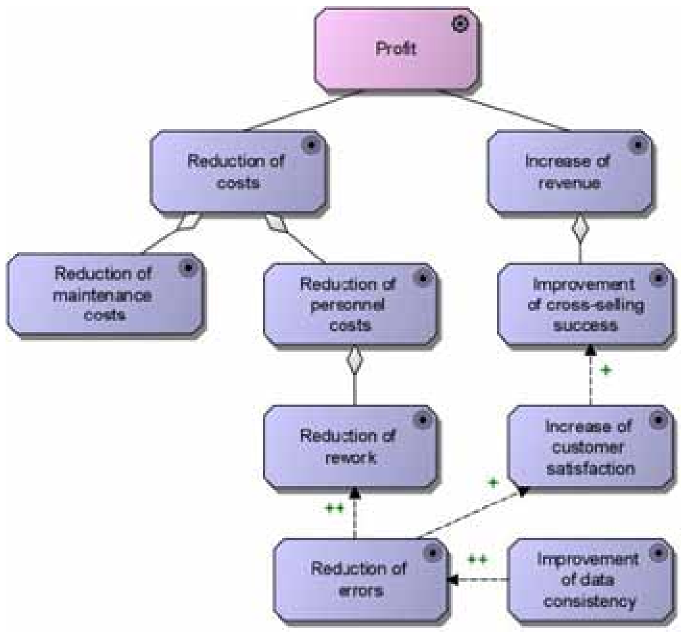


Figure 14. Business goals associated with the driver profit (Jonkers, Band, & Quartel, 2012)



established a shared front-office as a contact centre for sales services but there are still three independent back-offices that manage the insurance products of the original companies.

A Shared Service Centre (SSC) was created for document processing at the pre-merger headquarters, called PRO¬FIT that manages also the business processes. To ensure business continuity, the SSC also hosts trained personnel and equipment to support the front-office (Jonkers, Band, & Quartel, 2012).

Business architecture can model ArchiSurance's organizational structure, products, services, business processes, and data flows. Business architecture models the data, application, and technology architecture blueprints as shown in Figure 17. This view shows the structure of ArchiSurance (Jonkers, Band, & Quartel, 2012).

An ArchiMate business processes related to selected CSFs and the main business activities are:

- Marketing.
- Actuarial.
- Customer Relations.
- Underwriting.
- Claims.
- Finance.
- Document Processing.
- Investment Management.

Figure 17 shows the main business activities of ArchiSurance and the data flows (Jonkers, Band, & Quartel, 2012).

An ArchiMate business process, groups those activities that describe products or services. The business process viewpoint models the structure business processes. Figure 18, shows the two central

Figure 15. Case study's main departments (Jonkers, Band, & Quartel, 2012)

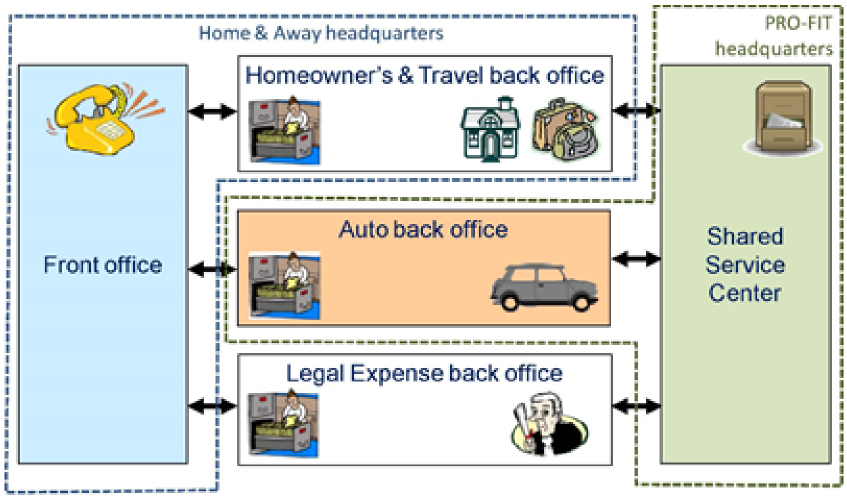
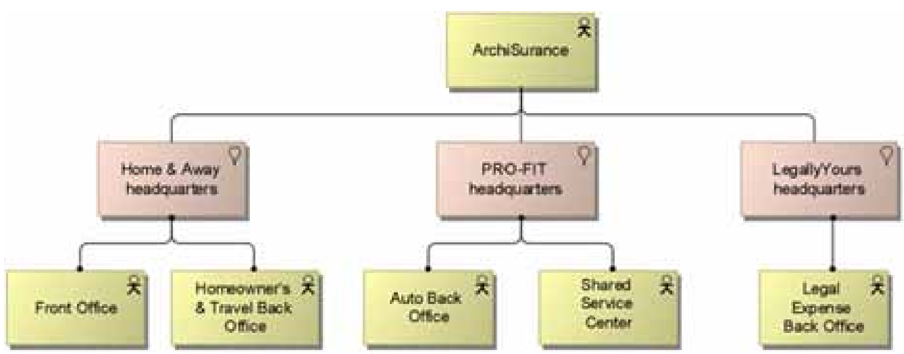


Figure 16. Organization View (Jonkers, Band, & Quartel, 2012)



business processes of ArchiSurance, with their high-level sub-processes: Contract management, which is performed when selling a new insurance product, and Handle claim, which is performed when a damage claim has been received. While the details of these processes may differ for the different types of insurance product, the main steps are the same (Jonkers, Band, & Quartel, 2012).

Information System's Architectures

This phase develops the *Project*'s ICT architectures and their baselines. After the merger, the three divisions have one web portal, online contact centre and document database. The *Project* has selected a strategic Client Relations Management (CRM) system and integrated it in: 1) Home & Away; and 2) PRO-FIT. After the merger ArchiSurance's CSFs are also: 1) performance expectations; 2) minimize ICT costs. Home & Away continue using policy administration and financial system, while PRO-FIT continue using their original custom monolithic applications.

Using ArchiMate the ACS, defines an Application Co-operation viewpoint, as shown in Figure 19, to present the overview of the ACS's application landscape and the dependencies between them. This

Figure 17. Global organizational structure of ArchiSurance (Jonkers, Band, & Quartel, 2012)

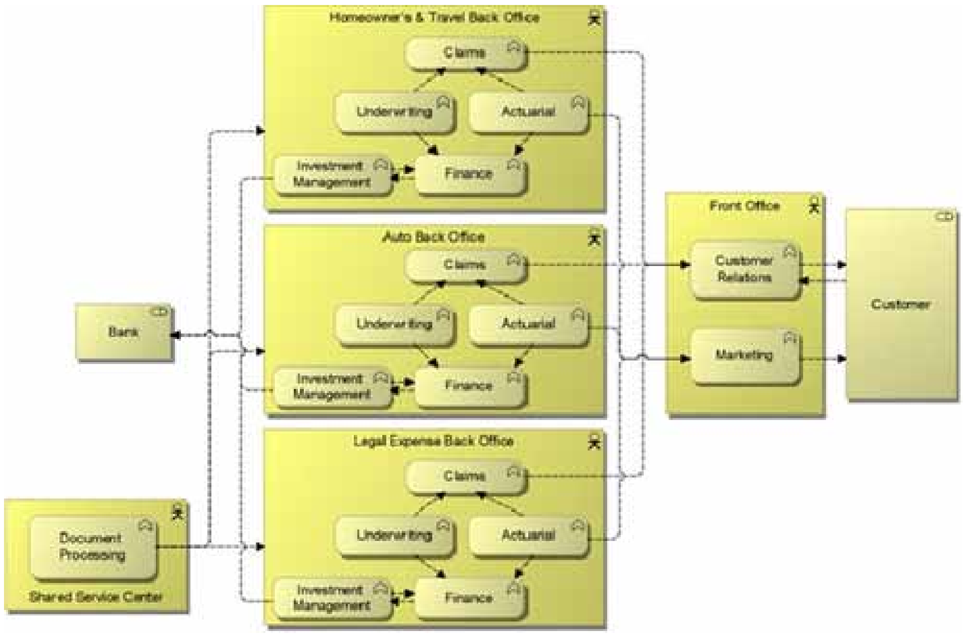
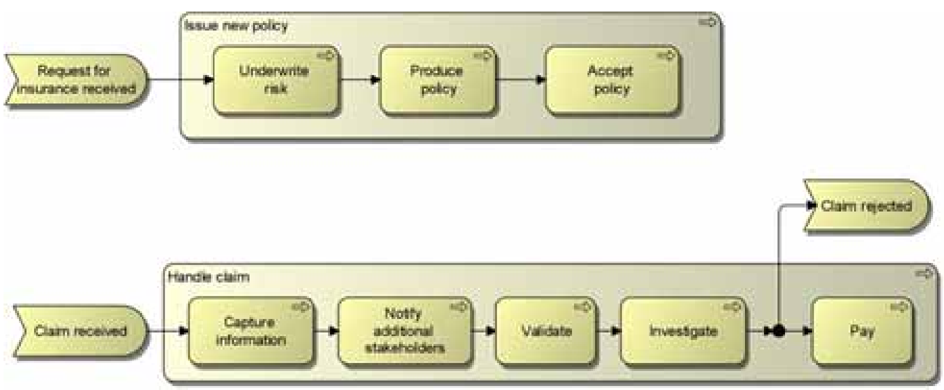


Figure 18. Business process view (Jonkers, Band, & Quartel, 2012)



viewpoint is applied to develop an overview of the application landscape of the business enterprise. This viewpoint is also applied to present the internal orchestration of microartefacts needed by the business processes.

The ACS uses the Application Usage viewpoint to describe how applications integrate business processes. This view is used to design business applications by selecting the needed microartefacts called by business processes. It identifies also the relationships of business processes and applications that are useful to *Project* teams.

The Application Service concept has a crucial role in this viewpoint, where Figure 20, shows the set of microartefacts used by Home & Away division of ArchiSurance, and its main processes of claim handling.

Figure 19. Application Landscape (Jonkers, Band, & Quartel, 2012)

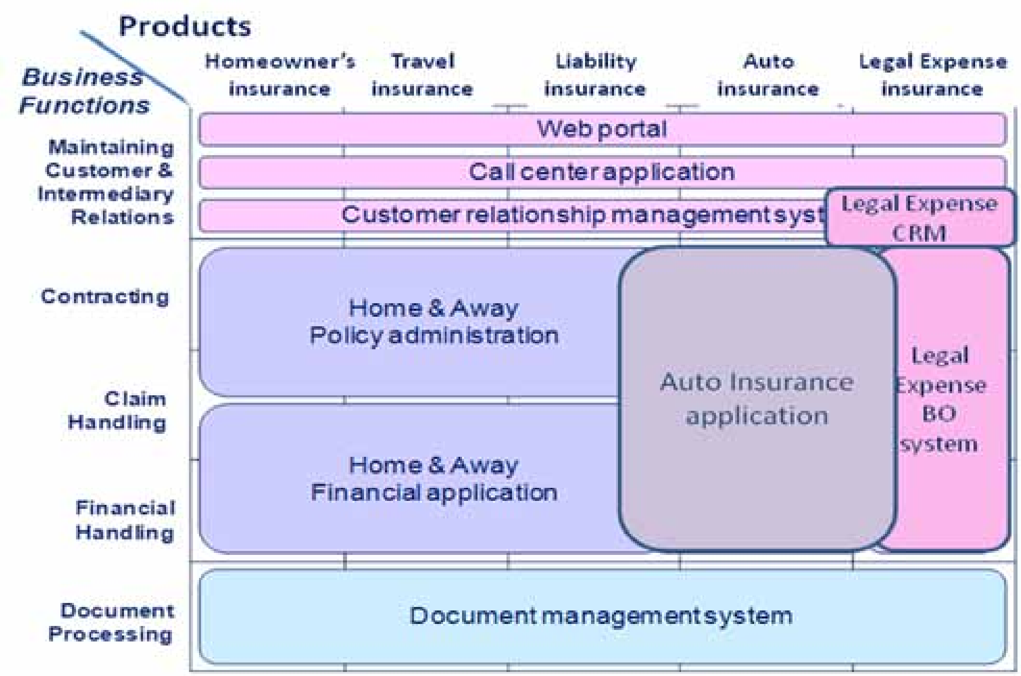
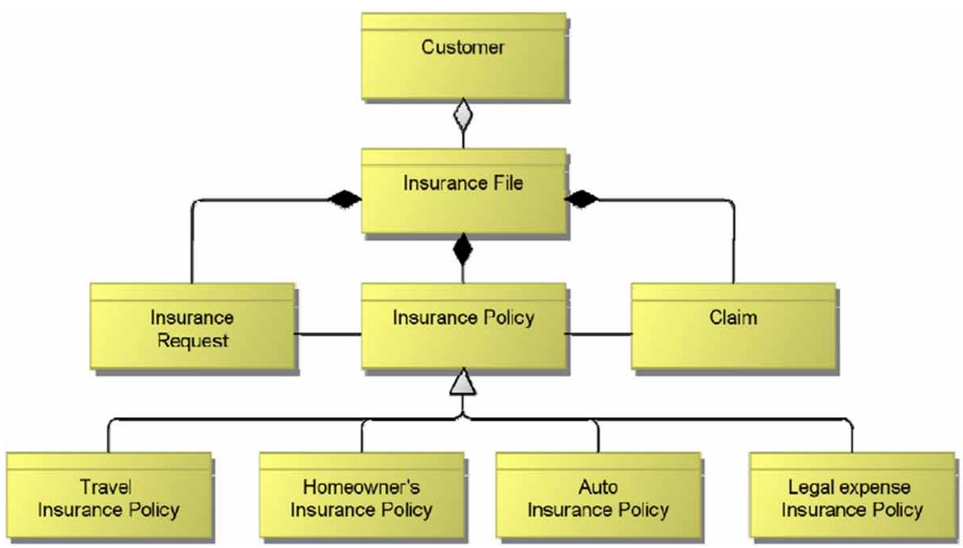


Figure 20. Application alignment (Jonkers, Band, & Quartel, 2012)



ArchiSurance data architecture describes the main relationships between its conceptual business objects and the *Project*'s logical data objects. ArchiMate defines also the Information Structure viewpoint for the presented purpose; the Information Structure viewpoint is similar to the traditional data models. The used data viewpoints that the ACS uses is the Logical Data diagram; Figure 21, shows a subset of the business objects that ArchiSurance defines.

Figure 21. Information structure view (Jonkers, Band, & Quartel, 2012)

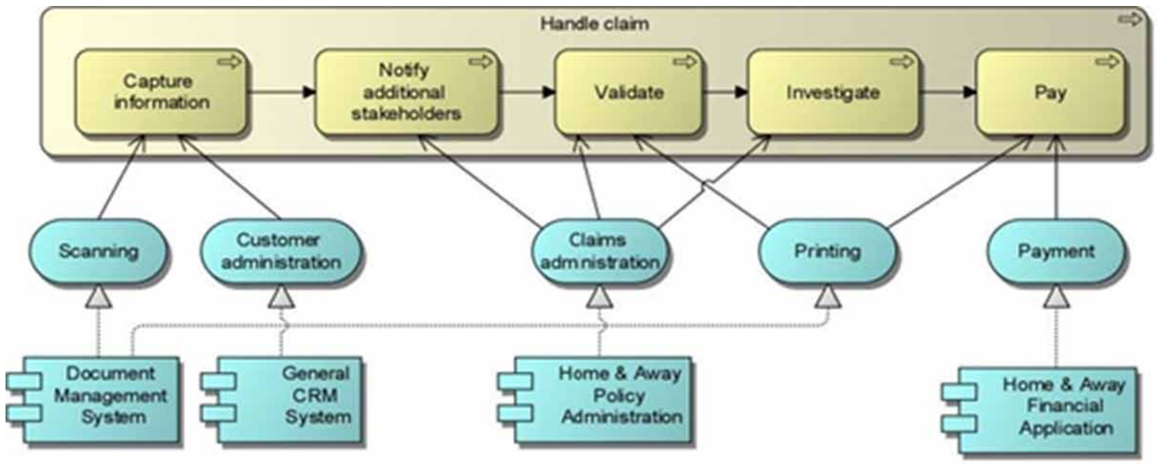
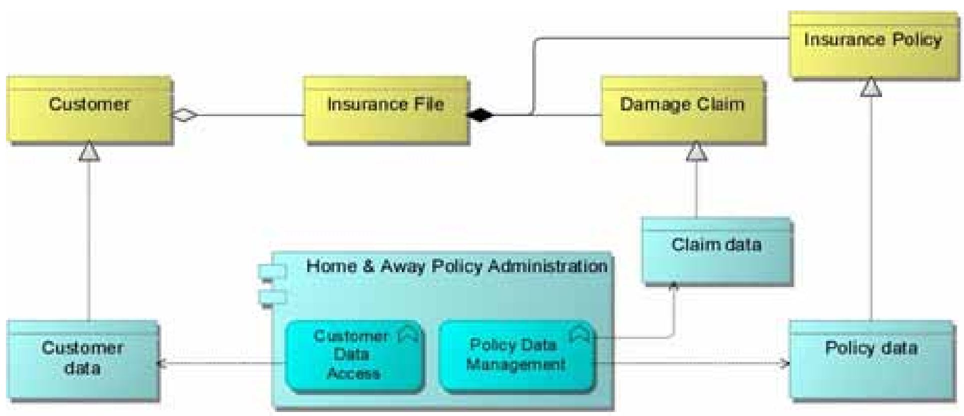


Figure 22. Data Dissemination Diagram (Jonkers, Band, & Quartel, 2012)

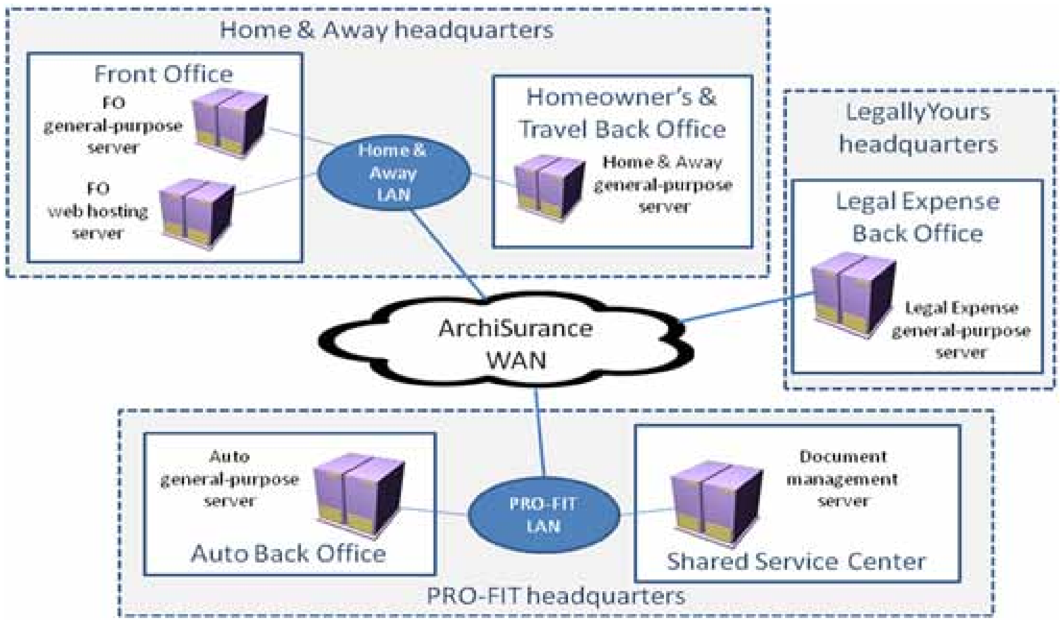


A component, the customer data, is in the insurance file, which contains: 1) insurance requests; 2) insurance policies; and 3) damage claims. The purpose of the Data Dissemination diagram is to show the relationship between the entity sets data, business services, and application components. The diagram shows how the logical objects are to be implemented. Assigning business value to data is a CSF that is related to the business criticality of the ICT infrastructure (Jonkers, Band, & Quartel, 2012).

Technology Architecture

This phase develops the ACS's technology architecture and its baselines. Figure 23., shows the technical infrastructure landscape of ArchiSurance. The front-office is based at the Home & Away headquarters where a general-purpose web-server is hosted. The SSC is based at PRO-FIT headquarters with own server, dedicated to document management system. The ACS describes a Local Area Network that connects servers and desktops in all ArchiSurance locations, which in turn are also mutually connected by a corporate Wide Area Network (Jonkers, Band, & Quartel, 2012).

Figure 23. Infrastructure landscape (Jonkers, Band, & Quartel, 2012)



The ACS presents an infrastructure viewpoint that shows the software and hardware infrastructure elements which support the Application Layer, like: 1) physical devices; 2) networks; and 3) system software. Figure 24 shows the ACS's infrastructure components, grouped by location and department.

Requirements Management and Tests

For each phase of the *Project*, EAP is based on the testing and validation of business requirements. The ADM is controlled and monitored in real-time and supports the microartefacts' interactions using HMM formalism, various types of tests and a holistic integration and tests driven developments as shown in Figure 25 (Vicente, Gama & Mira da Silva, 2013).

The Architecture Development Method Critical Success Factors

Based on the review of literature, the most important ADM's CSFs that are used are evaluated to the following:

As shown in Table 4, the result tries to prove or justify that it is possible to integrate and automate the ADM. The next CSA to be analysed is the holistic management of the DMS category.

Figure 24. Infrastructure View (Jonkers, Band, & Quartel, 2012)

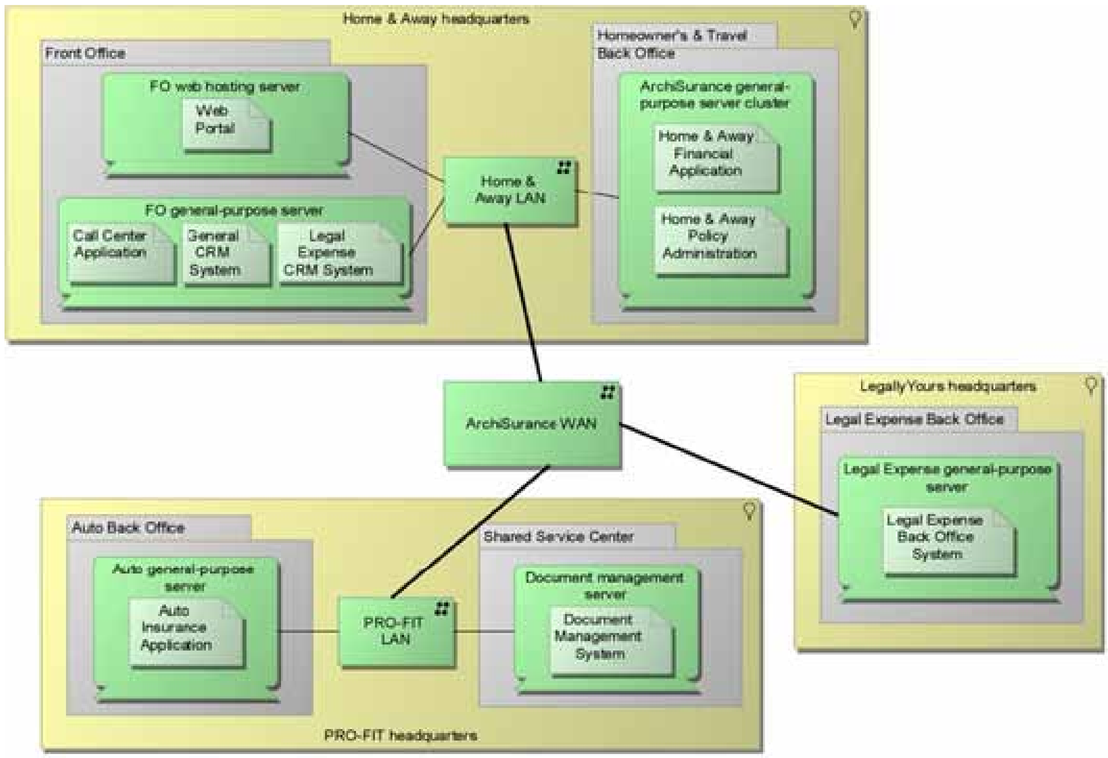


Figure 25. The TKM&F's global tests environment

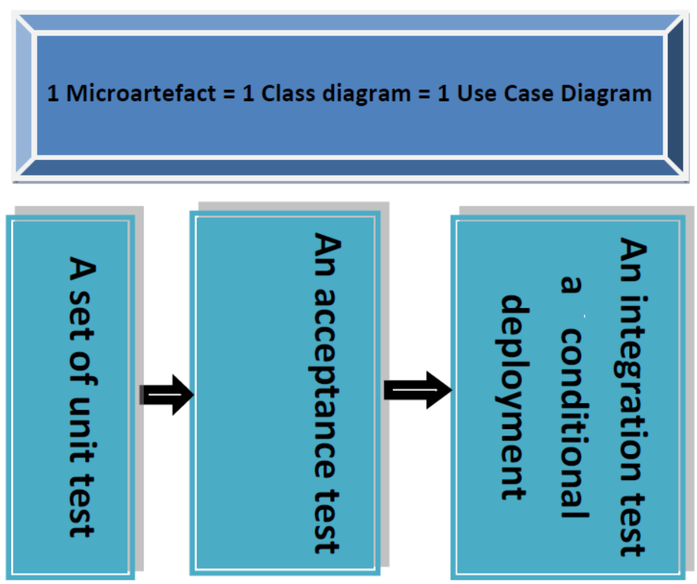


Table 4. The critical success factors that have an average of 9.0

Critical Success Factors	AHMM enhances: KPIs	Weightings
CSF_ADM_IntegrationProcesses	Supported	From 1 to 10. **8 Selected**
CSF_ADM_Phases	Supported	From 1 to 10. **10 Selected**
CSF_ADM_Requirements	Automated	From 1 to 10. **9 Selected**

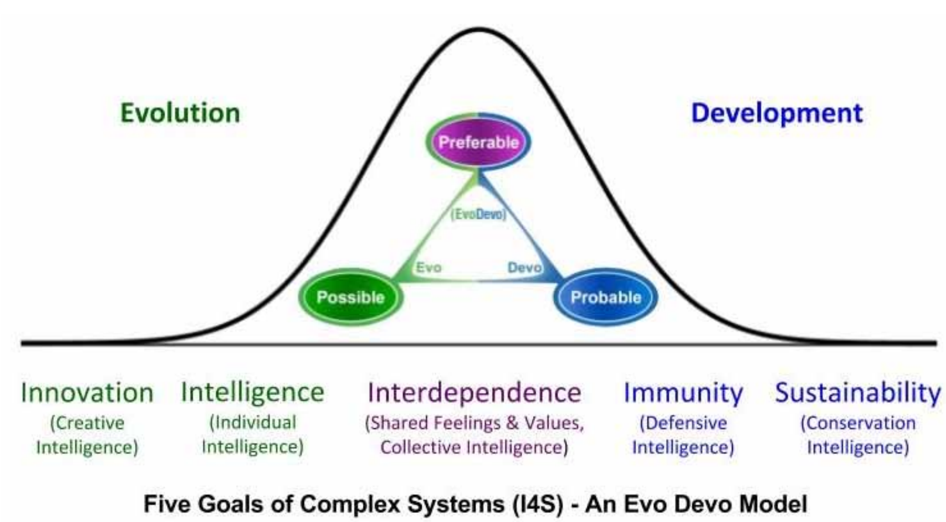
INTEGRATION OF THE CASE STUDY WITH THE DECISION MAKING SYSTEM

Complex Decision Systems

This research is about cross-functional complex intelligent systems' management that refers to classical domains like knowledge management, mathematical systems, systems analysis and global systems engineering; which is the main feature of the HMM formalism, as shown in Figure 26. Complex systems' holistic management is an approach for building and deploying complex business systems and it can replace conventional and archaic methods with a set of the HMM that manages *Project*'s microartefact to act as a DMS. Complex systems management can be adapted to the *Project*'s problems and requests by using HMM based DMS (Daellenbach & McNickle, 2005). The *Project* requests are processed by using the *TKM&F's* HMM, as shown in Figure 22 that in turn are based on the selected critical success areas and factors that can be used as a Knowledge Management System (KMS) which has a very complex system evolution nature.

This research and development project is about cross-functional complex *Project*s' management that refers to the transformation of classical domains like knowledge management, mathematical systems, systems analysis and global systems engineering; which are supported by the HMM formalism, as shown in Figure 26. Holistic management of complex decision systems is an approach for building complex business systems (Daellenbach & McNickle, 2005).

Figure 26. Complex system's nature and approach (Foresight Guide, 2017)



Knowledge Management Support

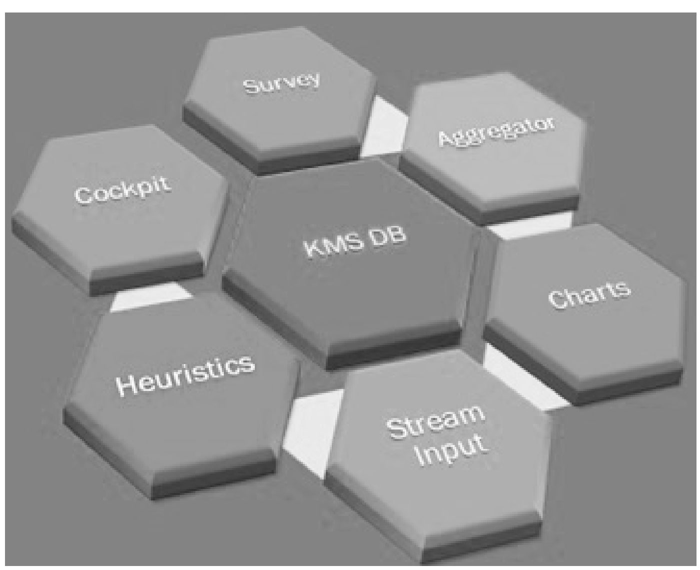
The *Project*s' microartefacts contain the needed set of actions to manage knowledge items. The needed actions are described using an internal ML environment that is based on *TKM&F's* Holistic Mapping Concept. This Holistic Mapping Concept links microartefacts to the knowledge system. The *Project* team identifies the initial set of CSFs to be used in the knowledge and decision systems, as shown in Figure 27 (Trad, 2018a).

The Decision Making Process

The ML microartefacts mechanisms contain the needed set of actions to enable their automated knowledge storage and delivery. The needed actions are described using an internal ML environment that is based on a Holistic Mapping Concept (HLC). This research's *TKM&F's* HLC relates and assembles the *Project*'s microartefacts and resources; it links them also to the KMS. This HLC automates the autonomic ML microartefacts' instances management in all of the ADM's phases; and it is the skeleton of the HMM and its

connections to all the *Project*'s microartefacts (The Open Group, 2011a). The *Project*'s HMM system has to identify the initial set of CSFs to be used in the KMS and DMS. The HMM based DMS, where any *Project* team configures the types of microartefacts and CSFs to be used; these microartefacts are orchestrated by the HMM's choreography engine. The HMM based DMS' actions map to the various ICT system's mechanisms to deliver the needed actions. The HMM instance is present in all the *Project*'s processes; such a set of actions is modelled and presented in this book's experiments or proof of concepts (The Open Group, 2011a; Trad & Kalpić, 2017a, 2017b, 2017c).

Figure 27. The knowledge management subsystem



The Decision Making System's Critical Success Factors

Based on the literature review process, the most important decision making system's CSFs that are used are evaluated to the following:

As shown in Table 5, the result tries to prove or justify that it is complex, possible and even mature to implement a DMS using the HMM formalism and that will be presented in the ACS/PoC section.

INTEGRATION OF THE PROTOTYPE WITH BUSINESS AND ARCHITECTURE TRANSFORMATION SCENARIOS

This ACS/PoC implementation uses the default demo, as the experiment's business case. The demo application is an insurance management system that has a CRM System, a mainframe, claim files service, customer file service. The demo application manages, registers, accepts, valuates and invoices the claims activities. The demo application uses the Archi Archimate modelling tool for the PoC.

Application Portfolio Rationalization Scenario, a Business Case

The lack of agility in business systems and in this ACS, the ArchiSurance application architecture; makes *Project* prone to failure. Due to the merger, the business system's landscape has become siloed, what results in major data redundancy, functional overlap and archaic integration, using various data formats and technologies. ArchiSurance executive management is anxious about the situation, especially if it prefers a holistic approach to the various types of problems. This business case tries to unbundle the ICT as shown in Figure 28 (Jonkers, Band, & Quartel, 2012).

The technical infrastructure must be simplified, and the isolated back-office servers will be replaced by a common server cluster. To ensure business continuity, a fail-over line of servers will be installed.

The Method's Phases' Setup

The ACS/PoC's phases' setup looks as follows:

- Phase A or the Architecture Vision phase, establishes an architecture effort and initiates an iteration of the architecture development cycle by setting its scope, constraints, and goals; also qualifies the business conditions and implements the Statement of Architecture Work; as shown in Figure 29. Goals and principles are related to the project's requirements, as shown in Figure 30.

Table 5. The critical success factors that have an average of 10

Critical Success Factors	AHMM4T enhances: KPIs	Weightings
CSF_DMS_ComplexSystemsIntegration	FullySupport	From 1 to 10. **10 Selected**
CSF_DMS_KMS	Enabled	From 1 to 10. **10 Selected**
CSF_DMS_DMP	Intgerates	From 1 to 10. **10 Selected**

Figure 28. Application unbundling (Jonkers, Band, & Quartel, 2012)

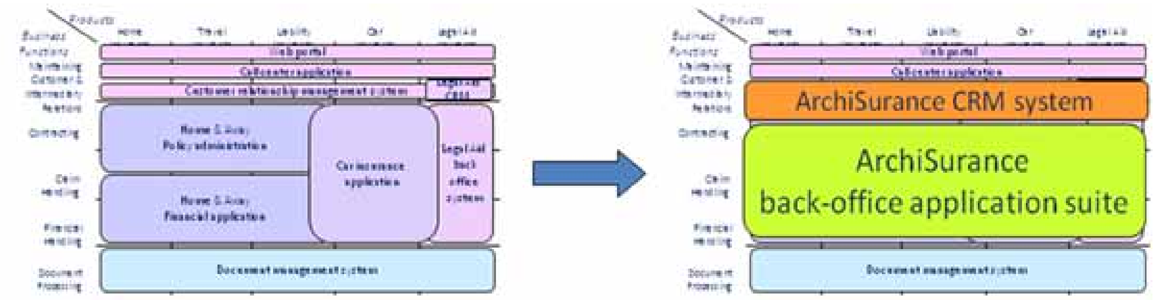


Figure 29. Transformation goals (Jonkers, Band, & Quartel, 2012)

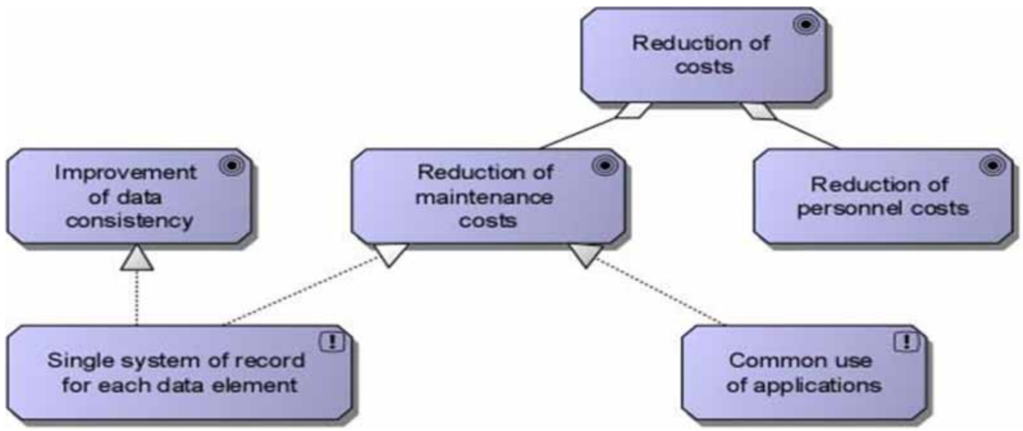
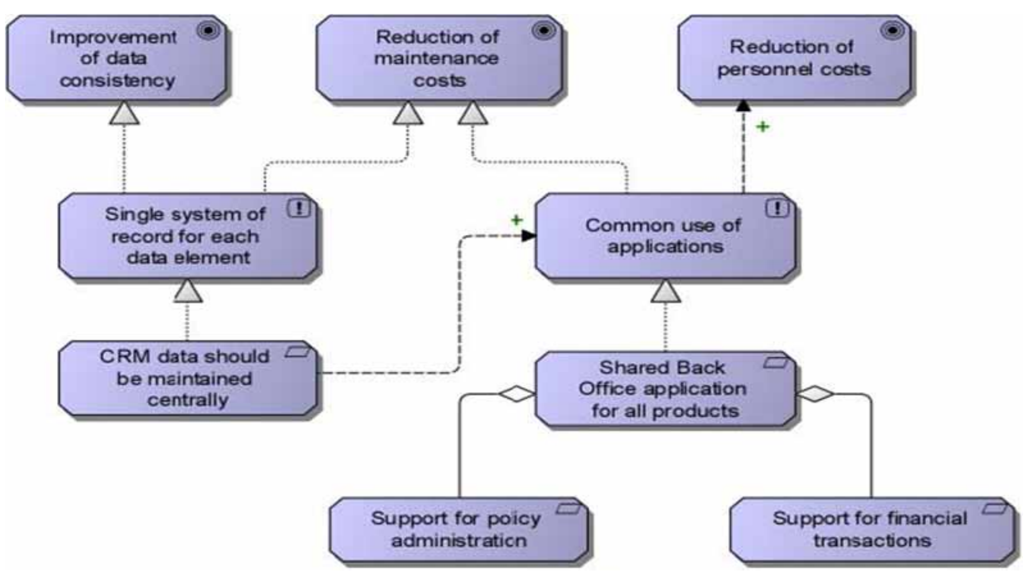


Figure 30. Goals and principles (Jonkers, Band, & Quartel, 2012)



A Goal Refinement Viewpoint is implemented to refine the original goals into requirements, CSFs or constraints using aggregation relationship.

- Phase B or the Business Architecture phase shows how the *Project*'s target architecture realizes the key business requirements and related CSFs. For this goal an Introductory View is presented, as shown in Figure 31 and the Requirements Realization Viewpoint, which enables modelling of the requirements.
- Phase C or the Target Application Architecture and Gap Analysis phase shows and uses the Application Communication Diagram, as presented in Figure 33 which shows the modelled target application landscape. The CRM requirements for legal insurance customers are supported by the central CRM system and there is no need for a new component; added to that, a new back-office system is introduced.
- Phase D or the Target Technology Architecture and Gap Analysis phase shows the infrastructure view below in Figure 35, which presents the target technical infrastructure landscape. Figure 35, visualizes the outcomes of a global gap analysis for the technology architecture phase. The common back-office servers are to be removed. The original set of servers of Home & Away are to become the common service cluster. A back-up document management server is to be placed in the Home & Away back-office. The new back-office suite and the document management system are to be synchronized, and an additional back-up server cluster is to be placed in the SSC at PROFIT headquarters.
- Phases E and F, Implementation and Migration Planning; the transition architecture, proposing possible intermediate situation ("plateau"). A gap between the baseline architecture and the target architecture should be detected. The baseline, target, and transition architectures, as well as their relationships, are shown using the Migration viewpoint in Figure 38. The ICT department does not have the needed resources to finish the integration of the back-office systems and the CRM simultaneously. Transition architecture supports the planning of *Project*s such as the CRM integration. The sequence of these subprojects is related to the transition architectures as shown in Figure 40, the Project Context diagram.

Figure 31. Goal Refinement Viewpoint (Jonkers, Band, & Quartel, 2012)

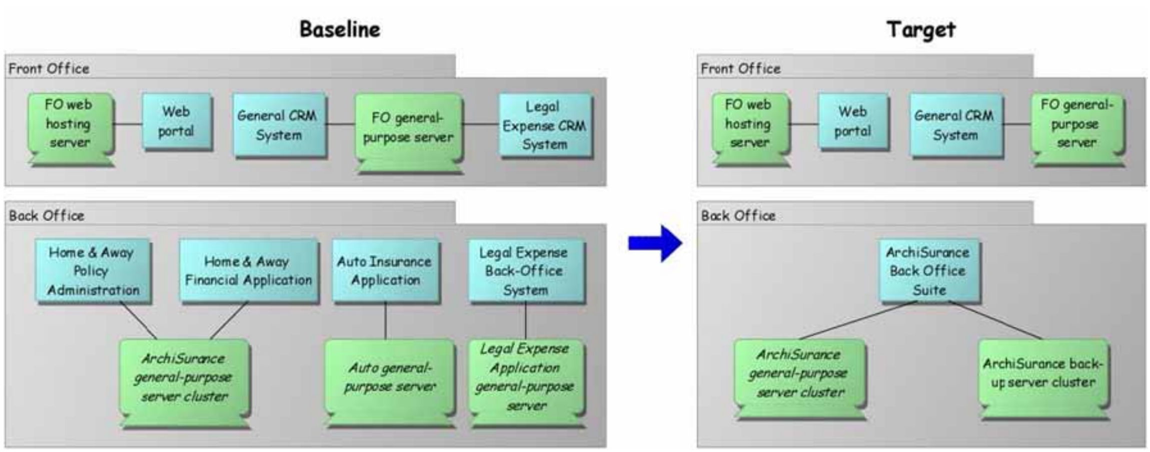


Figure 32. Requirements Realization Viewpoint (Jonkers, Band, & Quartel, 2012)

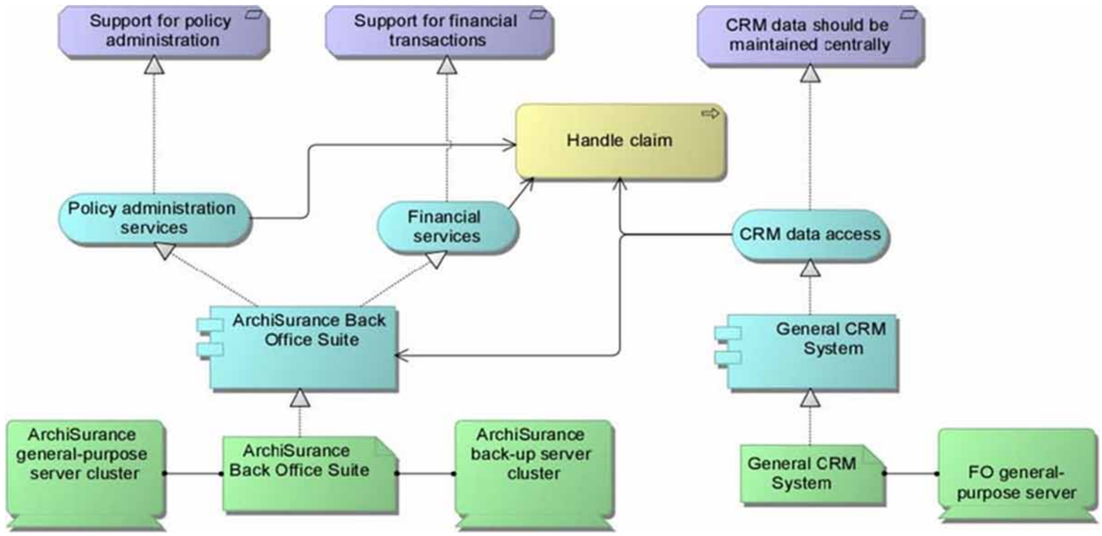


Figure 33. Goal Refinement Viewpoint (Jonkers, Band, & Quartel, 2012)

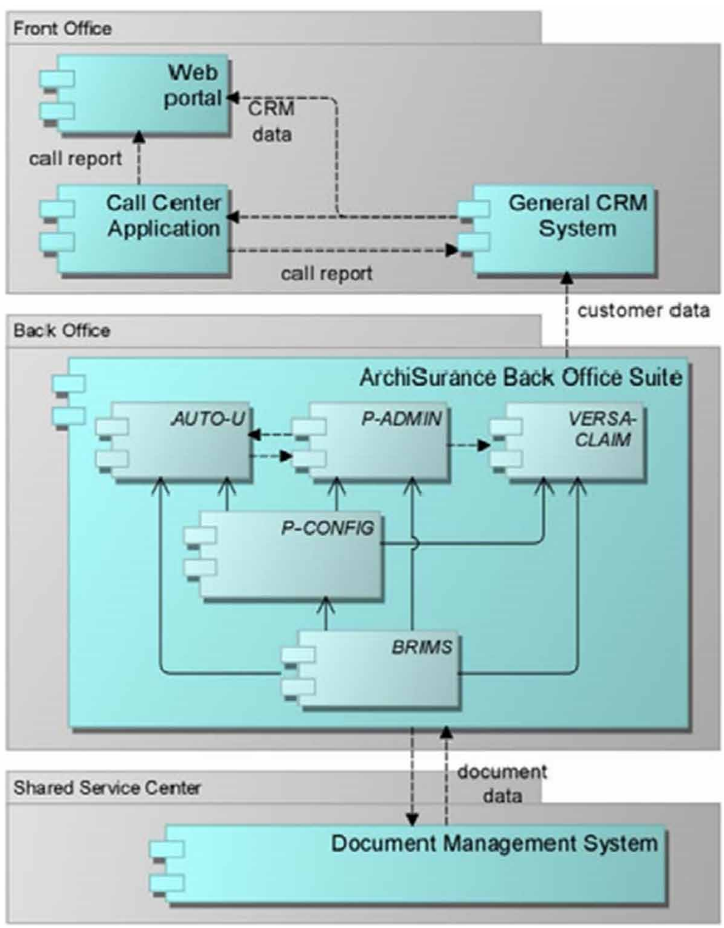


Figure 34. Target Application Architecture: Application Co-Operation View (Jonkers, Band, & Quartel, 2012)

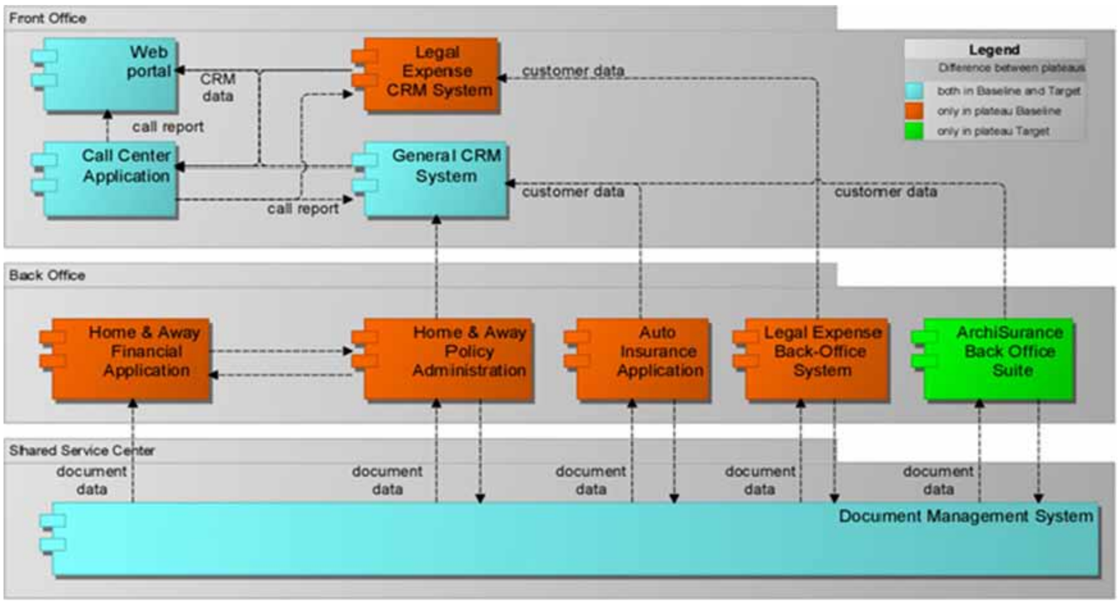


Figure 35. Application Architecture: Gap analysis (Jonkers, Band, & Quartel, 2012)

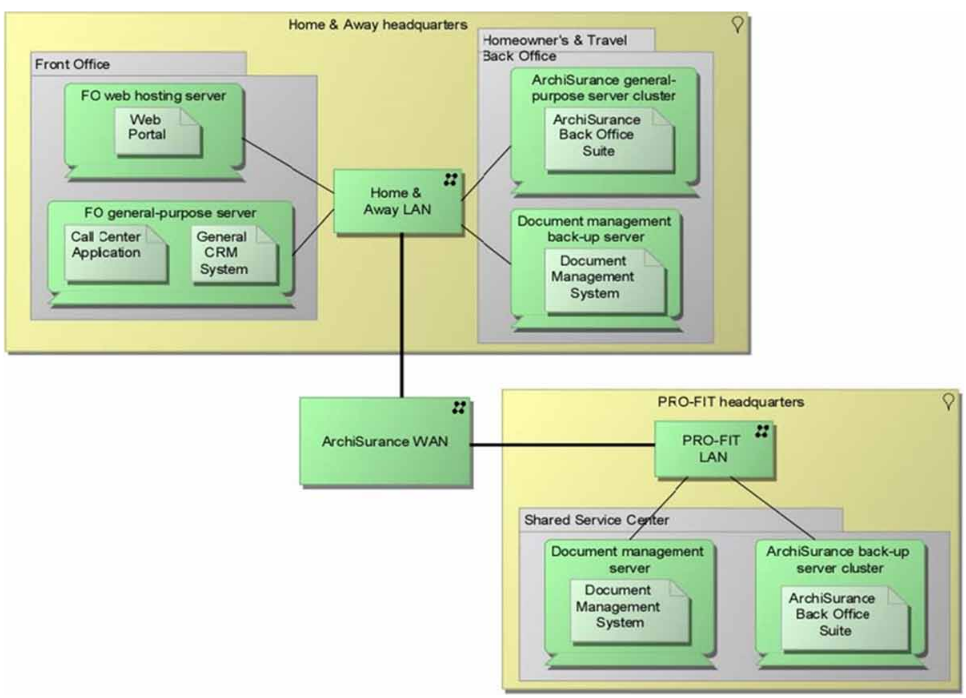


Figure 36. Target Technology Architecture: Infrastructure View (Jonkers, Band, & Quartel, 2012)

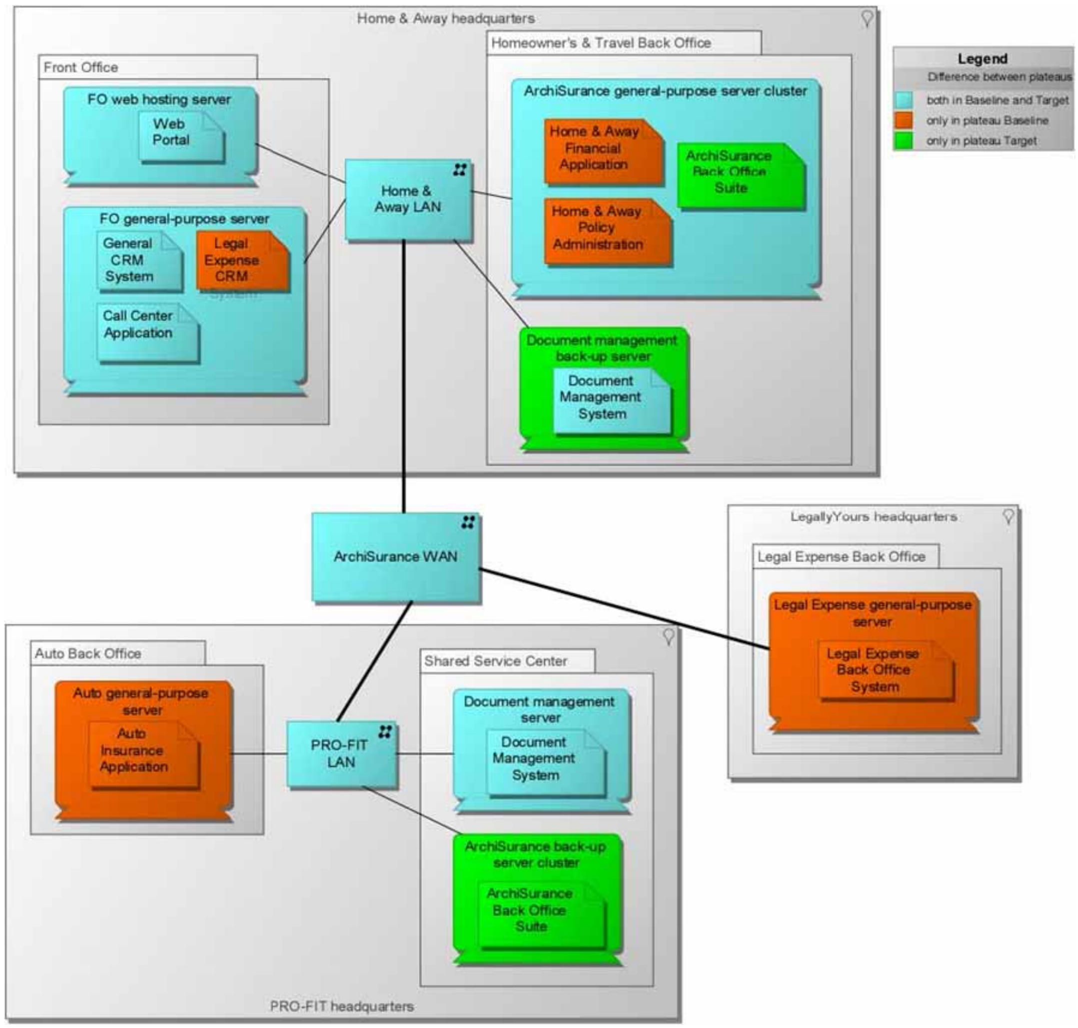


Figure 37. Technology Architecture: Gap Analysis (Jonkers, Band, & Quartel, 2012)

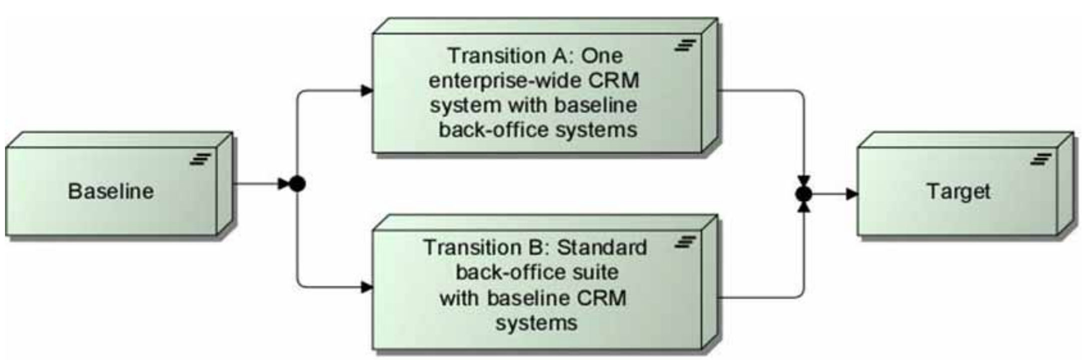


Figure 38. Migration View (Jonkers, Band, & Quartel, 2012)

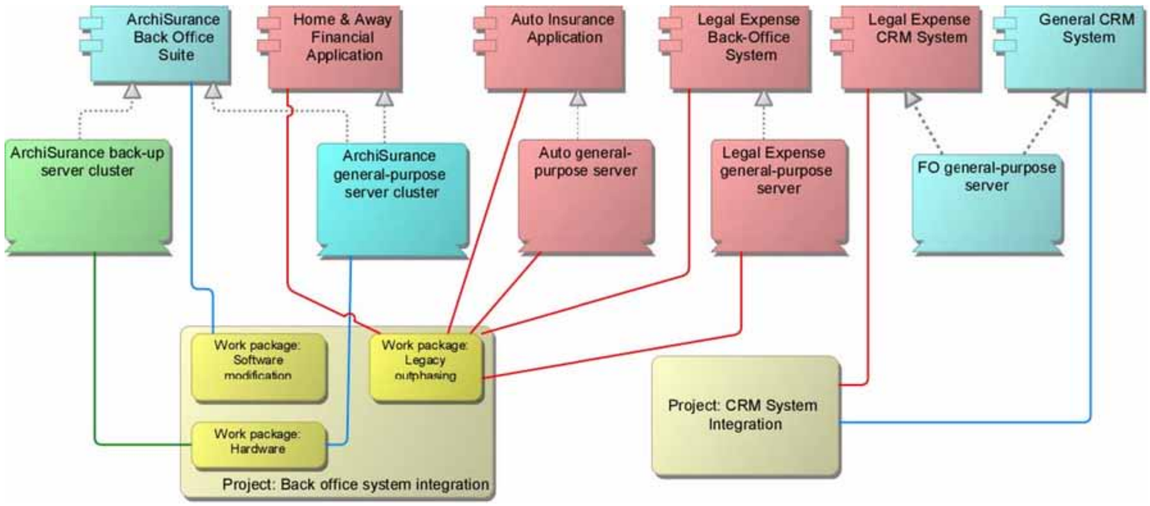
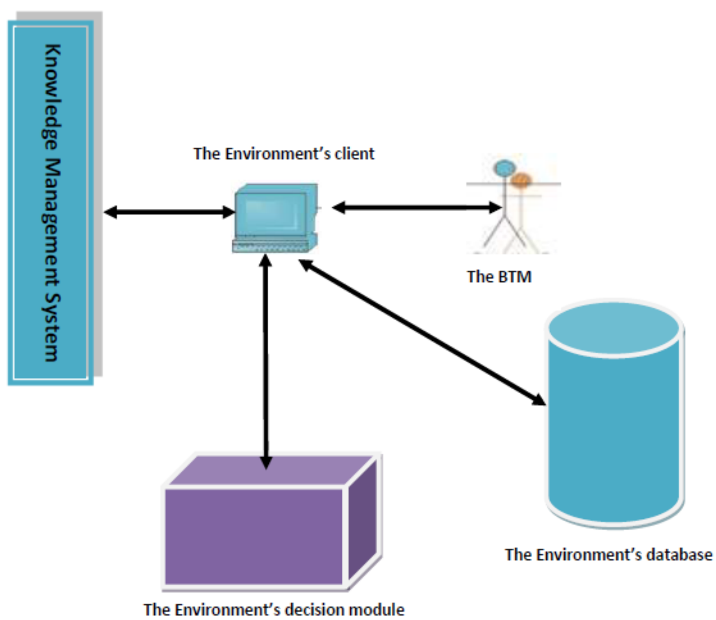


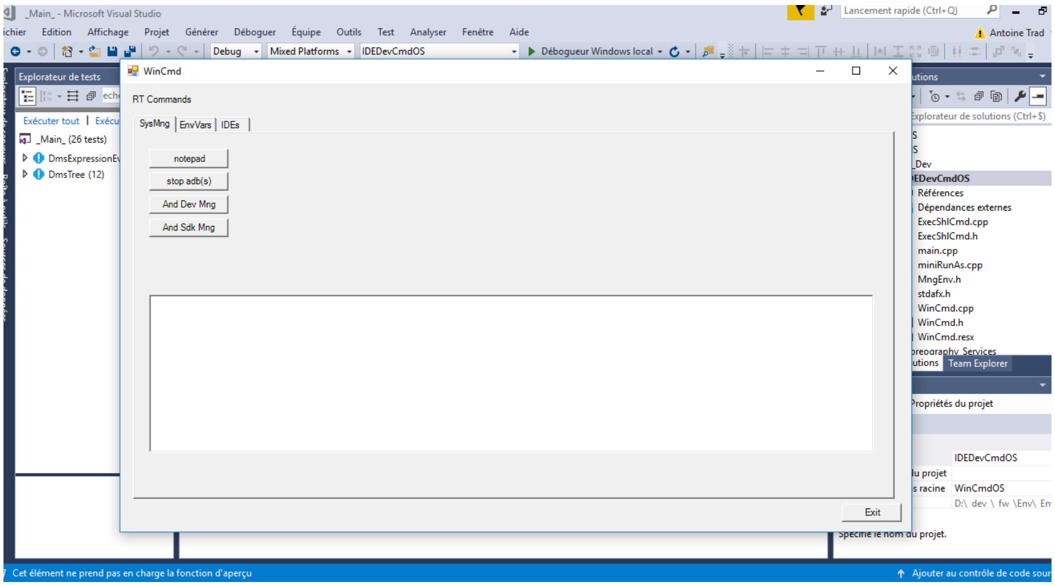
Figure 39. Project Context Diagram (Jonkers, Band, & Quartel, 2012)



The Proof of Concept

This chapters' research experiments or Proof of Concepts (PoC) are all implemented using the already mentioned research's cluster framework, known as the *TKM&F* The PoC is based on the HMM formalism, on the end DMS and on an internal initial set of CSFs, that build an example for this book chapter, as presented in Tables 1 to 5. These CSFs have bindings to specific *Project* and ACS resources, where the HMM formalism was designed using ML microartefacts, object oriented and enterprise architecture

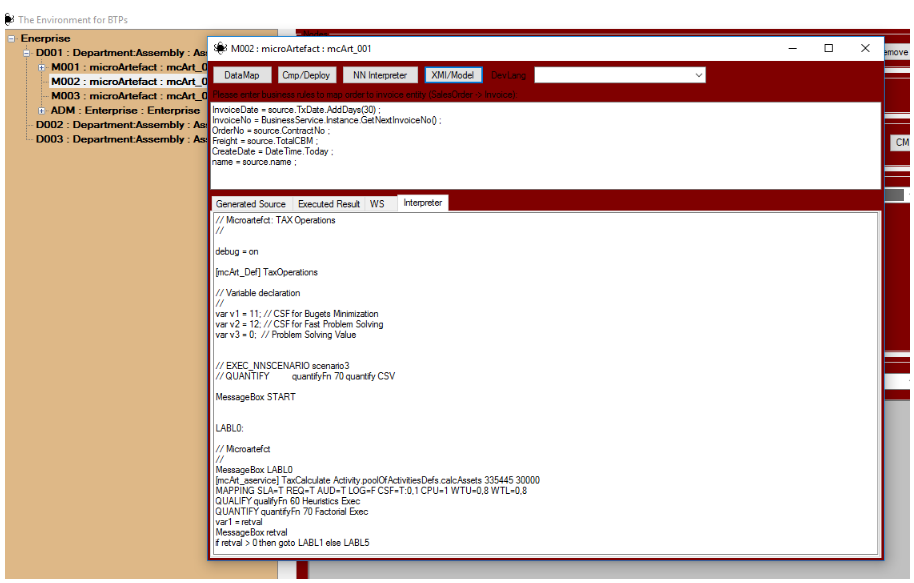
Figure 40. The TKM&F's interaction with the BTM as client



methodologies and related tools. The HMM based DMS processing model represents the relationships between this ACS's requirements, project's ML and generic microartefacts (or building blocks), global unique identifiers and the five defined CSAs.

The PoCs are achieved by using the development environment and the research framework's, *TKM&F* client's interface that is shown in Figure 38. From the *TKM&F* client's interface the ML development setup and editing interface can be launched, as shown in Figure 41.

Figure 41. The TKM&F's development setup interface



Once the development setup interface is activated, the NLP interface can be launched to implement the needed microartefact scripts to process the defined three CSAs. These scripts make up the kernel knowledge system and the HMM set of actions that are processed in the background. The HMM uses a knowledge database that automatically generates decision making actions which make calls to DMS, that manages the edited mathematical language script and flow. This research's instance of the HMM and its related CSFs were selected as demonstrated previously, as shown in Figure 42.

In this chapter's five tables and the result of the processing of the DMS, as illustrated in Table 6, show clearly that the HMM and ACS/PoC can be used for all the types of projects, including the one in this chapter. HMM is not an independent component and is bonded to all the *Project*'s overall risk architecture, hence there is a need for a holistic approach.

Figure 42. The heuristics tree configuration

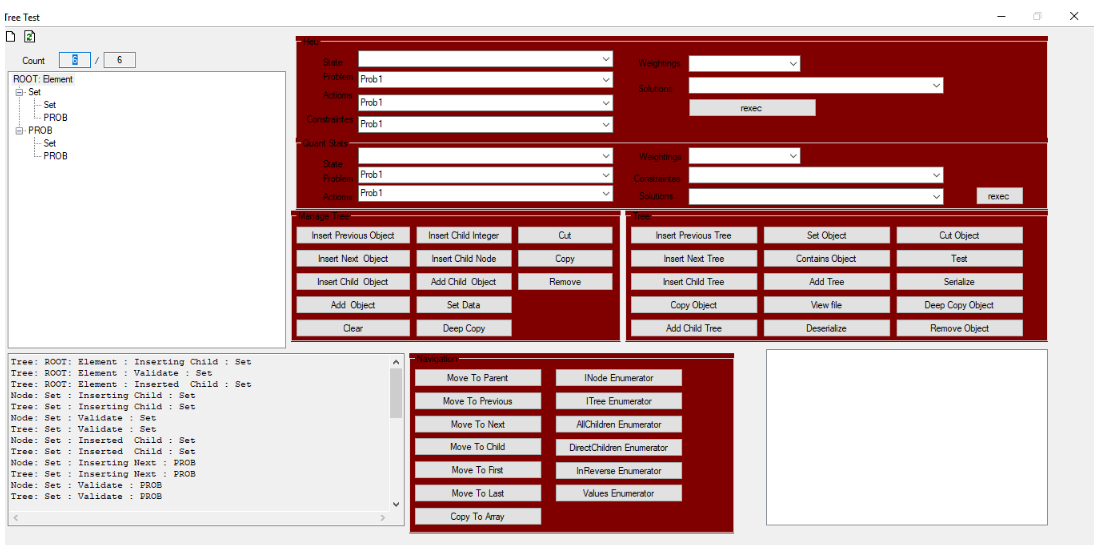


Table 6. The applied case study research's outcome

CSA Category of CSFs/KPIs	Influences transformation management	Average Result
The Applied Case Study Integration	CredibleStable	From 1 to 10. 9.33
The Usage of the Architecture Development Method	FullyIntegrated	From 1 to 10. 9.00
The Information and Communication Technology System	Transformable	From 1 to 10. 9.20
The Mathematical Model's Integration	Applicable	From 1 to 10. 9.33
The Decision Making System	Implementable	From 1 to 10. 10.00

The *TKM&F* and hence the HMM's main constraint to implement the ACS/PoC is that CSAs for simple research components, having an average result below 8.5 will be ignored. For the case in the current book,, average results for PoCs below 7.5 will be ignored. As shown in Table 6, this fact keeps the CSAs (marked in green) what helps to make this work's conclusion; and drops the ones in red. It means that the ACS/PoC and the HMM formalism of global integration are mature and can be used. Of course, there are difficulties integrating the HMM in *Project* and transformations must be done in multiple transformation sub-projects, where the first one should try to transform the base enterprise business systems, the information system and the decision making paradigm.

SOLUTION AND RECOMMENDATIONS

Because of very high score, above 9, Table 6 shows that an HMM based ACS/PoC implementation is not a very risky undertaking and that today the *TKM&F* is ready and is the only methodology and framework that can in parallel construct *Project*s, EAPs, MMs, DMS' and business engineering projects. The resultant technical and managerial recommendations are:

- Define a cross-functional and unique ACS to be used by all the *Project*s PoCs.
- Use a standard enterprise architecture methodology to model the ACS.
- Select the ACS' CSFs.
- Unbundle the enterprise system to deliver the needed ACS' microartefacts library.
- Model the ACS' ICT system based on the DMS concept.
- As a kernel model, implement a holistic DMS.

FUTURE RESEARCH DIRECTIONS

Future efforts in this research project will focus on the various functional languages environments that can be used in transformational initiatives within a cross-functional environments.

CONCLUSION

This chapter is part of a series of publications related to research of applied mathematical models, *Project*s, decision making systems and enterprise architectures. It is based on a mixed action research model; where critical success factors and areas are offered to help *Project* architects to diminish the chance of failure when building transformation projects. In this chapter, the focus is on the applied case study that defines a structured business case to be used throughout the book. The HMM based decision making engineering concepts are an important factor for the business information system's evolution and maintenance. The most important managerial recommendation that was generated by the previous research phases was that the business transformation manager must be an architect of adaptive business systems.

This chapter's and in general the book's PoCs are based on the CSFs' binding to a specific research resources (or requirements) and the internal reasoning model that represents the relationships between this research's concepts, requirements, microartefacts and CSFs. The final result clearly implies that the proposed ACS to verify each chapter (or research question) is credible and can be used. To support such complex experiments, the authors recommend performing the *Project* implementation operations through multiple independent sub-projects (or PoCs), where the priority is to transform the information system, structure a mathematical model, decision making system and global architecture, as described in this book's chapters.

ACKNOWLEDGMENT

In a work as large as this research project, technical, typographical, grammatical, or other kinds of errors are bound to be present. Ultimately, all mistakes are the authors' responsibility. Nevertheless, the authors encourage feedback from readers identifying errors in addition to comments on the work in general. It was our great pleasure to prepare this work. Now our greater hopes are for readers to receive some small measure of that pleasure.

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KEY TERMS AND DEFINITIONS

ACS: Applied case study.
ADM: Architecture development method.
AMM: Applied mathematical model.
CRM: Client relationship management.
CSA: Critical success area.
CSF: Critical success factors.
DMS: Decision-making system.
EAP: Enterprise architecture project.
HMM: Holistic mathematical model.
ICT: Information and communication technologies.
JEE: Java extended edition.
ML: Mathematical language.
MM: Mathematical model.
NLP: Natural language programming.
Project: Business transformation project and enterprise architecture project.
RAD: Rapid application development.
RQ: Research question.
SSC: Shared service centre.
TKM: Trad Kalpić methodology.
TKM&F: Trad Kalpić methodology and framework.
TMM: Transformation mathematical model.
TOGAF: The Open Group's architecture framework.

Chapter 3
An Applied Mathematical Model for Business Transformation:
The Holistic Critical Success Factors Management System (HCSFMS)

ABSTRACT

The original HMM uses a natural language- or behaviour-driven development environment that can be adopted by development teams by using and integrating factors' categories in their system; that is why the authors propose the use of the holistic critical success factors management system (HCSFMS), and they implement a proof of concept (PoC) to prove this chapter's concept feasibility and levels of integration risks. The HCSFMS supports decision-making systems (DMS), business transformation projects, and enterprise architecture projects (EAP) (or simply the project). The PoC is based on a fictious case from the insurance domain.

BACKGROUND

In this book's chapter the authors present the cross-business domain Holistic Mathematical Model (HMM) for various types of projects and the manner they use critical success factors and areas (Trad & Kalpić, 2018a; Trad & Kalpić, 2018b). This chapter is based on an authentic and proprietary mixed research method that is supported by an underlining mainly qualitative holistic reasoning model module that is based on critical success factors (Trad & Kalpić, 2017a, 2017b, 2017c, 2017d; Gunasekare, 2015). The original HMM uses a natural language or behaviour-driven development environment that can be adopted by development teams by using and integrating factors' categories in their system; that is why the authors propose the use of the Holistic Critical Success Factors Management System (HCSFMS) and they implement a Proof of Concept (PoC) to prove this chapter's concept feasibility and levels of integration risks (Myers, Pane, & Ko, 2004; Neumann, 2002). The HCSFMS supports Decision Making Systems (DMS), Business Transformation Projects and Enterprise Architecture Projects (EAP) (or simply the *Project*). The PoC is based on a fictious case from the insurance domain (Jonkers, Band, & Quartel, 2012).

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INTRODUCTION

A Critical Success Factor (CSF) is the most basic item of the *Project* and is selected and tuned to enable the *Project's* goals refocus to insure the enterprise's business sustainability. After detailed analyses processes, like the literature review process, CSFs are selected from various areas like business processes, accountancy, enterprise skills… This chapter combines Artificial Intelligence (AI), Knowledge Management (KM), heuristics/applied mathematical models (mainly used in the HMM), Enterprise Architecture (EA), information technology management, business transformation and various engineering fields; by using a central pool of CSFs. Integrating a HCSFMS should be the first fundamental strategic goal for the transformed business company and its decision system (Trad & Kalpić, 2018a, 2018b), as shown in Figure 1. Figure 1 is fundamental for the whole research project and used in the whole book.

The proposed HCSFMS integration concept: 1) is holistic; 2) uses a tuning/reasoning engine that contains modelling techniques; 3) interfaces qualitative research methods; 4) offers a weighting and rating concept; and 5) is the base of the framework that can be used by any type of *Project*. The authors based their Research and Development Project (RDP) method on intelligent neural networks and it is influenced by the authors' previous works (Trad & Kalpić, 2018a). The HCSFMS integration concept is business and technology driven and it is agnostic to any specific application and business environment, as shown in Figure 2. The HCSFMS is the base of the authors' unique research framework that is based on the industry architecture standards, like the Architecture Development Method (ADM), which is also based on CSFs (The Open Group, 2011a). EA is used as a central building block to develop *Projects,* where the business transformation manager or an enterprise architect (or simply *Manager*) can use the HCSFMS for transformation processes and to deliver recommendations (Trad & Kalpić, 2017b, 2017c; Thomas, 2015; Tidd, 2006). The RDP is based on a cross-functional literature review, a qualitative meth-

Figure 1. Technology Trends (Cearley, Walker, Burke, 2016)

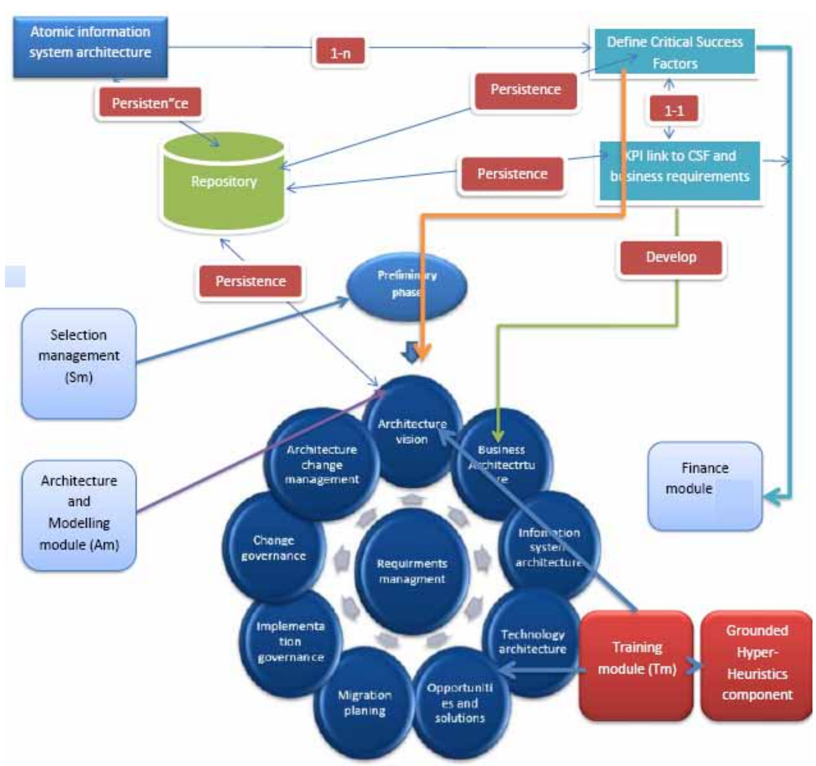
odology and on a PoC for the proposed hypotheses. In a *Project*, the *Manager*'s role is important and his or her (for simplicity, in further text – his) decisions are supported by using the HCSFMS interaction with other sub-systems (Lanubile, Ebert, Prikladnicki, Vizcaíno, & Vizcaino, 2010). A holistic systems approach is the optimal choice to model such a HCSFMS, as shown in Figure 2, where the decision model interacts with the external world via an implemented framework to manage CSFs (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a).

Most *Projects* lack a holistic synchronized agility approach, that can be insured by the HCSFMS' approach that is this work's focus (Thomas, 2015; Cearley, Walker & Burke, 2016).

FOCUS OF THE CHAPTER

This book's framework or the Trad Kalpić Methodology and Framework (*TKM&F*) enables the use of the HCSFMS for use in *Projects* and offers a set of integration recommendations (Meneses-Ortegon & Gonzalez, 2016) ; that had been developed by the authors, using the Microsoft Visual Studio .NET, C/C++, Microsoft Office and Java development environments. These recommendations can be applied by *Managers*, architects, analysts and engineers to enable the transformation processes. Archaic *Projects* are silo black-boxes and their internal and external components are not synchronized and it is impossible to implement CSF management system in the enterprise's Information and Communication Systems (ICS) (Desmond, 2013). The HCSFMS can be used to evaluate the feasibility and status of

Figure 2. The research framework's concept (Trad & Kalpić, 2016a)



*Project*s in different application fields. This HCSFMS uses pseudo neural networks which can execute specific calls to quantitative modules structured in an architecture framework like the ADM (The Open Group, 2011a; Tidd & Bessant, 2009). As shown in Figure 1, intelligent systems are a strategic trend and it has been decided by the authors that *TKM&F* should be based on intelligent microartefacts that in turn are based on the transformed service library (Johnson & Onwuegbuzie, 2004; Trad & Kalpić, 2017b; 2017c; 2018a; 2018b; Tidd, 2006). The *TKM&F's* applied research methodology is based on a mixed methodology (Easterbrook, Singer, Storey, & Damian, 2008). For a successful integration of the HCSFMS, the *Project's* team's role is to select and evaluate the right CSFs that are essential for the *Project's* implementation. Selecting a huge set of possible CSFs, can negatively influence such *Project*s; a holistic system approach is the optimal choice to implement an HCSFMS (Simonin, Bertin, Traon, Jezequel, & Crespi, 2010; Daellenbach & McNickle, 2005; Trad & Kalpić, 2017d). The *TKM&F* can be used by business users to manage CSFs and launch the DMS or KMS. HCSFMS' integration, like for example in a PoC, can be complex and problematic. The problem is due to the complexity of selection of the appropriate CSFs, what is also a long and risky process. The current book's chapter tries to prove, the HCSFMS' integration feasibility through a Research Question (RQ).

THE RESEARCH PROCESS

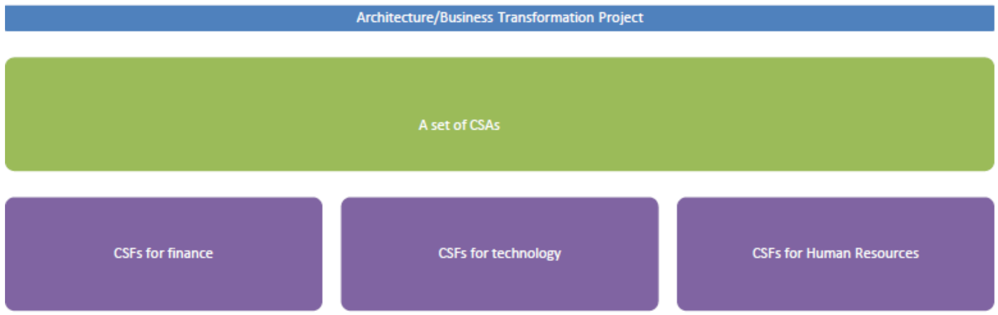
The *TKM&F* is unique and can be considered as a pioneering undertaking in the field of *Projects* and it recommends linking the Mathematical Model (MM) to all levels of a transformation process (Trad & Kalpić, 2018a, 2018b; Agievich, 2014). BTPs are very risky and have a very high failure rate and one of the concrete reasons is that these projects lack a cross-functional and holistic coordination; especially if the *Project* understands merges or new important ventures (Zaiane & Ben Moussa, 2018). *Projects* are complex and risky, causing high failure rates and one concrete reason is the lack of a holistic coordination and that is why the authors propose the HCSFMS (Tidd & Bessant, 2018).

Critical Success Areas, Factors and Project Items

The HCSFMS promotes the transformation through the use of Critical Success Area (CSA) as a set of CSFs where the CSF is a set of Key Performance Indicators (KPI), where each KPI corresponds to a single *Project* requirement and/or an item that can be a knowledge item, requirement or feature. For a specific vision's goal, requirement or problem, a *Manager* or enterprise architect can identify a CSF, which is important to map the *Project's* items (Peterson, 2011). Therefore, CSFs reflect key factors that must meet the strategic *Project's* objectives and tuned constraints. Measurements are used to evaluate factors in each of the CSA sets, where CSFs can be internal or external to the environment; like for example: 1) *Project* requirement or item, is an external one; 2) gap analysis is internal CSF; and 3) decisions making in real time is also internal.

The HCSFMS is based on CSAs, where: 1) each CSA corresponds to a distinctive *Project* domain, like for example, auditing; 2) each CSF maps to a set of requirements, like for example, accounting balance sheet evaluation; and 3) each KPI corresponds to a single transformation or architecture project requirement (Farhoomand, 2004); as shown in Figure 3, where a CSF corresponds to a knowledge item and a microartefact scenario, as *Project* items.

Figure 3. Categories of classified factors (Trad & Kalpić, 2017b, 2017c)



For an effective selection of the HCSFMS's default CSFs, there is a need for a detailed (re)search process (Putri & Yusof, 2009). CSFs are important for the mapping between the *Projects'* main objectives, business requirements, microartefacts' scenarios (that is a set of scripts calling action as code), organisational structure (Peterson, 2011). For example, CSFs can express the main *Project* objectives that can/should be met and the defined HMM's limit constraints. The HMM's qualitative pseudo-heuristic algorithms and punctual calls to quantitative analysis, which can be used to evaluate for example the *Project's* failure quotas in each CSA that can be managed from an applied research framework (Trad & Kalpić, 2017b, 2017c).

The Applied Research Framework

The *TKM&F* defines an alignment strategy of the *Project* that manages the enterprise's microartefact, CSAs/CSFs libraries (which are classical libraries containing code and configurations) that in turn are modelled by an architecture formalism like the ADM (Lankhorst, 2009; Trad & Kalpić, 2018d, 2018e). The HCSFMS that can be applied to various types of *Projects* is a part of the Knowledge management module (Km) and the Decision module (Dm), that in turn are parts of the *TKM&F*. In this chapter, the authors propose a set of HCSFMS managerial and technical recommendations on how a reusable real-world *TKM&F* should be implemented in form of a PoC (Trad 2018a, 2018b, 2018c, 2018d).

This chapter's research and the resultant experiment are also a part of the Selection management, Architecture-modelling, Control-monitoring, Decision-making, Training management, Project management, Finance management, Geopolitical management, Knowledge management, Implementation management and Research management Framework (SmAmCmDmTmPmFmGmKmImRmF, for simplification reasons, the already mentioned term *TKM&F* is used). The *TKM&F* is not a black-box product, it is rather an enterprise methodology, architecture, strategy, recommendations and vision that each enterprise should implement by its own *Project*. This chapter's RQ is: "Can a holistic critical success factors' and areas' management system support the implementation of decision-making systems, business transformation projects and enterprise architecture projects".

A common holistic objective of this book on *Projects* is to deliver solutions and recommendations by proposing a real-world framework named the *TKM&F,* which is owned in its totality and copyright by the authors; where this book is an IGI Global copyright object, distinct and different from *TKM&F*. This chapter's RQ was formulated after an extensive literature review. The *TKM&F* is composed of the following modules that can be applied related to the Framework.:

- "Sm": for the selection management;.
- "Am": for the architecture and modelling strategy;
- "Cm" for the control and monitoring strategy;
- "Dm" for the decision-making strategy;
- "Tm" for the training management;
- "Pm" for the project management strategy;
- "Fm" for the financial management's support;
- "Gm" for the Geopolitical mind-mining;
- "Km" for Knowledge management;
- "Im" for Implementation management;.
- "Lm" for Legal management.

This chapter is a part of many years of research that has produced a large set of articles, related to decision making, enterprise architecture and applied mathematics. An extensive literature review process was undertaken and has produced usable items, microartefacts and research artefacts. In this chapter, parts of previous works are reused for the better understanding of this complex iterative research topic and process; if everything were simply referenced, it would be tedious to read and to understand this article.

The Research Literature Review

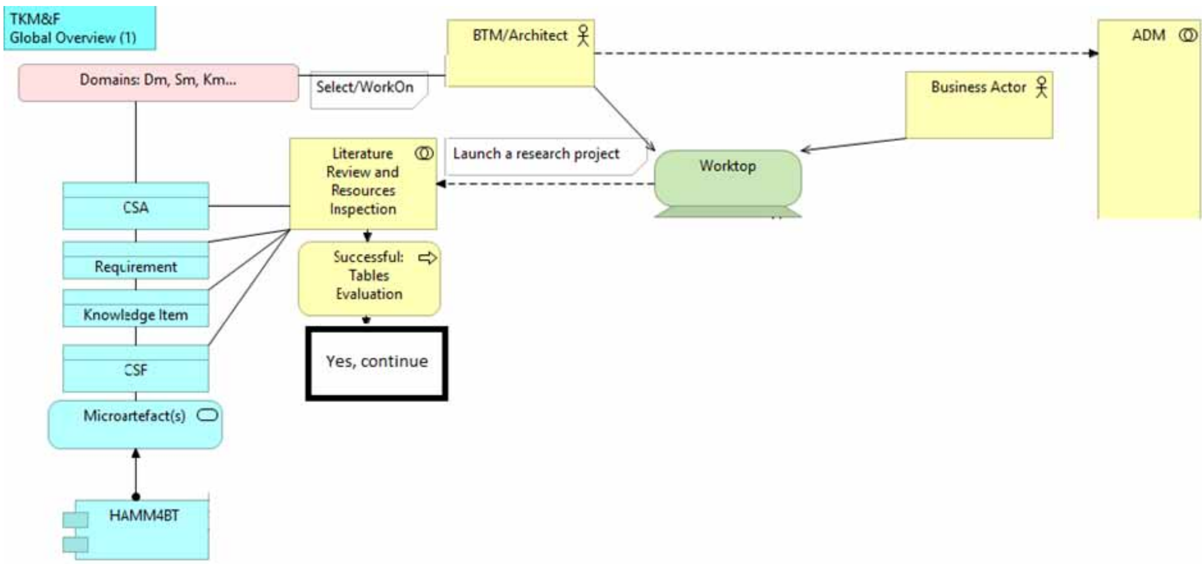
As already mentioned, this chapter's RQ that is focused on HCSFMSs and the outcome is that very scarce scholar or even general literature and research resources exist on the selected subject and its integration in holistic management of *Projects*. Therefore, the authors consider their work as unique and a pioneering one; the most relevant conclusion derived from information found in literature, was that an immense gap would be encountered in HCSFMS integration in complex *Projects* (Kilmann, 1995). The *Managers*' or the enterprise *Project* architects' decisions made just-in-time, are proposed by using the outputs from the enterprise's various support, project, knowledge and decision management areas. The HMM-based DMS defines an alignment strategy of the enterprise's holistic architecture and overall resources that should manage and enrich the enterprise's microartefact libraries and areas, which in turn are modelled by an architecture formalism, like the ADM (Lankhorst, 2009).

Review and Check of the Critical Success Factors

As shown in Figure 4, a *Project* starts with the initial phase called the feasibility phase to check whether the whole undertaking makes sense. Based on the HCSFMS literature review and related evaluation processes, the most important extracted CSFs are used and evaluated using the following rules:

- References should be credible and are estimated by the authors; the notions of official ranking are less important and ignored, due to ego-concentration of lobbying of closed circles of influence; we can often find there same institutions and individuals. By references, it is meant the origins found in various types of literature and other CSF related resources, while the credibility of these references is estimated by Key Performance Indicators (KPI) that are related to requirements, which are empirically weighted as follows (Azadfallah, 2018): 1) the authors' academic and professional experiences that adds up to 20% of the whole estimation value; 2) statistical checkers like Gartner,

Figure 4. The framework's components and its mathematical model limited to the factor's qualification



Forester and others make 20% of the whole estimation value; 3) various company's and specialists surveying that is 20% of the whole estimation value; 4) CSF related code/application sources' prototyping that is 20% of the whole estimation value; and 5) simulation in the PoC and frequency build the final 20% of the whole estimation value.

- *Projects*, like mergers are the result of organisational changes in companies to act as a single enterprise with consolidated resources and business interests; and its success is measured by the CSFs, hence the literature references presented in the previous point.
- Applied modelling language should be limited in order to make the *Project* manageable and not too complex. Whether it is usable, can be estimated from literature review or from own working experience or reliable references like Gartner.
- The ADM is considered to be mature and it has been in use for more than ten years and it has been reported as successful; the interest in using TOGAF is very high and its ADM kernel consists about 90% of the practically used part of the methodology (Alm & Wissotzki, 2015; Kotusev, 2018). Unfortunately, that does not mean that *Projects* are granted to be successful and in fact their success rate is very low; serious publications present less than 10% success rate (Mintzberg, 1994).
- The ADM is appropriate for any project's local conditions and it manages the *TKM&F's* iterations.
- If the aggregations of all the *Project's* CSA/CSF tables are positive and exceed the defined minimum, the *Project* continues to its PoC or it can be used straightforward for problem solving.

The HCSMS's holistic approach cyclically interfaces: 1) project requirements; 2) various levels of architecture blueprints; 3) knowledge items and database; 4) a central DMS; and 5) the projects technology components through the use of a centralized ADM. The main reason for failures is because methodologies are not used in a holistic manner to achieve organizational alignment, centralized DMS and KMS (Syynimaa, 2015). This work is based on empirical engineering models.

Empirical Engineering Research Models

This chapter is based on an empirical engineering research approach (Johnson & Onwuegbuzie, 2004; Easterbrook, Singer, Storey, & Damian, 2008), and uses an authentic CSF based mixed method (where mixed research is a simplistic synonym) that can be considered as a natural complement to conventional qualitative and quantitative research methodologies, to deliver empirical pragmatism concepts to support a holistic approach for ultra-mixed methods research (Della Croce & T'kindt, 2002). CSF based empirical validity checks whether the RDP delivers credible contribution to existing scientific knowledge. These authors want to convince the respected readers that this chapter's recommendations and PoC are valid. The controlled experiment or PoC is a software prototype to test the RQ where the CSFs (or independent variables) are processed to evaluate their influence on the model's dependent variables. The PoC evaluates with precision the CSFs and their relationships. The HCSFMS is business-driven and is a part of the *TKM&F*; it is presented using a business case (The Open Group, 2011a).

Research Works

All the RDP's works follow and have the following construct:

- An introductory part that explains the overall research subject.
- The research part that explains the research concept.
- The business case or Applied Case Study (ACS) and PoC (Trad & Kalpić, 2018c) used to prove the researched subject, which is defined in two phases, the CSF qualification and the PoC phase.
- The ICT, ADM, KMS, DMS and CSA/CSF parts influence the RQ's context.
- A specialized part, like in this chapter the HCSFMS, is presented as the main research focus.
- Each part has an evaluation table that contains selected and weighted CSFs.
- The PoC, solutions and recommendations parts summarize the research work.

THE BUSINESS CASE

Business Context and Implementation

Projects are difficult to implement, because of their holistic nature, where the big part of complexity is met in its technical implementation phase (Watt, 2014; Gudnason & Scherer, 2012). The *TKM&F* can be applied to all types of *Projects* and business models (Joseph, 2014). Holistic business models, refer to any business, conducted using different types of electronic/distributed media; where the most common form is the business that makes its transactions and revenue via the World Wide Web that is based on business processes and internet technologies (e-business, 2014). The development and evolution of business engineering-related fields like blockchains are a fundamental factor for any economy. Business engineering-related fields have added significant savings in the building of business infrastructures, where they are also an enabler for DMS and support quicker response to market requests. Market requests, known as transactions, are essential for all business processing-related interactions (Kalpić, 2011). The technical implementation phase is the major cause of high failure rates in *Projects*. That is why the eBTMs' skills should encompass knowledge of: 1) Business infrastructure processes' architectures;

2) Business/web services' technologies; 3) real-time unbundling of business distributed environments (Willaert, 2001); 4) agile *Project* management; 5) implementation and integration (e)Business services; 6) organizational behaviour and engineering; 7) management sciences methodologies; 8) (e)enterprise or Enterprise 2.0 architectures and their integration in concrete *Project's* implementation phases (Platt, 2007). The actual hype of Enterprise 2.0 in the (e)business organizations is a buzzword introduced by the Harvard Business School in 2006; they describe the usage of W#eb 2.0 and Web 3.0 technologies in transformed enterprises in order to increase productivity and efficiency.

Modelling the Business Case

HCSFMS uses a fictitious ACS, developed by the Open Group as a reference study, it presents the possibilities to implement *Project*s' components; using a modelling environment (Beauvoir & Sarrodie, 2018). The HCSFMS is related to an insurance company named ArchiSurance that has resulted from the merger of three insurance enterprises. CSFs define and tune the actions needed to ensure the success of the *Project;* initially CSFs were used in the domains of data analysis and business analysis. CSAs define the range of satisfactory results that would ensure successful competitive performance for the transformed enterprise; this process starts by identifying the sets of CSFs, which enable enterprises to focus their actions on enhancing their capabilities by respecting the defined CSFs.

Integrating Factors

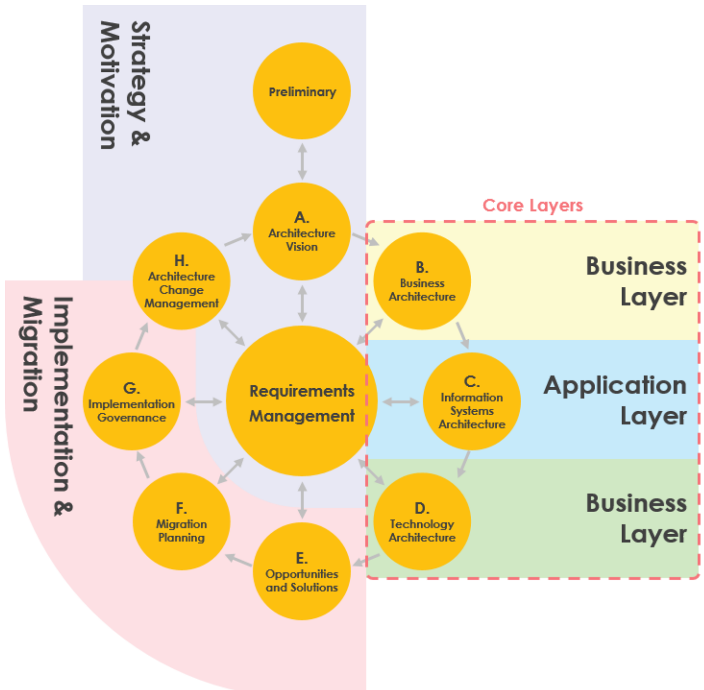
A CSF is measurable and mapped to a weighting that is roughly estimated in the first iteration and then tuned through the following ADM iterations (Morrison, 2016). Once the initial set of CSFs has been identified, then the *Project* can use the HCSFMS to tune the next iterations' CSFs. The proposed HCSFMS delivers a set of CSFs for an aligned *Project,* is a part of the *TKM&F* (Trad & Kalpić, 2018a, 2017b, 2017c).

The HCSFMS is used by the *Project* and its transformation scenarios and is the basis of the PoC. The HCSFMS illustrates the realistic use of the CSFs in the context of a transformation process using The Open Group's Architecture Framework's (TOGAF) and its ADM.

The Architecture Development Method

This RDP focuses on the design of transformations' and EA models for *Projects'* integration that is mainly motivated by the high failure rates as well as the lack of credible recommendations (Gartner, 2017). This RDP presents the influence of CSFs to assure a successful implementation of a *Project*, therefore there is a need of a holistic architecture. In the actual age of intelligence, complexity, knowledge, economy and hyper-technology, evolution, Internet of Things, globalization, progress and hyper-engineering is not a set of dislocated isles of inventions and discoveries, in fact they are interconnected because of the following simplistically presented facts (Kinnunen, Ylä-Kujala, Marttonen-Arola, Kärri, … Baglee, 2018); there is a need for a dynamic HCSFMS based *projects* to manage corporate intellectual assets (Gardner, 1999). The implementation of a HCSFMS using the ADM is one of this most important CSFs that can influence the *Project* (Lusa & Sensuse, 2011). At the beginning of a *Project*, the ADM's Preliminary Phase defines the main CSFs.

Figure 5. The architecture development method's phases (Visual Paradigm, 2019)



The Critical Success Factors in a Business Case Study

Based on the CSF literature review process, the important business case's CSFs are used and evaluated.

As shown in Table 1, the result's aim is to prove or justify the HCSFMS' business case that is based on the global *Project's* case and how it can be used with the *TKM&F* for the PoC. The next CSA to be analysed is the holistic MM's integration.

The Research Section's Link to the Applied Mathematical Model

This section's deduction is that the ACS is crucial for the RDP's credibility, where it forms the basis for its mathematical model.

Table 1. The applied case study's critical success factors that have an average of 9.25

Critical Success Factors	KPIs	Weightings
CSF_BusinessCase_Modelling	Complex_NeedsUnbundling	From 1 to 10. **08 Estimated**
CSF_BusinessCase_Factors	Complex_Classification	From 1 to 10. **08 Estimated**
CSF_BusinessCase_References	Limited_Silos	From 1 to 10. **08 Estimated**
CSF_BusinessCase_ArchitectureDevelopmentMethod	Integrated	From 1 to 10. **10 Estimated**

valuation

USAGE OF THE APPLIED MATHEMATICAL MODEL

The Basic Element

A CSF is the basic element of the MM, it is central to the *TKM&F*, which enables the processing. The CSF defines the algorithm nodes that are identified as vital for successful targets to be reached and maintained. Is a MM basics, an element is necessary for the *Project* to measure its success or failure (Morrison, 2016).

The Model's Basics

The *TKM&F* offers a CSF-based HMM that is an abstract model, containing a proprietary Mathematical Language (ML) that can be used to script, transform and implement the behaviour of any business system and its HCSFMS (Goikoetxea, 2004). The HMM nomenclature is presented to the reader in a simplified form in Figure 6, to be easily understood on the cost of a holistic formulation of the architecture's vision.

As shown in Figure 6:

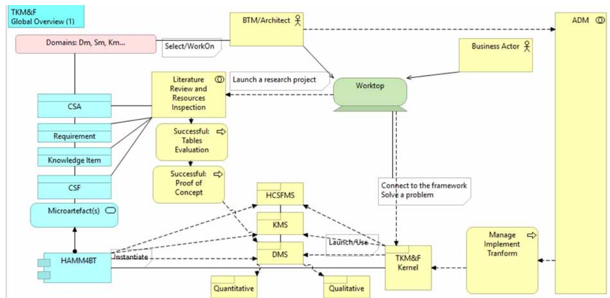
- The abbreviation "mc" stands for micro.
- The symbol $\sum$ indicates summation of weightings/ratings, denoting the relative importance of the set members selected as relevant. Weightings as integers range in ascending importance from 1 to 10.
- The symbol $\underline{\cup}$ indicates sets union.
- The proposed HMM enables the possibility to define *Project*/EAPs as a model; using CSFs weightings and ratings.
- The selected corresponding weightings for CSF ϵ { 1 … 10 }; are integer values.
- The selected corresponding ratings for CSF ϵ { 0.00% … 100.00% } are floating point percentage values.

Figure 6. The applied mathematical model's nomenclature (Trad, & Kalpić, 2017a)

AMM4BT

rncRequirement	= KP I	(1)
CSF	= Σ KPI	(2)
CSA	= Σ CSF	(3)
Requirement	= $\underline{\cup}$ rncRequirement	(4)
(e)neuron	= action+ rncInteligenceArtefact	(5)
mcArtefact	= $\underline{\cup}$ (e)neurons	(6)
rncEnterprise	= $\underline{\cup}$ mcArtefact	(7)
(e)Ellterprise	= $\underline{\cup}$ rncEnterprise	(8)
mcArtefactScenario	= $\underline{\cup}$ mcArtefactDecisionMaking	(9)
IntelligenceComponent	= $\underline{\cup}$ mcArtefactScenario	(10)
OrganisationalIntelligence	= $\underline{\cup}$ InteligenceComponent	(11)
AMM4BT	= ADM+ OrganisationalIntelligence	(12)

Figure 7. The framework's components and its mathematical model



The Applied Mathematical Model's Structure

A holistic HMM's has a composite structure that can be viewed as follows:

- The static view has a similar static structure like the relational database model's structure that includes sets of CSAs/CSFs, which map to tables and provide the ability to create them and apply actions on these tables; in the case of HMM they are microartefacts and not tables (Lockwood, 1999).
- In the behavioural view, these actions are designed using a set of mathematics nomenclature; the implementation of the HMM is in the internal scripting language, used also to tune the CSFs (Lazar, Motogna, & Parv, 2010).
- The skeleton of the *TKM&F* uses microartefacts' scenarios to support just-in-time *Project* requests.

The Applied Transformation Mathematical Model

The HMM that can be modelled after the following formula for the Transformation Mathematical Model (TMM) that abstracts the *Project*:

$\text{iHMM} = \text{Weigthing}_1 * \text{iHMM\_Qualitative} + \text{Weigthing}_2 * \text{iHMM\_Quantitative}$ (1).

where the iHMM, is an HMM evaluation for one and single iteration.

$\text{HMM} = \sum \text{iHMM}$ for an enterprise architecture's instance (2).

(TMM):

$\text{TMM} = \sum \text{HMM}$ instances (3).

The objective function of the TMM's formula can be optimized by using constraints and with extra variables that need to be tuned using the HMM. The variable for maximization or minimization can be, for example, the *Project* success, costs or other (Dantzig, 1949; Sankaralingam, Ferris, Nowatzki, Estan, Wood & Vaish, 2013). For this PoC, the success will be the main constraint and success is quantified as a binary 0 or 1. The objective function definition will be:

Minimize risk TMM (4).

Minimization of the *Project's* risk is done using a goal function. The TMM is the combination of an EAP, *Project* methodologies and a holistic mathematical model that integrates the enterprise organisational concept, information and communication technologies (Lazar, Motogna, & Parv, 2010).

As shown in Figure 7, the HMM is a part and is the skeleton of the *TKM&F* that uses microartefacts' scenarios to support just-in-time requests of the HCSFMS. The HCSFMS components interface the DMS and KMS, as shown in Figure 7, to manage and map CSFs to knowledge items. An instance of the HMM is created at the *Project's* initialization phase and takes care of the logical interaction of various elements. As mentioned and shown in Figure 7, if the aggregation of all the *Project's* CSA/CSF tables exceeds the defined minimum, the *Project* continues to its PoC or can be used for problem solving, using the heuristic algorithm with punctual calls to quantitative methods. The *Project's* initialization phase generates the needed CSFs and hence creates the types of problems and actions to be solved.

The HMM is a part and is the skeleton of the *TKM&F* that uses microartefacts' scenarios to support just-in-time requests of the HCSFMS. The HCSFMS interfaces the DMS and KMS, as shown in Figure 8, by using the data architecture and intrefaces, to manage and map CSFs to knowledge items.

Framework's Applied Mathematical Model Integration

A generic *Project* model and its kernel ADM are the base of this RDP and they are the basics of its *TKM&F*. The authors want to propose the HMM to represent the *TKM&F* architecture and solve its integration problems (Agievich, 2014).

The Mathematical Model's Integration Critical Success Factors

Based on the literature review and the resultant CSF evaluation phase, the most important HMM's CSFs that are used are evaluated in the following table:

As shown in Table 2, the result's aim is to prove or justify that HMMBT is mature and possible to structure a *Project's* case and indicate how it can be used with the *TKM&F* for the next phase, the PoC. The next CSA to be analysed is the holistic management of the ICT system.

Figure 8. The decision-making system's just-in-time data sources (Daellenbach & McNickle, 2005)

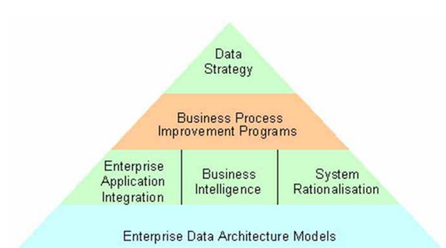


Table 2. The critical success factors that have an average of 9.16

Critical Success Factors	HMM - KPIs	Weightings
CSF_HMM_TKM&F_Integration	StableTested	From 1 to 10. **09 Estimated**
CSF_HMM_InitialPhase	RobustTested1	From 1 to 10. **10 Estimated**
CSF_HMM_PoCPhase	StableTested	From 1 to 10. **10 Estimated**
CSF_HMM_Qualitative&Quantitative	Complex	From 1 to 10. **07 Estimated**
CSF_HMM_Final_TMM	VerifiedModel	From 1 to 10. **10 Estimated**
CSF_HMM_ADM_Integration	Synchronized	From 1 to 10. **9 Estimated**

valuation

The Research Section's Link to the Information and Communication Technology

This section's deduction is that the ICT's environment's unbundling is a crucial process for the business environment and for the RDP's credibility.

THE KMS INTEGRATION IN THE INFORMATION AND COMMUNICATION TECHNOLOGY SYSTEM

The Factors as the Base of the Unit of Work

Selecting a CSF directs the implementation of microartefact granularity and responsibility for a given scenario, what is a complex undertaking; added to that, there is the complexity in implementing the "1:1" mapping, implementation and classification of the engineered microartefacts, as shown in Figure 9. The EA concept uses methodologies, like the TOGAF's ADM that supports a set of the *TKM&F's* microartefact scenarios that are implemented using the HMM ML used to dynamically evaluate compound expressions, according to the HMM principles (Neumann, 2002).

Holistic Qualification Procedures

An adapted development and iterative process of operations can be integrated to support synchronized implementation approach; where the evolution of ICS based on the integration of Internet of Things (IoT) and cloud computing technologies needs holistic robust management approaches that support *Projects'* resources/assets to be protected and, hence, improve profitability (D'Emilia & Galar, 2018). Figure 10 shows, a DMS subsystems interact to solve many types of problems and events may cause a *Project* to fail, these problems are frequently justified by the human behavioural aspects translated into para-psychology finger-pointing strategies.

Actual immaturity of design, development, qualification and operations for *Projects* still are in an infancy age, or simply chaotic. Tools for implementation environments are still confronted with serious

Figure 9. The framework's microartefact interactions

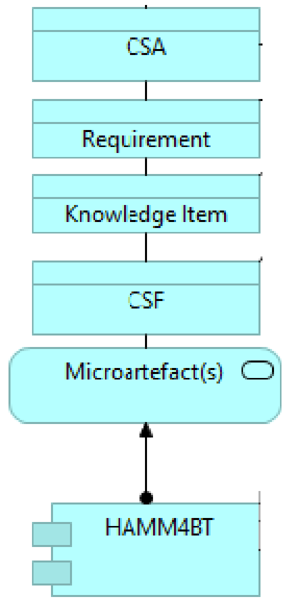
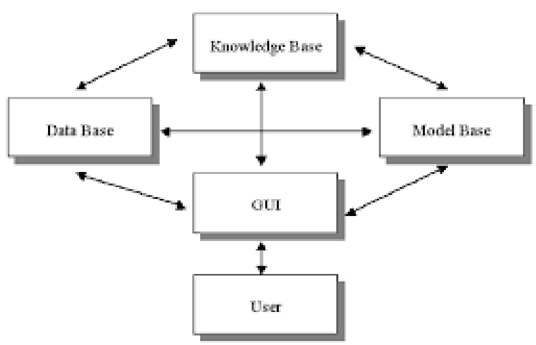


Figure 10. The decision making based systems' evolution (Panetta, 2016; Gartner, 2013)



project issues. These problems show that tools are inappropriate for large enterprise intelligent systems and the authors recommend the use HCSFMS patterns (Panetta, 2016).

Building a *Project* and the corresponding large set of heterogeneous software modules can be very complex and problematic; the main problem can arise due to the company's lack of a manageable holistic approach and the over-emphasized hyper-agility, based on a jungle of shareware gadgets. The current chapter tries to prove that these problems can be countered with the implementation of an HCSFMS based DMS. Use of simplistic agilization (Tomlin & Lawrie, 2008) methodologies and DMS silos to manage isles of business technologies are the main problems in a *Project* or in enterprise projects in general (Asan & Bilgen, 2013); such projects lack holistic and synchronized implementation approach (Thomas, 2015; Cearley, Walker & Burke, 2016).

Factor Patterns

HCSFMS pattern(s), as shown in Figure 11, is (are) managed in the TKM&F repository; these patterns express a structural concept for CSF data structure and implementations. The pattern offers the following: 1) a set of predefined CSFs for structural, knowledge and intelligence templates to instantiate microartefact scenarios; 2) description of their responsibilities, relationships and content; 3) a help to define complex relationships between *Project's* microartefacts; 4) definition of a default CSA and CSF sets model; and 5) simplification for the CSF table evaluations.

The *TKM&F* repository components support the *Project* by offering default CSF sets to handle various types of *Project's* resources.

Resources, Artefacts and Factors

The *TKM&F's* repository maps and relates the selected CSFs to various types of *Project's* resources, like architecture models, microartefacts and requirements; as shown in Figure 12 it can deliver an interface to the KMS. This mapping concept associates CSFs and microartefact scenario instances in all of the implementation phases of the ADM (The Open Group, 2011a). The HCSFMS manages the CSFs and mappings in the *TKM&F's* repository and identifies the initial set of CSAs/CSFs to be used, as shown in Figure 12.

The Information and Communication Technology's Critical Success Factors

Based on the literature review process and factors' evaluation, the most important ICT's CSFs that are used are evaluated to the following; where Rapid Application Development (RAD) tools and approach are used:

Figure 11. The pattern's storage in the framework's repository

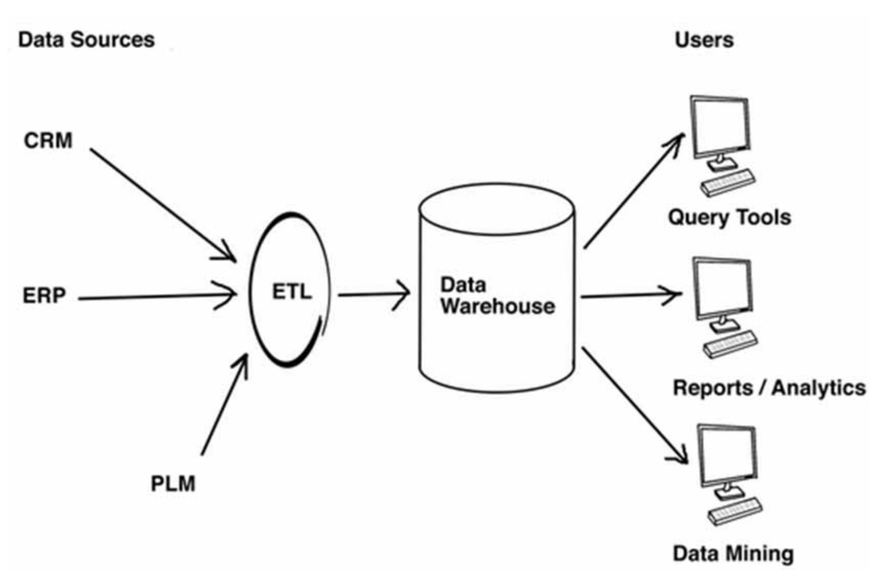


Figure 12. The knowledge management subsystem

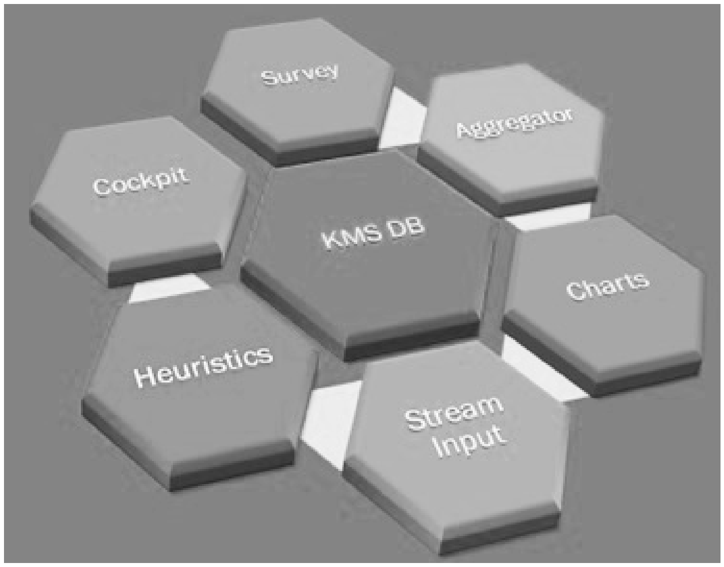


Table 3. The critical success factors that have an average of 9.25

Critical Success Factors	HMM - KPIs	Weightings
CSF_ICT_IntegrationProcesses	MatureSupported	From 1 to 10. **09 Estimated**
CSF_ICT_Operations&Choreography	SimpleAutomated	From 1 to 10. **09 Estimated**
CSF_ICT_DesignProcess	SimpleSupported	From 1 to 10. **09 Estimated**
CSF_ICT_McLifecycle	ExistingProcedures	From 1 to 10. **10 Estimated**
CSF_ICT_RAD	ExistingEnvironments	From 1 to 10. **10 Estimated**
CSF_ICT_Tests	ExistingTests	From 1 to 10. **10 Estimated**
CSF_ICT_StorageRepository	Supported	From 1 to 10. **08 Estimated**
CSF_ICT_Mapping	Supported	From 1 to 10. **09 Estimated**

valuation

As shown in Table 3, the result's aim is to prove or justify that it is possible to implement a HCSFMS with the ICT system that enables the next CSA to be analysed, which is the integration of the ADM.

The Research Section's Link to the Architecture Development Method

This section's deduction is that the ICT and other fields are dependent on an enterprise architecture paradigm and therefore the ADM is crucial for the integration of the HCSFMS.

THE INTEGRATION WITH THE ARCHITECTURE DEVELOPMENT METHOD

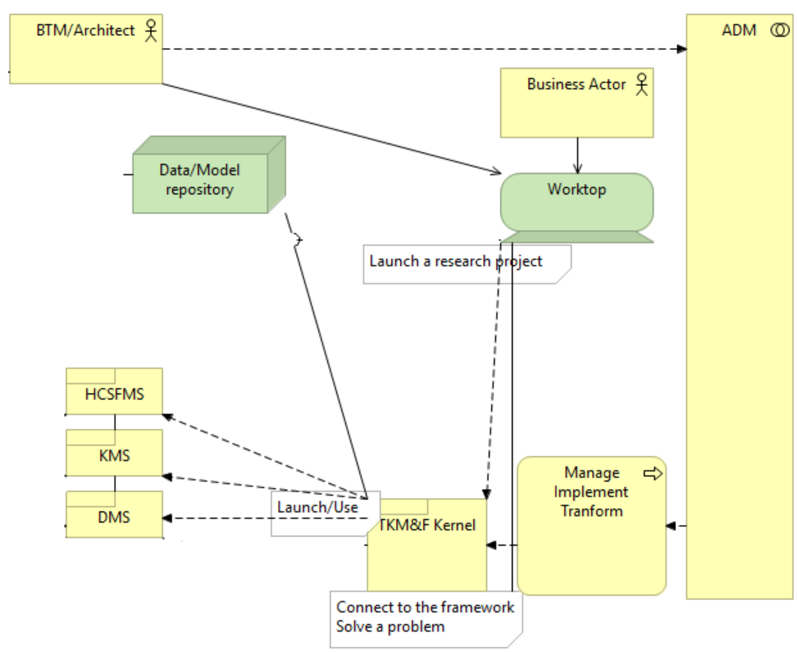
The HCSFMS' integration with the ADM, enables the automation of the CSFs management and evaluation. The ADM is a generic method and recommends a set of phases and iterations to develop the *Project*; it designs parts of the transformed system interfaces and other deliverables also with other internal and market frameworks.

Architecture Phases

As shown in Figure 13, the ADM manages the *Project's* development iterations; in this section the authors present ADM's phases and the HCSFMSs implications (Visual Paradigm, 2019):

- The preliminary phase selects the relevant CSFs and the way in which they will be weighted and rated.
- The architecture vision and business architecture phases define the CSFs constraints and objective functions to be used.
- The information system architecture phase selects the ICT's set of CSFs.
- The technologies architecture phase selects the technology's set of CSFs.
- The requirements management and tests phases manage the evaluation of CSFs.

Figure 13. The architecture method's interaction



The Architecture Development Method Critical Success Factors

Based on the literature review and CSF evaluation process, the most important ADM's CSFs are evaluated to the following:

As shown in Table 4, the result tries to prove or justify that it is possible to integrate and automate the ADM's interaction with the *TKM&F*; and the next CSA to be analysed is the holistic management of the DMS.

The Research Section's Link to the Architecture Development Method

This section's deduction is that the HCSFMS can be integrated in the *Project* and a holistic ADM and the HCSFMS are mature to be used to support KMs and DMSs; or any other intelligence-based system.

THE HOLISTIC KNOWLEDGE MANAGEMENT SYSTEM

For a KMS, the principle of identifying and selecting CSFs as a basis to manage information items is a holistic management concept that offers also the possibility to support evaluation. This concept was applied in many fields where CSAs/CSFs are critical to the success of *Projects*, in the way where the objectives are associated with the CSFs and their evaluation, that can estimate success or failure rates (Rockart, 1979).

The Holistic Knowledge Management Basics

The KMS interfaces the HCSFMS that links a CSF to one or more knowledge items that correspond to various just-in-time microartefact scenarios. Knowledge items and microartefact scenarios are responsible for the manipulation of intelligence and to control various processing activities. The KMS supports the HCSFMS underlying mechanics to manage sets of factors' weightings to direct actions that are called knowledge/intelligence microartefacts. Weighting/rating concept enables the HCSFMS patterns and microartefacts to build an intelligent subsystem that delivers answers in the form of knowledge values known as items. In *Project* cases, fast change requests may generate an important set of corresponding intelligence solutions that can be ambiguous and requires actions complex to implement. The HCSFMS is responsible for a rational access for enterprise knowledge extraction, related to CSFs and is based on

Table 4. The critical success factors that have an average of 9.0

Critical Success Factors	HMM - KPIs	Weightings
CSF_ADM_CSF_Initialization&Setup	MatureStatus	From 1 to 10. **10 Estimated**
CSF_ADM_IntegrationProcesses	StandardSupported	From 1 to 10. **08 Estimated**
CSF_ADM_Phases	Supported	From 1 to 10. **10 Estimated**
CSF_ADM_Requirements	MappingAutomated	From 1 to 10. **09 Estimated**

valuation

a holistic systemic approach (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a). A successfully integrated HCSFMS can give a company the most important competitive business advantages that may ensure its future and it is not a secret that intelligence microartefacts are the basis of any successful *Project* (Trad, 2018a; Trad, 2018b; Trad, 2018c). Major research and advisory companies like Gartner, confirm that knowledge services will leverage business ICTs' components from various enterprise departments, as shown in Figure 14. Gartner confirms also that services are the dominating business enablers for Fortune 500 companies, which need dynamic business knowledge and intelligence support (Clark, Fletcher, Hanson, Irani, Waterhouse & Thelin, 2013).

Knowledge Item's Microartefacts and Access Management

As shown in Figure 15, the knowledge items that are through the internal mapping system related to CSFs and microartefact(s) scenarios are classified in specific CSAs. A HCSFMS concept expresses a fundamental structural *Project's* concept for its implementation; which enables a holistic approach to knowledge access and its mapping to CSFs.

The Holistic Knowledge Access Management

A HCSFMS is managed by the *TKM&F*, where the *Manager* or enterprise architect configures the CSFs, KPIs and hence the CSAs to be processed. This fact enables the activation of sets of microartefacts' scenarios responsible for the implementation of mechanisms. The HCSFMS concept is implemented in all of the *Project's* components and it enables the delivery of the requested CSF and the mapped knowledge items, as shown in Figure 15 (The Open Group, 2011a; Trad & Kalpić, 2017a, 2017b, 2017c).

Figure 14. The neural network enterprise architecture component graph (Clark, Fletcher, Hanson, Irani, Waterhouse & Thelin, 2013)

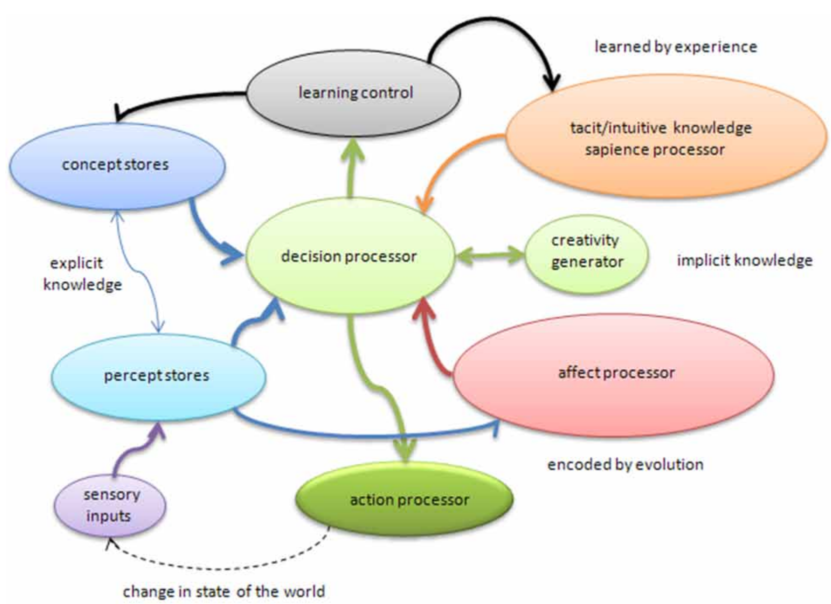
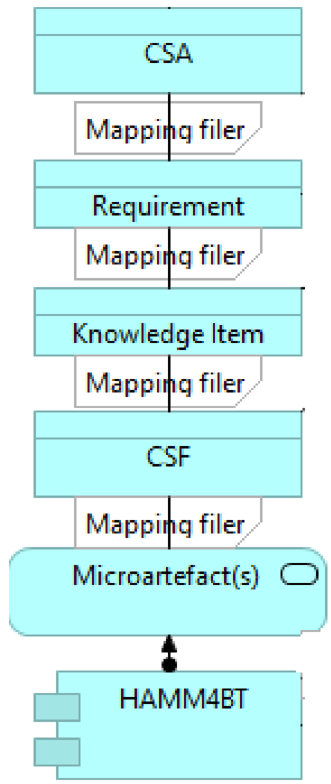


Figure 15. Mapping factors to other resources



The Knowledge Management Success Factors

Based on the literature review, the most important knowledge CSFs that are used are presented in Table 5.

The Modules Chained Link to the Intelligence Support or Decision System

The KMS' integration result proves that it is possible to implement an HCSFMS to interface the DMS.

THE INTEGRATION WITH THE DECISION-MAKING SYSTEM

Complex Decision Systems

The HCSFMS interfaces the DMS that is aimed for complex *Project* management and is supported by this RDP's HMM formalism. DMS holistic management is an approach for building complex business systems using a central decision process that is based on independent sets of CSFs (Daellenbach & McNickle, 2005).

Table 5. The critical success factors that have an average of 9.5

Critical Success Factors	HMM - KPIs	Weightings
CSF_KMS_Integration	FullySupported	From 1 to 10. **10 Estimated**
CSF_KMS_Mapping	ComplexToImplement	From 1 to 10. **08 Estimated**
CSF_KMS_Patterns	Implementable	From 1 to 10. **10 Estimated**
CSF_KMS_AccessManagement	StandardIntgeration	From 1 to 10. **10 Estimated**

valuation

The Decision-Making Process

In the HCSFMS based DMSs, *Project* team members can select and tune types of CSAs and CSFs to be processed. The selected CSFS are orchestrated by the HMM's choreography engine that is the base of the DMS, as shown in Figure 16. The HMM instance is in all of the *Project*'s processes; such a set of CSFs are mapped to microartefacts (or sets of actions); like the ones presented in this chapter's experiment or a proof of concept (The Open Group, 2011a; Trad & Kalpić, 2017a; Trad & Kalpić, 2017b; Trad & Kalpić, 2017c).

The Decision-Making System's Critical Success Factors

Based on the literature review and evaluation processes, the most important DMS's CSFs that are used are evaluated to the values in Table 6.

As shown in Table 6, the result tries to prove or justify that it is possible and even mature to implement a DMS using the HMM formalism and that will be presented in the HCSFMS section.

The Research Section's Link to the Proof of Concept

This chapter's deduction that selects and evaluates the CSFs, is based on the six tables that this RDP has generated, and the following phase is the PoC implementation.

THE PROTYPE'S INTEGRATION WITH CRITICAL SUCCESS FACTORS

Ronald (Ronald, 1961) argues that the term CSF should not be used, but he would rather use critical elements and non-critical elements of a business transformation to control success that today is understood as success factors. The HCSFMS' concept and its efficiency are presented in this book's chapters in ACS/PoC and they show how CSFs estimate success or failure of *Projects* (Lebreton, 1957). Such an ACS/PoC approach starts with the question: "What are the essential CSFs that produce success in my company?" (Spencer, 1955). The HCSFMS' ACS/PoC uses the default book's ACS, as this experiment's case. The ACS is an insurance management system that has an archaic information system, a mainframe, claim files service, customer file service. The ACS manages, registers, accepts, valuates

Figure 16. The proposed methodology and framework pyramid

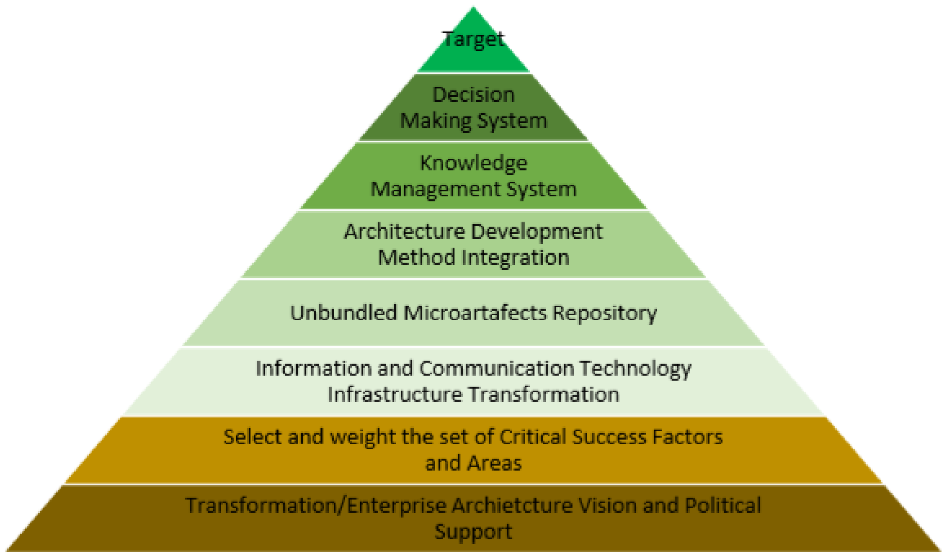


Table 6. The critical success factors that have an average of 9.5

Critical Success Factors	HMM - KPIs	Weightings
CSF_DMS_ComplexSystemsIntegration	Supported	From 1 to 10. **09 Estimated**
CSF_DMS_HCSFMS_Interfacing	Supported	From 1 to 10. **09 Estimated**
CSF_DMS_KMS_Interfacing	IntegrationEnabled	From 1 to 10. **10 Estimated**
CSF_DMS_DMP	IntgeratesAsKernel	From 1 to 10. **10 Estimated**

valuation

and invoices claims activities. The demo application uses the *TKM&F* for the ACS/PoC implementation (Trad & Kalpić, 2018c).

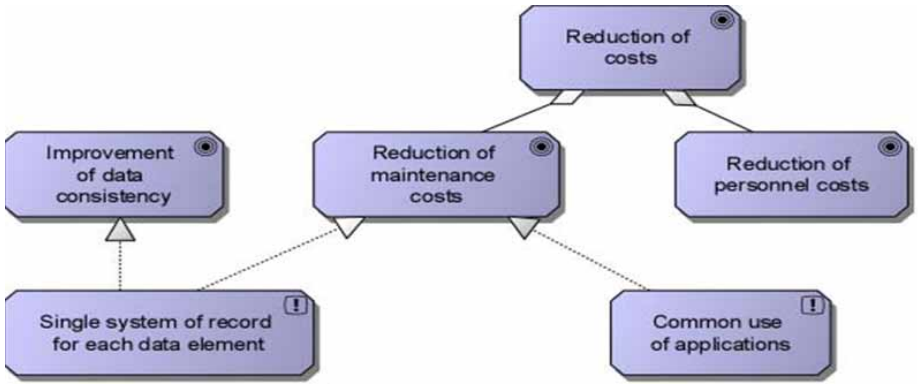
Application Portfolio Rationalization Scenario, Data Unification

This PoC implementation, the ArchiSurance ACS is used; due to the merger, the business system's landscape has become siloed, what results in major data and knowledge redundancy, functional overlap and archaic integration, using multiple formats and technologies. For this PoC, a holistic approach is tested to structure the sets of CSAs/CSFs and evaluate them. The software structure must be transformed to improve data and hence CSFs' inspection quality, as shown in Figure 17 that can be considered as the base sets of CSAs.

Setup and Factors for the Phases of the Architecture Method

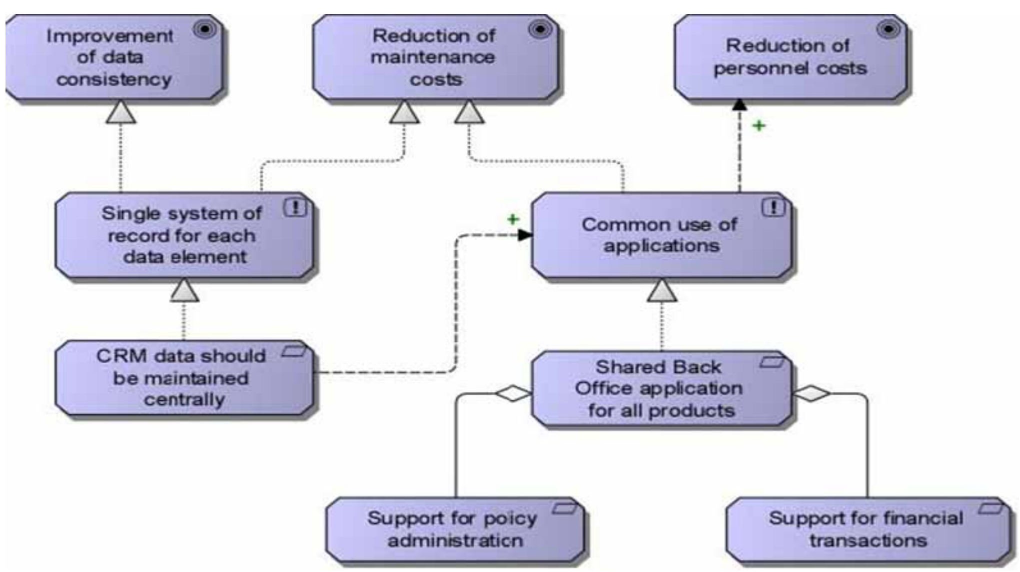
The setup of HCSFMS's implementation phases looks as follows:

Figure 17. Transformation goals (Jonkers, Band, & Quartel, 2012)



- phase A or the Architecture Vision phase, establishes an architecture effort and initiates an iteration of the architecture development cycle by setting its scope, constraints, and goals, which all are translated into sets of CSFs for the PoC.
- Phase B or the Business Architecture phase shows how the *Project*'s target architecture realizes the key *Project's* requirements and links them to the related/mapped CSFs for the PoC.
- Phase C or the Gap Analysis phase shows and uses the Application Communication Diagram, which shows the modelled target application landscape.
- Phase D or the Target Technology Architecture and Gap Analysis phase shows the final *Project's* infrastructure, which is here limited.
- Phases E and F, Implementation and Migration Planning; the transition architecture proposes possible intermediate situation and evaluates the *Project's* status against the defined CSFs.

Figure 18. Goals and principles (Jonkers, Band, & Quartel, 2012)



The Proof of Concept

The chapters' PoC is implemented using *TKM&F* was developed exclusively by the authors, as already mentioned. The PoC is based on the HMM and the HCSFMS, whose instances interface the DMS that is launched once after the internal initial set of CSFs has been elected and estimated. That is implemented in this chapter, and is presented and evaluated in Tables 1 to 6 as shown in Figure 19.

These CSFs have bindings/mappings to specific *Project* resources, where are used microartefacts and EA methodologies and related tools. The HCSFMS model represents the relationships between the *Project* requirements and CSAs/CSFs and global unique identifiers, as shown in Figure 20.

Figure 19. The TKM&F sequence of phases

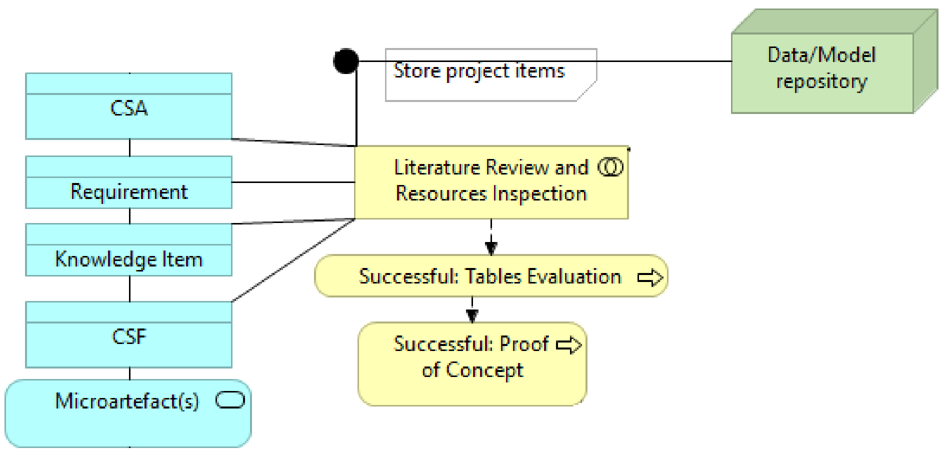
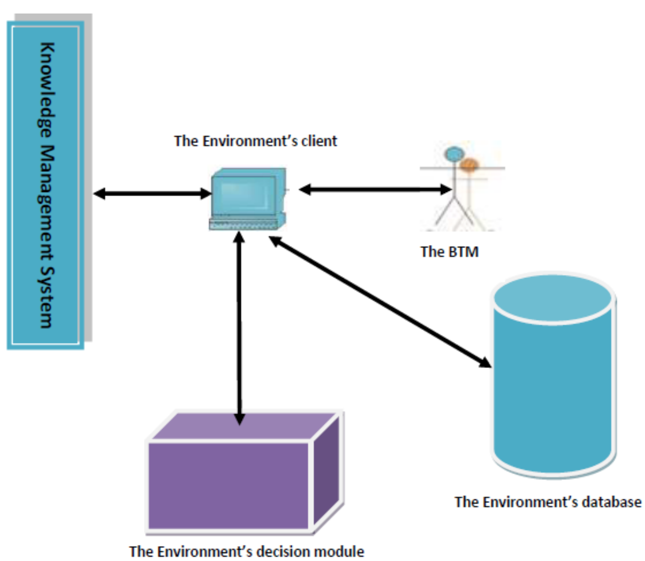


Figure 20. The TKM&F's interaction with the Manager as client



The PoC is achieved by using the *TKM&F* client's interface that is shown in Figure 21; where all the fields cannot be explained here because of the their multitude. From the *TKM&F* client's interface the ML development setup and editing interface can be launched.

Once the development setup interface is activated, the NLP interface can be launched to implement the needed microartefact scripts to process the defined six CSAs. After starting the *TKM&F's* graphical interface, the sets of CSFs are selected, as shown in Figure 22.

Then follows the CSF attachment to a specific node of the *TKM&F's* graphical tree, as shown in Figure 23. As already mentioned, the *TKM&F* uses a large set of abbreviations and the user should refer to the *TKM&F's* user's guide which can accessed by contacting the authors (Trad, 2018a; Trad, 2018b).

These scripts make up the intelligence basis and the HMM's instance set of actions that are processed in the background. The HMM uses a knowledge database that automatically generates DMS actions, that manages the edited mathematical language script and flow, as shown in Figure 24. A detailed example is presented in the book's part V.

This research's instance of the HMM and its related CSFs were selected as demonstrated previously, as shown in Figure 24.

Figure 21. The TKM&F's graphical interface

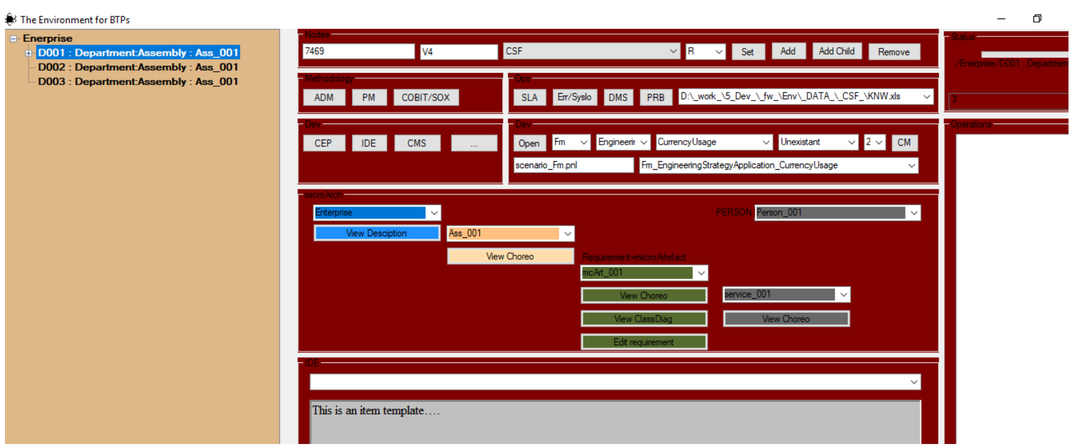


Figure 22. The TKM&F's factor setup interface

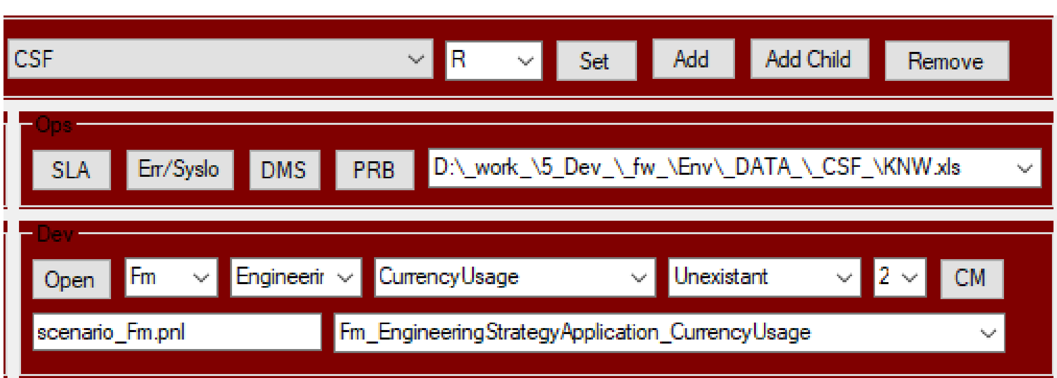


Figure 23. The TKM&F's factor in the tree structure

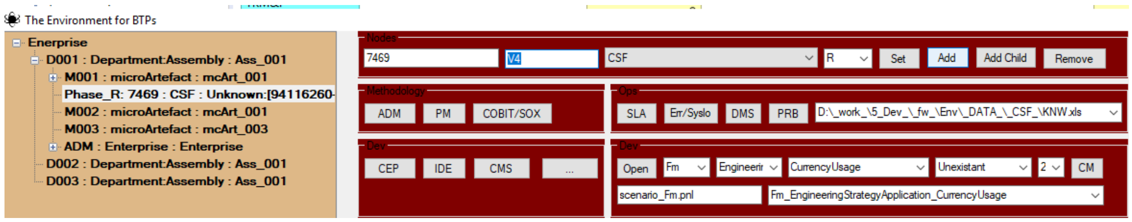


Figure 24. The edited mathematical language script and flow

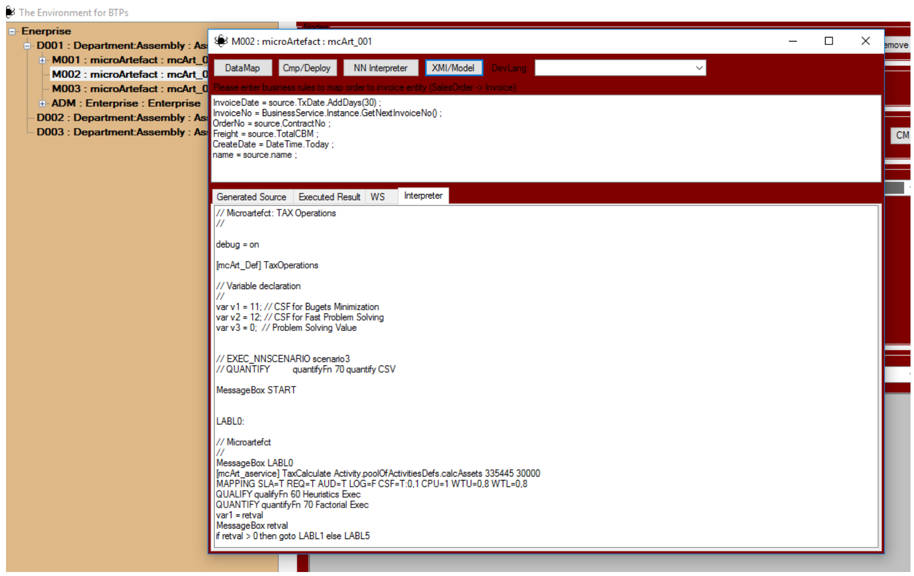
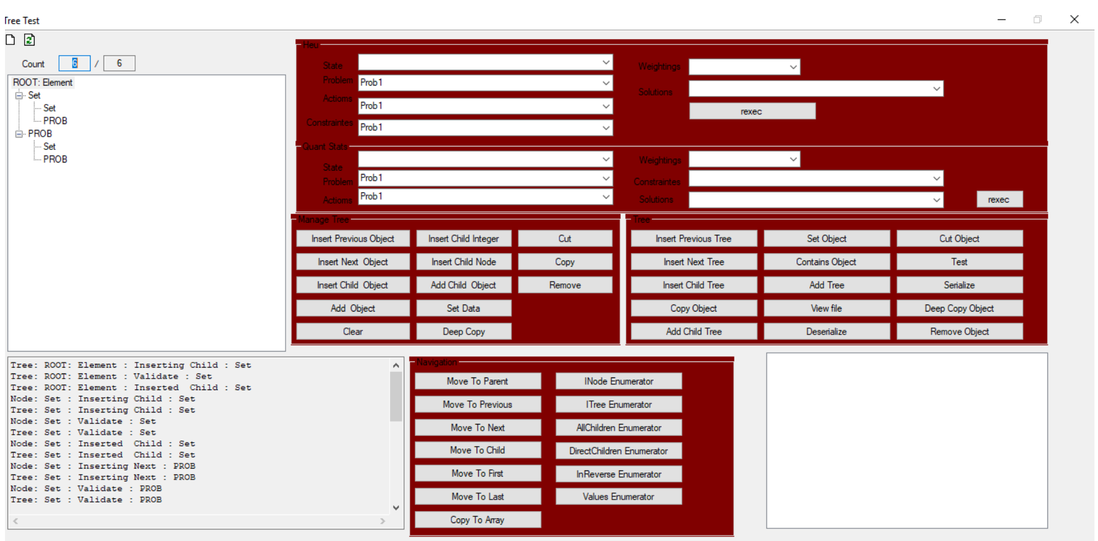


Figure 25. The heuristics tree configuration



Once the microartefact is ready, the CSF and NLP files are configured as shown in Figure 25.

The six tables in this chapter and the result of the processing of the first initial phase, as illustrated in Table 7, show clearly that the HCSFMS can be used in *Projects*. HCSFMS is not an independent component and is bonded to all the *Project*'s overall architecture, hence there is a need for a holistic approach.

The *TKM&F* and hence the HMM's main constraint to implement the HCSFMS is that CSAs for simple *Project* components, having an average result below 8.5 will be ignored. In the case of the current CSF evaluation an average result below 7.5 will be ignored. As shown in Table 7, this fact keeps the CSAs (marked in green) that helps to make this work's conclusion; and drops the ones in red. It means that the HCSFMS integration is mature and can be used in all types of projects. Of course, there is complexity in integrating the HCSFMS in *Projects* and the used transformation processes must be done in multiple transformation sub-projects, where the first one should try to transform the base enterprise business services repository.

SOLUTION AND RECOMMENDATIONS

Because of very high score, above 9, Table 7 shows that the HCSFMS implementation is not a risky transformation process and that today the *TKM&F* is ready and is the only methodology and framework that can in parallel construct BTPs, EAPs, MMs, KMS, DMS' and business engineering projects. In this chapter that is related to the HCSFMS transformation projects, the authors propose the following set of architecture, technical and managerial recommendations:

- Unbundle the enterprise's services and requirements to deliver the needed HCSFMS' factors classification.
- Setup the weighting and rating rules.
- Setup the mapping concept.
- Design a central HCSFMS to be used in the *Project*s.
- Use a standard enterprise architecture methodology to model the HCSFMS.

Table 7. The holistic factor management system research's outcome

CSA Category of CSFs/KPIs	Influences transformation management	Average Result
The Applied Case Study Integration	CredibleStable	From 1 to 10. 9.25
The Usage of the Architecture Development Method	FullyIntegrated	From 1 to 10. 9.00
The Information and Communication Technology System	Transformable	From 1 to 10. 9.25
The Mathematical Model's Integration	IsApplicable	From 1 to 10. 9.16
The Decision Making System	Implementable	From 1 to 10. 9.50
The Holistic Knowledge Making System	Implementable	From 1 to 10. 9.50

- Select the HCSFMS' CSFs, KPIs and CSAs.
- Model the HCSFMS' and microartefacts interaction.
- Define the interface to the KMS and DMS.
- A HCSFMS concept must be established and tried to check its feasibility.
- A *Project* must build a central factors management system.
- Enormous efforts must be applied to integrate underlying ICT system to support the unbundling process. Here the main problem is alignment because project resources are siloed in traditional systems.
- HCSFMS should replace traditional obsolete factors evaluation mechanisms.
- The architecture development method's integration in a HCSFMS enables the automation of its interfaces.
- The *Project* must be separated in multiple transformation projects, where the first one should attempt to transform the information system's services.

FUTURE RESEARCH DIRECTIONS

The research project's future efforts will focus on the various e-technology environments that can be used in transformational initiatives in cross-functional environments.

CONCLUSION

This RDP is based on the *TKM&F* unique mixed research model; where an initial sets of CSFs and CSAs are proposed to support the *Project Managers* and architects to minimize the chances of failure when transforming a business system. This chapter is part of a series of research works related to HMM, *Project*s, DMSs and KMSs. This chapter is based on the mentioned mixed research model and its CSAs/CSFs sets to evaluate each *Project* phase. In this chapter, the focus is on the HCSFMS that defines a central factor pool to be used throughout the *Project*. The most important managerial recommendation that was generated by the previous research phases was that the business transformation manager must be an architect of adaptive business systems.

This chapter's and in general the book's PoCs are based on the CSFs' binding to a specific research resources (or requirements) and the internal reasoning model that represents the relationships between these CSFs, requirements, microartefacts and KM items. The final result clearly implies that the proposed HCSFMS is credible and can be used to support such complex *Projects*, where the priority is to support the transformation processes of the information system, decision making system and global architecture, using the HMM. HCSFMS describes a structured inter-relationship development of various knowledge/requirement fields and the implementation of microartefacts. The HCSFMS component's global integration is an important factor for the *Project's* success. The PoC was based on the CSAs/CSFs links to a specific *Project* resources and the reasoning model evaluated the selected CSFs. The deduced result implies that an attempt of HCSFMS-based transformation can be successful.

ACKNOWLEDGMENT

In a work as large as this research project, technical, typographical, grammatical, or other kinds of errors are bound to be present. Ultimately, all mistakes are the authors' responsibility. Nevertheless, the authors encourage feedback from readers identifying errors in addition to comments on the HCSFMS and the *TKM&F* in general. It was our great pleasure to prepare this chapter and its experiment. Now our greater hopes are for readers to receive some small measure of that pleasure and support for his project.

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KEY TERMS AND DEFINITIONS

ADM: Architecture development method.
CSA: Critical success area.
CSF: Critical success factor.
DMS: Decision-making system.
EA: Enterprise architecture.
EAP: Enterprise architecture project.

GUID: Global user identifier.
HMM: Holistic mathematical model.
ICT: Information and communication technologies.
KM: Knowledge management.
KMS: Knowledge management system.
Manager: Business transformation manager.
ML: Mathematical language.
MM: Mathematical model.
NLP: Natural language programming.
Project: Business transformation project.
RDP: Research and development project.
RQ: Research question.
TKM&F: Trad Kalpić methodology and framework.
TOGAF: The Open Group's architecture framework.

Chapter 4
An Applied Mathematical Model for Business Transformation and Enterprise Architecture:
The Research Development Project Concept (RDPC)

ABSTRACT

The HMM research and development project concept (RDPC) uses factor-driven research and reasoning concept that is supported by a behaviour-driven development environment or a natural language programming that can be easily adopted by any RDPC, where the HMM framework offers such a high level factors editing their logic implementation environment that it can be used by any RDPC researchers without any prior knowledge in computer sciences, technical, or even advanced mathematics. The RDPC is a meta-model that can be used for research topics on enterprise architecture, business transformation or decision-making systems, mathematical models-algorithms. It is supported by many real-life cases. The uniqueness of this RDPC also promotes the future transformation project's unbundling and the alignment of various enterprise resources including services, architecture standards, and strategies to support business transformation processes as the first.

BACKGROUND

This chapter is part of a book on business and technology transformation projects that is a conclusion of many years of research. This research project proposes a set of related cross-business domain Holistic Mathematical Model (HMM). This book's chapters are the result of a lifetime of research on business and technology transformations, applied mathematics, decision making systems, software modelling, business engineering, financial analysis and global enterprise architecture; it is based on an authentic and proprietary mixed research method that is supported by an underlining qualitative holistic reasoning model (Trad & Kalpić, 2017a, 2017b, 2017c, 2017d; Gunasekare, 2015). The proposed research project concept is based on neural network, an empirical process that is mainly based on the beam-search heuris-

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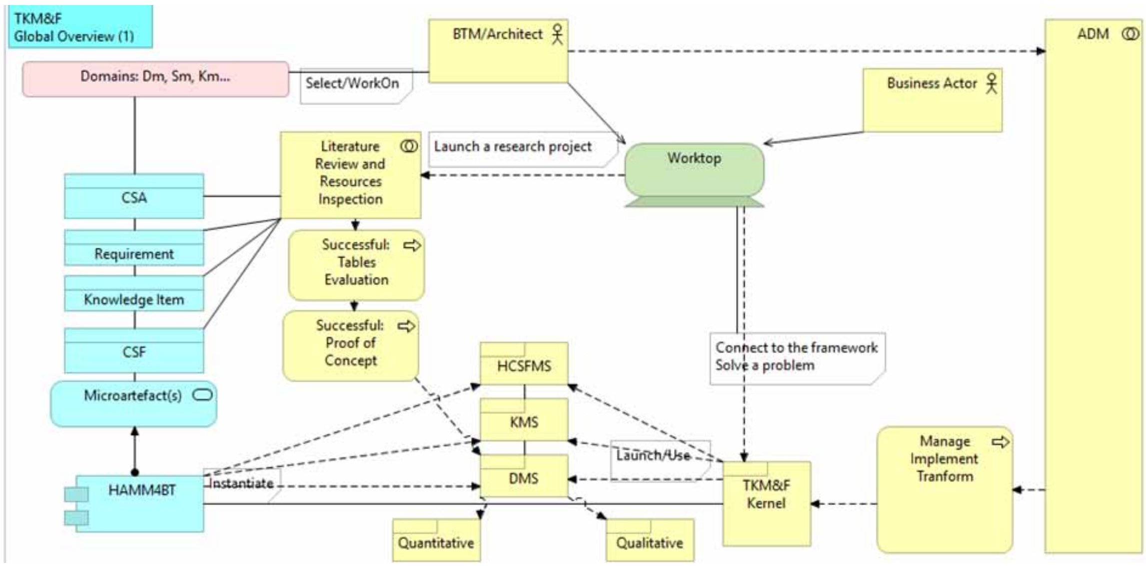
tic decision-making process. The proposed research project concept can be used to implement any type of research initiatives that uses decision analytics and it can support complex inquiries on enterprise's information and communication technology environments to form an optimal research blueprint or paradigm. The HMM Research and Development Project Concept (RDPC) uses a factors' driven research and reasoning concept that is supported by a behaviour driven development environment or a natural language programming that can be easily adopted by any RDPC (Myers, Pane, & Ko, 2004; Kim & Kim, 1999; Della Croce & T'kindt, 2002); where the HMM framework offers such a high level factors editing their logic implementation environment that can be used by any RDPC researchers without any prior knowledge in computer sciences, technical or even advanced mathematics.

INTRODUCTION

The RDPC is a meta-model that can be used for research topics on, enterprise architecture, business transformation or decision making systems, mathematical models-algorithms, is supported by many real-life cases. The uniqueness of this RDPC is that the it promotes also the future transformation project's unbundling and the alignment of various enterprise resources including services, architecture standards and strategies to support business transformation processes as the first step of any undertaking (Farhoomand, 2004). Actual archaic RDPCs are managed as separate research projects where their internal and external quantitative (sub)methods deliver focused recommendations. This book's authors consider existing works interesting but not sufficient because of the lack of a holistic approach with regards with existing methodologies (Creswell, & Plano Clark, 2017). Such works are a jumpstart to the authors' proposed framework, and its RDPC.

The HMM RDPC uses a real-world research model that can be used in a large variety of research fields and topics, like: 1) business transformation; 2) business engineering; 3) decision making; 4) organisational engineering; and 3) enterprise architecture development RDPCs. This book's overall recommendation is to use the enterprise's Information and Communication System's (ICS) to implement a Decision Making System (DMS) which uses the HMM model to solve research questions (or initiatives) by offering a set of credible solutions in the form of architecture, business operations, domain specific scientific or operational recommendations, for any type of research question in any research field. The proposed research solution can be applied by enterprise architects, business managers, business analysts and project engineers to enforce the implementation of a future business solution; and surpasses the business environment's actual archaic Research and Development (RD) activities. The HMM RDPC is a model first driven approach that is supported by this research's applicable framework (IBM, 2001; Trad & Kalpić, 2018a, 2018b). This RDPC combines research fields related to: 1) Knowledge Management (KM); 2) classical research approach; 3) enterprise architecture iterative concept; 4) heuristics/mathematical models and artificial intelligence; 5) technology management theories; 6) business transformation; and 7) business engineering fields (Tidd & Bessant, 2009). Building RDPC experiments based on a unique, innovative and holistic Mathematical Model (MM) is a pioneering undertaking and its results can be used as credible research solutions for the researched topic, as shown in Figure 1 that shows the mixed method or the unique method that inter-connects qualitative and quantitative methods (McMullen & Tarasewich, 2005; Trad, 2018a).

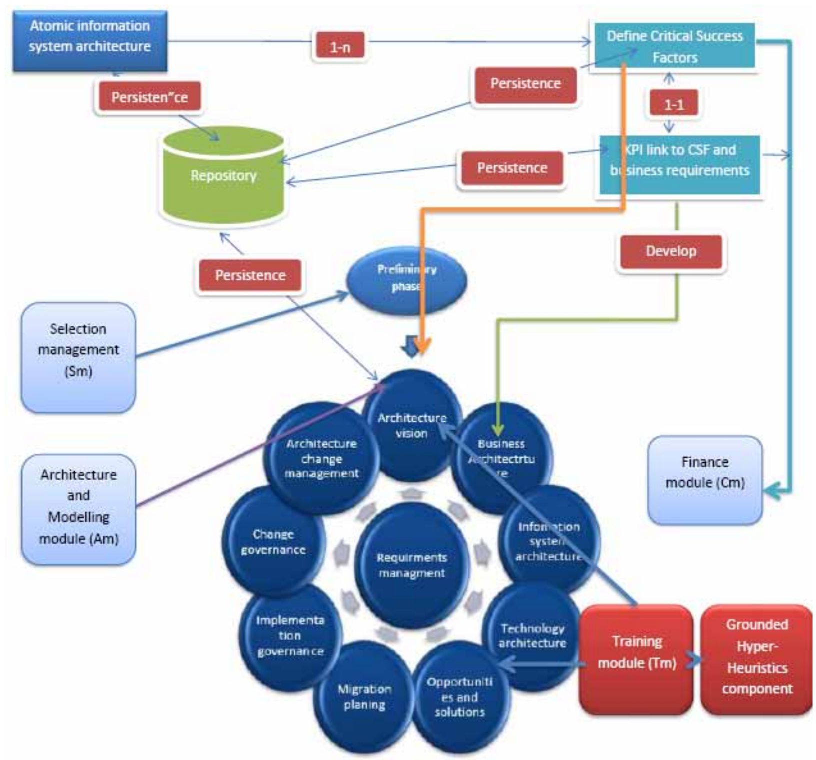
Figure 1. The TKM&F's unique method and the research development framework



The RDPC enables the implementation of a cross-functional DMS based research that is based on: 1) a qualitative research method; 2) a set of quantitative modules; and 3) an iterative heuristics tree that unifies the DMS's algorithmic actions. The RDPC structure manages sets of factors that are known in classical research, as the dependent or independent variables. The authors based their unique research model, mainly on intelligent heuristics neural networks with specific calls to quantitative functions and is supported by microartefacts driven development models, where various disciplines, like, decision making, enterprise architecture applied mathematics and information technology are complementary, due to the use of many existing industry standards, like the Architecture Development Method (ADM) and its Archimate language (The Open Group, 2011a; Tidd & Bessant, 2009). The RDPC's is applied mathematics driven and is agnostic to any specific research on business, enterprise architecture or technology environments, as shown in Figure 2, and is founded on a genuine research framework that in turn is based on tuneable heuristics and will be introduced (Johnson & Onwuegbuzie, 2004).

This chapter proposes a cross-domain RDPC for business transformation projects and Enterprise Architecture (EA) projects (or simply *Project*) that are the result of a long research on business transformations, applied mathematics, software modelling, business engineering, financial analysis and enterprise architecture (Trad & Kalpić, 2018d). This ultimate research book is based on an authentic and proprietary unique mixed research method, known as the RDPC that is in turn based on mainly qualitative holistic reasoning model module (Trad & Kalpić, 2017a, 2017b, 2017c, 2017d; Gunasekare, 2015). The proposed HMM RDPC structure, functions like the heuristics tree engine, which uses empirical research processes that are mainly based on the beam-search like heuristic decision-making process. The RDPC can be used to implement a research project for *Project*, EA, DMS or an expert system topics, to verify the feasibility to integrate in the enterprise's business, ICS environments. The RDPC uses an internal natural language that can be easily adopted by the research teams (Myers, Pane & Ko, 2004). The HMM based RDPC offers a high level research environment that can be used by any research team in any field. The uniqueness of the RDPC and its focus is on the usage of a Mathematical Model (MM) and an inte-

Figure 2. The TKM&F's framework and interaction



grated Mathematical Language (ML), who promote a holistic research model to inspect, transformation initiatives, the possible alignment of various technology fields, enterprise architecture initiatives, the integration of a central decision making system to support Business Transformation Projects (*Project*) which are this chapter and book's focus (Farhoomand, 2004).

THIS CHAPTER'S AND BOOK'S FOCUS

This RDPC proposal's main aim is to deliver a skeleton to build RD initiatives that should be capable of delivering solutions in the form of applicable recommendations for solving research questions on, *Project*s or enterprise architecture problems; this book's RDPC or applied research methodology is based on: 1) a multi-domain literature review; 2) a qualitative methodology; 3) a quantitative methodology; and 4) an engineering oriented Proof of Concept (PoC or a controlled experiment) for the related meta-hypotheses; the optimal research methodology can be various fields that are presented in this book's organisation.

The Book's Organization

This book is organized into four parts containing twenty two chapters. A brief description of each of the chapters follows (Trad & Kalpić, 2018d):

- Part 1: contains the introductory and common chapters. It also identifies the importance of implementing a decision making system.
- Part 2: contains the human resources, information and communication technology, and enterprise architecture.
- Part 3: contains the intelligence based microartefacts, mathematical model's structure and implementation, neuronal language like programming scripts, knowledge management systems, and decision making systems implementation.
- Part 4: contains the *Project*'s structure and its integration in the transformed enterprise. This part's chapters presents various application domains in which this approach can be applied.
- Part 5: contains the PoC and the deduced results and presents various managerial and technical recommendations for various HMM application domains. In particular this part makes a conclusion and introduction to other book's chapters that share the same characteristics of its *TKM&F* and RDPC's cluster applied to a resource management system; in part V, where four chapters are dedicated to present the entire concept. In which a whole chapter is dedicated to the PoC.

The Research and Development Project's Cluster

This research cluster is a set of similar research fields that are driven in parallel for a unique global research question and goal (Cambridge University Press, 2018). This global book's research main topic is related to *Project*s and their enterprise architecture implementation disciplines and the ultimate research question is: "Which business transformation manager characteristics and which type of support should be assured in the implementation phase of a business transformation project?" This research question and its analysis are genuine because of the immense gap in this field.

The Research and Development Project's Gap

Today an important gap exists in this research area (Cambridge University Press, 2018) and the RDPC is a pioneering work in this field; and it tries to link the RDPC to all levels of the EA's and to the underlying software research topics (Agievich, 2014), using a mathematical model and a holistic approach. This is achieved by using a central qualitative motor, which is based on beam-search heuristics (Kim & Kim, 1999; Della Croce & T'kindt, 2002). *Project*s are very risky and have a very high failure rate and one of the concrete reasons is that these projects lack a cross-functional holistic research coordination. That is why the authors would like to contribute to enhance the success rate of such RDs (Tidd & Bessant, 2018). HMM based RDPCs use Critical Success Factors (CSF) which are managed by an internal reasoning framework. In the mentioned research field there is an immense research gap and the authors propose a holistic approach that unifies the following:

- RDPC with other external research frameworks or integrates results' sources, like the Gartner or Forster ones.
- Has a manageable holistic RDPC overview.
- An applied MM that maps to all the RDPC's components.
- The integration of a DMS as the kernel of the RDPC.
- The management of Critical Success Areas (CSA) and CSF.
- Implementation strategy for the development of ML microartefacts.

- The RDPC's evaluation mechanism.

HMM based RDPCs use CSFs which are managed by this research project's reasoning.

The Research and Development Project's Framework

The RDPC analysts' conclusions can be made just in time; these conclusions are synthesized by using the outputs from the research communities sources, project, knowledge and decision management areas. The HMM based RDPC defines an alignment strategy of the overall of research resources that should manage and enrich the enterprise's ML microartefact libraries and areas that in turn are modelled by an architecture formalism, like the ADM (Lankhorst, 2009). The RDPC supports such a complex formalism that combines topics like, enterprise architecture, decision making and various implementation standards with an applied mathematical model (Goikoetxea, 2004; Johnson & Onwuegbuzie, 2004); in a unique holistic research model, as shown in Figure 3.

Unfortunately, today, most research frameworks are archaic and silo-built; added to that the immense set of applied factors, influences negatively such a complex research process. A global RDPC is optimal for *Project*s' related research initiatives (Daellenbach & McNickle, 2005) where the RDPC supports the integration of a DMS for research purposes. The RDPC can be applied to various types of research topics and it is a part of the framework's Research module (Rm). In this book's chapter, the authors propose a set of RDPC application recommendations on how a research framework should be implemented in form of a prototype for all the enterprise's research areas as shown in Figure 4 (Trad 2018a; Trad 2018b; Trad 2018c; Trad 2018d).

The RDPC supports wide spread standardized methods, like The Open Group's Architecture Framework's (TOGAF) ADM and the Unified Modelling Language (UML), where each RDPC microartefact, circulates through all of ADM phases. In this research, TOGAF was selected and used, but any other architecture framework would fit in this generic RDPC proposal. These ML microartefacts contain their private sets of CSFs known as areas, where these CSF areas can be applied to (Peterson, 2011): a) select the important CSFs; b) weight and rate the CSFs; c) estimate the RDPC's instance status using the DMS's interface. The actual research article and the resultant experiment are also a part of the Selection management, Architecture-modelling, Control-monitoring, Decision-making, Training management,

Figure 3. The TKM&F's research enterprise model's parts.

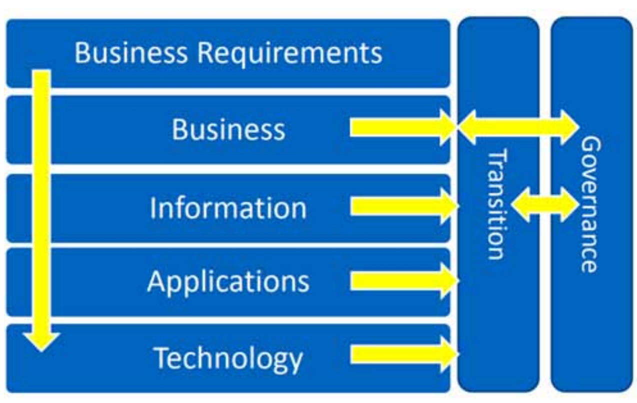
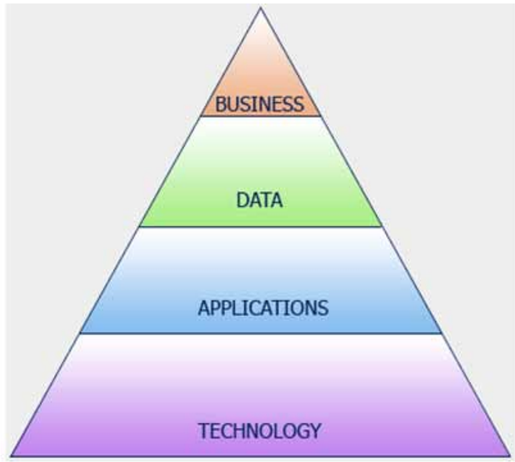


Figure 4. The components of a business and information system.



Project management, Finance management, Geopolitical management, Knowledge management, Research management and Implementation management Framework (SmAmCmDmTmPmFmGmKmImF, for simplification reasons, in further text the term Trad Kalpic Methodology & Framework *TKM&F* will be used). The *TKM&F* is not a black-box product to be applied as-is, it is rather an enterprise architecture strategy, recommendations and vision that each enterprise should implement by itself.

The Framework or the *TKM&F* is composed of the following modules:

- "Sm": for the selection and risk evaluation management of the *Project* and EA RDPCs team members.
- "Am": for the architecture and modelling strategy and risk evaluation that can be applied to a *Project* and EA RDPCs.
- "Cm" for the control and monitoring strategy and risk evaluation that can be applied to a *Project* and EA RDPCs.
- "Dm" for the decision-making strategy and risk evaluation that can be applied to a *Project* and EA projects.
- "Tm" for the training/education management and risk evaluation that can be applied to a *Project* and EA RDPCs.
- "Pm" for the project management strategy and risk evaluation that can be applied to a *Project* and EA RDPCs.
- "Fm" for the financial management's and risk evaluation that can be applied to a *Project* and EA RDPCs.
- "Gm" for the Geopolitical mind-mining, justification and risk evaluation that can be applied to a *Project* and EA RDPCs.
- "Km" for Knowledge management and risk evaluation that can be applied to a *Project* and EA RDPCs.
- "Im" for Implementation management and risk evaluation that can be applied to a *Project* and EA RDPCs.
- "Lm" for Legal management and risk evaluation that can be applied to a *Project* and EA RDPCs.

- "Rm" for Research management that can be applied to a *Project* and EA RDPCs.

This chapter is a part of many years of research that has produced a large set of articles, related to research methodologies, decision making, enterprise architecture and applied mathematics. An extensive literature review process was undertaken and has produced usable items, microartefacts and research artefacts. In this article, parts of previous works are reused for the better understanding of this complex iterative research topic and process; if everything was simply referenced it would have been impossible to read and to understand this article. This article can be considered as a non-conventional and pioneering one, in the field of holistic business transformation and enterprise architecture projects. Each book chapter can be read in an independent manner. This article's research question is: "Can an applied mathematical model be applied to implement business transformation projects and enterprise architecture research projects?" That was developed after an extensive literature review.

The Research and Development Project's Literature Review

As already mentioned, this research cluster that is focused on *Project*s and enterprise architecture has an extensive Literature Review Library (LRL) that contains major publications related to the research topic. For this research article the literature review process focused on the following subjects:

- Research methodologies and approaches.
- Modelling RDPCs for enterprise architecture using mathematical model.
- Modelling RDPCs for *Project*s using a mathematical model.
- The role of CSFs in a mathematical model.
- Integrating qualitative and quantitative methods.
- LRL classifications and hierarchy.

The LRL's classification and inspection outcome, is that very little scholar or even general literature and research resources exist on the selected research topics; and on a unified and holistic view of the assembly of treated research subjects is totally inexistent. The authors consider their work as a pioneering one; the most relevant works found are:

- Models provide abstractions of a real world physical system, like the enterprise's ICS. A model allows engineers to brainstorm the ICS issues, by filtering unneeded details and to focus on its fundaments. All of engineering fields use models to understand complex, real-world systems. Modelling is the process of describing relevant characteristics of a business domain in a well-defined language or diagram. A modelling language codifies the microartefacts of which a model consists (Hinkelmann, 2016).
- Modeling is a descriptive design process which validates principles and explores the system's structure. Modeling artefacts is the design and testing of a business system using a PoC (Sankaralingam, Ferris, Nowatzki, Estan, Wood, & Vaish, 2013).
- Model driven architecture is defined by the Object Management Group (OMG) that is an design paradigm is a way to organize and manage enterprise architectures that are supported by automated tools, microartefacts and services. The ADM, supports the development of a research

model and it facilitates the transformations between different types of research models, as shown in Figure 5 (Hinkelmann, 2016).

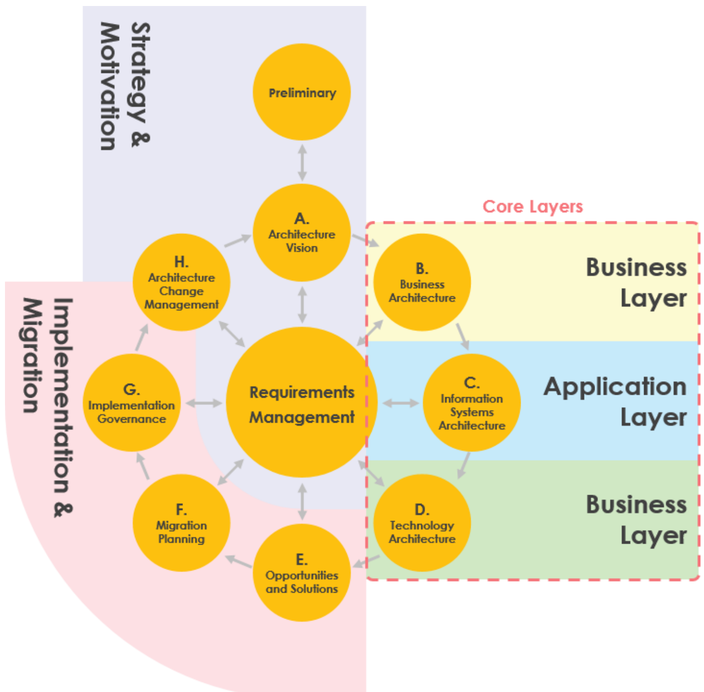
- The gap, in *Project*s and EA projects, is defined as the difference between their adoption and their implementation's iterations; and the gap of EA usage is still huge today. What is the reason that EA methodologies are not used extensively to gain a sustainable business system, achieve a greater level of organizational alignment, improved decision-making, and improved performance; it is unclear…(Syynimaa, 2015).
- A decision making system should include CSFs in its processes in the form of a structured mathematical model where CSF sets are used to represent relationships among a set of many interrelated (dependent or independent) variables (Norusis, 1993; Dogan, Çalgici, Arditi, & Gunaydin, 2015).
- A mathematical model can be used in an RDPC to resolve various types of dependencies that can appear because of the use of a huge set of a research project resources. The lack of interdependencies management can result in silo projects and the use of a holistic methodology can insure success. A mathematical model can be used to represent relations between the *Project*'s modules and resources where they can be mutually exclusive using constraints. A mathematical model facilitates a dynamic possibility to generate a feasible *Project* plan. A holistic mathematical model can support a decision making system that offers solutions to *Project* problems. A *Project* plan is generated by the DMS's heuristics motor to realize enterprise transformation (Giachetti, 2012; Kim & Kim, 1999).
- An applied mathematical model is the description of a business system using mathematical concepts and language; these models are applied in natural sciences, engineering fields like, computer sciences, ... (Sankaralingam, Ferris, Nowatzki, Estan, Wood, & Vaish, 2013).
- Multi-criteria or a multi-factor model for decision making needs a mixed method based on qualitative and quantitative criteria. Qualitative analysis is used for judgment in imprecise situations that are known as subjective conclusions. Quantitative criteria and analysis are applied for precise and objective measurements; these criteria sets can be inputted as numerical serial sequences, where these sequences can be timestamped to become precise data sets. The HMM RDPC aggregates the qualitative and quantitative data stream in a heuristic multi-criteria model (Zandia & Tavana, 2011; Kim, Kim, 1999).
- A modelling system: should be able to model all possible types of problems and to offer possible solutions using a natural formalism that can be applied in various situations. In enterprise architecture and DMSs, mechanistic models can be used (Sankaralingam, Ferris, Nowatzki, Estan, Wood, &Vaish, 2013).

As already mentioned, this book's chapter uses a unique mixed methods research that can be considered as a natural complement to traditional qualitative and quantitative research, in order to deliver an authentic empirical engineering research model (Easterbrook, Singer, Storey, & Damian, 2008).

Empirical Engineering Research Model

The presented RDPC is based on an empirical engineering research approach because of the following facts (Johnson, Onwuegbuzie, 2004; Easterbrook, Singer, Storey & Damian, 2008):

Figure 5. Relation of an architecture model with a modelling language for microartefacts (Hinkelmann, 2016).



- It uses an authentic mixed method (where mixed research is a simplistic synonym) that can be considered as a natural complement to conventional qualitative and quantitative research methodologies, to deliver empirical pragmatism concepts as a possible holistic approach for mixed methods research. Such a holistic approach provides an authentic framework for designing and implementing long term mixed methods research.
- Today we have five classes of research methods that are the most relevant to applied mathematics in engineering fields: 1) controlled experiments or PoCs; 2) building case studies; 3) survey research; 4) ethnographies; and 5) action research.
- Engineering and applied mathematics researchers are very poor at making theories and related research explicit (Jorgensen & Sjøberg, 2001). Many of such empirical studies, developed in the last few decades, failed to relate data collected in the research to the underlying research theory. The clear results are hard to obtain and final results are difficult to interpret and apply, while various resultant studies are incomparable.
- Positivism argues that the project's knowledge must be founded on logical reasoning from a well-defined set of observable facts that are presented as CSFs. Positivists are known to be reductionist, because they research a set of phenomena by unbundling them into smaller distinct components, in this research they are labelled microartefacts. For Positivists, scientific knowledge and recommendations are built iteratively from verifiable factors, and inferences based on these CSFs. Positivists promote methods that start with precise theories from which verifiable hypotheses can be extracted and proofed separately. Hence, positivism is most closely associated with controlled

experiment or a PoC; nevertheless, quantitative survey research and case studies are also used to verify a positivist instance in a precise period of time.

- This research considers that qualitative research is a huge set of quantitative analysis schemas that are used to verify a precise hypothesis, using precise constraints and it is variable in time.
- This research uses Action Research (AR) which helps the researchers to solve a real *Project* problem and also stores the gained knowledge and experience of solving the problem; this is known as the knowledge item (Berger & Rose, 2015). Most empirical research methods try to analyse the world as it is, qualitative action researchers try to offer recommendations for specific *Project* situations, with the explicit goal to enhance the *Project*. AR is applied in education, where transformations in educational fields cannot be analysed without implementing them, and where implementation of a transformation process implies a long term engagement, because the recommendations may have an immense influence. AR has also been adopted in information science's research and development processes; *Project*s may require many years to be implemented. In the presented fields, AR is a new discipline, and there are many initiatives on finding the appropriate methodology, and there are even many debates on the validity of AR as an empirical method. That is why the authors propose a research method that fills the gaps and insures its empirical validity.
- Empirical validity checks if the research work is acceptable as a contribution to existing scientific knowledge, this article's researchers want to convince the valuable readers that this article's recommendations and the related PoC are valid.
- A controlled experiment or a PoC is a software prototype of a testable hypothesis where one or more CSFs (or independent variables) are processed to evaluate their influence on the model's dependent variables. Controlled experiments or PoCs permits to evaluate with precision the CSFs and if they are related, whether the cause–effect relationship exists between these CSFs.

This research article is a an empirical research and it includes a PoC and uses action research (Easterbrook, Singer, Storey & Damian, 2008). The proposed HMM based RDPC is a holistic-driven model which is based on three areas of research that represent separate sets of CSFs:

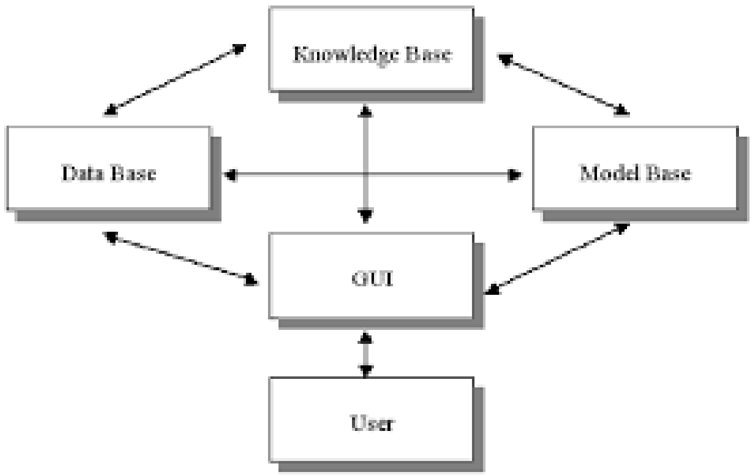
- The mathematical model with its artefacts.
- The mathematical model's integration in the information and communication technology system.
- The holistic management of the decision making system, using a mathematical model.

In RD projects, there are today high levels of pressure to move always faster and to become more agile and in the same be capable of insuring, for the transformed business system, high levels of: 1) performance; 2) security; 3) availability; and 4) reliability. The mentioned immense pressure is the main cause that RDPC's are complex (Kornilova, 2017); and there is a specific requirement on how to select research variables, as shown in Figure 6.

Variables and Factors

Factors (or research variables) are the most basic and important element of this RDPC and a factor has its origin in dependent and independent variables (NC State University, 2004):

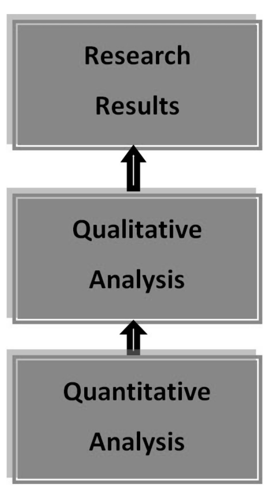
Figure 6. The decision making interaction (Trad, 2018a).



- Dependent Variable (DpV): A DpV is what a classical research project measures and affected in the experiment and. The DpV supports and responds to the independent variable's change actions. DpV dependents on the independent variable. In a classical research project, every DpV has an independent variable.
- Independent Variable (IdV): is the variable that an RDPC controls and it affects (uses in object oriented terms) the dependent variable. In many the RDPC is not be able to manipulate the IdV.

In this RDPC a factor is only generic variable and the authors see an overhead in using DpV and IdV management. The factor or the critical success factor is used in the mixed method as shown in Figure 7.

Figure 7. The mixed method (Trad, 2018a).



Critical Success areas and Factors

The RDPC is based on CSAs which are categories of sets of CSFs where in turn, each CSF is a set of selected Key Performance Indicators (KPI), where: 1) each CSA corresponds to a *Project* domain, like for example, finance; 2) each CSF corresponds to a set of project requirements, like for example, accounting balance sheet finalization; and 3) each KPI corresponds to a single transformation or architecture project requirement (Farhoomand, 2004); as shown in Figure 8.

For an effective selection of the RDPC's CSFs there is a need for an extensive literature review and very good knowledge of RDs (Nilda Tri & Yusof, 2009). For each RDPC research question, a researcher can define the initial set of CSFs. CSFs are important for the mapping between the RDPC's requirements, microartefacts, organisational items to an HMM instance (Peterson, 2011). CSFs can express for example the RDPC's requirements' evaluation that can be met and are defined in the RDPC's goals and HMM's limit constraints. The HMM's qualitative heuristic algorithms and punctual qualitative analysis can be used to evaluate for example the *Project*'s failure quota in each CSA, where CSFs can be internal or external; like: 1) the *Project*'s gap analysis is an internal CSF; and 2) client's purchase predictions is an external one as shown in Figure 8. Once the *Project*'s initial set of CSFs have been selected, then the *Project*'s members can use the HMM based RDPC to query for possible credible research solutions (Trad & Kalpić, 2017b, 2017c).

THE RESEARCH FRAMEWORK'S BUILDING BLOCKS AND THEIR APPLICATION

In the past four decades, various important scientific, engineering, business and technical developments have brought business innovation and transformation RD aspects to the forefront. The most important development is the fact of increased dependence of RDPCs on information and ICS, MM and automation. A second important evolution, influenced by the evolution of ICSs, a holistic approach to RDPCs. In the past RDPCs focused on quantitative methods. Today RDPCs are complex and are handicaped by a simplistic approach. The consequence of the hyper-evolution of ICSs and complexity have increased the importance of MMs. Technology, data and ICS support RDPC to realize their objectives and sup-

Figure 8. Presents categories of classified factors (Trad & Kalpić, 2017b; Trad, & Kalpić, 2017c).

ports domain researchers to conclude their RDPC. The RDPC, its technology, data and EA models have to be transformed and made accessible to a research project and it has to be protected against simplistic approaches. A successful RDPC insures that research is unified and virtualized, insuring credible conclusions, that also the research data content and form maintain their integrities. Today RDPC due to the evident fact of the technology evolution, has to develop complex MM. This book proposes, a methodology for RDPCs that is based on the unit of work (Trad, 2013a).

The Model's Unit of Work

A holistic alignment, identification and classification of all the RDPC's resources must be done, so that the research process can start. A holistic alignment needs also, to define the Unit of Work (UoW) or the basic microartefact. Using the "1:1" mapping concept, the microartefact is represented with a class diagram and can be represented also by an extensible Mark-up Language (XML) model. Such a mapping concept, is based on an automated naming convention that can link all the RDPC's resources. The mapping concept supports the interoperability between all the RDPC's modules and enables the use of ML microartefacts that uses ADM (Mehra, Grundy & Hosking, 2005; Scherer & Schapke, 2011).

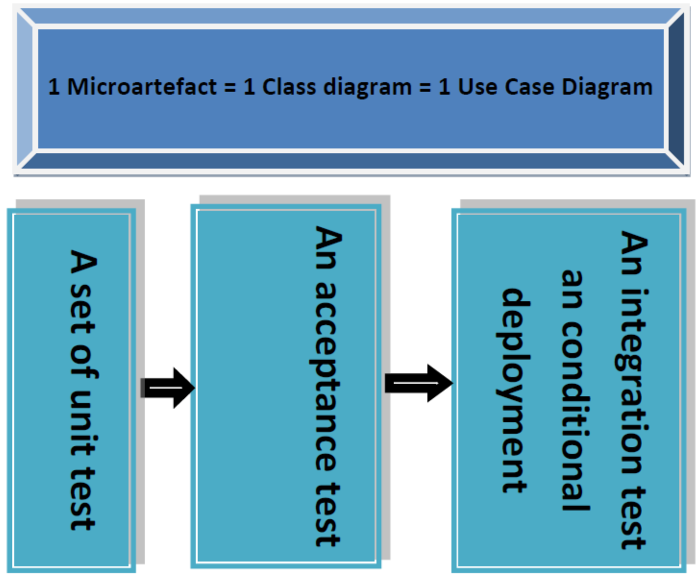
Architecture Development Method's Integration

A DMS based RDPC is needed due to various resources (for a summary and review see Mikko Siponen's chapter in this book, besides Dhillon et al, 1996; Dhillon, 1997) and due to many problems in implementing complex RDPCs. Research and related credible sources have proved that in many RDPCs internal simplistic quantitative methods may cause failure (Backhouse & Dhillon, 1995). Many RDPC RQs are very complex when handling virtual global business organizations topics; the RQ is fairly wide and includes many topics, like the reality of transformation projects.

A determinant factor in conducting an RDPC is the role of the applied MM. Such an RDPC should be assisted with an efficient architecture framework like TOGAF that includes services and building blocks assembling concepts. There is a need to build a concise MM's, services and building block's composite model; shortly a "holistic brick". A holistic brick is composite model can be used as a template for a variety of RD projects. This research phase's focus is on the various technology and methods that can support a holistic RDPC. The theory and concept of composite RDPC suggest that implementers must be able to reuse proven components that emerge from the best practices in order to solve generic RD implementation requirements. Composite MM promote the concept of services building and solution blocks. Without the use of composite MM researchers, would be poorly applying research techniques; and that can result in that the target RDPC fails to deliver (Trad & Kalpić, 2016a).

The RDPC's integration with the ADM, enables the automation and the auto-generation of the research project's ML. These microartefacts management scripts, circulate throughout all of the ADM phases and in various iterations. This circulation process is synchronized and managed by their Global User Identifiers (GUID). The ADM encloses cyclic processes that are managed by RDPC iterations. The RDPC formalism is agnostic and is not dedicated to any specific research field. The ADM is controlled and monitored in real-time and supports the microartefacts' interactions using the RDPC formalism various types of tests and a holistic integration and tests driven developments as shown in Figure 9 (Vicente, Gama, & Mira da Silva, 2013).

Figure 9. The TKM&F's global tests environment.



Mathematical Microartefacts

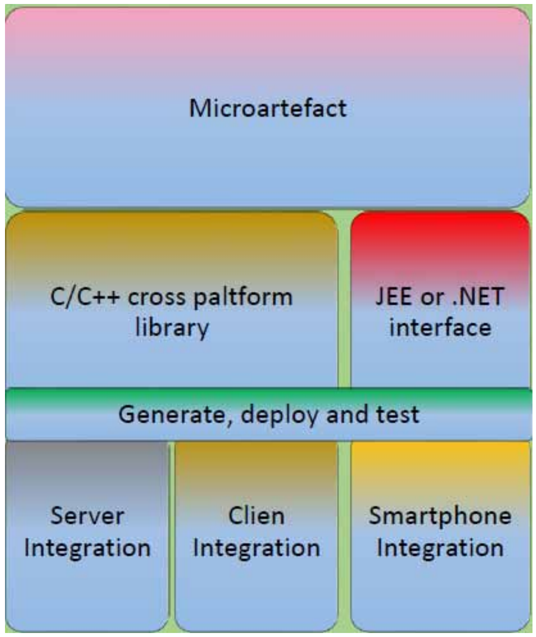
A ML microartefact is any microartefact that is a part of the *TKM&F* and which interacts with a multitude of microartefacts in a coordinated manner. A ML microartefact uses the ADM to assist the RDPC's process (The Open Group, 2011a). The HMM, includes various types of mechanisms that use heuristics scenarios to make the RDPC's integration more flexible and to avoid the simplistic quantitative research deductions (Trad & Kalpić, 2017a; Nakakawa, van Bommel, & Proper, 2010). The HMM supports the RDPC, by offering ML microartefacts to handle various types of research methods. In Figure 10, the authors present the optimal microartefact construct, where the biggest part of microartefacts are written in portable and optimized C/C++.

A set of ML microartefacts can be archived in a software component written in any programming language. The usage of microartefacts provides some of the mechanisms needed to make HMM offer a pluggable component in the distributed ADM (Kraisig, Rosélia, Welter, Haugg, Cargnin, Roos-Frantz, Sawicki, & Frantz, 2016).

Types of Research Problems Basics and Integration

The types of research problems correspond to the sets of CSFs, where each CSF corresponds to a type of research item like a hypotheses. The *TKM&F* offers the evaluate a hypothesis and it must sense the need to use of tractable events and not just have the capability to present marketing outcomes. This research cluster proposes optimal approaches to prediction, prognostication, and risk management; that are the basic structures of business and organizational engineering that need a specific framework or simply the *TKM&F*.

Figure 10. The microartefact development components and layers.



An Agile Implementation Process

A holistic enterprise transformation needs the right frequency of agility that is achieved by combining various application fields like: 1) business; 2) infrastructure technology; 3) applied mathematics and algorithmics; and 4) software implementation methodologies. The goal is to promote transcendent *Project* automation scripts to be finalized in various levels of the implementation phase (Tidd & Bessant, 2009). In order to unbundle and maintain the existing enterprise environment and glue its legacy of newly innovated microartefacts in its dynamic ICS, an adapted HMM formalism is needed. Using a mixed bottom-up approach, the BTM can design an IS HMM formalism that can handle various types of software microartefacts' automation. *Project*'s holistic agility is supported by the following disciplines:

- Agile methodologies and their implementation.
- Change management and integration.
- Integration tests of the ML microartefacts.

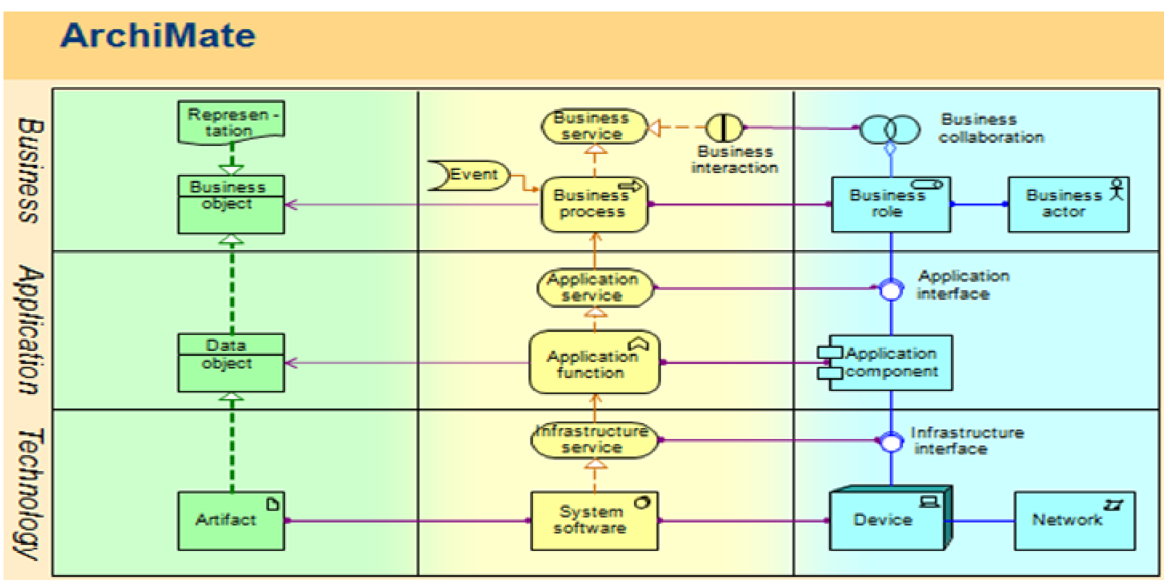
Integration with Existing Rapid Application Development

HMM needs a real world, technically agnostic, development tool like the enterprise's Rapid Application Development (RAD) environments; by agnostic the authors would like to point out the importance of abstracting the software implementation processes. RAD tools have been the ICS's obsession since the right beginning of programming techniques or more precisely since COmmon Business Oriented Language's (COBOL) birth. COBOL is still largely the most used programming language today and not Java, C/C++ or .NET, as usually thought; it is estimated that around 80% of the world's software is still in COBOL and it is advancing. The Java Extended Edition (JEE) total approach caused major problems in the software industry mainly because of a large set of tools needed and for promoting the promise that tools would solve all types of *Project* problems (Kraisig, Rosélia, Welter, Haugg, Cargnin, Roos-Frantz, Sawicki, & Frantz, 2016). So instead of engineering HMM solutions, JEE or other RAD engineers preferred spending weeks searching for and then integrating tools or gadgets that could have been developed in a shorter period of time, what complicates the adoption of a holistic n-tier architecture.

A Holistic n-tier Architecture

A fundamental CSF in the *Project*'s implementation process, is the role of the holistic n-tier architecture's blueprint and its application strategy; where the integration of HMM based DMS in the ICS, is the backbone of the future n-tiered decoupled business system. An adaptable, tuneable and cross-functional HMM formalism is important for the future of any business or information system and a holistic integration strategy has to be defined using a standardized methodology like TOGAF and its Archimate modelling environment (Vicente, Gama & Mira da Silva, 2013), as shown in Figure 11. Feasibility is an important CSF for a *Project* that in general are very complex to manage and implement; EA methodologies can improve the feasibility of a distributed business system by transforming their architecture, architecture, design, development, integration and maintenance processes and financial transactions; nevertheless, EA standard methodologies must be supported by an additional automated mechanism like the authors' HMM formalism that fits in the architecture development methodologies like the ADM (Tripathy, & Mishra, 2017; Greefhorst, 2009).

Figure 11. Archimate modelling environment (Greefhorst, 2009; Vicente, Gama, & Mira da Silva, 2013).



Architecture Development Method's Integration

The HMM integration with the ADM, enables the automation and the auto-generation of the project's ML and other generic microartefacts. These microartefacts management scripts, circulate throughout all the ADM phases and in various iterations. This circulation process is synchronized and managed by their GUIDs. The ADM encloses cyclic processes that are managed by *Project* iterations; where information about all ML microartefacts are logged in ICS tracing subsystem. The HMM formalism is agnostic and is not dedicated to any specific business environment or information technology platform, where the HMM's integration with the ADM offers: 1) a just-in-time ML microartefact management; 2) performance and reliability prediction and stabilization; and 3) HMM and ML microartefacts integration with Archimate. The ADM is controlled and monitored in real-time and supports the microartefacts' interactions using HMM formalism various types of tests and a holistic integration and tests driven developments (Vicente, Gama & Mira da Silva, 2013).

Holistic Tests, Performance, Integration and Monitoring Environment

The major problem that causes a *Project* to be stopped or to fail, is the performance problem that in general in business enterprises is translated and justified by the human behavioural aspects; that is the major reason for the emergence of the saviour's new mirage, Microservices and astonishingly again with the same mammoth approach, JEE… Actual immature development and operations for decision making systems is still in an infancy age and enterprises are losing a lot of energy on putting *Project*s together. JEE RAD and hyper comfort natural implementation environments are still confronted with serious project issues. These problems show that RAD tool are still immature for large enterprise intelligent applications and hence *Project*s (Gartner, 2016). Possible types of tests that can enhance the process are:

- Test driven developments: the actual standard Test Driven Development (TDD) approach is an archaic manual approach and a concept where software developers design the test first pattern and then do the development, where they keep the sets of portable code (Janzen & Saiedian, 200 5). When applying the TDD to HMM the question is: which type of development driven method is optimal, TDD or DDD or any other, even if both methods are usable. Unit testing proposed in this research is more adapted for building *Project* microartefacts. *Project*'s are huge projects, where the tests are auto-generated and the integration of ML microartefacts needs the model first methodology that can be used with various technologies. The DDD or model first is optimal for the HMM formalism that must be assisted by an Acceptance Test Driven Development (ATDD) methodology (Design Patterns, 2015).
- Acceptance test driven development: Acceptance Test-Driven Development (ATDD) is used to engage collaborate clients, DMS specialists, *Project* engineers, project testers and software engineers and assist their communication (Koudelia, 2011). Based on standard TDDs, the standard ATDD methodology is based on developing tests where tests represent the results of the behaviour of a set of *Project* ML microartefacts. In the standard ATDD's approach, business users contribute to define workable acceptance tests or use behaviour driven development techniques (Koskela, 2007).

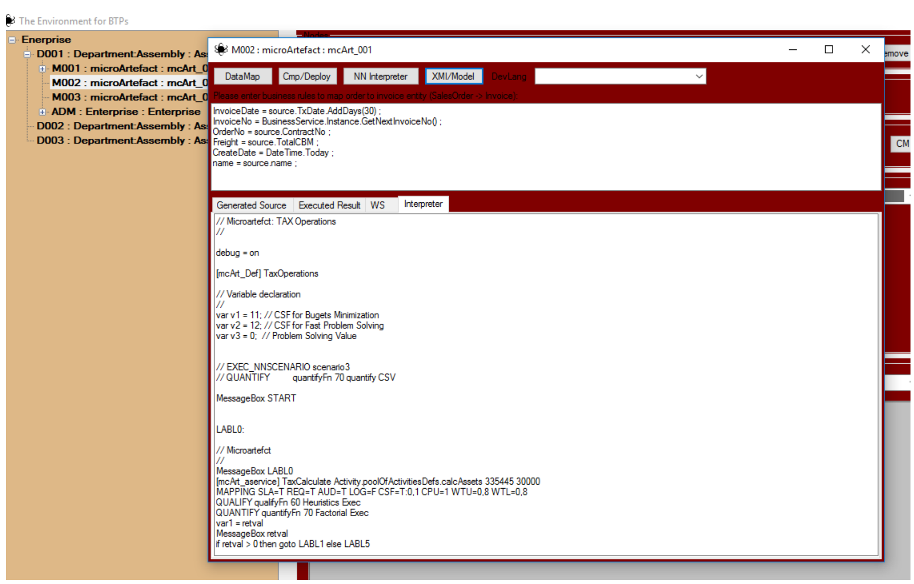
- Behaviour driven development: the HMM's internal ML is similar to the Behaviour Driven Development (BDD) method that includes unit, integration and acceptance tests that serve as a formalism for communication, or a well-structured modelling language, between the BTM, the business users and the *Project*'s engineers as shown in Figure 12, where it delivers a set of models (Soeken, Drechsler & Wille, 2012). The HMM's internal ML (a pseudo BDD) comprises an internal resources mapping subsystem to link prose to business system's source code. The HMM's internal ML prose scenarios contain information to automate the linkage of the needed *Project*'s classes and the *Project*'s team-members can assist in adding code snippets to the generated ML microartefact instances. The HMM's internal ML enables a fully-automatic unit, integration and acceptance tests that are used with the architecture iterations (Lazar, Motogna & Parv, 2010).

The RDPC, serves many research fields and in this PoC a decision making process is used (Taleb, 2012; Trad & Kalpić, 2017b, 2017c).

The Decision Making Process

The HMM based DMS is managed by the *TKM&F*, where any RDPC user can configure the types of ML microartefacts and CSFs to be used; these ML microartefacts are orchestrated by the HMM choreography engine. The HMM based DMS' actions map to the various to the ICSs' mechanisms to deliver actions. The HMM formalism is implemented in all of the RDPC's processes and the implementation of microartefacts is intended to deliver recommendations; such a set of actions can be modelled and managed by the HMM that is implemented with an experiment or a PoC (The Open Group, 2011a; Trad & Kalpić, 2017a, 2017b, 2017c).

Figure 12. The modelling language environment structure



Today's dependency of RDPCs on automation and hence on ICS, RDPC teams have to establish a proactive DMS based concept that uses CSFs. Unfortunately credible research sources seem to prove the opposite and such RDPCs are managed like simple quantitative research exercises. Traditional RDPCs avoid a holistic approach and concentrate on simplistic quantitative sampling that are an insignificant topic and avoid complexity to solve complex and very risky research RQs (Trad & Kalpić, 2017a, 2017b, 2017c, 2017d; Gunasekare, 2015).

THE RESEARCH FRAMEWORK'S APPLICATION DOMAINS

Application Domains

The RDPC can be applied in the following research topics:

- Business transformations.
- Applied mathematics.
- Software modelling and implementation.
- Business engineering and modelling.
- Audit and risk management of technology components.
- Global enterprise architecture.
- Legal and financial analysis.

Law and Finance Research Basics and Integration

RDPCs face the challenge of implementing appropriate procedures that adequately supports the RQ. Complex facts can damage the RDPC and disable its credible functioning (Trad & Kalpić, 2014a). RDPC's holistic mechanisms, should be also capable of supporting the complex topics on various types of environment like for example geopolitics (Trad & Kalpić, 2017f).

Geopolitics research basics and integration

HMM based RDPs, support societal transformation research initiatives as they are a top objective for geopolitical events and origins. Researchers can learn how a specific geopolitical transformation event can deliver detailed analysis to explain, justify and/or execute the successful reinvention of a concrete event. That implies that RDPCs on business and societal transformation are crucial for future of any geopolitical research initiative.

THE RESEARCH'S IMPLEMENTATION

The Research's Domain Case

This chapter's PoC implementation (which is in the same time this RDPC's experiment) that is used throughout all the book's chapters, uses the default demo application named Handle Claim Process case study that comes with the Archi Archimate tool (Beauvoir & Sarrodie, 2018), as the experiment's RDPC's case.

The Proof of Concept

As already presented, the RDPC's PoC was implemented using the research's cluster framework known as the *TKM&F* that had been developed by the two authors, using the RDPC's ML, Microsoft's Visual Studio .NET, C/C++ and Java Extended Edition (JEE). The PoC is based on the HMM based DMS and an internal set of CSFs' that are presented in CSA/CSF Tables. These CSFs have bindings to specific research resources, where the RDPC was designed using an ML microartefacts, object oriented and enterprise architecture methodologies and tools. The HMM based RDPC processing model represents the relationships between this research's requirements, project ML generic and microartefacts (or building blocks), unique identifiers and the three defined CSAs.

SOLUTION AND RECOMMENDATIONS

In this book that is related to the RDPCs, the authors propose a whole set of research recommendations, the RDPC delivers a set of CSF tables that result from the HMM processing. Such a practice is complex and very risky and should be simplified by the structured use of MM, EA, DMS and DMS.

FUTURE RESEARCH DIRECTIONS

The *TKM&F* future research efforts will focus on the various decision making system like on automated tests in transformational initiatives in a cross-functional environment; in fields like decision systems.

CONCLUSION

This research chapter is part of a book related to *Project*s, ICSs, MMs, DMSs and EAs. The RDPC is based on mixed action research model; where CSFs and CSAs are offered to help researchers to support complex RDPC integrations. In this research, the focus is on the research formalism that supports in defining a structured inter-relationship of ML microartefacts with RQs. RDPCs are an important predisposition for the *Project* related research and the most important recommendation that was generated by the primary RQ was that the business transformation manager must be an architect of adaptive business systems.

ACKNOWLEDGMENT

In a work as large as this research project, technical, typographical, grammatical, or other kinds of errors are bound to be present. Ultimately, all mistakes are the authors' responsibility. Nevertheless, the authors encourages feedback from readers identifying errors in addition to comments on the work in

general. It was our great pleasure to prepare this work. Now our greater hopes are for readers to receive some small measure of that pleasure.

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KEY TERMS AND DEFINITIONS

ADM: Architecture development method.

AMM: Applied mathematical model.

AofABS: Architect of adaptive business systems.

CRM: Client relationship management.

CSF: Critical success factors can be used to manage the statuses and gaps in various project plans and gives the projects the capacity to proactively and automatically recognize erroneous building blocks and to just-in-time reschedule the project plan(s).

DevOps: Development and operations is an abbreviation for "development" and "operations"; is a software engineering methodology for managing software development (Dev) and technology operations (Ops). The main aim of DevOps is to enable automation and tracing for all phases of software implementation, from integration, testing, releasing to deployment and infrastructure management.

DMP: Decision-making process.

DMS: Decision-making system.

DpV: Dependent variable.

EA: Enterprise architecture aims to simplify the information systems (IS) of a company, and to reduce the cost of IS development and evolution.

EMS: Enterprise knowledge management.

GUID: Global user identifiers.

HMM: Holistic mathematical model.

ICS: Information and communication system.

IDDevOps: Development and operations engineering.

IdV: Independent variable.

JEE: Java extended edition.

KIDP: Knowledge and intelligence design pattern.

KMS: Knowledge management system.

LRL: Literature review library.

Manager: Business transformation manager, in this research and framework.

MFD: Model first driven.

ML: Mathematical language.

MM: Mathematical model.

NLP: Natural language programming.

Project: Business transformation project.

RDPC: Research and development project.

TKM&F: This research's framework.

TOGAF: The Open Group's architecture framework.

UoW: Unit of work.

Chapter 5
An Applied Mathematical Model for Business Transformation and Enterprise Architecture:
The Holistic Profile Management System (HPMS)

ABSTRACT

The HMM application for manager's profile management uses a natural language development environment and for that goal the authors propose to use the holistic profile management system (HPMS) that can be used, for example, by the enterprise's human resources. The HPMS activities are supported by a central decision-making system (DMS), knowledge management system (KMS), and an enterprise architecture project (EAP). The proof of concept (PoC) is based on a business case from the insurance domain, where the central point is the capacity of the selected manager profile to successfully start and finalize a BTP or an EAP (or simply a project).

BACKGROUND

The profile of a Business Transformation Manager (BTM or simply, *Manager*) has become a central issue in managing innovation related initiatives; where this article is mainly based on Farhoomand's work that describes three basic profiles, the Advocate, the Technocrat and the Samaritan (Farhoomand, 2004). The authors try to prove that the profile is a combination of these three profiles, strengthened with a holistic architect's approach and modelled using an Holistic Mathematical Model (HMM), used to support the selection and training of a *Manager*; who is a leader and main architect of Business Transformation Projects (BTP). The HMM is based on Critical Success Factors (CSF) (Trad & Kalpić, 2018a, 2018b) and this article is based on a unique mixed research method that is supported by mainly qualitative research module (Trad & Kalpić, 2017a, 2017b, 2017c, 2017d; Gunasekare, 2015). The HMM application for *Manager*'s profile management uses a natural language development environment and

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for that goal the authors propose to use the Holistic Profile Management System (HPMS) that can be used, for example, by the enterprise's human resources (Blackburn & Rosen, 1993; Myers, Pane, & Ko, 2004; Neumann, 2002).

INTRODUCTION

The HPMS activities are supported by a central Decision Making System (DMS), Knowledge Management System (KMS) and an Enterprise Architecture Projects (EAP). The Proof of Concept (PoC) is based on a business case from the insurance domain (Jonkers, Band & Quartel, 2012a; Trad, 2013), where the central point is the capacity of the selected *Manager* profile to successfully start and finalize a BTP or an EAP (or simply a *Project*). The PoC shows the selection process of a *Manager* profile to transform the traditional insurance enterprise into an agile and automated enterprise. *Projects* are managed by *Manager*s, who are (or should be) supported by a methodology and a framework that can estimate the risks of failure of a *Project*; at the same time they should be capable of managing the implementation processes. The HPMS supports the selection and training of *Manager*s, who are responsible for the implementation of the complex components of a *Project* (Trad & Kalpić, 2016b). The word selection does not stand just for the simple inspection activity but for a holistic profile analysis and selection approach that identifies the *Manager*'s complex profile and background.

BACKGROUND

The riskiest CSF in a *Project* transforming a traditional business environment (BE) into a lean and automated BE, is the role of the *Manager* and his capabilities in managing the implementation phase of the *Project*. The basic profile and education of a *Manager* has not been sufficiently investigated in a holistic manner in order to design and define the right profile; and that is the main chapter's goal (Trad & Kalpić, 2013a); by holistic the authors refer to a cross-functional approach. A *Manager* profile that has to manage the complex implementation phase of a *Project* that requires a specific set of DMS, KMS, EA, design and implementation skills. The *Project*'s Implementation Phase (PIP) is the major cause of high failure rates (CapGemini, 2009). Analysing the failure rates, the authors have found that only around 12% of BEs successfully finish *Projects* (Tidd & Bessant, 2009). Therefore, there is a tremendous need for more research on the *Manager's* profile that needs holistic EA and implementation skills for the PIP. The knowledge gap was acknowledged and confirmed, due to the fact that the existing literature and various methodologies treating *Projects* offer practically no insight into the profile of the *Manager* as an Architect of Holistic Business System (AofHBS) (SAP, 2013a); Actual *Projects* are reliant on business schools accountants profiles... Holistic approach and managing PIP complexity requires a mixed method that is mainly based on a hyper-heuristics model. The AofHBS must be capable of transforming the BE's Information and Communication Systems (ICS) and to exploit the technologies in order to successfully conduct the *Project*. Such *Manager*s and organizations need holistic methodologies, like SAP's *Manager*2 or even better, the one proposed by the authors, that encompasses Enterprise Architecture (EA) and the management of *Project*s (Uhl & Gollenia, 2012). Using Google Scholar to match the combinations of the keywords: 1) *Manager* and DMS; 2) *Manager* and EA; 3) EA and DMS… shows that the authors and their unique framework have a total lead (Trad & Kalpić, 2019a). This chapter shows that the *Manager* is an AofHBS with holistic or cross-functional skills, is mainly a technocrat, to the opposite of applied methods of business schools to use cheap interface accountants, who are schooled to deliver tuned balance sheets (The Economist, 2000).

The AofHBS manages *Projects* that involve complete digitization of value chains and business processes automation, and enables a traditional BE to create new business models and hence business excellence. A capable *Manager* can make transformed BEs like Cisco Systems, Dell Computer and many others report important financial gains due to *Projects* (Barua, Konana, Whinston, & Yin, 2001). This research phase uses the Trad Kalpić Methodology and Framework (*TKM&F*), as shown in Figure 1 (Trad & Kalpić, 2018f), which is based on CSFs from various areas like EA, DMA, business processes, accountancy, enterprise skills….

This chapter presents a set of HPMS managerial recommendations and combines needed fields, like Knowledge Management (KM), applied mathematical models, EA, information technology management and business transformation. Integrating a HPMS should be a fundamental strategic *Project's* goal (Trad & Kalpić, 2018a, 2018b; Cearley, Walker & Burke, 2016), where Figure 2 is fundamental to understand the whole research project and it is used in the whole book.

The proposed HPMS uses the *TKM&F* that is based on the Research and Development Project (RDP) of intelligent neural networks (Trad & Kalpić, 2018a). The HPMS is agnostic to any specific application field, as shown in Figure 3, and is based on the Architecture Development Method (ADM) (The Open Group, 2011a).

Figure 1. The research framework's concept (Trad & Kalpić, 2016a)

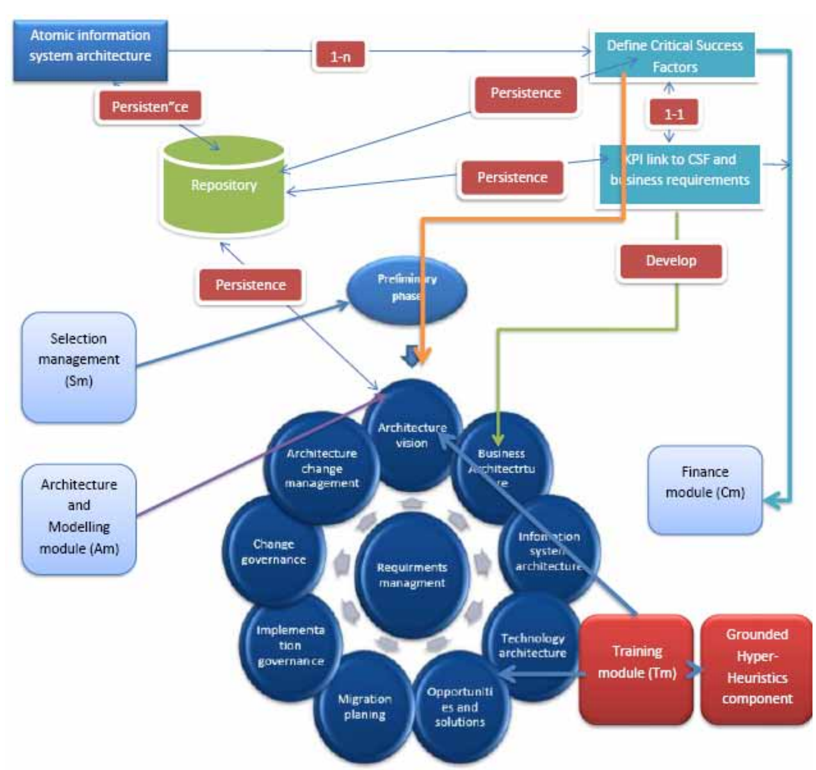


Figure 2. The research framework's interaction flow (Trad, 2018a)

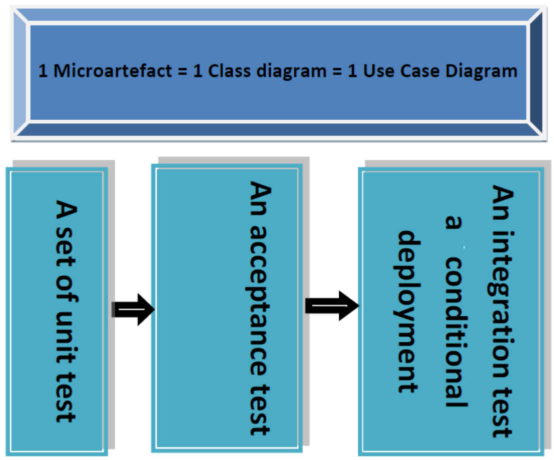


Figure 3. The research framework's architecture method's interface (The Open Group, 2011a)

The used EA method and its ADM are central to implement *Projects,* where the HPMS is used for the *Manager*'s selection (Trad & Kalpić, 2017b, 2017c; Thomas, 2015; Tidd, 2006). In *Projects*, the *Manager*'s role is important and his or her (in further text – his) actions are supported by a a DMS as shown in Figure 4.

The HPMS uses a holistic approach, as shown in Figure 5, where it uses profile CSFs (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a).

The authors will try to prove that a qualified technocrat's profile would be a base for the AofHBS (Farhoomand, 2004); who needs to be assisted with by a DMS (Trad & Kalpić, 2013c). *Projects* lack a holistic approach to support the HPMS and that is this work's focus (Thomas, 2015; Cearley, Walker & Burke, 2016; Trad & Kalpić, 2016b).

Figure 4. Business decision management system

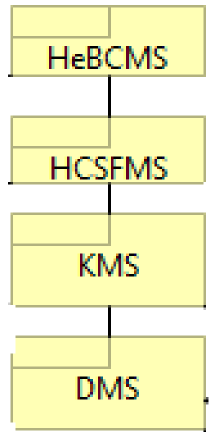
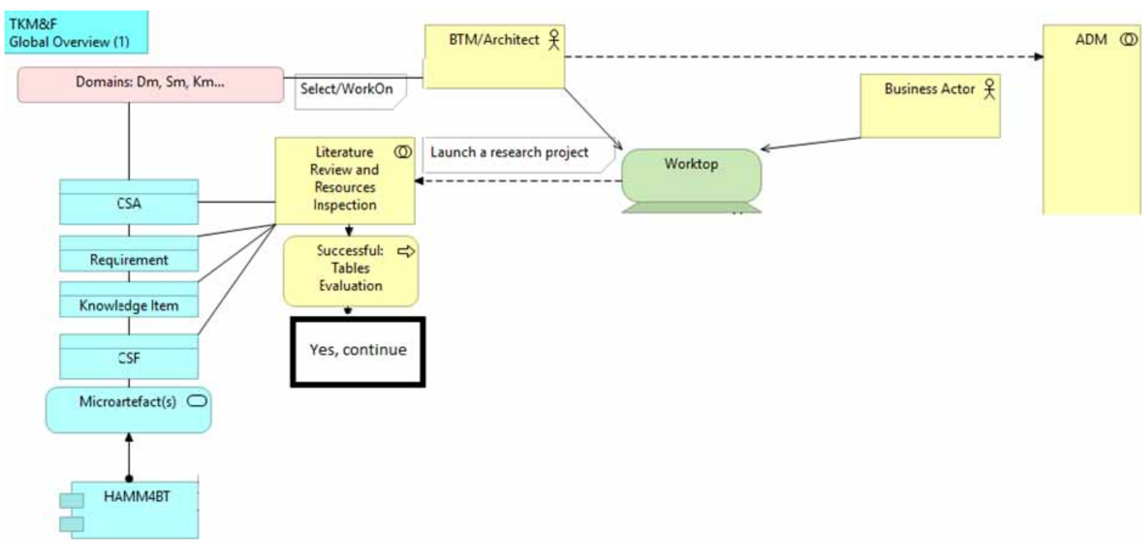


Figure 5. Interaction with factors



FOCUS OF THE ARTICLE

HPMS recommendations can be applied by *Project's* stakeholders (Desmond, 2013) that uses *TKM&F* microartefacts (Johnson & Onwuegbuzie, 2004; Trad & Kalpić, 2017b, 2017c, 2018a). The RDP is based on a mixed methodology and is unique (Easterbrook, Singer, Storey & Damian, 2008); where this chapters tries to prove the HPMS' feasibility through a Research Question (RQ).

THE RESEARCH PROCESS

Projects failure rates are high and are constantly increasing (Bruce, 1994) that is due to the complexity encountered in the PIP (CapGemini, 2009); to enhance the success rate, the authors propose the *TKM&F* that is unique and can be considered as a pioneering approach. *TKM&F* recommends linking a Mathematical Model (MM) to all levels of the *Project*, as shown in Figure 6 (Trad & Kalpić, 2018b; Agievich, 2014), including the CSF based HPMS (Tidd & Bessant, 2018).

The Applied Research Framework

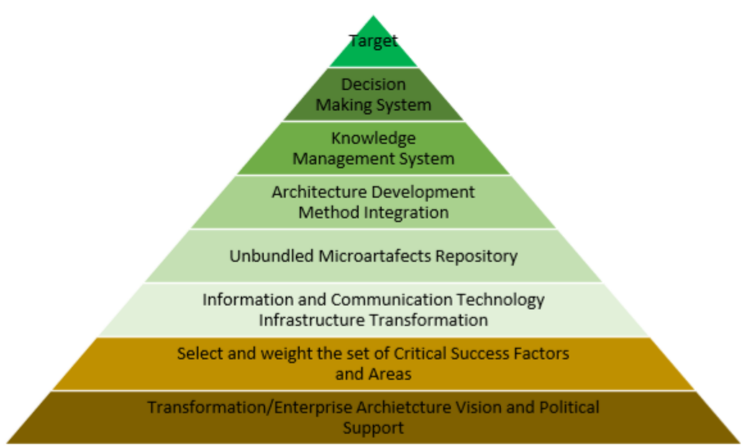
The HPMS can be applied to various types of *Projects* (Trad 2018c, 2018d) and is a part of the Selection management, Architecture-modelling, Control-monitoring, Decision-making, Training management, *Projects* management, Finance management, Geopolitical management, Knowledge management, Implementation management and Research management Framework (SmAmCmDmTmPmFmGmKmImRmF, for simplification reasons, in further text the term *TKM&F* will be used). This chapter's RQ is: "Which business transformation managers' characteristics are optimal for the implementation phase of business transformation and enterprise architecture projects?" (Trad, 2011a; Trad & Kalpić, 2011a).

The *TKM&F* is owned in its totality including copyright, by the authors; where this chapter is an IGI Global copyright and these two objects are distinct and different. This chapter's RQ was formulated after a literature review process.

The Research's Literature Review and Gap

The knowledge gap was acknowledged, mainly because the existing literature, on failure rates and on various methodologies treating *Projects*, offer practically no insight into the profile of the *Manager* as an AofHBS; which can setup *Project*s and can manage their PIP (SAP, 2013a; Trad & Kalpić, 2013b, 2013c). This RDP inspects the *Manager*'s profile, which is mainly based on the AofHBS model that makes it unique.

Figure 6. Presents levels of project's interaction (Trad & Kalpić, 2017b, 2017c)



The Research's Uniqueness

The uniqueness of this research promotes a holistic unbundling process, the alignment of standards and strategies to support *Projects* (Farhoomand, 2004). The uniqueness of this research project is based on its holistic approach that combines: 1) *Project*; 2) HMM; 3) software modelling and architecture; 4) business engineering; 5) financial analysis; 6) *Manager* AofHBS profile; 6) EA; and 7) it offers a methodology and Framework.

Review's and Check of the Critical Success Factors/Critical Success Areas

The HPMS promotes the transformation through the use of Critical Success Area (CSA) that contains a set of CSFs, where a CSF is a set of Key Performance Indicators (KPI), where each KPI corresponds to a single *Projects* requirement and/or an item that can be a profile requirement or skill that has a column in each evaluation table (Putri & Yusof, 2009; Peterson, 2011;Trad & Kalpić, 2018f). As shown in Figure 7, a *Project* starts with the first phase called the feasibility phase to check the basic CSFs, to check if the *Project* makes sense; it ends with success or failure. Based on the HPMS literature review and related evaluation processes, the most important extracted CSFs that are used and evaluated using the following rules (Trad & Kalpić, 2018f):

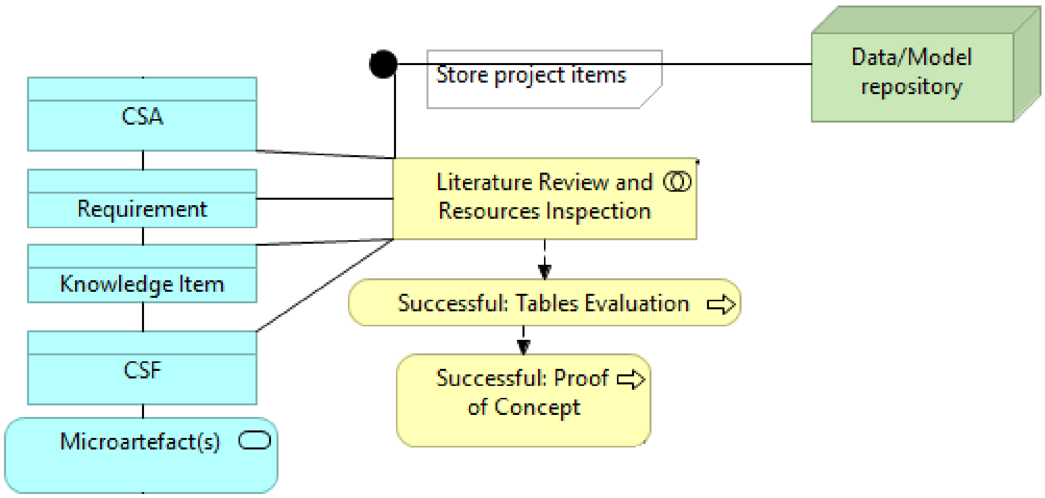
- References should be credible and are estimated by the authors and follow a classification supported by the CSF management system.
- *Projects* like mergers are the result of organisational changes in companies to act as a single enterprise with consolidated CSFs, resources and business interests.
- Applied modelling language should be limited in order to make the *Projects* manageable and not too complex.
- The ADM is considered to be mature if it has been in use for more than ten years and that it has been reported as successful to enforce the interest in using the ADM.
- The ADM is appropriate for any project's local conditions and manages the *TKM&F's* iterations and CSFs tuning.
- If the aggregations of all the *Project's* CSA/CSF tables are positive and exceed the defined minimum, the *Projects* continues to its PoC or can be used for problem solving.

THE BUSINESS CASE

Managing the Business Case

HPMS uses an Applied Case Study (ACS), developed by the Open Group as a reference study, it presents the possibilities to implement *Projects*' components and is related to an insurance company named ArchiSurance (Trad & Kalpić, 2018f); in this chapter it is used to check the HPMS' feasibility.

Figure 7. The factors interaction in the TKM&F



Integrating Critical Success Factors

A CSF is measurable and mapped to a weighting that is roughly estimated in the first iteration and then tuned through ADM iterations, to verify the AofHBS profile using the DMS; where a holistic business and enterprise architecture CSFs are essential (Felfel, Ayadi, & Masmoudi, 2017). The main issue here is how to define the background and selection aspects for such a profile; and how to interrelate the different business-EA skills (KPMG, 2014).

The Architecture Development Method and Projects

This RDP focuses on the design of *Projects'* integration and presents the influence of HPMS to select the *Manager*. In the actual age of distributed intelligence, complexity, knowledge, economy and technology (Gardner, 1999). HPMS offers a pattern that includes a hyper-heuristics tree that supports a wide class of problem types, and it is a major benefit (Markides, 201), where the DMS offers a set of AofHBS profiles (Trad, Kalpić & Fertalj, 2002; Trad & Kalpić, 2014d). The *TKM&F's* parts, must synchronize with the ADM that are shown in Figure 8.

The Business Case Study's Critical Success Factors

Based on the CSF review process, the important business case's CSFs that are used and evaluated

As shown in Table 1, the result's aim is to prove or justify that the HPMS' business case and how it can be used with the PoC. The next CSA to be analysed is the holistic MM's integration.

The Research Section's Link to the Applied Mathematical Model

This section's deduction is that the applied MM is crucial for the RDP's credibility. Where it is the basis for its mathematical model and structure.

Figure 8. Business architecture phases (The Open Group, 2014b)

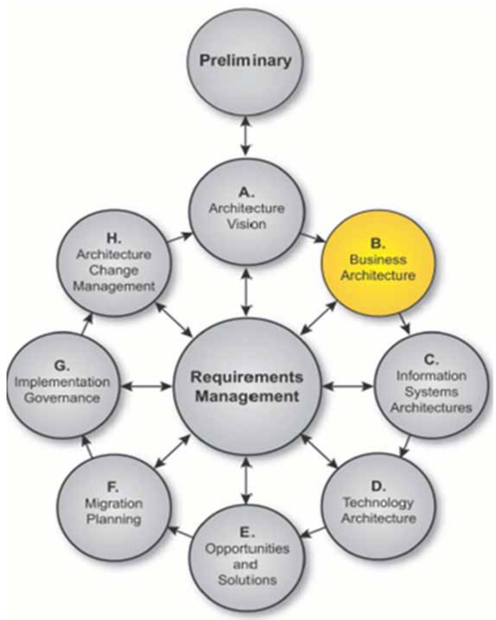


Table 1. The applied case study's critical success factors that have an average of 8.63

Critical Success Factors	KPIs	Weightings
CSF_BusinessCase_Modelling	Complex_NeedsUnbundling	From 1 to 10. **08 Selected**
CSF_BusinessCase_Factors	Complex_Classification	From 1 to 10. **08 Selected**
CSF_BusinessCase_References	Limited_Silos	From 1 to 10. **08 Selected**
CSF_BusinessCase_ArchitectureDevMethod	Integrated	From 1 to 10. **10 Selected**
CSF_BusinessCase_Technologies	UniquePlatform	From 1 to 10. **09 Selected**
CSF_BusinessCase_Governance	Advanced	From 1 to 10. **09 Selected**
CSF_BusinessCase_Transformation_TKM&F	NoDifference	From 1 to 10. **10 Selected**
CSF_BusinessCase_AofHBS_Extension	ComplexProfile	From 1 to 10. **08 Selected**

THE APPLIED MATHEMATICAL MODEL'S USAGE

The Basic Element

The HPMS CSFs define the initial algorithm nodes that are identified as vital for successful targets to be reached and maintained and is the MM's basic element that is needed for the *Projects* to estimate its success or failure (Morrison, 2016).

The Mathematical Model's Basics

The HPMS uses a CSF based HMM that is an abstract model containing a proprietary Mathematical Language (ML) that can be used to automate, transform and implement the behaviour of the HPMS. The HMM nomenclature that is presented to the reader in Figure 9, in a simplified form, to be easily understood, on the cost of a holistic formulation of the model.

As shown in Figure 9:

- The symbol ∑ indicates summation of weightings/ratings, denoting the relative importance of the set members selected as relevant. Weightings as integers range in ascending importance from 1 to 10.
- The symbol $\underline{U}$ indicates sets union.
- The proposed HMM enables the possibility to define *Project* as a model; using CSFs weightings and ratings.
- The selected corresponding weightings to: CSF ϵ { 1 … 10 }; are integer values.
- The selected corresponding ratings to: CSF ϵ { 0.00% … 100.00% } are floating point percentage values.

A weighting is defined for a HPMS CSF and a rating for a KPI.

A Quantitative-Qualitative Research Mixed Model

A problem, RQ, CSF or phenomenon are examined in iterations relating breadth and depth, using heuristics/beam search, which is specialized for unknown problems or the ones that appear in a preliminary phase or first iterations. Then, the *TKM&F* qualitative research module input data stream(s) consist(s) of sets of numbers that are collected from sets generated by using designed/structured and approved/validated data object-collection modules and statistically processed.

Figure 9. The applied mathematical model's nomenclature (Trad, & Kalpić, 2017a)

AMM4BT

mcRequirement	= KP I	(1)
CSF	= Σ KPI	(2)
CSA	= Σ CSF	(3)
Requirement	= $\underline{U}$ mcRequirement	(4)
(e)neuron	= action+ mcInteligenceArtefact	(5)
mcArtefact	= $\underline{U}$ (e)neurons	(6)
mcEnterprise	= $\underline{U}$ mcArtefact	(7)
(e)Ellterprise	= $\underline{U}$ mcEnterprise	(8)
mcArtefactScenario	= $\underline{U}$ mcArtefactDecisionMaking	(9)
IntelligenceComponent	= $\underline{U}$ mcArtefactScenario	(10)
OrganisationalIntelligence	= $\underline{U}$ InteligenceComponent	(11)
AMM4BT	= ADM+ OrganisationalIntelligence	(12)

The Applied Mathematical Model's Structure

The HMM for HPMS has a composite structure that can be viewed as follows:

- The static view; it has a similar static structure like the relational model's structure.
- The behavioural view; these actions are designed using a set of mathematical nomenclature.
- It is the skeleton of the *TKM&F* that uses microartefacts' scenarios to support HPMS requests.

The Applied Business Transformation Mathematical Model

The HMM can be modelled after the following formula for Business Transformation Mathematical Model (*BTMM*) that abstracts the *Projects*:

HMM = Weigthing_1 * HMM_Qualitative + Weigthing_2 * HMM_Quantitative (1).

HMM = $\sum$ HMM for an enterprise architecture's instance (2).

(*BTMM*):

BTMM = $\sum$ HMM instances (3).

The objective function of the *BTMM*'s formula can be optimized by using constraints and with extra variables that need to be tuned using the HMM. The variable for maximization or minimization can be, for example, the *Project's* success, costs or another CSF. For the HPMS PoC the success will be the main and only constraint and success is quantified as a binary 0 or 1. where the objective function definition will be:

Minimize risk *BTMM* (4).

The *BTMM* is the combination of a *Project* methodologies and a holistic mathematical model that integrates the enterprise organisational concept, information and communication technologies (Lazar, Motogna & Parv, 2010).

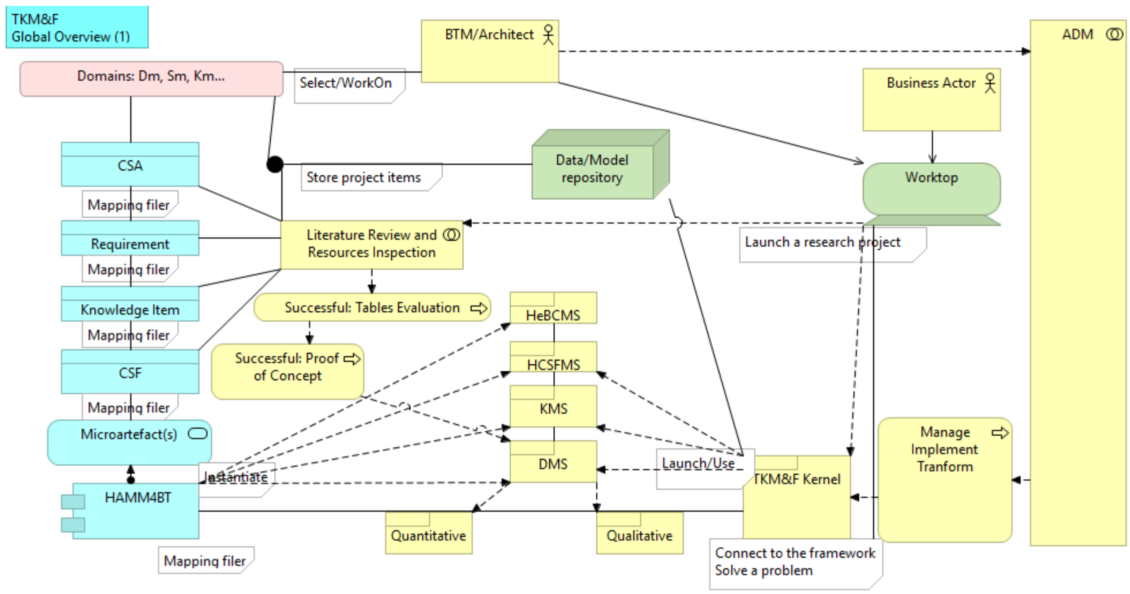
As shown in Figure 10, the HMM is a part and is the skeleton of the *TKM&F* that uses microartefacts' scenarios to support HPMS requests (Kim & Lennon, 2017).

The HPMS components interface the DMS and KMS, as shown in Figure 11, to evaluate, manage and map CSFs for selection activities; if the aggregations of all the *Project's* CSA/CSF tables is exceeds the defined minimum the *Projects* continues to its second part, the HPMS PoC.

Framework's Applied Mathematical Model Integration

The *Project's* initialization phase generates the needed CSFs and hence creates the types profile issues to analyzed.

Figure 10. The framework's components and its mathematical model



The HMM is a part and is the skeleton of the *TKM&F* that uses microartefacts' scenarios to support HPMS requests (Agievich, 2014).

The Mathematical Model's Integration Critical Success Factors

Based on the HPMS review process and the most important CSFs that are evaluated as follows:

As shown in Table 2, the result's aim is to prove or justify that HMM is mature and possible to be used for the HPMS and can be used for the PoC. The next CSA to be analysed is the holistic management of the ICS.

The Research Section's Link to the Information and Communication System

This section's deduction is that the ICS' unbundling is a crucial process for the BE.

THE KMS' INTEGRATION IN THE INFORMATION AND COMMUNICATION TECHNOLOGY SYSTEM

Distributed Unit of Work

Microartefact granularity and responsibility for a given MM scenario is a complex undertaking (Kim & Lennon, 2017); added to that there is the implementation of the "1:1" mapping and classification of the transformed microartefacts, as shown in Figure 12; where each resource passes from one component to

Figure 11. The decision making interface

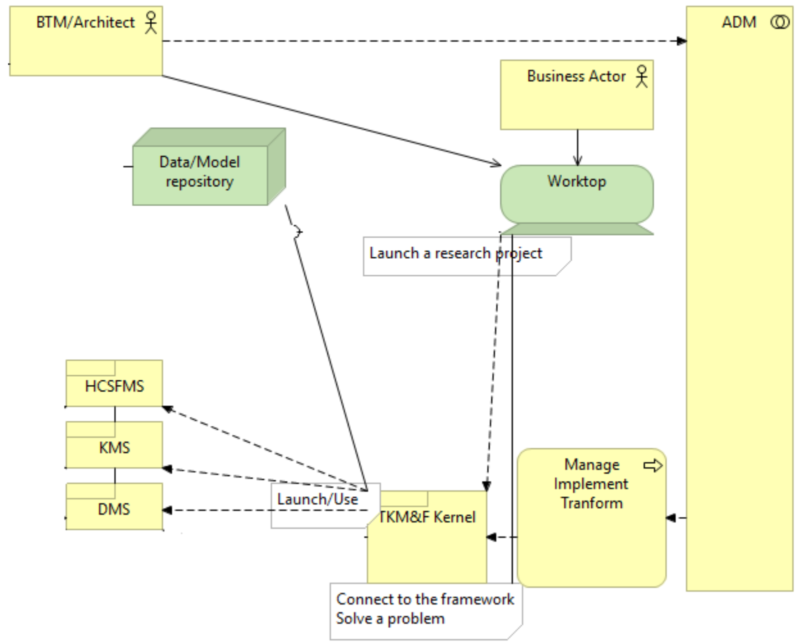


Table 2. The critical success factors that have an average of 9.15

Critical Success Factors	KPIs	Weightings
CSF_AHMM4BT_TKM&F_Integration	StableTested	From 1 to 10. **09 Selected**
CSF_ AHMM4BT_InitialPhase	RobustTested	From 1 to 10. **10 Selected**
CSF_ AHMM4BT_PoCPhase	StableTested	From 1 to 10. **10 Selected**
CSF_ AHMM4BT_Qualitative&Quantitative	Complex	From 1 to 10. **07 Selected**
CSF_ AHMM4BT_Final_eBTMM	VerifiedModel	From 1 to 10. **09 Selected**
CSF_ AHMM4BT_ADM_Integration	Synchronized	From 1 to 10. **09 Selected**
CSF_ AHMM4BT_HPMS_Interfacing	StableTested	From 1 to 10. **10 Selected**

the other with a mapping concept. The EA concept uses methodologies like The Open Group's Architecture Framework's (TOGAF) ADM that supports a set of the *TKM&F's* and HPMS (Neumann, 2002).

Architecture and Technology Standards

A *Manager* must have the skills to manage agile *Project* and its PIP; where an adequate mapping concept is used to integrate standards (OASIS, 2014); that is a recommendation. The strategy is enabled by the establishment of an ADM based iterative model that can map *Project's* microartefacts in a linear "1:1" manner (The Open Group, 2011b), as shown in Figure 13.

Figure 12. The framework's microartefact interactions

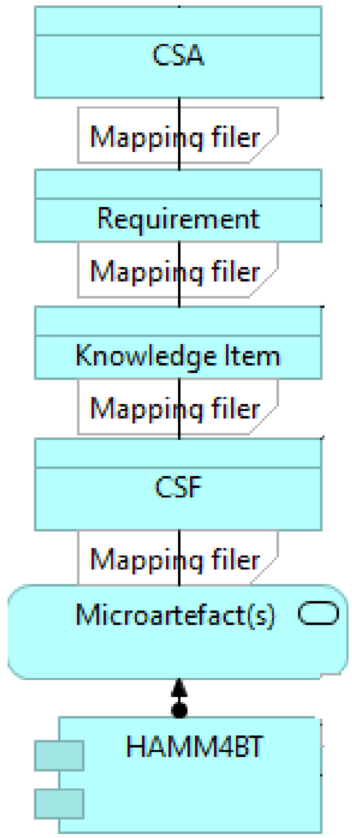
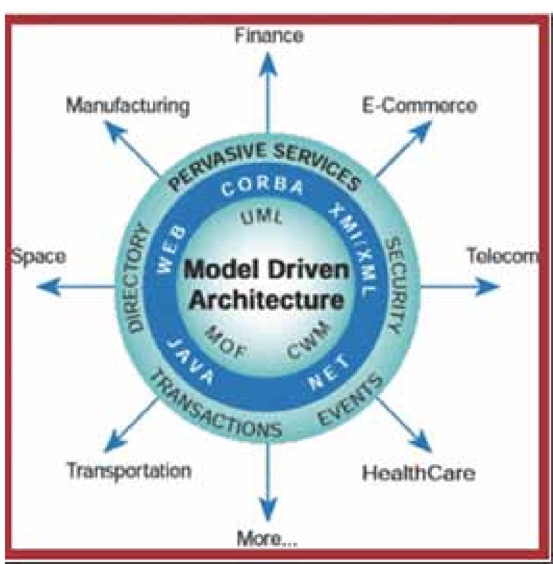


Figure 13. The iterative architecture development process (The Open Group, 2011a)



The scope's difficulty and complexity lie in capability of a BE to synchronize the *Project's* vision with its capabilities (Trad & Kalpić, 2015b).

Project Strategy

The *Manager* must be capable of integrating the *TKM&F's* using a pseudo bottom-up approach that is based on Service Oriented Architecture (SOA) concept that is described in Capgemini's SOA framework, as shown in Figure 14 (Gartner, 2005).

Security Capacities

The HPMS defines *Manager* capabilities to protect the *Project* from attack by: 1) localizing gaps in the infrastructures of partners; 2) review of detection, and real-time security solutions; 3) blocking of cumulative attacks; 4) defining a security strategy to locate potential weaknesses; 5) building a robust defence; 6) integrating security in transactions; and 7) applying qualification procedures (Clark, 2002).

Holistic Qualification Procedures

Figure 15 shows actual immaturity of design, development, qualification and operations for *Projects* that still are in an infancy age, or simply chaotic. Tools for implementation environments are still confronted with serious project issues. These problems show that tools are still inappropriate for large enterprise intelligent systems and the authors recommend the use HPMS CSF based patterns (Gartner, 2013).

Figure 14. Services integration (The Open Group, 2011c)

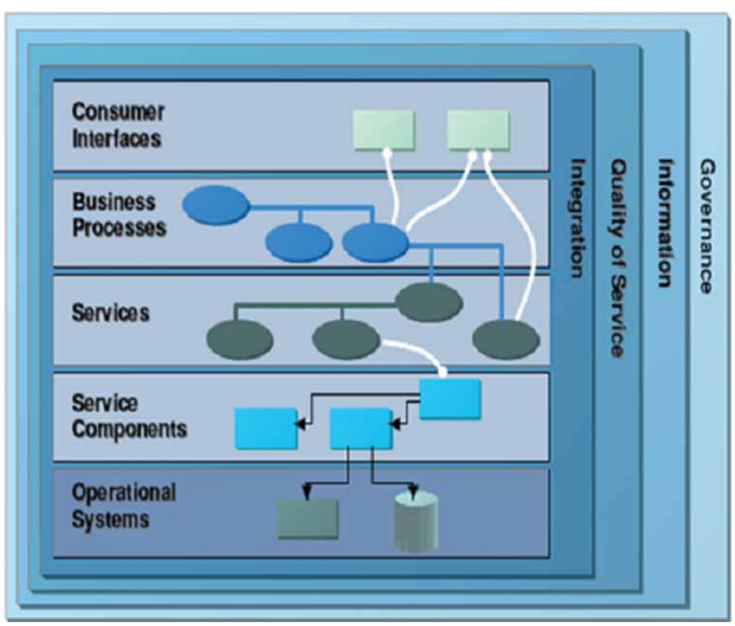


Figure 15. The decision making based systems' evolution (Gartner, 2013)

Resources, Artefacts and Factors Management

The *Manager* must have the capacity to manage the *TKM&F's* repository that maps HPMS CSFs to types of *Project's* resources, as shown in Figure 20. This mapping concept associates CSFs, resources and microartefact scenario instances to HPMS requests (The Open Group, 2011a).

The Information and Communication System's Critical Success Factors

Based on the review process and factors' evaluation, the most important HPMS ICS CSFs are evaluated as follows:

As shown in Table 3, the result's aim is to prove or justify that it is possible to implement a HPMS which interacts with the ICS that enables the next CSA to be analysed, which is the integration of the ADM.

The Research Section's Link to the Architecture Development Method

This section's deduction is that the ICT and other fields are dependent on an EA paradigm and therefore the ADM is crucial for the integration of the HPMS.

Figure 16. The knowledge management subsystem

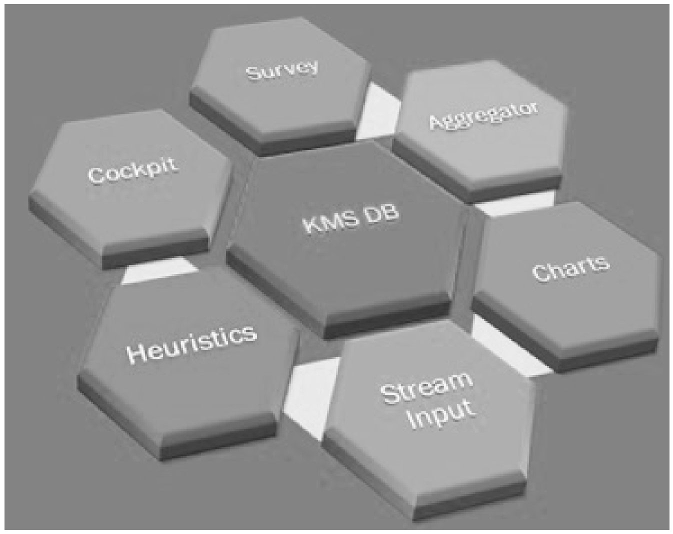


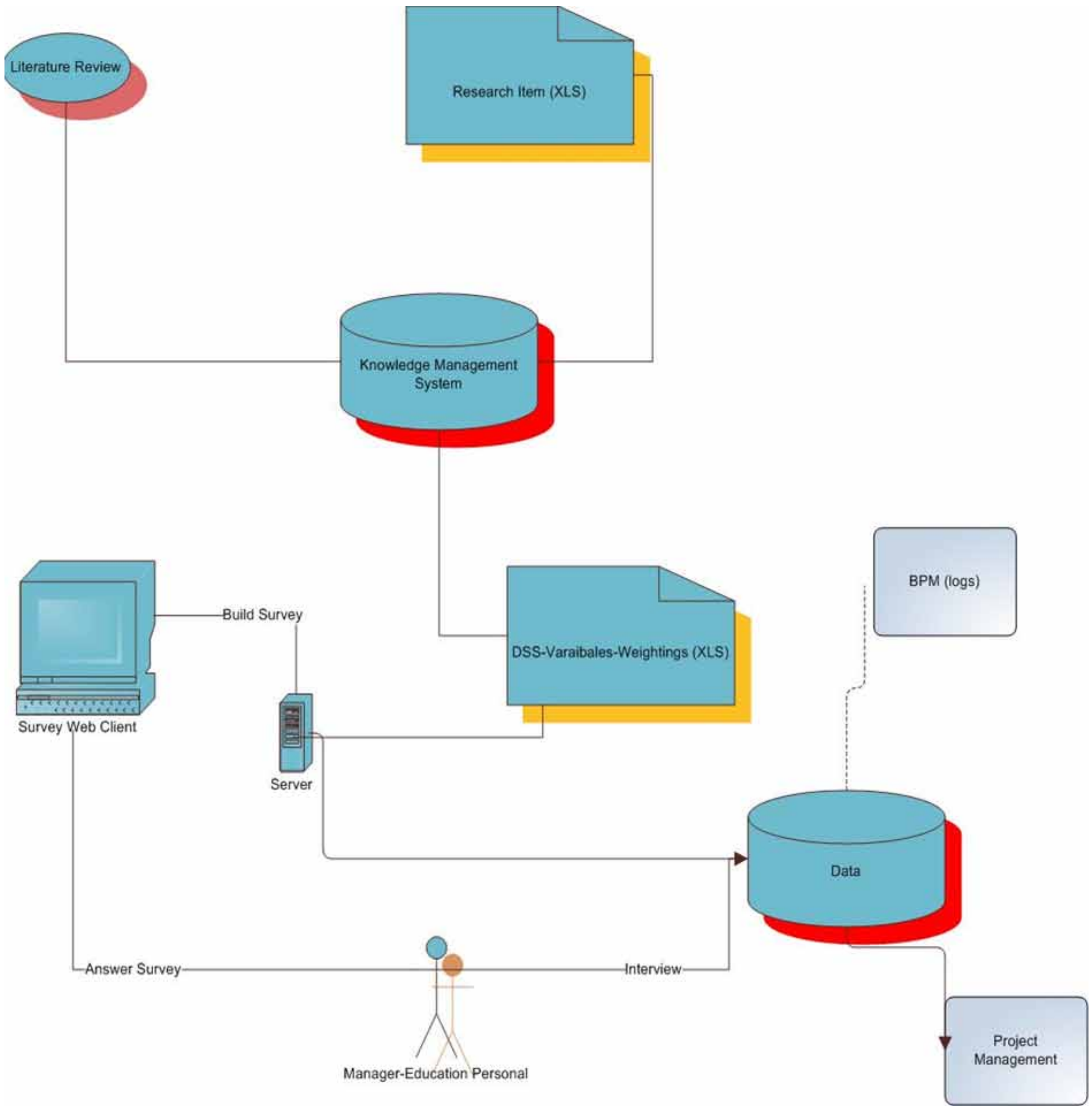
Table 3. The critical success factors that have an average of 9.10

Critical Success Factors	AHMM enhances: KPIs	Weightings
CSF_ICS_IntegrationProcesses	MatureSupported	From 1 to 10. **09 Selected**
CSF_ICS_Operations&Choreography	SimpleAutomated	From 1 to 10. **09 Selected**
CSF_ICS_DesignProcess	SimpleSupported	From 1 to 10. **09 Selected**
CSF_ICS_McLifecycle	ExistingProcedures	From 1 to 10. **10 Selected**
CSF_ICS_RAD_eBPM	ComplexEnvironments	From 1 to 10. **08 Selected**
CSF_ICS_Tests	ExistingTests	From 1 to 10. **10 Selected**
CSF_ICS_StorageRepository	Supported	From 1 to 10. **08 Selected**
CSF_ICS_Mapping	Supported	From 1 to 10. **09 Selected**
CSF_ICS_HPMS_StandardsIntegration	Supported	From 1 to 10. **09 Selected**
CSF_ICS_HPMS_Strategy	Supported	From 1 to 10. **10 Selected**
CSF_ICS_HPMS_Security	Integrated	From 1 to 10. **10 Selected**

THE INTEGRATION WITH THE ARCHITECTURE DEVELOPMENT METHOD

The ADM is a generic method and recommends a set of phases and iterations to develop the *Projects*; it designs parts of the transformed system interfaces and other deliverables also with other internal (like the HPMS) and market frameworks. The HPMS defines a set of basic EA requirements for AofHBS profile's selection, training and evaluation; that are stored in the *TKM&F* KMS database, as shown in Figure 17 (Trad & Kalpić, 2014e).

Figure 17. The knowledge management system item

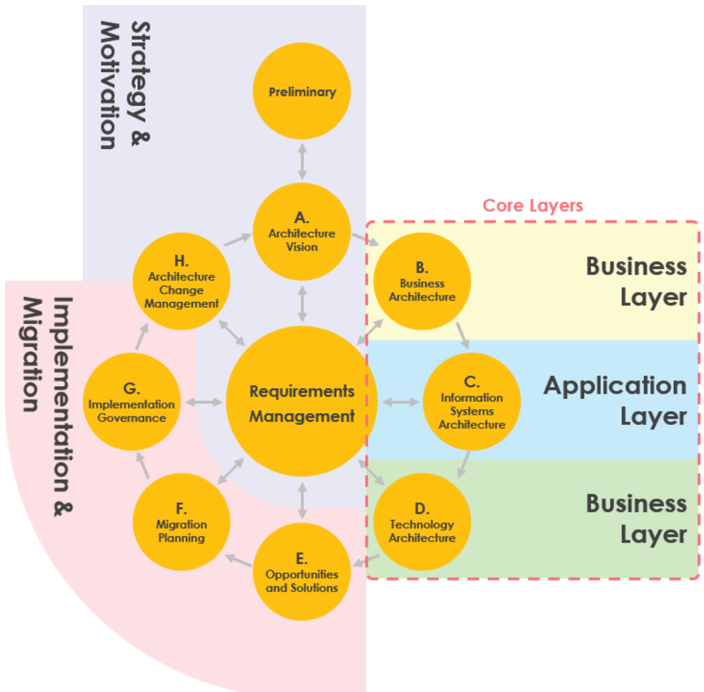


Architecture Phases

As shown in Figure 18, the ADM manages the *Project's* development iterations; in this section the authors present ADM's phases and the HPMS' interactions:

- The preliminary phase selects the relevant CSFs and interactions.
- The architecture vision and business architecture phases interactions.
- The information system architecture phase's interactions.
- The technologies architecture phase's interactions.
- The requirements management and tests phase's interactions.

Figure 18. The architecture method's interaction



Business Architecture

The *Manager* must use the *TKM&F* ao apply standards that deliver added value and robustness to *Projects*. In order to move towards a just-enough business architecture that is known as the target or final interaction architecture as shown in Figure 19, where the important adjacent domains are clearly shown and the others are blurred because of their low level of importance (OASIS 2006).

The AofHBS profile must be capable to align: 1) the business enterprise's traditional architecture vision (as shown in Figure 20); 2) the business architecture principles; and 3) standards management to support EA. The traditional business architecture layers that are shown in Figure 20, represent a silo model of the fundamental components. These four components are very hard to melt down into an agile BE and holistic EA (Trad & Kalpić, 2015a).

The Architecture Development Method Critical *Success* Factors

Based on the literature review and CSF evaluation process, the most important ADM's CSFs are evaluated to the following:

As shown in Table 4, the result tries to prove or justify that it is possible to integrate and automate the ADM's interaction with the HPMS; and the next CSA to be analysed is the holistic management of the KMS.

Figure 19. The business interaction architecture (OASIS, 2006)

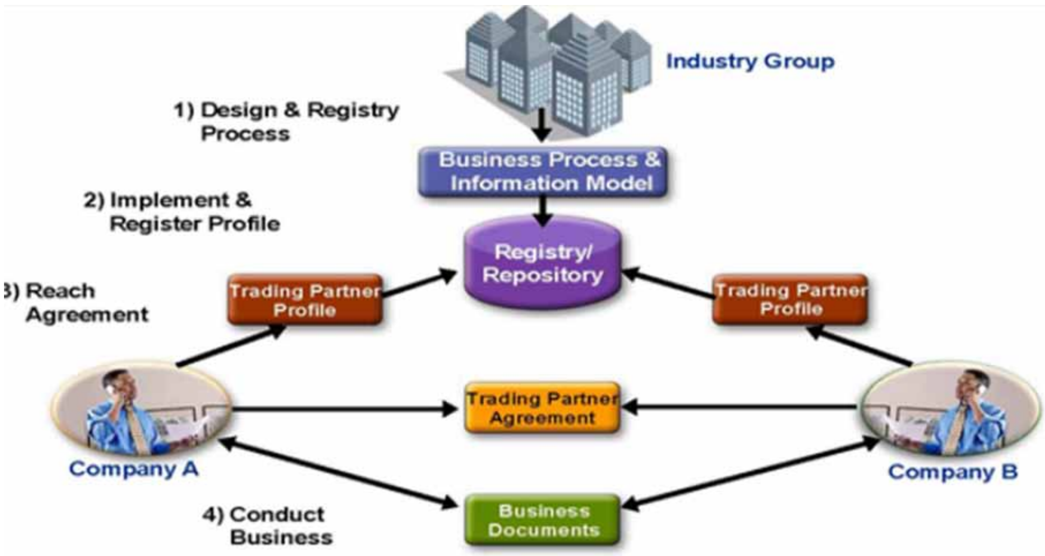


Figure 20. Traditional architecture levels (The Open Group, 2011a)

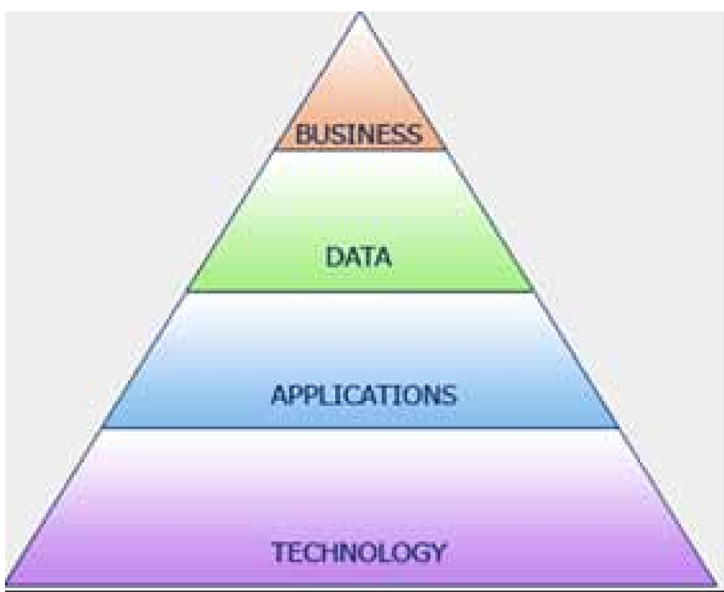


Table 4. The critical success factors that have an average of 9.40

Critical Success Factors	AHMM enhances: KPIs	Weightings
CSF_ADM_CSF_Initialization&Setup	MatureStatus	From 1 to 10. **10 Selected**
CSF_ADM_IntegrationProcesses	StandardSupported	From 1 to 10. **08 Selected**
CSF_ADM_Phases	Supported	From 1 to 10. **10 Selected**
CSF_ADM_Requirements	MappingAutomated	From 1 to 10. **09 Selected**
CSF_ADM_HPMS_Architecture	FullySupported	From 1 to 10. **10 Selected**

The Research Section's Link to the Electronic Knowledge Management System

This section's deduction is that the HPMS can be integrated in the *Projects* and a holistic ADM. Now follows the HPMS interfacing the KMS.

THE HOLISTIC ELECTRONIC KNOWLEDGE MANAGEMENT SYSTEM

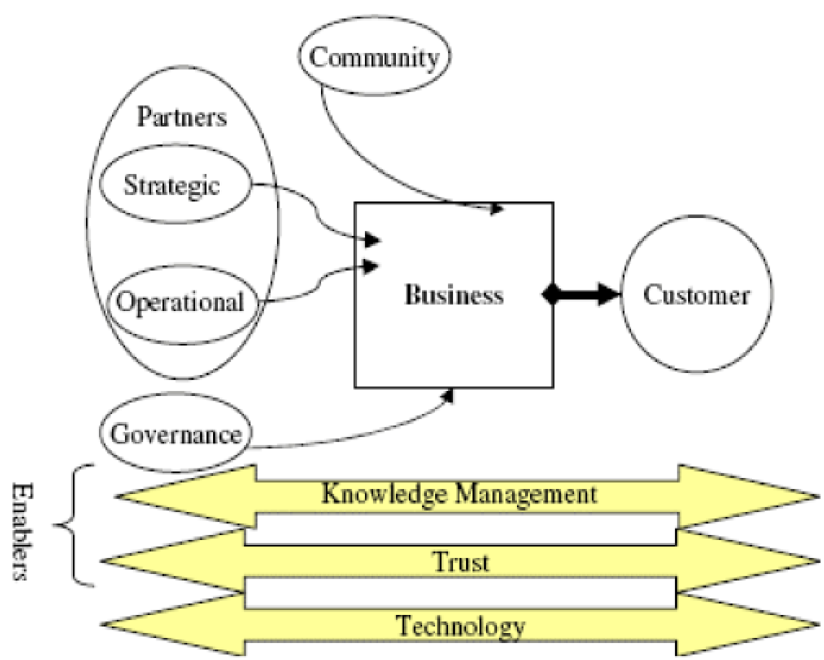
The Holistic Electronic Knowledge Management

The AofHBS must be capable of managing electronic Knowledge Items (eKI); where eKIs and micro-artefact scripts are responsible of the manipulation of intelligence and they control various knowledge processes. The KMS supports the HPMS underlying mechanics to manage eKI microartefacts. The *Manager* is responsible for designing eKI's extraction using holistic systemic approach (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a). A HPMS interfaces the KMS to enable an efficient search process (Trad, 2018c).

The Holistic Knowledge Strategy

An HPMS interfaces the KMS/eKI, where sets of AofHBS profile are stored (Trad & Kalpić, 2017a; Trad & Kalpić, 2017b; Trad & Kalpić, 2017c). The interface strategy is included in the architecture roadmap and the *Manager* must select tools for the KMS management (Alhawamdeh, 2007), as shown in Figure 21.

Figure 21. Knowledge management and the business environment



The Knowledge Management Success Factors

Based on the literature review, the most important knowledge CSFs that are used are:

The Modules Chained Link to the Intelligence Support or Decision System

The KMS' integration result prove that it is possible to implement an HPMS to interface the DMS.

THE INTEGRATION WITH THE DECISION MAKING SYSTEM

A Complex Process

AofHBS profile management is supported by the HPMS' selection, training and evaluation using the DMS (Şeref, Ahuja, & Winston, 2007). The DMS' results are presented as a set of possible solutions or possible AofHBS profiles (SAP, 2013a). The best solution proposes the right AofHBS profile in relation to the selection, evaluation and training activities.

A Risky Process

HPMS, KMS and DMS integration may face problems due to complex CSF evaluation process that implies that the analysis and management of risk is one of the important pre-requisites to ensure the success of HPMS activities. The HPMS uses the DMS risk management capabilities (Hussain, Dillon, Chang & Hussain, 2010).

The Decision Making Process

The decision making process is supported by the HMM formalism that uses a holistic approach for delivering a set of AofHBS possible profile in form of solutions (Daellenbach & McNickle, 2005). The HPMS interfaces the DMS, in which various profiles are selected and tuned, using selected CSF sets for profiles that are orchestrated by the HMM's choreography engine.

Table 5. The critical success factors that have an average of 9.20

Critical Success Factors	AHMM4BT enhances: KPIs	Weightings
CSF_KMS_ICTIntegration	FullySupported	From 1 to 10. **10 Selected**
CSF_KMS_eKI_Mapping	ComplexToImplement	From 1 to 10. **08 Selected**
CSF_KMS_Patterns	Implementable	From 1 to 10. **10 Selected**
CSF_KMS_HPMS_Integration	Implementable	From 1 to 10. **09 Selected**
CSF_KMS_HPMS_AccessManagement	StandardIntgeration	From 1 to 10. **09 Selected**
CSF_KMS_HPMS_ProfileMatching	ComplexToImplement	From 1 to 10. **08 Selected**

The Decision Making System's Critical Success Factors

Based on the literature review and evaluation processes, the most important DMS's CSFs that are used are evaluated to the following:

As shown in Table 6, the result tries to prove or justify that it is possible and even mature to implement a holistic and distributed DMS using the HMM formalism and that will be presented in the HPMS section.

The Research Section's Link to the Holistic Profile

This chapter's deduction that selects and evaluates the CSFs, is based on the six tables that this RDP has generated and the following phase is the HPMS.

THE HOLISTIC PROFILE

Basics

The AofHBS should have a deep understanding of *Projects* and the DMSs that is the first step towards the transformation process. He needs also in-depth knowledge of: 1) electronic lean business environment architectures; 2) integrated development environments; 3) business people integration, 4) agile project management; and 5) coordination of computer engineers. The AofHBS acts as business and information systems solution designer and implementation architect (SAP, 2013a; SAP, 2012a). Estimated AofHBS skills require a profound knowledge of the EA, business architecture, business processes, DMS, KMS, services technologies and project management fields. That rounds up the profile of an AofHBS who acts as a coordinator of EA teams (Trad & Kalpić, 2014f).

The Profile's Role

AofHBS profile and skills have an enormous impact on the concrete PIP of *Projects*, where the managerial aspects of such *Projects* are not well defined. Currently there is no business or enterprise architecture set of recommendations and educational curriculum for such profiles (Trad, 2011a; Laudon, K., & Laudon, 2011). There is an essential need for more research on the AofHBS' profiles and role for increasingly

Table 6. The critical success factors that have an average of 9.20

Critical Success Factors	AHMM4T enhances: KPIs	Weightings
CSF_DMS_ComplexSystemsIntegration	Supported	From 1 to 10. **09 Selected**
CSF_DMS_HPMS_Interfacing	Supported	From 1 to 10. **09 Selected**
CSF_DMS_KMS_Interfacing	IntegrationEnabled	From 1 to 10. **10 Selected**
CSF_DMS_DMP	IntgeratesAsKernel	From 1 to 10. **10 Selected**
CSF_DMS_HolisticApproach	Supported	From 1 to 10. **08 Selected**
CSF_DMS_AofHBS_ProfileOptimization	Supported	From 1 to 10. **08 Selected**

competitive BEs. *Projects'* influences the way business processes are managed and integrated, that consequently forces BEs to continuously innovate. Many selection factors directly or indirectly affect the HPMS. The role is a set of CSFs, where the HPMS proposes a profile role to insure the reusability of existing requirements for microartefacts, components and EA paradigms.

Architecture Skills

The HPMS can help executive management select an AofHBS for the *Project's* PIP, in any of its stage of development; that helps also in the maintenance of the resulting BE. The AofHBS manages mechanistic BEs that will be challenged to use their *Project* results in order to change their business operations, re-engineer their ICS, or to re-schedule various tasks of project management plans; which could result in automating tasks that might have been performed manually in the past. The *Manager* should be capable of offering: 1) the concept of PIP using emerging technologies; 2) solutions that are based on legacy systems as a better balance between costs, benefits and risk; and 3) a new BE EA concept. These adaptive BEs are based on stateless business objects in the form of services, they are a shift within the EA paradigm (Trad, & Kalpić, 2001).

Architecture Framework Usage and the Role of an Enterprise Architect

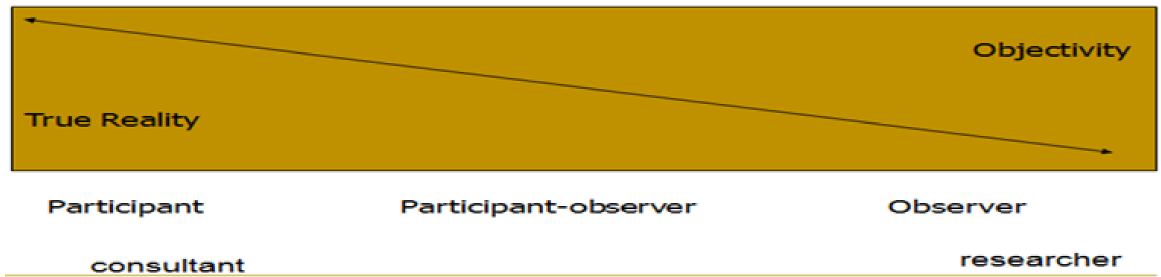
Meta-management and business integration require a AofHBS profile who must be an avant-garde innovation project manager. The AofHBS must be an excellent agile project manager, who is capable of implementing a very light version of the disciplines TOGAF, service and processes. The use of processes will enhance the management of knowledge and help in the selection of an AofHBS. Such need for a specific profile requires a special educational curriculum. Future AofHBS' need to have the ability to deeply understand each company's unique enterprise architecture, and to swiftly identify *Project* steps and to effectively implement them into their business processes as the basis for a future sustainable profitable enterprise. According to the latest Gartner Study, "the ability to apply versatile and extensive methodological skills in managing business processes is the number one business priority for successful entrepreneurial activities" (Trad, & Kalpić, 2014e; Trad, Kalpić, 2014g). The implementation of this managerial recommendation in the real world is done by selection of the right AofHBS who has this main quality and at least some education in business and/or information technology.

AofHBS needs to be supported by a standardized architecture framework like the *TKM&F*, that interfaces TOGAF and can be used to establish a basic *Project's* blueprints. That would be a recommended approach to follow in order to structure the PIP that needs the following steps: 1) unbundling through business services; and 2) modelling and integration. The implementation of this managerial recommendation in the real world is done by the training of the selected AofHBS who should have had at least minimal experience before.

Needed Experience

This RDP is also based on the authors' experiences in various domains of business engineering and respective EA/ICS consultancy. In their carriers, the authors have often encountered *Projects* with serious problems having high rates of failure. This fact motivated them to pursue this RDP and contribute to this endemic problem related to complex *Project*s in mechanistic BEs; and to promote the optimal AofHBS profile. The difficulty lies in the duration of *Projects* that take many years to be finalized.

Figure 22. The synergy between real world experience and research outcomes (Trad, & Kalpić, 2011)



The complex activity of interconnecting the company's business processing nodes that is known as unbundling, is extremely complex and in general it causes major resistance; consequently it may cause *Project*s to fail (Farhoomand, Lynne, Markus, Gable, & Khan, 2004). The HPMS offers a selection and training framework, where the training part is supposed to enhance the *Manager*'s knowledge by adopting holistic skills.

Holistic Characteristics

The AofHBS must have a holistic profile and the most important recommendation is that he has cross-functional skills (CapGemini, 2007). The preferred basic profile is a flexible and intelligence-based person, who is able to transform the BE and is also capable of exploiting the inter-related avant-garde technologies in order to successfully conduct *Project*s. Managing of complex skills and educational concepts, requires a mixed method that is mainly based on action research; a hyper-heuristics model (Trad, & Kalpić, 2014e; Trad, Kalpić, 2014g). The implementation in the real world is done by the HPMS selection of the right *Manager* that has this main quality and has been proven in industry.

Needed Hands-On Skills

The AofHBS must have extensive skills in *Project*'s and especially PIPs, his empirical hands-on skills must encompass: 1) knowledge of business architectures and business process management; 2) automated business environments; like mechanistic BEs (Krigsman, 2008); 3) agile project management; 4) knowledge management integration; 5) organizational concepts; 6) management sciences methodologies; 7) enterprise architecture; and 8) other concrete *Project* implementation artefacts (Trad, & Kalpić, 2014e, 2014g). For this section, the authors recommend an experienced technocrat profile (Farhoomand, Lynne, Markus, Gable, & Khan, 2004) with a respective educational curriculum.

Business Modelling and Integration

The AofHBS must have extensive knowledge of business process modelling in *Project*s to manage the implementation of the existing business scenarios, into an automatized set of business processes. These process setups insure that the AofHBS rationalizes the enterprise's business scenarios and enable inter-enterprises eco-systems development through the business enterprise architecture framework. The implementation of this managerial recommendation in the real world is done by the training of the selected AofHBS who should have had the minimal experience before; here the authors consider it as a minor selection criterion.

Business Infrastructure Integration

The AofHBS must have extensive knowledge of business infrastructure integration in *Project*s to manage the implementation of the existing platform nodes, into an automatized and highly available BE infrastructure. This process is set up, to insure that the AofHBS can rationalize the BE's platform nodes and to enable intranet and extranet business communication through the EA framework's control. For various BEs that are transformed into mechanistic entities; with a generic business driven approach, where the business infrastructure implementation is a very important factor to glue its ICS to the external world, and to give it the needed leanness. The AofHBS should also implement the performance evaluation criteria used to monitor the progress of the *Project* (Trad, & Kalpić, 2014e, 2014g). The implementation of this managerial recommendation in the real world is done by the training of the selected AofHBS who should have had the minimal infrastructure experience before; here the authors consider that it is a selection criterion of lesser importance.

The Role of Soft Skills

The subject of soft skills management is a subject to many writings and research projects, that is why in this paper the authors do not treat how does the AofHBS manage the human factor, and the staff's para-psychological, behavioural and cultural aspects. The implementation of this managerial recommendation in the real world is done by the selection of a right AofHBS who has this very important soft qualities. The subject is out of this RDP's scope and the authors consider that it has been already researched by many scholars.

The Holistic Profile's Critical Success Factors

Based on the literature review and evaluation processes, the most important HPMS's CSFs that are used are evaluated to the following:

As shown in Table 7, the result tries to prove or justify that it is possible and even mature to implement a HPMS.

The Research Section's Link to the Proof of Concept

This chapter's deduction that selects and evaluates the CSFs, is based on the six tables that this RDP has generated and the following phase is the PoC's implementation.

Table 7. The critical success factors that have an average of 8.90

Critical Success Factors	AHMM4T enhances: KPIs	Weightings
CSF_HPMS_BasicSystemsIntegration	Supported	From 1 to 10. **09 Selected**
CSF_HPMS_Architecture_Skills	Supported	From 1 to 10. **09 Selected**
CSF_HPMS_ProfileRoles	ManagementEnabled	From 1 to 10. **09 Selected**
CSF_HPMS_DMP_ForProfileSearching	Intgerated	From 1 to 10. **10 Selected**
CSF_HPMS_HolisticApproach	Supported	From 1 to 10. **08 Selected**
CSF_HPMS_TKM&F_Support	Intgerated	From 1 to 10. **10 Selected**
CSF_HPMS_RoleOfExperience	Analyzable	From 1 to 10. **09 Selected**
CSF_HPMS_HandsOn_Skills	Auditable	From 1 to 10. **08 Selected**
CSF_HPMS_Soft_Skills	Auditable	From 1 to 10. **08 Selected**
CSF_HPMS_BusinessModellingIntegration_Skills	Supported	From 1 to 10. **09 Selected**
CSF_HPMS_BusinessInfrastructureIntegration_Skills	Supported	From 1 to 10. **09 Selected**

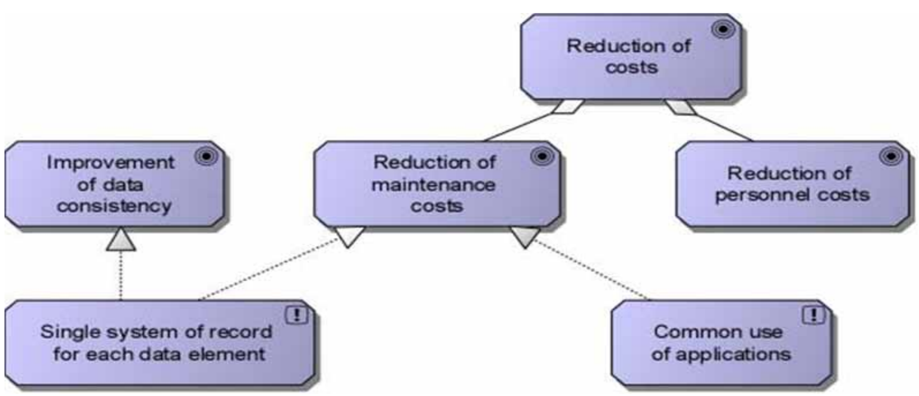
THE PROTYPE INTEGRATION

The ACS is an insurance management system that has an archaic ICS, a mainframe, claim files service, customer file service.

Application Portfolio Rationalization Scenario, Data Unification

This HPMS PoC, uses the ArchiSurance ACS; to select the AofHBS and uses a structured pool of CSFs to satisfy the HPMS requirements, as shown in Figure 23 that can be considered as the base sets of CSAs.

Figure 23. Transformation goals (Jonkers, Band & Quartel, 2012)



Setup and Critical Success Factors of the Architecture Method's Phases

The HPMS's needed skills for:

- phase A or the Architecture Vision phase, needs architecture roadmap; as shown in Figure 24.
- Phase B or the Business Architecture phase, needs *Project's* target architecture and requirements definition.
- Phase C or the Gap Analysis phase, needs for modelling a target application landscape.
- Phase D or the Target Technology Architecture and Gap Analysis phase needs the final *Project's* infrastructure design.
- Phases E and F, Implementation and Migration Planning, needs the transition architecture, proposing possible intermediate situation and evaluates the *Project's* status.

This PoC focuses on the *Manager*'s capability to make a common application architecture, a goal that can be seen in Figure 24.

The Proof of Concept

The chapters' PoC is implemented using the authors' *TKM&F*. The PoC is based on the HMM's instance and the HPMS interfaces the DMS that uses the profile CSFs, That is an example for this chapter, it is presented and evaluated in Tables 1 to 8 as shown in Figure 25.

The required skills have mappings to specific *Projects* resources like CSFs, as shown in Figure 26.

The used microartefacts are designed using EA methodologies and the HPMS concept defines relationships between the HPMS requirements and microartefacts, using global unique identifiers, as shown in Figure 27.

Figure 24. Goals and principles (Jonkers, Band & Quartel, 2012)

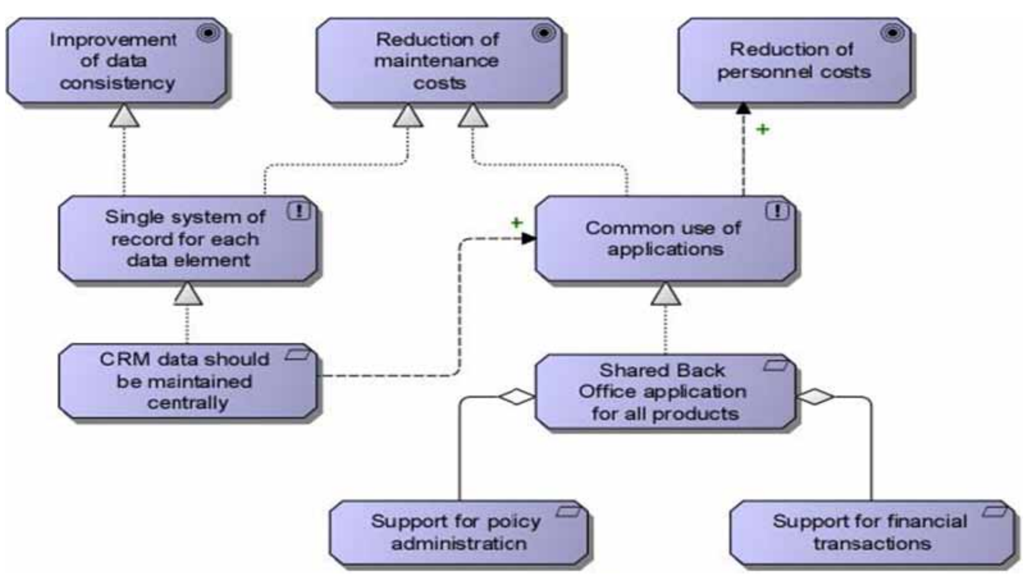


Figure 25. The TKM&F sequence of phases

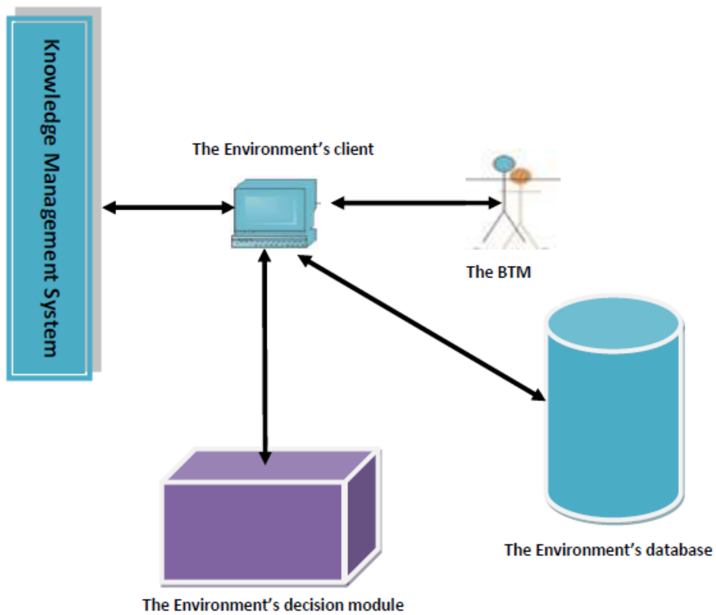


Figure 26. The TKM&F microartefacts concept

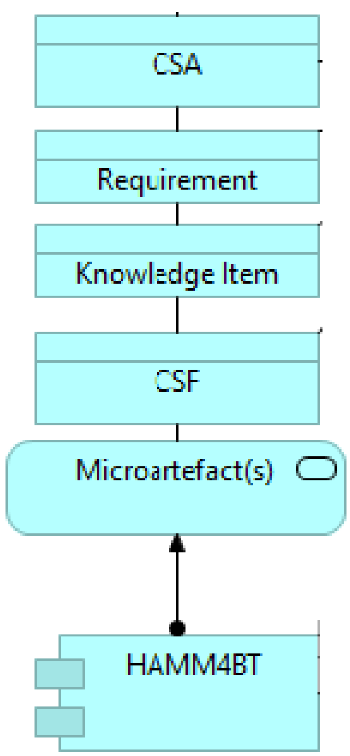
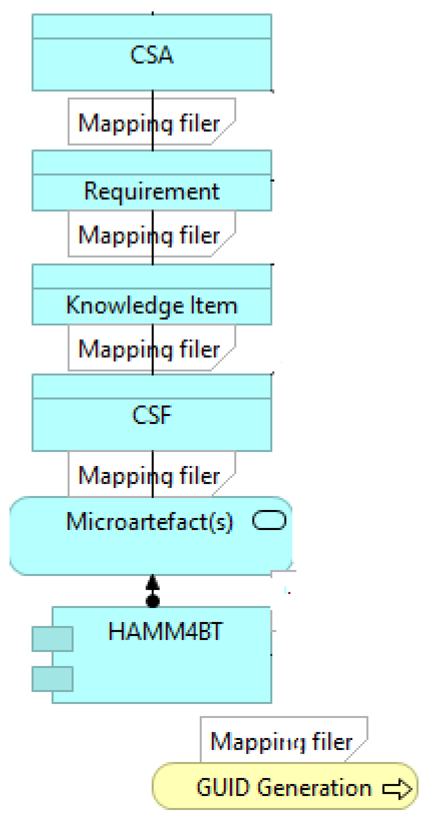


Figure 27. The TKM&F's global unique identifiers interaction



The PoC is achieved by using the *TKM&F* client's interface that is shown in Figure 28; where the starting activity is to structure the organizational part.

Once the development setup interface is activated, the NLP interface can be launched to implement the needed microartefact scripts to process the defined six CSAs. After starting the *TKM&F's* graphical interface, the sets of CSFs are selected, in this case for training *Manager*s, as shown in Figure 29.

Then follows the CSF attachment, for training *Manager*s, to a specific node of the *TKM&F's* graphical tree, as shown in Figure 30; to link later the microartefacts.

From the *TKM&F* client's interface the ML development setup and editing interface can be launched to develop the microartefacts that are related to the CSF, responsible for training *Manager*s, as shown in Figure 31.

These scripts make up the intelligence basis and the HMM's instance set of actions that are processed in the background to support services to be used in microartefacts. The HMM uses services that are called by the DMS actions, that manage the edited mathematical language script and flow, for training *Manager*s, as shown in Figure 32.

This research's HPMS instance, the HMM and its related CSFs, for training *Manager*s, were selected as demonstrated previously, as shown in Figure 33.

Once the microartefact is ready, the CSF and NLP files are configured as shown in Figure 33. In this chapter's seven tables and the result of the processing of the first initial phase, as illustrated in Table 8, shows clearly that the HPMS can be used in *Projects*. HPMS is not an independent component and is bonded to all the *Project's* overall architecture, hence there is a need for a holistic approach.

Figure 28. The TKM&F's client interaction

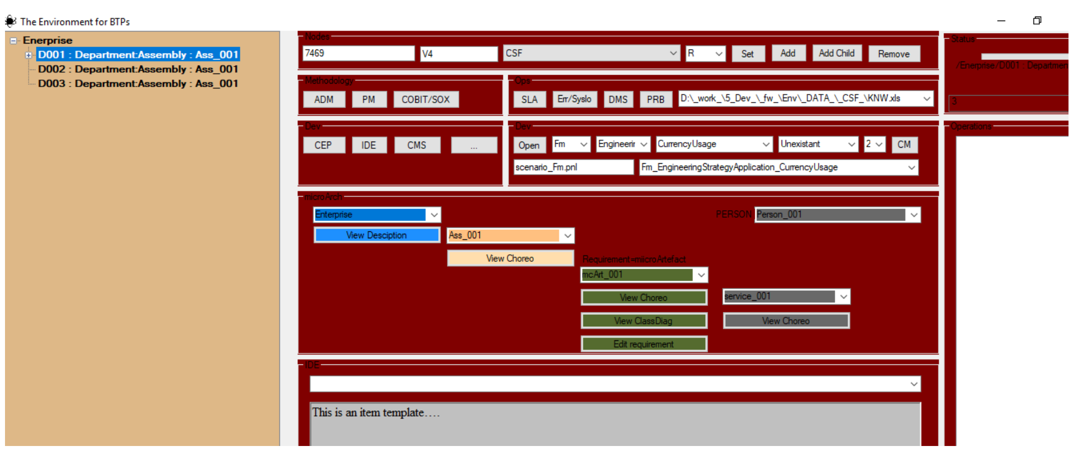


Figure 29. The TKM&F's factor setup interface.

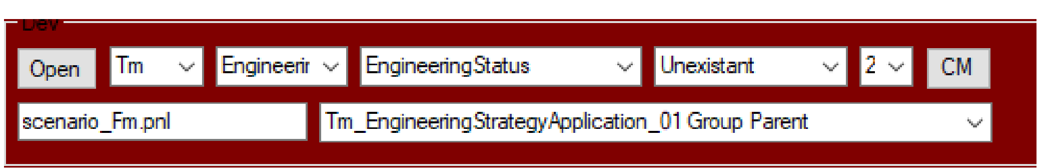


Figure 30. The TKM&F's factor setup interface

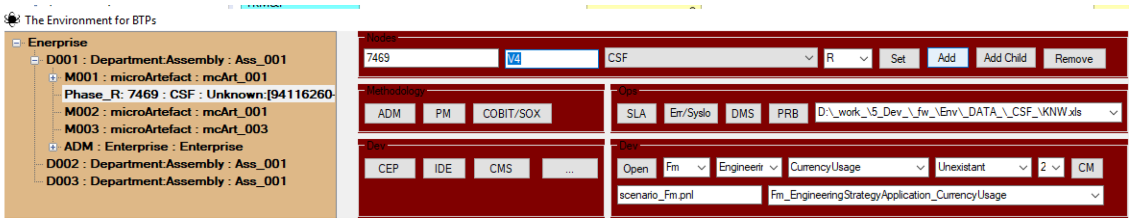


Figure 31. The edited mathematical language script and flow

```
// Microartefct: Tm Operations
//

debug = on

[mcArt_Def] TmOperations

// Variable declaration
//
var v1 = 11; // CSF for Training Minimization
var v2 = 12; // CSF for Fast Problem Solving
var v3 = 0;  // Problem Solving Value


// EXEC_NNSCENARIO scenario
// QUANTIFY     quantifyFn 70 quantify CSV

MessageBox START


LABL0:

// Microartefct
//
MessageBox LABL0
[mcArt_aservice] TmCalculate Activity.poolOfActivitiesDefs.calcAssets 120 30
MAPPING SLA=T REQ=T AUD=T LOG=F CSF=T:0,1 CPU=1 WTU=0,8 WTL=0,8
QUALIFY qualifyFn 60 Heuristics Exec
QUANTIFY quantifyFn 70 Factorial Exec
var1 = retval
MessageBox retval
TESTS UNIT
if retval > 0 then goto LABL1 else LABL5
```

The *TKM&F* and hence the HMM's main constraint to implement the HPMS is that CSAs for simple *Projects* components, having an average result below 8.5 will be ignored. In the case of the current CSF evaluation an average result below 7.5 will be ignored. As shown in Table 8, this fact keeps the CSAs (marked in green) that helps to make this work's conclusion; and drops the ones in red. The result 8.90 means that the HPMS integration is mature and can be used in all types of *Projects, where* the complexity is integrating the HPMS in *Projects* that must be done in multiple transformation sub-projects (small iterations), where the first one should try to define the basic AofHBS and iterate the reach the right profile.

Figure 32. The heuristics tree configuration

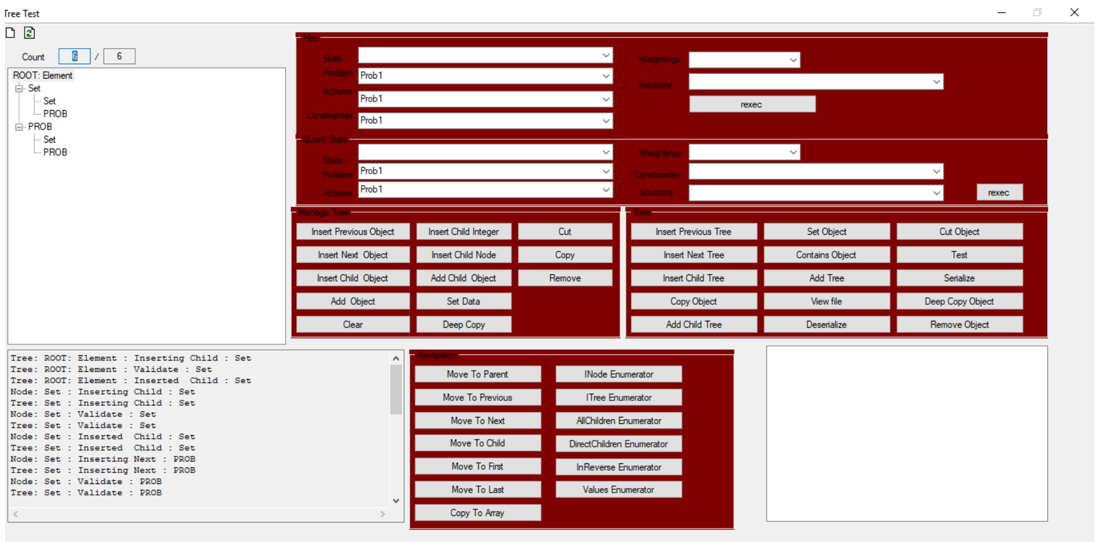
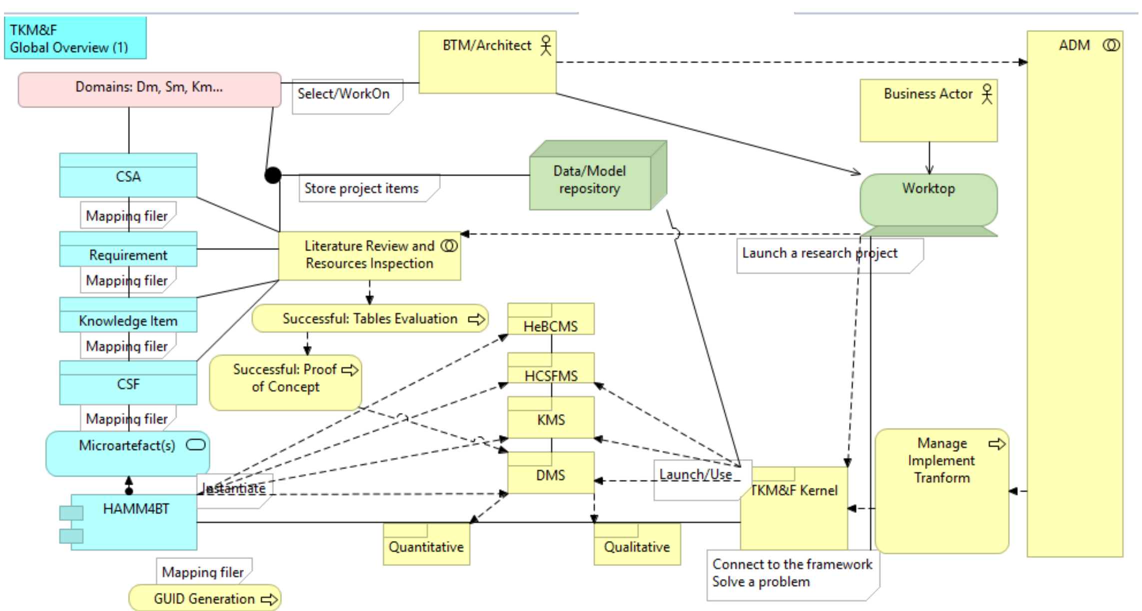


Figure 33. The TKM&F's components' interaction



SOLUTION AND RECOMMENDATIONS

The managerial recommendations are needed for finding the solutions to enable HPMS. The HPMS CSFs are the result of the literature review and the surveys outputs and are used in the hyper-heuristics research model. In this article, the focus is on the AofHBS profile, capabilities and educational prerequisites. These characteristics and prerequisites are needed to holistically manage the design PIPs. The

Table 8. The holistic factor management system research's outcome, is 9.00

CSA Category of CSFs/KPIs	Influences transformation management	Average Result
The Applied Case Study Integration	CredibleStable_Complex	From 1 to 10. 8.63
The Usage of the Architecture Development Method	FullyIntegrated	From 1 to 10. 9.40
The Information and Communication Technology System	Transformable	From 1 to 10. 9.10
The Mathematical Model's Integration	IsApplicable	From 1 to 10. 9.15
The Decision Making System	Implementable	From 1 to 10. 9.00
The Holistic Knowledge Making System	Implementable	From 1 to 10. 9.00
The Holistic Profile Management System	Implementable	From 1 to 10. 8.90

research tris to define the optimal profile and his educational curriculum, which should be adequate for the finalization of *Project*s. There has been a lot developed and written on enabling success in *Projects*, but the authors propose to inspect why they fail in the PIP. That is mainly due to the AofHBS lack of knowledge in managing business integration and implementation and the non-existence of an adequate training and educational curriculum. Because of very high score, above 9, Table 8 shows that the HPMS implementation is not a risky transformation process and that today the *TKM&F* is ready and the only methodology and framework that can in parallel construct *Projects*, EAPs, MMs, KMS, DMS' and *Projects*. The resultant technical and managerial recommendations are:

- A HPMS concept must be established and tried to check its feasibility and it should replace traditional obsolete factors evaluation mechanisms.
- The *Project*'s technical PIP, is the major cause of high failure rates in (e)transformations, therefore there is a need for an optimal architecture pattern and a qualified *Manager*.
- The *Manager* must be an architect and a technocrat, who is capable of supporting and designing the transformation process of the enterprise (Trad & Kalpić, 2013b, 2014d; Farhoomand, Lynne, Markus, Gable & Khan, 2004).
- The *Manager* must have extensive experience in (e)Business transformation projects: the *Project*'s PIP is the main cause of high failure rates (Neumeier, 2009; Capgemini, 2007; Capgemini, 2009).
- The *Manager* must be an agile project manager, who is capable of implementing a light version of an EA framework and of management of process models (Uhl & Gollenia, 2012).
- The *Manager* must have cross-functional skills (The Economist, 2000); such a person can be described as flexible and adaptable, capable of managing complexity. (Uhl & Gollenia, 2012; The Open Group, 2011b, 2011c).
- Knowledge gap; the literature review proved the existence of a knowledge gap between the traditional management skills and educational prerequisites for *Project*s (Trad & Kalpić, 2013).
- Evolutionary Mixed Method; this research uses an evolutionary research model in order to create the initial AofHBS profile and educational prerequisites (Trad & Kalpić, 2013).

- The *Project* PoC and interviews delivered the research's recommendations on how to select and educate AofHBS' (Trad & Kalpić, 2014a).
- Managerial recommendations, benefits and framework uses a qualitative hyper-heuristics model, which confirmed the survey outcomes; and delivered the managerial recommendations and benefits. The *Project* research project proposes a concrete framework on how to select, train and evaluate an AofHBS.
- AofHBS profile and educational prerequisites produce general profiles that can cope with heterogeneous complexity and fast changes. These high frequency changes are mainly due to the hyper-evolution of technology. The research confirms the role of *Manager* as an AofHBS.

HPMS managerial recommendations, and the *TKM&F*, round up the approach needed for the complex PIP. The AofHBS' selection pattern, defines the *Manager*'s profile and educational prerequisites that round up a selection and educational capacities, on how to select and train a *Manager*.

FUTURE RESEARCH DIRECTIONS

During the literature and resources review process the authors were negatively intrigued by the superficial and exclusively cost-oriented (or business outcome oriented) approach that is adopted by traditional businesses managers to manage *Projects*. The future research and development process will continue to tune the *TKM&F* and will work more specifically on the decision module's evolution.

CONCLUSION

The most important managerial recommendation that was generated by the previous research phases was that the business transformation manager must be an architect of adaptive business systems.

The PoC was based on the CSAs/CSFs links to a specific *Projects* resources and the reasoning model evaluated the selected CSFs. The deduced result implies that an attempt of HPMS based transformation can be successful. In this chapter, the focus is on the optimal *Manager*'s profile to holistically manage the design and PIP of a *Project*. There has been a lot developed and written on enabling success in transformation projects, but the authors propose to inspect why *Manager*s fail in the PIP of a *Project*. That is mainly due to the *Manager*'s lack of knowledge in managing business integration and implementation and the non-existence of adequate business enterprise architecture integration for such research question. The most important findings in this phase are: 1) The *TKM&F* proof of concept (PoC): The PoC and interviews proved the approach and delivered the recommendations on how to select and educate *Manager*s (Farhoomand, Lynne, Markus, Gable, & Khan, 2004) and EA integration, benefits and framework. *TKM&F* proposes a set of recommendations on how to proceed with the *Projects* where *Manager*s must attempt holistic implementation that is "*a proven approach that unites all disciplines in an organization to collaborate together to enable disruptive change*" and where "…*a few things have become clear: business transformation leaders require technical skills to define comprehensive and complete technical solutions and equally important, also require skills to build consensus among all affected stakeholders*". In a meta-managerial business driven coordination, the information technology is a commodity used to glue the various business components (Uppal & Rahman, 2013). There has been a lot of development and research work on the reasons for success or failure in *Projects*, but the authors propose to inspect the holistic aspects *Projects*. The managerial recommendations are offered to help *Manager*s to decrease the high failure rates and are a result of the resources review, surveys outputs, interviews, simulation and prototyping. The already published research and development publications have produced the following outcomes:

- Knowledge gap; the research has proved the existence of a multi-dimensional knowledge gap that exists between traditional management skills and the needed skills for *Projects*' management (Trad & Kalpić, 2014d).
- An evolutionary mixed method was developed in order to create the initial *Manager*'s profile (Trad & Kalpić, 2014d).
- The actual business environments produce general profiles that can hardly cope with complexity of heterogeneous business systems. These high frequency changes are mainly due to the hyper-evolution of technology and a tough competition.
- The PoC proved the research feasibility and delivered the recommendations on how to select and support *Manager*s (Willaert, 2001).

The *TKM&F* supports the *Manager* by using the HPMS pattern and delivers a set of managerial recommendations for *Projects*.

ACKNOWLEDGMENT

In a work as large as this research project, technical, typographical, grammatical, or other kinds of errors are bound to be present. Ultimately, all mistakes are the authors' responsibility. Nevertheless, the authors encourage feedback from readers identifying errors in addition to comments on the HPMS and the *TKM&F* in general. It was our great pleasure to prepare this chapter and its experiment. Now our greater hopes are for readers to receive some small measure of that pleasure and support for his project.

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KEY TERMS AND DEFINITIONS:

ADM: Architecture development method.
CSA: Critical success area.
CSF: Critical success factors.
DMS: Decision-making system.
EA: Enterprise architecture.
HMM: Holistic mathematical model.
HPMS: Holistic knowledge management system.
KMS: Knowledge management system.
Manager: Business transformation manager.
NLP: Natural language programming.
PIP: Project implementation phase.
RDP: Research and development projects.
RQ: Research question.
TKM&F: Trad Kalpić methodology and framework.
TOGAF: The Open Group's architecture framework.

Chapter 6
An Applied Mathematical Model for Business Transformation and Enterprise Architecture:
The Holistic Mathematical Model (HMM)

ABSTRACT

This chapter proposes a cross-business domain holistic mathematical model (HMM) that is the result of a lifetime of research on business transformations, applied mathematics, software modelling, business engineering, financial analysis, and global enterprise architecture. This research is based on an authentic and proprietary mixed research method that is supported by an underlining mainly qualitative holistic reasoning model module. The proposed HMM formalism attempts to mimic some functions of the human brain, which uses empirical processes that are mainly based on the beam-search, like heuristic decision-making process. The HMM can be used to implement a decision-making system or an expert system that can integrate the enterprise's business, information, and communication technology environments.

BACKGROUND

The HMMI can be used to implement a decision making system or an expert system that can integrate in the enterprise's business, information and communication technology environments. The HMMI uses a behaviour driven development environment or a natural language environment that can be easily adopted by the project's development teams (Myers, Pane, & Ko, 2004; Kim & Kim, 1999; Della Croce & T'kindt, 2002). The HMMI offers a high level implementation environment that can be used by any team member without any prior computer sciences qualification. The HMMI can be used also to model Enterprise Architecture (EA) blueprints, business transformation projects or knowledge management systems; it is supported by many real-life cases of various business domains. The uniqueness of this research is that the HMMI promotes a holistic unbundling process, the alignment of various EA standards and transformation strategies to support business transformation projects (Farhoomand, 2004). The proposes HMMI has been applied to verify various cases in different fields; and the results were

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than satisfying. Like for example, it was applied in this case is to financial services engineering and evaluation, to support the detection of financial irregularities and crimes. Gigantic financial crimes like the ones, related to fraud and money laundering that damage many countries, and this case it is related to the Swiss, Union des Banques Suisse (UBS) (Stupples, Sazonov, & Woolley, 2019), in which 32 trillion US dollars are hidden. Where the author estimated the hidden amount to 40 trillion US dollars…

INTRODUCTION

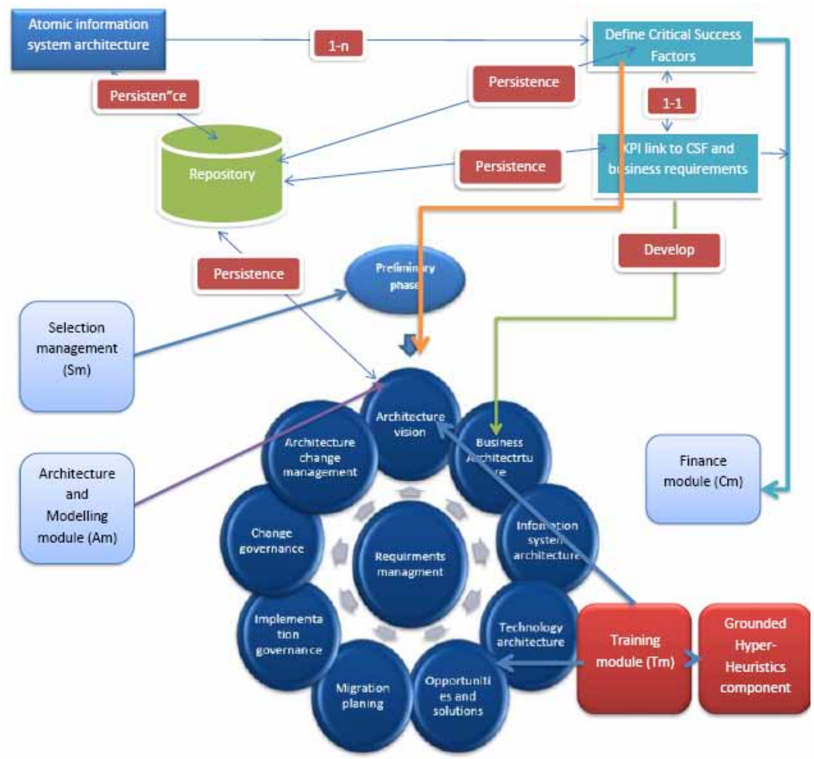
Actual archaic Business Transformation Projects (or simply the *Project*) are managed as separate black-boxes that are isolated silos where their internal and external components create a messy hairball that is called the enterprise's Information and Communication System (ICS) (Desmond, 2013). As already mentioned, the HMMI is based on many real-life cases and uses a model that can be used in a large variety of application fields, like: 1) business transformation projects; 2) business engineering projects; 3) critical success factors management; and 4) EA development procedures. This article recommends that the ICS's Decision Making System (DMS) uses the HMMI instance to solve problems by offering a set of possible solutions in the form of architecture, managerial and technical recommendations or blueprints, for any type of business problem; by using a central qualitative method based on a beam search (heuristic tree) that uses quantitative methods at its nodes. The proposed HMMI's implementation is very complex and needs a profound understanding of many fields. The DMS' actions produce solutions, which have the form of technical and managerial recommendations, can be applied by the business environment's architects, business managers, business analysts and project engineers to enforce the implementation of the transformation processes. A DMS is a multi-objective, multi-project, multi-factor (CSF) and *Project* problem in the context of a complex implementation phase. The DMS attempts simultaneously to maximize the success rate. Such processes should surpass the business environment's currently used usual DMs. The HMMI is a model first modelling environment that is supported by an applicable framework (IBM, 2001; Trad & Kalpić, 2018a, 2018b). This article's background combines Knowledge Management (KM), innovative decision making systems approach, enterprise architecture, heuristics/mathematical models, information technology management, business transformation initiatives and business engineering fields (Goikoetxea, 2004; Tidd & Bessant, 2009). As shown in Figure 1, where the major strategic technology trend is artificial intelligence based systems; so the author concludes that building an innovative HMMI model (Cearley, Walker & Burke, 2016; Thomas, 2015; Ho, Xu & Dey, 2010). The HMMI model enables the implementation of a generic and cross-functional reasoning engine that is mainly based on: 1) factors classification and management mechanism; 2) an adapted qualitative heuristics tree (beam search) research method; and 3) a set of quantitative modules that can be triggered from the tree's nodes. The HMMI manages sets of factors which can be applied to *Project* or to any other type of project. This article's author based his research model mainly on intelligent neural networks which can execute specific calls to quantitative modules and is supported by information technology driven development models, where both disciplines, applied mathematics and information technology models are complementary, due to the use of many existing industry standards, like for example the Architecture Development Method (ADM) (The Open Group, 2011a; Tidd & Bessant, 2009). The HMMI holistic concept is mainly business driven and is agnostic to a specific business environment's internals. As shown in Figure 1, it has been decided by the author that this genuine research framework should be founded on DMS microartefacts that in turn are based on existing standards (Johnson & Onwuegbuzie, 2004).

Figure 1. Technology Trends (Cearley, Walker, & Burke, 2016)

Actually, there are many mathematical models and EA methodologies that can be used to implement *Project* (Gartner, 2016), but all of them lack a systemic holistic approach. The Business Transformation Manager (or simply the *Manager*) or an enterprise architect can integrate an HMMI based DMS in the architecture roadmap of a *Project* to support its complex and risky transformation implementation, probable ventures and future maintenance (Zaiane & Ben Moussa, 2018; Trad & Kalpić, 2017b, 2017c, 2018a, 2018b; Thomas, 2015; Tidd, 2006). The HMMI model aim is to deliver a generic skeleton for a DMS that is capable to deliver just-in-time solutions in the form of applicable actions or recommendations for solving *Project* or EA problems. To achieve this goal, the research methodology is based on: 1) a multi-domain literature review; 2) a qualitative methodology; 3) a quantitative methodology; and 4) an engineering oriented proof of concept (or a controlled experiment); which is the optimal methodology applied in information technology, applied mathematics and other types of engineering projects (Easterbrook, Singer, Storey, & Damian, 2008).

For a successful integration of the HMMI in *Project*s, the *Manager*'s profile and role are crucial and his or her (for simplicity, in further text – his) decisions are supported by the selection and implementation of CSF that are essential for the *Project* development process. A holistic system approach is the optimal choice to integrate an HMMI based DMS in the *Project* (Simonin, Bertin, Traon, Jezequel & Crespi 2010; Daellenbach & McNickle, 2005; Trad & Kalpić, 2017d). The HMMI based DMS interacts with business users by means of a graphical user interface in order to manage the CSFs and launch the reasoning process, as shown in Figure 2.

Figure 2. The research framework's concept (Trad & Kalpić, 2017d)



*Project*s lack holistic and synchronized implementation approach (Thomas, 2015; Cearley, Walker & Burke, 2016). As shown in Figure 3, an adapted development and iterative process of operations can be adapted to support synchronized implementation approach.

The HMMI classifies CSFs in Critical Success Areas (CSA) groups as shown in Figure 4. In *Project*s, there is pressure to offer robust systems. The mentioned pressure is the main cause that a *Project* can fail or is simply cancelled (Kornilova, 2017).

THE RESEARCH PROCESS

The Research Cluster

The research cluster is a set of similar research fields, in parallel with a unique research question and goal (Cambridge University Press, 2018). The main topic of this global research is related to *Project*s and their enterprise architecture implementation disciplines. The ultimate research question is: "Which business transformation manager characteristics and which type of support should be assured in the implementation phase of a business transformation project?"

Figure 3. The agilization process (Kornilova, 2017)

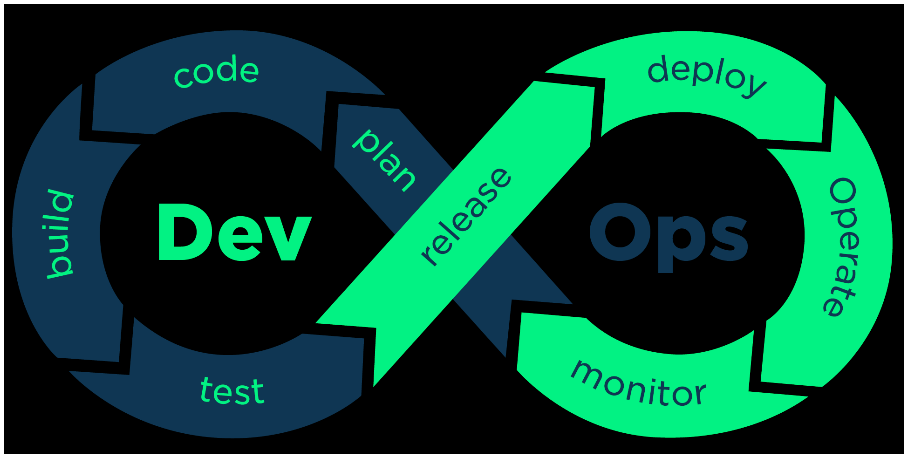
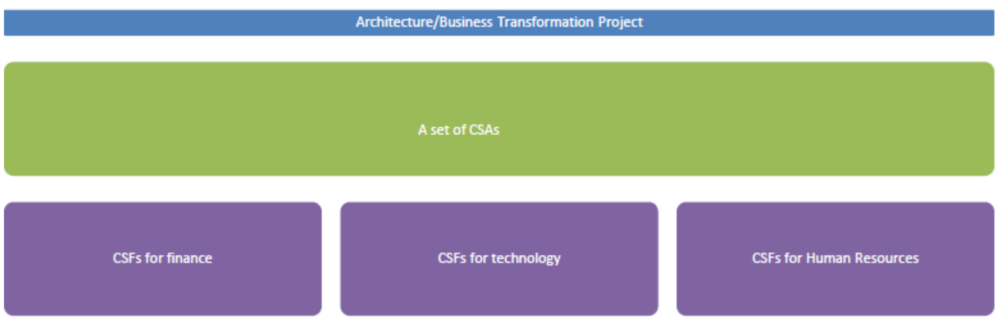


Figure 4. Structure of critical success descriptors (Trad, 2018a)



The Research's Uniqueness

The uniqueness of this research is that the HMMI promotes a holistic unbundling process, the alignment of various EA standards and business strategies to support *Project*s (Farhoomand, 2004). The uniqueness of this research project is based on its holistic approach that:

- Combines: 1) *Project*; 2) HMMI; 3) software modelling and architecture; 4) business engineering; 5) financial analysis; 6) *Manager*; and 6) global enterprise architecture. And offers a methodology and Framework.
- Using a scholar search engine (like Google's) combining the previous topics, clearly shows the uniqueness and the lead of the author's works.

This research question and its analysis are genuine and intended to close the immense gap in this field.

The Research Gap

Today an important gap exists in *Project* research areas (Cambridge University Press, 2018) and this research is a pioneering work in the field. It tries to link the Mathematical Model (MM) to all levels of the EA and to the underlying resources (Agievich, 2014). This is achieved by using a central qualitative engine, which is based on beam-search heuristics (Kim & Kim, 1999; Della Croce & T'kindt, 2002). *Project*s or ventures, are very risky and have a very high failure rate and one of the concrete reasons is that these *Project*s lack a cross-functional and holistic coordination; especially if the *Project* understands merges or new important ventures (Zaiane & Ben Moussa, 2018). That is why the author would like to contribute to enhance the success rate of *Project*s (Tidd & Bessant, 2018). To close or at least narrow the gap in the mentioned research field, the author proposes a holistic approach that unifies the following:

- An applied mathematical model that maps to all the project's components.
- A concrete manageable holistic HMMI project overview.
- The integration of a HMMI based DMS as the kernel of the *Project*.
- The CSA and CSF management.
- Implementation strategy for the development of microartefacts.
- The *Project*'s risk and audit management.

The Research Framework

HMMI based DMS uses CSFs, which are managed by this research's framework. The HMMI based framework supports a complex formalism that combines EA, DMS and various standards with a mathematical model (Goikoetxea, 2004; Johnson & Onwuegbuzie, 2004), as shown in Figure 5. Unfortunately, most of the existing formalisms are archaic, and silo-built. Examples of such archaic sets of facts are: 1) the set that influences microartefacts' management, like the governance of Service Oriented Architecture (SOA) modules (IBM, 2014); that are based on Internet and e-business e-service configuration/tuning, mechanics and quality (Kim & Lennon, 2017); 2) the set that influences the implementation of complex software management systems (Newman, 2015); 3) the set that influences the DMS (Busenitz, 2014); and 4) the set that influences the implementation of a KMS. A global HMMI concept is optimal for *Project*s (Daellenbach & McNickle, 2005) where it supports the integration of a holistic EA for a *Project*. The HMMI is a part of the Decision making module (Dm) and the Architecture module (Am), that in turn are parts of the framework. In this article, the author proposes a set of HMMI managerial and technical recommendations on how to used a framework in a *Project* (Trad 2018a; Trad 2018b; Trad 2018c; Trad 2018d).

The HMMI supports standards, like The Open Group's Architecture Framework's (TOGAF) ADM, where each *Project* microartefact circulates through its phases. In this research, TOGAF is used, but other architecture frameworks can also be used. These microartefacts contain their private sets of CSFs that can be applied to (Peterson, 2011): a) select the initial CSFs; b) weight and rate the CSFs; c) estimate the *Project*'s status using the DMS; and to eventually take a decision on *Project*'s continuation; d) control and monitor the needed DMS mechanisms; e) specialize the HMMI based DMS skills; and f) support the DMS automation processes. The actual research chapter and the resultant experiment are also a part of the Selection management, Architecture-modelling, Control-monitoring, Decision making, Training management, Project management, Finance management, Geopolitical management, Knowledge

Figure 5. The components of a business and information system

management and Implementation management Framework (SmAmCmDmTmPmFmGmKmImF, for simplification reasons, in further text the term the Trad-Kalpić Methodology and Framework *TKM&F* will be used). The *TKM&F* is not a black-box product to be applied as-is, it is rather a transformation strategy that offers recommendations and vision on how to implement a *Project*.

This article can be considered as a non-conventional and pioneering one, in the field of holistic *Project*s and EA projects. This article's research question is: "Can an applied holistic mathematical model be used to implement business transformation projects and enterprise architecture projects?". It was formulated after an extensive literature review.

The Research's Literature Review

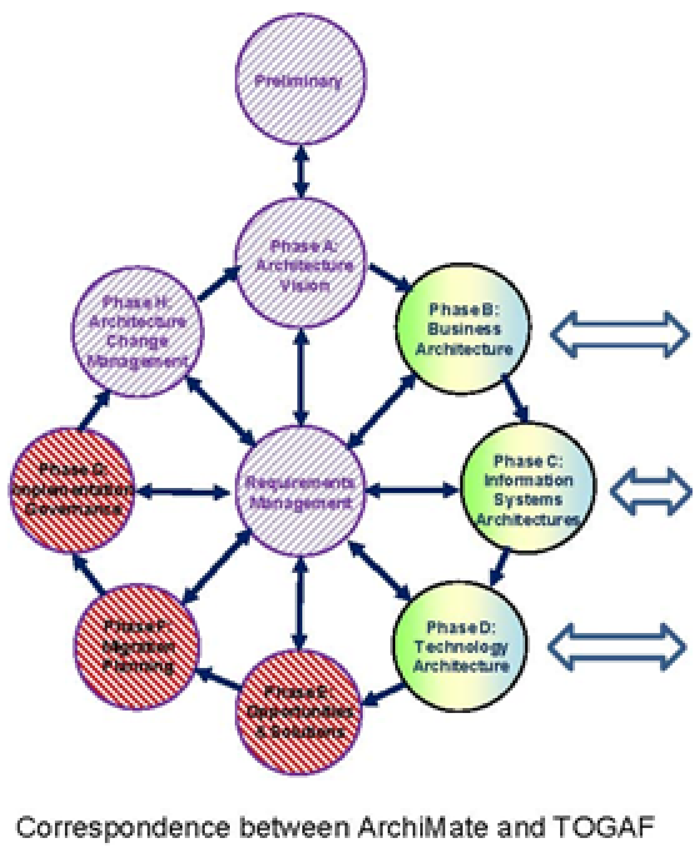
As already mentioned, this research cluster that is focused on *Project*s and EA; and owns an extensive literature library that contains major publications related to the research topics. For this research article, the literature review process has focused on the following subjects:

- Modelling EA with a mathematical model.
- Modelling *Project*s with a mathematical model.
- Modelling an enterprise with a mathematical model.
- The role of CSFs in a mathematical model.
- Integrating qualitative and quantitative methods.

The outcome is that very little scholar or even general literature and research resources exist on the selected subject. The author considers his work as a pioneering one; the most relevant works found are:

- Models that provide abstractions of a real world physical system (Hinkelmann, 2016).
- Modeling is a descriptive design process which validates principles (Sankaralingam, Ferris, Nowatzki, Estan, Wood, & Vaish, 2013).
- Model driven architecture: is defined by the Object Management Group, as shown in Figure 6.
- The gap between the adoption and its usage is still huge today (Syynimaa, 2015).
- A decision making system (Norusis, 1993; Dogan, Çalgici, Arditi, & Gunaydin, 2015).
- A mathematical model, the HMMI approach (Giachetti, 2012; Kim & Kim, 1999).
- An applied mathematical model is the description of a business system using mathematical concepts and language (Sankaralingam, Ferris, Nowatzki, Estan, Wood, & Vaish, 2013).
- Multi-criteria or a multi-factor model for decision making needs a mixed method based on qualitative and quantitative criteria (Zandia & Tavana, 2011; Kim & Kim, 1999).

Figure 6. Relation of an architecture model with a modelling language for microartefacts. (Hinkelmann 2016)



Empirical Engineering Research Model

This research article is based on an empirical engineering research approach because of the following facts (Johnson & Onwuegbuzie, 2004; Easterbrook, Singer, Storey, & Damian, 2008):

- It uses an authentic mixed method (where mixed research is a simplistic synonym) that can be considered as a natural complement to conventional qualitative and quantitative research methodologies.
- Today we have five classes of research methods that are the most relevant to applied mathematics in engineering fields.
- Engineering and applied mathematics researchers are very poor at making theories and related research explicit.
- Positivism argues that the project's knowledge must be founded on logical reasoning from a well-defined set of observable facts that are presented as CSFs.
- This research considers that qualitative research is a huge set of quantitative analysis schemas.
- This research uses Action Research (AR) which helps the researchers to solve a real *Project* problem and also stores the gained knowledge and experience of solving the problem; this is known as the knowledge item (Berger & Rose, 2015).
- Empirical validity checks if the research work is acceptable as a contribution to existing scientific knowledge.
- A controlled experiment or a PoC is a software prototype of a testable hypothesis where one or more CSFs (or independent variables) are processed to evaluate their influence on the model's dependent variables.

This research article is an empirical research and it includes a proof of concept and uses action research (Easterbrook, Singer, Storey & Damian, 2008). The proposed HMMI based DMS is a business-driven model which is based on three areas of research that represent separate sets of CSFs:

- The mathematical model with its artefacts.
- The mathematical model's integration in the information and communication technology system.
- The holistic management of the decision making system, using a mathematical model.

A MATHEMATICAL MODEL'S MAIN ARTEFACTS

The *Project* has a major precondition and that is, that the traditional business environment has to undergo a total and successful unbundling process, before the transformation activities start (Türkmen, & Soyer, 2020). The unbundling insures that the ICS microartefacts are ready to be used; this is the most delicate and complex undertaking in *Project*s and the main cause of their failure. For illustration, here we present some typical examples for ICS microartefacts:

- SOA unbundling procedures.
- Microartefacts development cycles.
- Reengineering of classical software systems.
- …

This research offers a mathematical model, the HMMI that is an abstract model containing a Mathematical Language (ML) that can be used to describe and implement the behaviour of any business system and its ICS (Goikoetxea, 2004). The HMMI that is based on related research by many authors and development works, can be used in natural sciences, social sciences and engineering fields; where managers, engineers, computer scientists, and economists can use HMMI to solve project problems and model its kernel architecture.

Author's Related Works

The author has researched the presented topics for a long time, resulting in more than 90 articles, considering the possibility of applying an MM in *Project*s. Before forming and finalizing a complete applied mathematical model, finally named the HMMI, the author would like to invoke their previous most important works related to this article:

- The "Selection and Training Framework" (STF) for Manager's in Business Innovation Transformation Projects" - The mathematical model (Trad & Kalpić, 2014a).
- The Selection, Control, Decision making and Training Framework for Managers in Business Innovation and Transformation Projects-Decision making model (Trad & Kalpić, 2015a).
- The Selection, Control, Decision making and Training Framework for Managers in Business Innovation and Transformation Projects-Managerial Recommendations for enterprise architecture (Trad & Kalpić, 2015b).
- The (e)Business Transformation Framework for (e)commerce Architecture-Modelling Projects (Trad & Kalpić, 2016a).
- A Transformation Framework Proposal for Managers in Business Innovation and Business Transformation Projects-A heuristics decision module's background (Trad & Kalpić, 2016b).
- A Transformation Framework Proposal for Managers in Business Innovation and Business Transformation Projects-A heuristics decision module's design concept (Trad & Kalpić, 2016c).
- Business Transformation Projects-An EA Applied Mathematical Model / The Basics (Trad & Kalpić, 2017b).
- Business Transformation Projects-An EA Applied Mathematical Model / Proof of Concept (Trad & Kalpić, 2017c).
- The Business Transformation and EA Framework / The London Inter Bank Offered Rate Crisis - The Model (Trad & Kalpić, 2017e).

These works promoted the need to develop a holistic model that tackles the various business and technical domains in a coordinated process; and above all, to prove that such a model can be the fundament and skeleton of a holistic EA of a *Project*.

A Holistic Approach

There are many different views on how to manage a transformation process, there is a need for a holistic approach to manage possible risks and to avoid a practically certain failure. Traditionally, risk concepts and possible failures were associated with a single origin or factor. Failure may be defined as a violation of an internal risk factor of the business system that can be due to various types of problems. The possibility of failure can be represented in various types of problems that can occur. A set of important, mainly permanent, constraints exist that can make *Project*s very fragile. These constraints depend on the level of enterprise's global status and on the way *Project* development planning is managed. To understand better the notions of holism and related mathematical models, the history of evolution of sciences and mathematics is important, in order to show that this evolution is very old and interrelated.

History, Technology and Evolution of Mathematical Sciences

Interconnection is enabled by the following facts:

- The generalisation of the alphabet gave the possibility to prose the problem. The Greeks inherited their alphabet from the Semite Phoenicians, shown in Figure 7. The Phoenician alphabet was spread across the Mediterranean to the rest of the then known world. It was later assimilated and modified by the Greeks and by most of the world cultures to change the way of communication (Allan, 2015).
- The Semite Phoenicians introduced counting systems (numerical characters), geometry and arithmetic. The Greeks were heavily indebted to the Phoenicians for their knowledge of applied mathematics, especially arithmetic (the art of calculation). The most known for such a propagation were Pythagoras and Thales who were Phoenicians, according to Herodotus (Hetzron, 1997; Ball, 2010).
- Evolution of various mathematical fields like heuristics geometry, algebra… (Martin, 1981).
- The development of algorithmics, like operational research, heuristics,…
- The establishment of EA standards, that in turn have roots in UML.
- The HMMI that inherits most of the previous evolutions and proposes a holistic approach to various domains.

Figure 7. The Phoenician alphabet (Allan, 2015)

This implies that there is a need for a holistic perspective for the *Project* that can base its architecture and design on an underlying mathematical model that is founded CSAs and CSFs (Goikoetxea, 2004; Cardona, 2004).

A Mathematical Model's Basics

Polderman and Willems (Polderman & Willems, 1998) argue that mathematical model is a subset of real world's possibilities and that mathematical model is a description of reality; in this research case, the reality is a *Project*. Once a mathematical model is established, it can offer a certain subset of possible solutions or explanations. The mathematical model acts as an exclusion law which admits and records accepted solutions. The subset of accepted solutions is called the behaviour of the mathematical model. Such an approach defines the basis of a dynamical system as subset of time-evolution that can be traced with a set of timestamps. A mathematical model as an exclusion law, offers the explanation and origin of events that can take or have taken place; and it can estimate whether they are factual or fictive, simply feasible or infeasible. Business and economic processes functions can explain that certain resources like materials, capital, and human labour can be planned to deliver a product or a service. Thus, it can be stated that a mathematical model offers a subset of the real world solutions, those solutions' instances that the model admits can be assumed as feasible ones. A mathematical model can contain different interrelated formulas or equations; in our modern times, even diagrams. The behaviour, and not the behavioural equations, can be considered as the central basics for the specification of a mathematical model like HMMI. In the HMMI the reality is the business context that understands: 1) enterprise architecture; 2) business transformations; 3) business and software engineering; 4) algorithmics; and 5) finance and audit. Whereas for the time variable, it is split in two categories: 1) greenfield, that occurs when the *Project* starts or for a *Project* major iteration, time is considered to be zero and a qualitative evaluation is executed for a go or no go recommendation(s); and 2) in a *Project* iteration, a time variable is set to evaluate a precise objective factor using a quantitative approach (Polderman & Willems, 1998). Kepler claimed using a mathematical model that planetary orbits non-obeying his three laws were impossible to take place (Britannica, 2018). This implies that there is a need for holistic perspective for the *Project* and its underlying mathematical model structure to prove if it can succeed (Cardona, 2004).

A Mathematical Model's Structure

The mathematical model's structure is used to resolve various types of interdependencies that can be used because of existence of a huge set of *Project* resources. These *Project*'s resources interdependencies can result in many silo subprojects that endanger the outcome of a *Project*. The use of a holistic methodology in the form of mathematical model structure can insure a successful outcome, or in the worst case, try to predict it. A mathematical model's structure represents the mapping relations between *Project*'s resources, like modules, microartefacts and resources that are not mutually exclusive. A mathematical model's structure facilitates a dynamic implementation to generate feasible *Project* objectives and an execution plan. A mathematical model's structure supports a decision making strategy that offers solutions to various *Project* problems. A *Project* plan is generated by the DMS's beam-search heuristics engine to realize enterprise transformation processes, using critical success areas and factors (Giachetti, 2012; Kim & Kim, 1999; Della Croce & T'kindt, 2002).

Critical Success Areas, Factors and decision Making

The HMMI is based on CSA which are categories of sets of CSF where in turn, each CSF is a set of selected Key Performance Indicators (KPI), where: 1) each CSA corresponds to a *Project* domain, like for example, finance; 2) each CSF corresponds to a set of project requirements, like for example, accounting balance sheet finalization; and 3) each KPI corresponds to a single transformation or architecture project requirement (Farhoomand, 2004); where the CSF/KPI elements interact with the ADM cyles, as shown in Figure 8.

For each *Project* problem type, a DMS qualified user can define the initial set of CSFs. CSFs are important for the mapping between the project requirements, microartefacts, organisational items to the HMMI structure (Nilda Tri & Yusof, 2009; Peterson, 2011). CSFs can express for example the *Project*'s performance requirements' control that must be met and is defined in the EA's strategic goals and HMMI's limit constraints. The HMMI's qualitative heuristic algorithms and punctual qualitative analysis can be used to evaluate for example the performances in each CSA, where CSFs can be internal or external; like: 1) the *Project*'s gap analysis is an internal CSF; and 2) client's purchase predictions is an external one as shown in Figure 9.

Figure 8. The factors' management environment

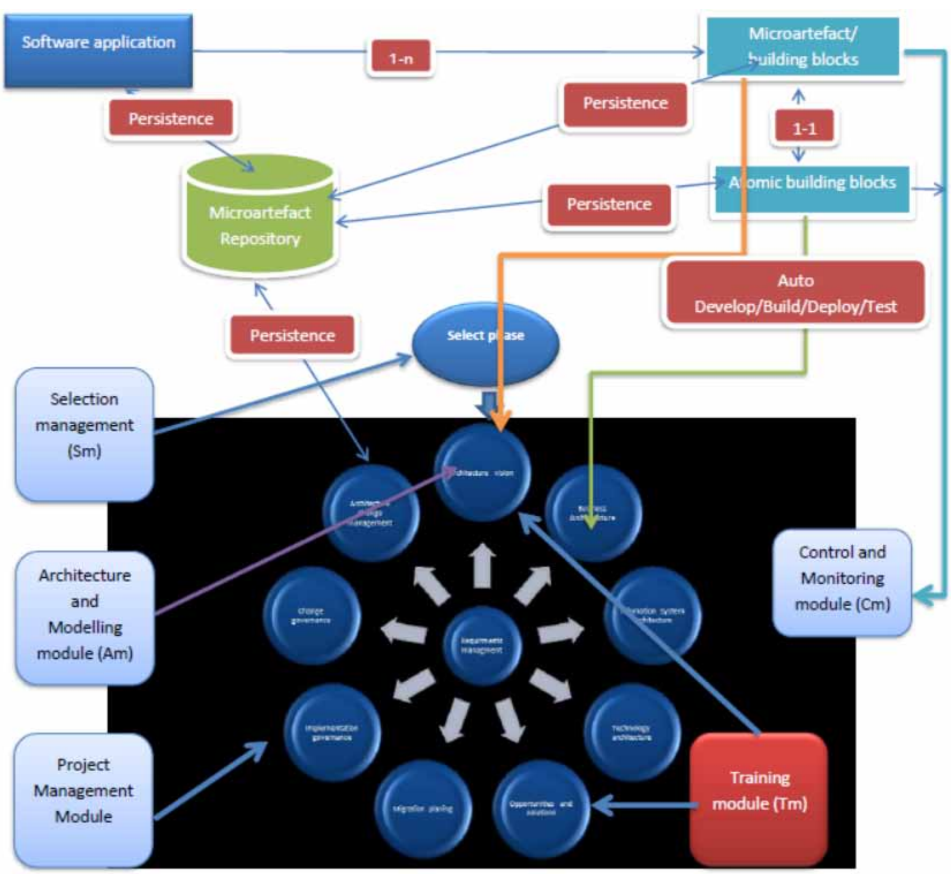
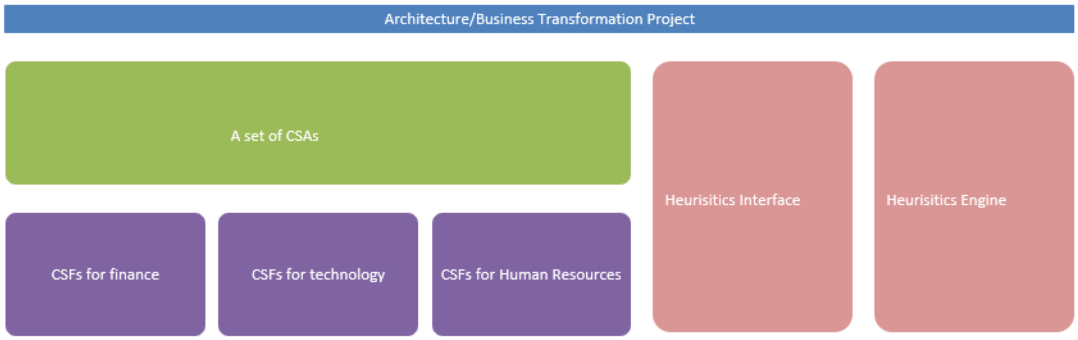


Figure 9. The factors' integration and heuristics (Trad & Kalpić, 2017b, 2017c)



Once the *Project*'s initial set of CSFs have been selected, then the *Project*'s members can use the HMMI based DMS to query for possible solutions. The DMS relates CSFs that maps to a *Project* requirement to a unit of work (Trad & Kalpić, 2017b, 2017c).

The Model's Unit of Work

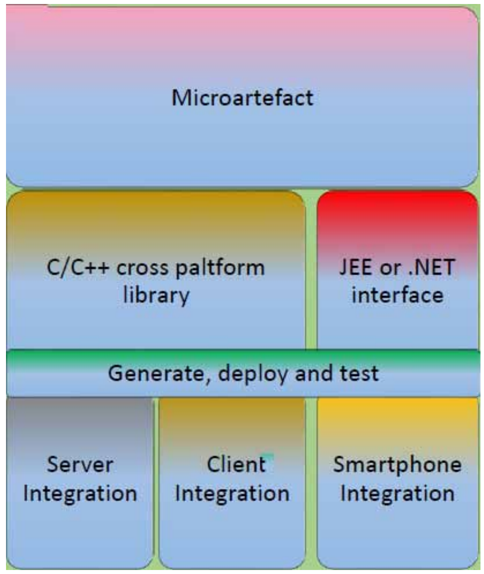
A holistic alignment and classification of all the *Project*'s resources must be done, so that the unbundling process can start. A holistic alignment needs also to define the HMMI Unit of Work (UoW) or a basic microartefact. Using the "1:1" mapping concept, the microartefact is represented with a class diagram and can be represented also by an extensible Mark-up Language (XML) model; like in the SOA unbundling and naming conventions. Such a mapping concept is based on an automated naming convention that can link all the *Project*'s resources. The mapping concept supports the interoperability between all the *Project*'s modules and enables the use of ML microartefacts that include the needed knowledge and intelligence support (Mehra, Grundy, & Hosking, 2005; Scherer & Schapke, 2011).

Mathematical Microartefacts

A mathematical microartefact is any *Project* microartefact that is a part of the HMMI and which interacts with a multitude of *Project* microartefacts in a coordinated manner. A ML microartefact uses the ADM to assist the *Project*'s implementation process (The Open Group, 2011a). The HMMI includes various types of mechanisms that use heuristics scenarios to make the *Project*'s integration more flexible and to avoid the classical and ridiculous archaic decision making systems and offer a holistic collaborative decision system (Trad & Kalpić, 2017a; Nakakawa, van Bommel, & Proper, 2010). The HMMI supports the *Project* by offering microartefacts to handle various types of decision scenarios. In Figure 10, the author presents the optimal microartefact construct, where the biggest part of microartefacts are written in portable and optimized C/C++.

A set of ML or generic microartefacts can be a library or any other software component written in any programming language. The usage of microartefacts provides some of the mechanisms needed to make HMMI offer a pluggable component in the distributed architecture model (Kraisig, Rosélia, Welter, Haugg, Cargnin, Roos-Frantz, Sawicki, & Frantz, 2016).

Figure 10. The microartefact development components and layers



The Microartefacts' Distributed Architecture Model

The previously developed Applied Mathematical Model (AMM) is an architectural instance that can be applied to a *Project*'s subproject. The *Project*'s decision making processes are based on the AMM formalism. The AMM has a defined nomenclature to facilitate its integration in an architecture model. The HMMI is the company's holistic MM and is a set of multiple coordinated AMMs that correspond to various just in time processing schemes which use the same *Project*'s central pool of CSAs and CSFs. The HMMI that is presented in Figure 11, to the reader in a simplified form, to be easily understood on the cost of a holistic formulation of the architecture's vision. The DMS uses an HMMI's instance to solve a *Project* problem.

The proposed architecture and the management of mathematical models enables the possibility to define EA as an AMM; using CSFs weightings and ratings, based on multicriteria (Azadfallah, 2018).

The symbol $\sum$ indicates summation of all the relevant named set members, while the indices and the set cardinality have been omitted. The proposed MM should be understood in a broader sense, more like set unions. As shown in Figure 11:

- The abbreviation "mc" stands for micro.
- The symbol $\sum$ indicates summation of weightings/ratings, denoting the relative importance of the set members selected as relevant. Weightings as integers range in ascending importance from 1 to 10.
- The symbol $\underline{U}$ indicates sets union.
- The proposed HMMI enables the possibility to define *Project*/EAPs as a model; using CSFs weightings and ratings.
- The selected corresponding weightings to: CSF ϵ { 1 … 10 }; are integer values.

Figure 11. The applied mathematical model's nomenclature (Trad & Kalpić, 2017a)

AMM4BT

rncRequirement	= KP I	(1)
CSF	= Σ KPI	(2)
CSA	= Σ CSF	(3)
Requirement	= $\underline{\cup}$ rncRequirement	(4)
(e)neuron	= action+ rncInteligenceArtefact	(5)
mcArtefact	= $\underline{\cup}$ (e)neurons	(6)
rncEnterprise	= $\underline{\cup}$ mcArtefact	(7)
(e)Ellterprise	= $\underline{\cup}$ rncEnterprise	(8)
mcArtefactScenario	= $\underline{\cup}$ mcArtefactDecisionMaking	(9)
IntelligenceComponent	= $\underline{\cup}$ mcArtefactScenario	(10)
OrganisationalIntelligence	= $\underline{\cup}$ InteligenceComponent	(11)
AMM4BT	= ADM+ OrganisationalIntelligence	(12)

- The selected corresponding ratings to: CSF ϵ { 0.00% … 100.00% } are floating point percentage values.

The Applied Mathematical Model's Structure

A holistic HMMI's has a composite structure that can be viewed as follows:

- The static view has a similar static structure like the relational model's structure that includes sets of CSAs/CSFs that map to tables and the ability to create them and apply actions on these tables; in the case of HMMI they are microartefacts and not tables (Lockwood, 1999).
- In the behavioural view, these actions are designed using a set of mathematics nomenclature, the implementation of the HMMI is in the internal scripting language, used also to tune the CSFs (Lazar, Motogna & Parv, 2010).
- The skeleton of the *TKM&F* uses microartefacts' scenarios to support just-in-time *Project* requests.

Enterprise Architect as an Applied Mathematical Model

A generic EA model and its ADM are the kernel of this research and they are the basics of its *TKM&F*. The author wants to propose a mathematical model to represent the *Project*'s global architecture and solve its problems. The literature review has shown that existing research resources on EA, as a mathematical model, are practically inexistent. This pioneering research work is cross-functional and links all the *Project*'s microartefacts to *Project*s and EA (Agievich, 2014); where the main reasoning component is a qualitative engine that is based on heuristics.

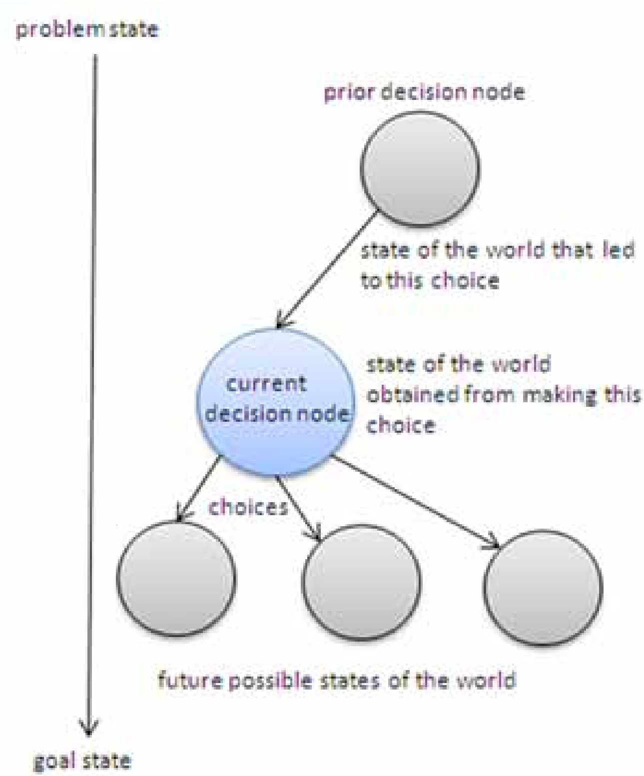
Heuristics and Action Research

The *Project*'s HMMI is based on a set of synchronized AMMs, where each AMM can launch a qualitative beam-search based heuristic processing (Kim & Kim, 1999; Della Croce & T'kindt, 2002).

. Weightings and ratings concept support the HMMI to find and select the optimal solution for a given *Project* problem. Actions research can be considered as a set of continuous beam-search heuristics processing phases and is similar to design and architecture processes, like the ADM (Järvinen, 2007). Fast changing *Project* client requests may provoke an important set of problems that can be hard to solve and makes the *Project* actions useless and complex to implement. The HMMI is responsible for the qualitative heuristic process for *Project*'s problem solving and synchronizes a set of AMMs which have also separate heuristics processes and are supported by a dynamic tree algorithm, as shown in Figure 12 (Nijboer, Morin, Carmien, Koene, Leon, & Hoffman, 2009) that manages tree nodes and their correlation with memorized patterns that are combinations of data states and heuristic goal functions. The AMM capacities are measured by analysing the *TKM&F's* AMM tree.

The AMM's concept is based on a holistic systemic approach to use all the *TKM&F's* components, being this chapter's main focus (Daellenbach & McNickle, 2005). Major research and advisory firms like Gartner, confirm that intelligence services will leverage business information systems' components from various enterprise activities and there are some simplistic attempts to deliver mathematical models for certain features of the information system (Kalimoldayev, Abdildayeva, Mamyrbayev, & Akhmetzhanov,

Figure 12. The applied heuristics tree algorithm (Nijboer, Morin, Carmien, Koene, Leon & Hoffman, 2009)



2016). Gartner confirms also that services are the dominating business enablers for Fortune 500 companies who need business intelligence support (Thomas, 2015; Clark, Fletcher, Hanson, Irani, Waterhouse & Thelin, 2013). The AMM's heuristics algorithm uses the microartefact as a UoW that is technically managed by TOGAF's ADM (The Open Group, 2011b); and is a detailed method and framework for the development of the AMM by using the choreography capacities. The AMM's building blocks are based on ML microartefacts that use a light version of the ADM (Trad & Kalpić, 2015c). This research proposal's approach is based on the simplification of the architecture as a holistic mathematical model, whereas TOGAF is too confused, complex and archaic. Nevertheless, TOGAF's ADM is a maturation of many previous models, like the Model Driven Architecture (MDA) and can be recommended to integrate a holistic DMS. Action-research based heuristics enables reflective practice that is the basis of a holistic approach to develop EAs where its kernel and skeleton are a dynamic DMS (Leitch & Day, 2006). Such a DMS is based on both qualitative and quantitative methods (Loginovskiy, Dranko, & Hollay, 2018).

Qualitative, Quantitative and the Notion of Time

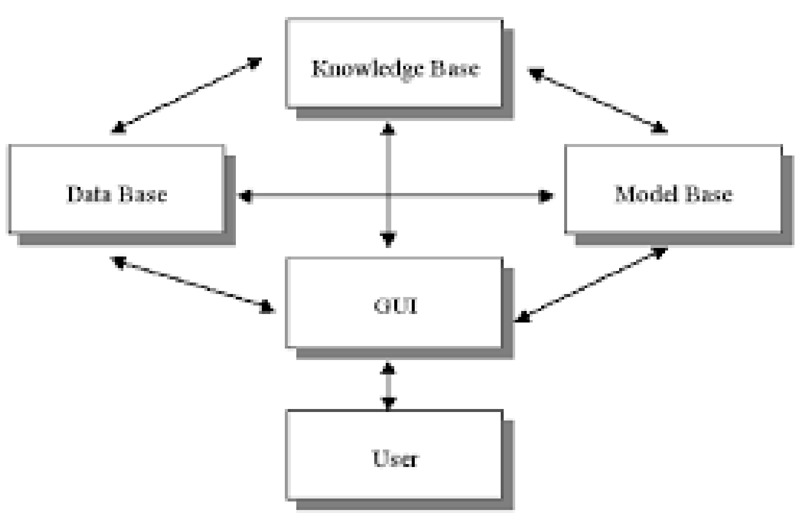
As already mentioned, the HMMI and its underlining set of AMMs is mainly a qualitative beam-search heuristic tree (Della Croce & T'kindt, 2002). In each of the tree's node a precise call to a quantitative function can be executed, by precision or objectivity the author refers to input data, constraint and above all a timestamp. These form the basis of an applied transformation mathematical model.

The Applied Transformation Mathematical Model

A holistic DMS is a part of the *TKM&F* that uses services to support just-in-time decision making. The DMS components and interfaces, as shown in Figure 13, are based on a light version of the ADM.

The transformation is the combination of an enterprise architecture methodology like TOGAF and the HMMI that can be modelled after the following formula for the Transformation Mathematical Model (TMM) that abstracts the *Project*:

Figure 13. The decision making system's just in time execution and its components



(HMMI):

$$AMM = Weigthing_1 * AMM\_Qualitative + Weigthing_2 * AMM\_Quantitative. \quad (1)$$

$$HMMI = \sum AMM \text{ for an enterprise architecture's instance.} \quad (2)$$

(TMM):

$$TMM = \sum HMMI \text{ instances.} \quad (3)$$

The objective function of the TMM's formula can be optimized by using constraints and with extra variables that need to be tuned using the HMMI. The variable for maximization or minimization can be, for example, the *Project* success, costs or other (Dantzig, 1949; Sankaralingam, Ferris, Nowatzki, Estan, Wood & Vaish, 2013). For this PoC the success will be the main and only constraint and success is quantified as a binary 0 or 1. Where the objective function definition will be:

$$\text{Minimize risk TMM.} \quad (4)$$

The HMMI is based on a concurrent and synchronized *TKM&F*, which uses concurrent threads that can make various AMMs run in parallel and manage information through the use of the HMMI's mathematical choreography/language. The TMM is the combination of an EA, *Project* methodologies and a holistic mathematical model that integrates the enterprise organisational concept, information and communication technologies that have to be formalized using a functional development environment.

Functional Development *TKM&F*

The *TKM&F's* internal functional development tool and its mathematical language can be used for various application domains and in general for hard systems' thinking. The author recommends the use of an interpretable scripting for building a DMS (Moore, 2014; North, 2010). The HMMI based DMS is business-driven and is founded on a genuine research framework that in turn is based on a ML to manage heuristics, enterprise architecture and information and communication artefacts (The Open Group, 2011a; Simonin, Bertin, Traon, Jezequel & Crespi, 2010). The complexity lies in how to integrate the HMMI and its programming ML in the enterprise's existing information and communication technology system.

The Mathematical Model's Critical Success Factors

Based on the literature review process, the most important mathematical model's CSFs that are used are evaluated to the following:

As shown in Table 1, the result's aim is to prove or justify that it is complex but possible to implement a mathematical model in the information system. The next CSA to be analysed is the holistic management of the ICS category.

Table 1. The critical success factors that have an average of 8.15

Critical Success Factors	KPIs	Weightings
CSF_MM_HolisicmEvolution	DifficultButImplementable	From 1 to 10. **6 Selected**
CSF_MM_Structure	Applicable	From 1 to 10. **10 Selected**
CSF_MM_CSA	Applicable	From 1 to 10. **10 Selected**
CSF_MM_Microartefacts	Applicable	From 1 to 10. **10 Selected**
CSF_MM_Architecture	DifficultButImplementable	From 1 to 10. **7 Selected**
CSF_MM_TransformationalModel	DifficultButImplementable	From 1 to 10. **7 Selected**
CSF_MM_FunctionalLanguage	Applicable	From 1 to 10. **10 Selected**

THE MATHEMATICAL MODEL'S INTEGRATION IN THE INFORMATION AND COMMUNICATION TECHNOLOGY SYSTEM

Today many technology standards exist, as shown in Figure 14, and their related tooling and development environments are supposed to support the iterative unbundling process of a traditional business and its information technology environments, through the execution of an agile process (Tidd & Bessant, 2009).

Development, Operations, Choreography and Maintenance

Actual architecture, modelling, development, operations, integration and transformation tools/environments are skeletons that should enclose various automated ML microartefacts building capabilities, needed in a holistic and unified implementation strategy for a *Project*. The *TKM&F* offers a high level interpreted ML environment, which includes the HMMI formalism that can be used to enable fast business transformation development, operations, integration and testing iterations and to support its implementation processes. Such a development environment must respect and adapt existing software implementation standards, as shown in Figure 14, and its main characteristics are (Kraisig, Rosélia, Welter, Haugg, Cargnin, Roos-Frantz, Sawicki, & Frantz, 2016):

- It uses the company's development environment(s) and does not alter any aspect of its global engineering.
- It offers mechanisms for the microartefacts' version management, deployment and testing.

The HMMI formalism is based on existing proven standard architectures that are based on service oriented architecture to support HMMI design process and choreography.

The Design First Approach

Defining a ML microartefact granularity and responsibility for a *Project* are a very complex undertaking in the holistic implementation of the *Project*. The design first approach supports the *TKM&F's* HMMI microartefacts design (Neumann, 2002). As shown in Figure 15, the HMMI based DMS offers an graphical user interface to manage the automated and auto-generated build and deploy formalism.

Figure 14. The existing design and implementation software standards

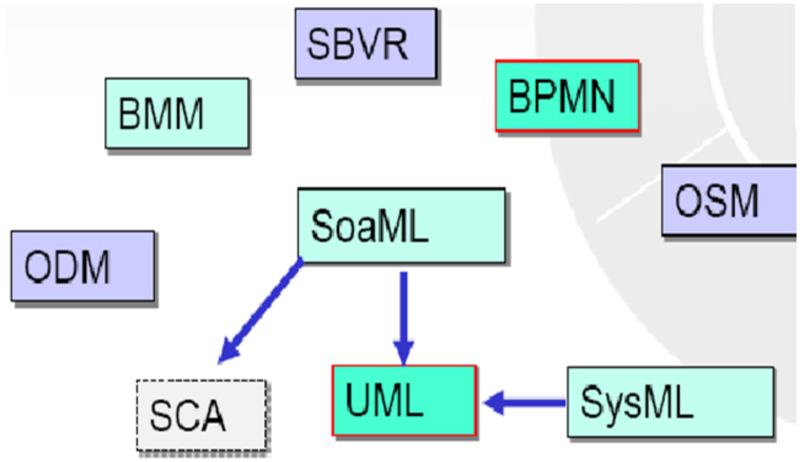
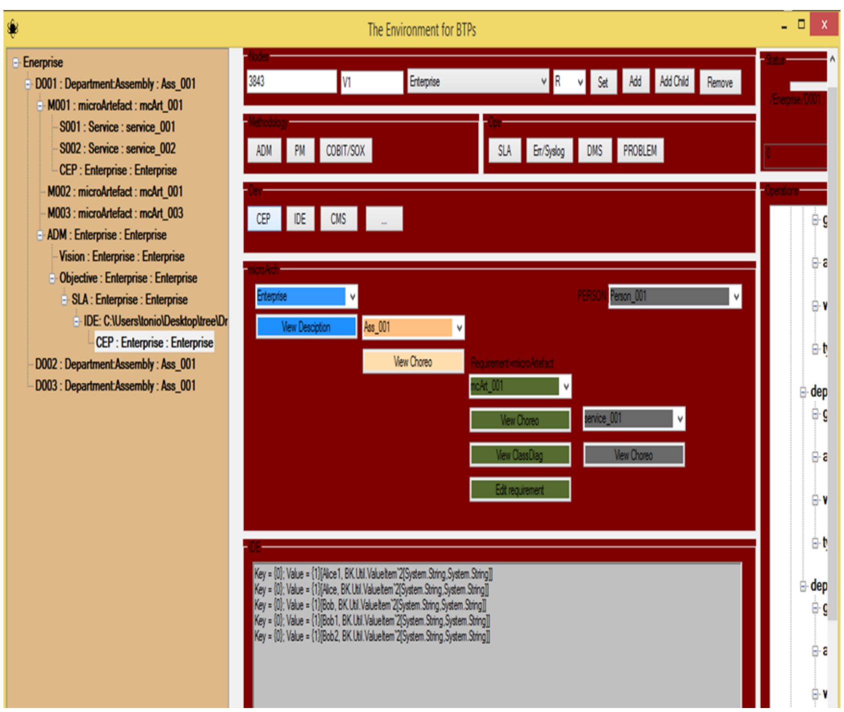


Figure 15. The graphical user interface for development and operation client interface



The HMMI formalism expresses a holistic structural concept or schema for the *Project*'s DMS's capabilities.

A Holistic Microartefacts Delivery Model

ML microartefacts' manipulation and its contained intelligence is in fact, a set of micro-actions that manage various business activities. The HMMI structure is used to generate ML microartefact instances and receives and evaluates change requests. The HMMI includes an ML to manage interaction with other *Project*'s microartefacts, as shown in Figure 16. The HMMI's concept is based on a holistic systemic approach to use all the *TKM&F's* ML microartefacts using an agile implementation process (Daellenbach & McNickle, 2005).

An Agile Implementation Process

In order to unbundle an existing enterprise environment and glue its legacy of newly innovated microartefacts, an adapted HMMI formalism is needed as shown in Figure 17. Using a mixed bottom-up approach.

Integration with Existing Rapid Application Development

HMMI needs a real world, technically agnostic, development tool like the enterprise's Rapid Application Development (RAD) environments; where RAD tools have been the ICS's obsession since the right beginning of programming techniques (Kraisig, Rosélia, Welter, Haugg, Cargnin, Roos-Frantz, Sawicki & Frantz, 2016). RAD tools and gadgets complicate the adoption of a holistic n-tier architecture.

Figure 16. The neural network tree processing component

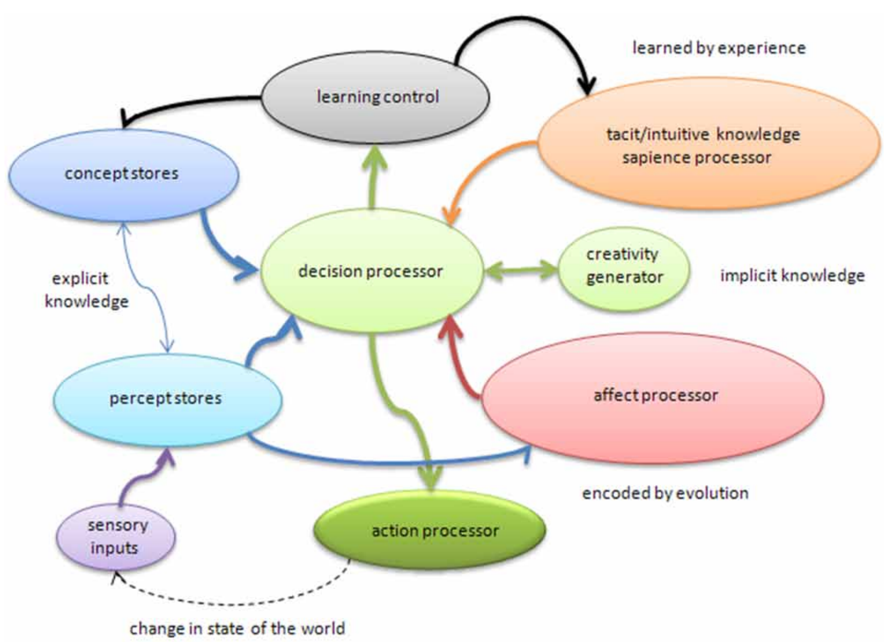
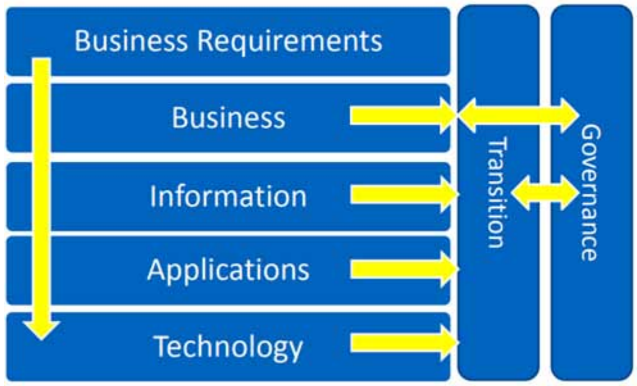


Figure 17. The information system's components



A Holistic n-tier Architecture

The integration of HMMI based DMS in the ICS, is the backbone of the future n-tiered decoupled business system (Loginovskiy, Dranko, & Hollay, 2018). An adaptable, tuneable and cross-functional HMMI formalism is important for the future of any business or information system and a holistic integration strategy has to be defined using a standardized methodology like TOGAF and its Archimate modelling environment (Vicente, Gama & Mira da Silva, 2013), as shown in Figure 18. The HMMI formalism fits in the ADM (Tripathy & Mishra, 2017; Greefhorst, 2009).

Architecture Development Method's Integration

The HMMI integration with the ADM, enables the automation and the auto-generation of the project's ML and other generic microartefacts. These microartefacts management scripts, circulate throughout all the ADM phases and in various iterations. (Vicente, Gama & Mira da Silva, 2013).

Figure 18. Archimate modelling environment (Greefhorst, 2009; Vicente, Gama & Mira da Silva, 2013)

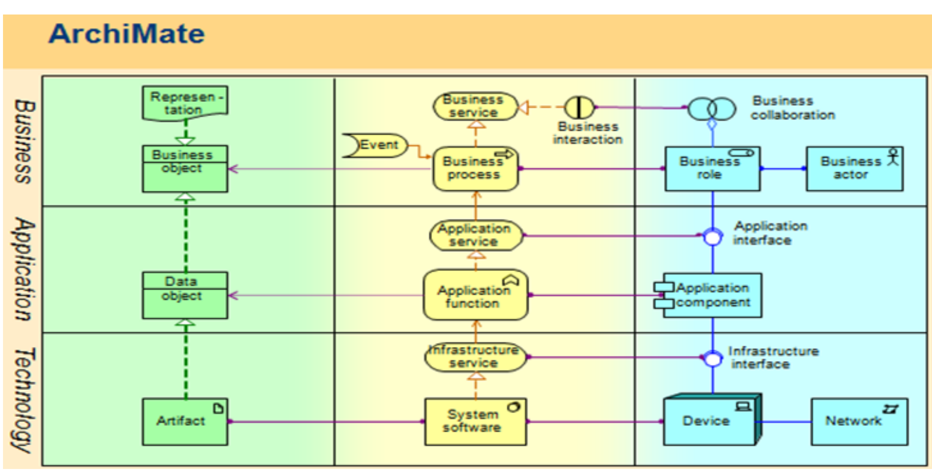
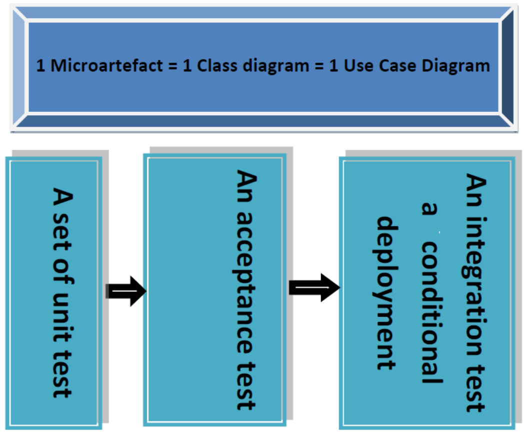


Figure 19. The TKM&F's global tests environment



Holistic Tests, Performance, Integration and Monitoring *TKM&F*

The major problem that causes a *Project* to be stopped or to fail, is the performance problem that in general in business enterprises is translated and justified by the human behavioural aspects; that is the major reason for the emergence of the saviour's new mirage, Microservices and astonishingly again with the same mammoth approach …

Figure 20. The decision making maturity evolution (Gartner, 2016)

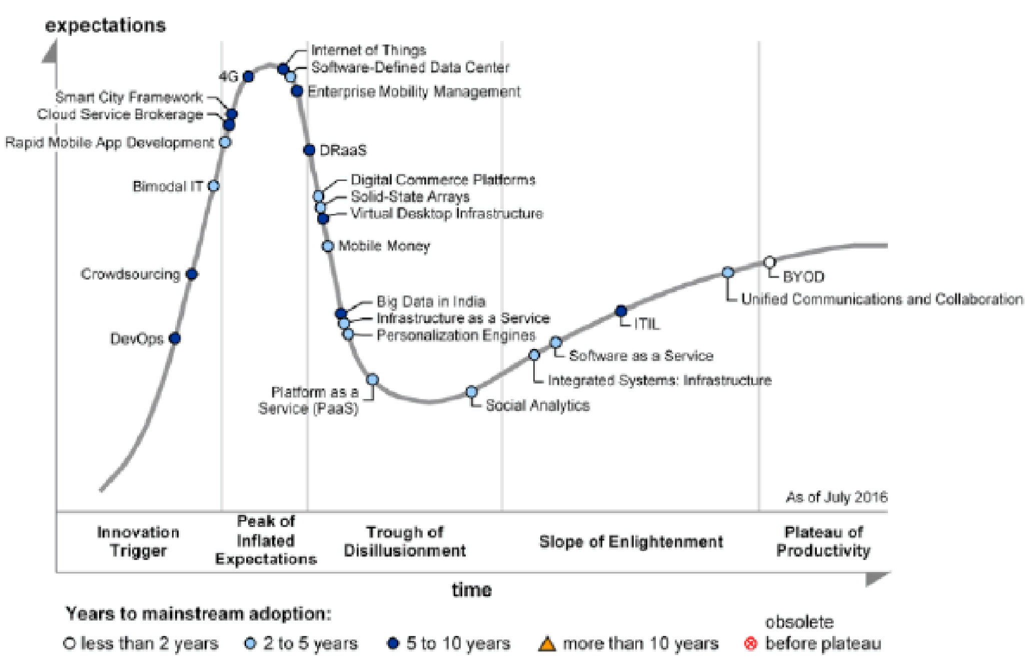


Figure 20 shows that actual immature development and operations for decision making systems is still in an infancy age and enterprises are losing a lot of energy on putting *Project*s together. RAD and hyper comfort natural implementation environments are still confronted with serious project issues. These problems show that RAD tool are still immature for large enterprise intelligent applications and hence *Project*s (Gartner, 2016), as shown in Figure 21.

The Mathematical Model's Integration in the Information and Communication Technology's Critical Success Factors

Based on the literature review process, the most important information and communication technology's CSFs that are used are evaluated to the following:

As shown in Table 2, the result tries to prove or justify that it is complex but possible to implement a mathematical model in the information and communication system. The next CSA to be analysed is the holistic management of the DMS category.

Figure 21. The modelling language environment structure

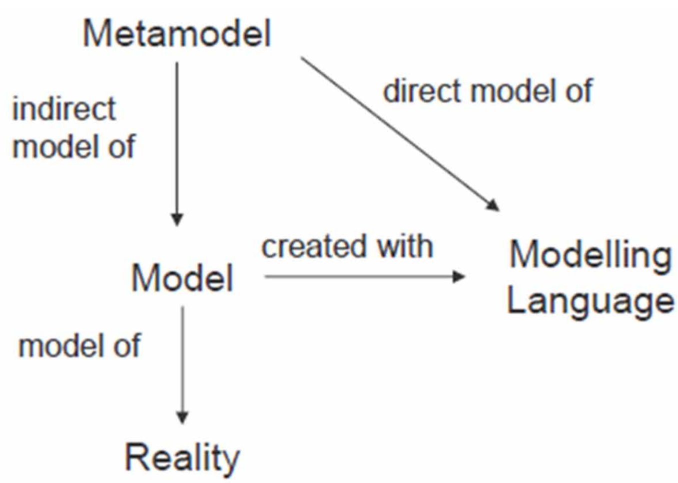


Table 2. The critical success factors that have an average of 7.15

Critical Success Factors	KPIs	Weightings
CSF_ICS_DevOps	Immature	From 1 to 10. **2 Selected**
CSF_ICS_DesignFirst	TooComplex	From 1 to 10. **6 Selected**
CSF_ICS_RAD	Ready	From 1 to 10. **9 Selected**
CSF_ICS_NTierArch	Applicable	From 1 to 10. **9 Selected**
CSF_ICS_ADM	Applicable	From 1 to 10. **9 Selected**
CSF_ICS_SysAdmin	TooComplex	From 1 to 10. **6 Selected**
CSF_ICS_Tests	Applicable	From 1 to 10. **9 Selected**

HOLISTIC MANAGEMENT OF THE DECISION MAKING SYSTEM

Complex Systems

Complex systems management can be adapted to the *Project*'s problems and requests by using HMMI based DMS (Daellenbach & McNickle, 2005). The *Project* requests are processed by using the *TKM&F's* HMMI, as shown in Figure 22 that in turn are based on the selected critical success areas and factors that can be used as a Knowledge Management System (KMS) which has a very complex system evolution nature.

Knowledge Management System

This research's *TKM&F's* relates and assembles the *Project*'s microartefacts and resources; it links them also to the KMS and automates the autonomic ML microartefacts' instances management in all of the ADM's phases (The Open Group, 2011a). The HMMI system has to identify the initial set of CSFs to be used in the KMS and DMS, as shown in Figure 23.

The Decision Making Process

The HMMI based DMS is managed by the *TKM&F*, where any *Project* user can configure the types of ML microartefacts and CSFs to be used; these ML microartefacts are orchestrated by the HMMI choreography engine. The HMMI based DMS' actions map to the various ISs mechanisms to deliver actions. The HMMI formalism is implemented in all of the *Project*'s processes and the implementation of microartefacts to deliver a DMS; such a set of actions can be modelled and managed by the HMMI that is implemented with an experiment or a proof of concept (The Open Group, 2011a; Trad & Kalpić, 2017a; Trad & Kalpić, 2017b; Trad & Kalpić, 2017c).

Figure 22. Complex system's nature and approach (Foresight Guide, 2017)

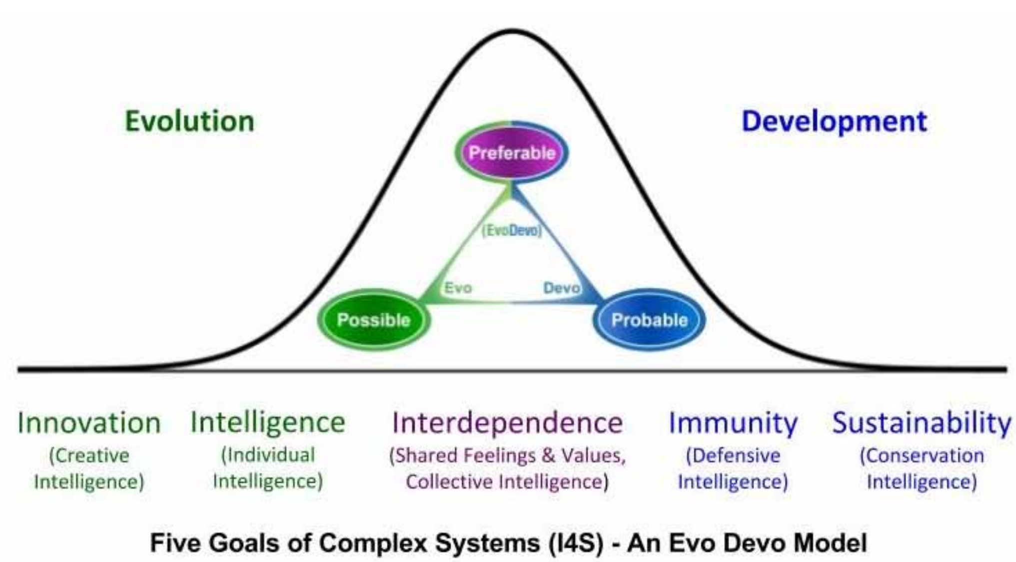
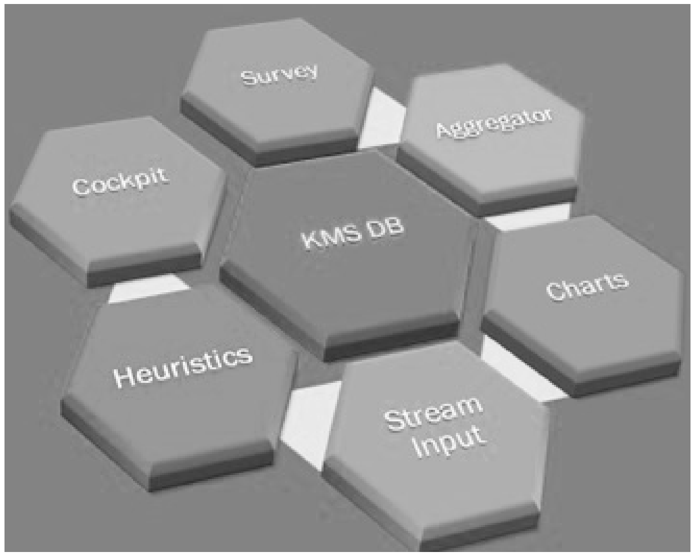


Figure 23. The knowledge management system



The Decision Making System's Critical Success Factors

Based on the literature review process, the most important decision making system's CSFs that are used are evaluated to the following:

As shown in Table 3, the result tries to prove or justify that it is complex but possible to implement a decision making system in the information system. The next step is the implementation phase.

THE RESEARCH'S IMPLEMENTATION

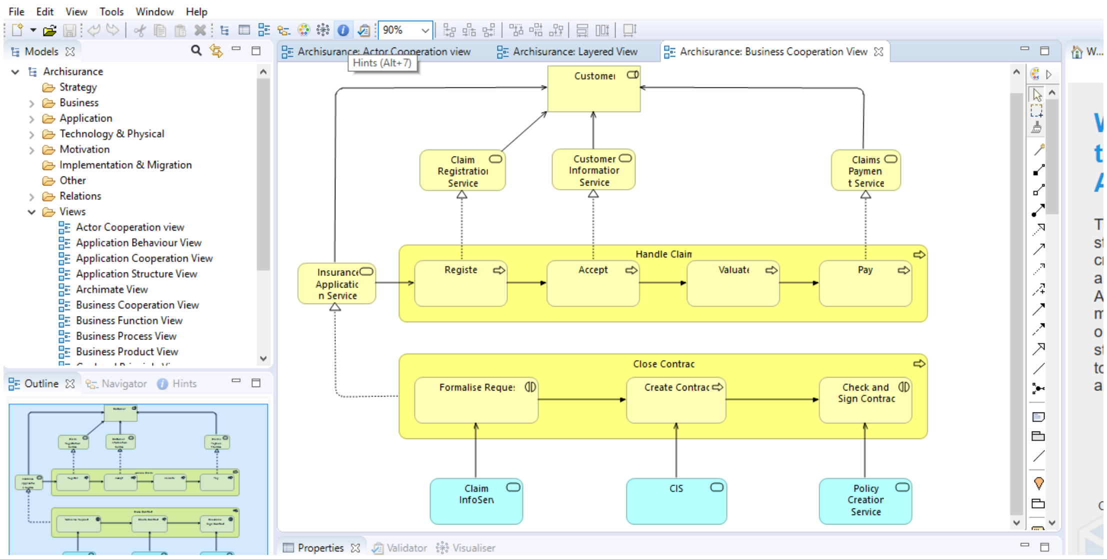
The Business Case

This PoC's implementation uses the default demo application named Handle Claim Process case study that comes with the Archi tool, as the experiment's business case. The demo application is an insurance claims management system that has a CRM System, a mainframe, claim files service, customer file service. The demo application manages, registers, accepts, valuates and invoices claims activities. The demo application uses the Archi Archimate modelling tool for the proof of concept, as shown in Figure 24 (Beauvoir & Sarrodie, 2018).

Table 3. The critical success factors that have an average of 9.7

Critical Success Factors	AHMM enhances: KPIs	Weightings
CSF_DMS_ComplexSystems	Support	From 1 to 10. **9 Selected**
CSF_DMS_KMS	Enables	From 1 to 10. **10 Selected**
CSF_DMS_DMP	Intgerates	From 1 to 10. **10 Selected**

Figure 24. Archi Archimate modelling tool, as shown in Figure 24 (Beauvoir & Sarrodie, 2018)



The Proof of Concept

The HMMI research experiment or Proof of Concept (PoC) was implemented using the research's cluster known as the *TKM&F* that had been developed by the author, using the Microsoft Visual Studio .NET, C/C++ and Java. The PoC is based on the HMMI based DMS and an internal set of CSFs' that are presented in Tables 1 to 3. These CSFs have bindings to specific research resources, where the HMMI formalism was designed using an ML microartefacts, object oriented and enterprise architecture methodologies and tools. The HMMI based DMS processing model represents the relationships between this research's requirements, project ML generic and microartefacts (or building blocks), unique identifiers and the three defined CSAs.

The proof of concept was achieved using the development environment and the research framework's, *TKM&F* client's interface that is shown in Figure 25. From the *TKM&F* client's interface the ML development setup and editing interface can be launched, as shown in Figure 26.

Once the development setup interface is activated the NLP interface can be launched to implement the needed microartefact scripts to process the defined three CSAs. These scripts make up the kernel knowledge system and the HMMI set of actions that are processed in the background. The HMMI uses a knowledge database that automatically generates decision making actions which make calls to DMS, that manages the edited mathematical language script and flow, as shown in Figure 27.

This research's instance of the HMMI and its related CSFs were selected as demonstrated previously, as shown in Figure 28.

In this article's three tables and the result of the processing of the DMS, as illustrated in Table 4, shows clearly that the HMMI is not an independent component and in fact it is strongly bonded to the *Project*'s overall risk architecture, hence has to have a holistic approach.

The *TKM&F* and hence the HMMI's main constraint is that CSAs for simple research components, having an average result below 8.5 will be ignored. In the case of the HMMI's holistic implementation

Figure 25. The TKM&F's client interaction

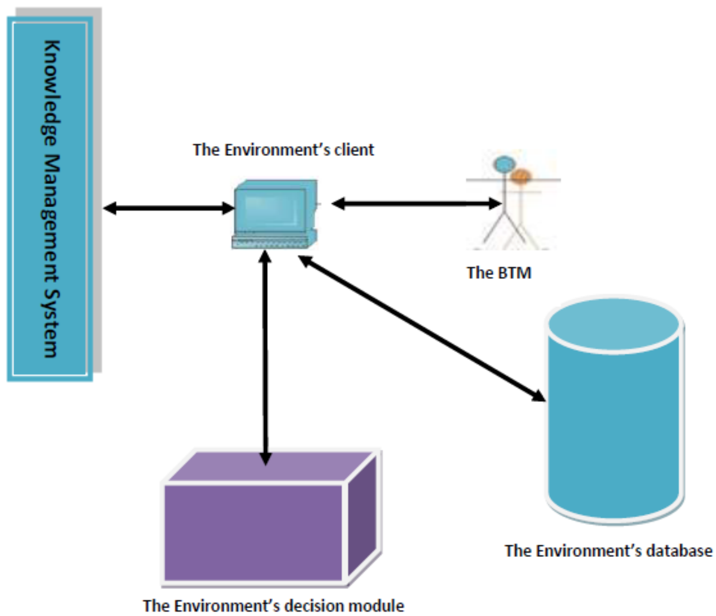
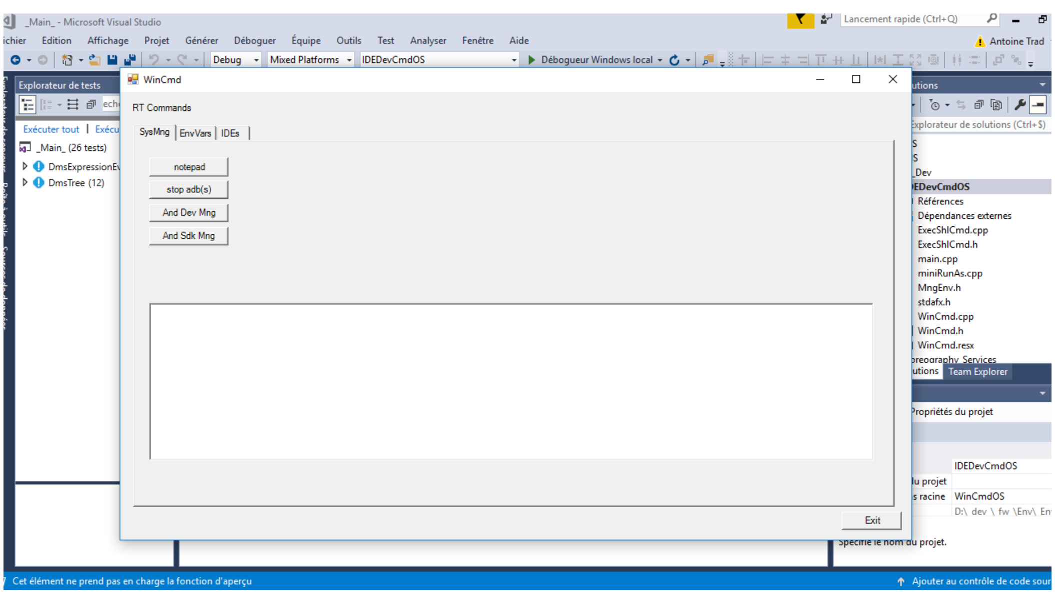


Figure 26. The TKM&F's development setup interface



an average result below 6.5 will be ignored. As shown in Table 4, this fact keeps the CSAs (marked in green) that helps to make this work's conclusion; and drops the ones in red. It means that such an HMMI formalism global integration will surely face difficulties and that the HMMI based transformation must be done in multiple transformation sub-projects, where the first one should try to transform the base enterprise systems, the information system and the decision making paradigm.

Figure 27. The edited mathematical language script and flow

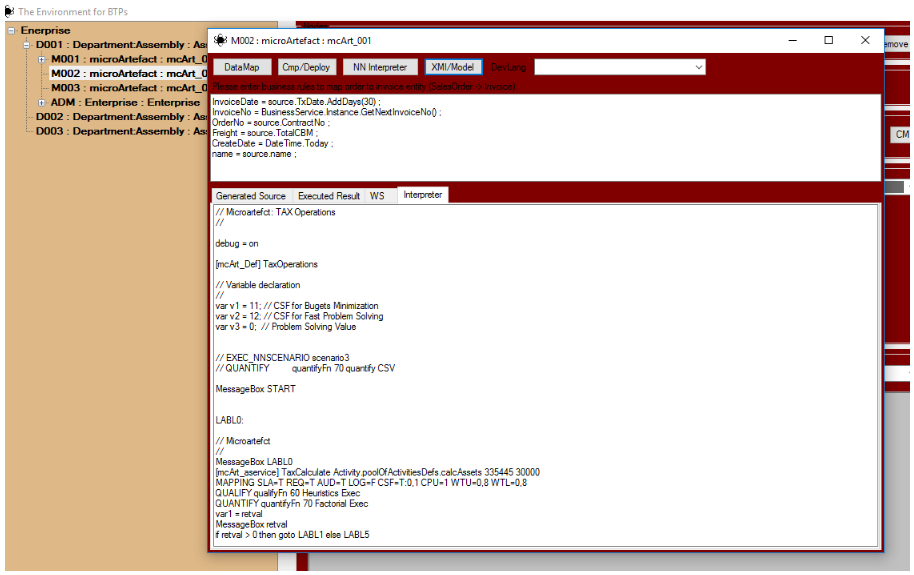


Figure 28. The heuristics tree configuration

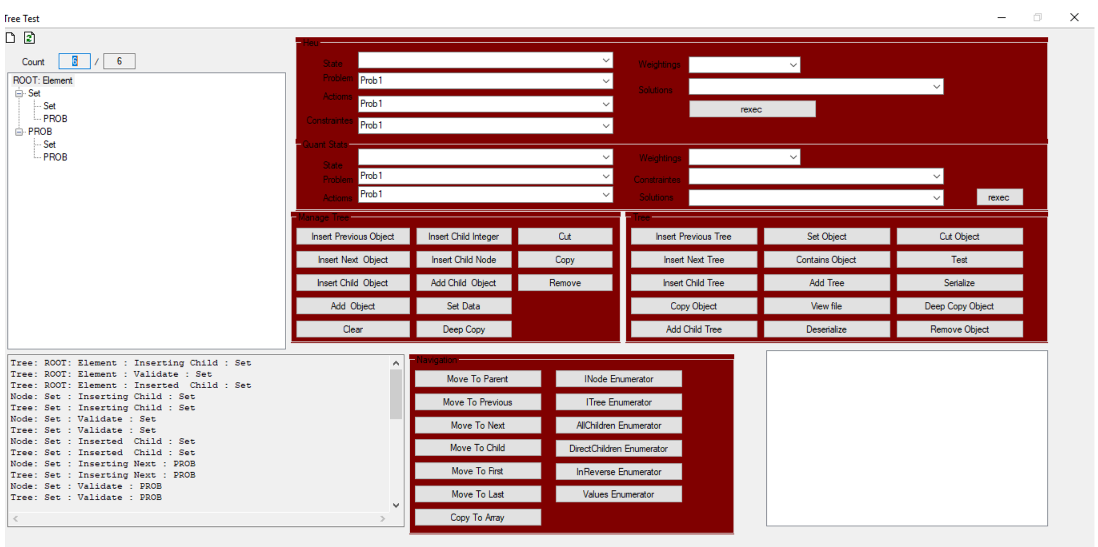


Table 4. The decision making management research's outcome

CSA Category of CSFs/KPIs	Influences IDDevOps management	Average Result
The Information and communication technology system	Built on silos/difficult to transform	From 1 to 10. 7.15
The mathematical model integration	Applicable	From 1 to 10. 8.15
The DMS	Implementable	From 1 to 10. 9.70

SOLUTION AND RECOMMENDATIONS

Table 4 shows that HMMI implementation is not a very risky and that a positive domain is the architecture and knowledge management; this research work and its PoC have fully achieved the defined objectives. The resultant technical and managerial recommendations are:

- EA methodologies improve the robustness of a distributed (or e-)business system by a *Project* and (e)transactions support (Tripathy & Mishra, 2017; Greefhorst, 2009).
- Unbundle the enterprise system to deliver the needed microartefacts library.
- Build an information system based on the HMMI-like concept.
- On top implement a DMS.

As shown in Figure 29, the HMMI instance is in all of the *Project*'s processes; such a set of CSF mapped actions; like the ones presented in this chapter's experiment or a proof of concept (The Open Group, 2011a; Trad & Kalpić, 2017a; Trad & Kalpić, 2017b; Trad & Kalpić, 2017c).

As shown in Figure 30, the HMMI is a part and is the skeleton of the *TKM&F* that uses microartefacts' scenarios to support just-in-time DMS requests. An instance of the HMMI is created at the *Project*'s initialization phase and takes care of the logical interaction of various elements. As mentioned and shown in Figure 30, if the aggregations of all the *Project*'s CSA/CSF tables exceeds the defined minimum, the *Project* continues to its PoC or can be used for problem solving using the heuristic algorithm with punctual calls to quantitative methods.

Figure 29. The proposed methodology and framework pyramid

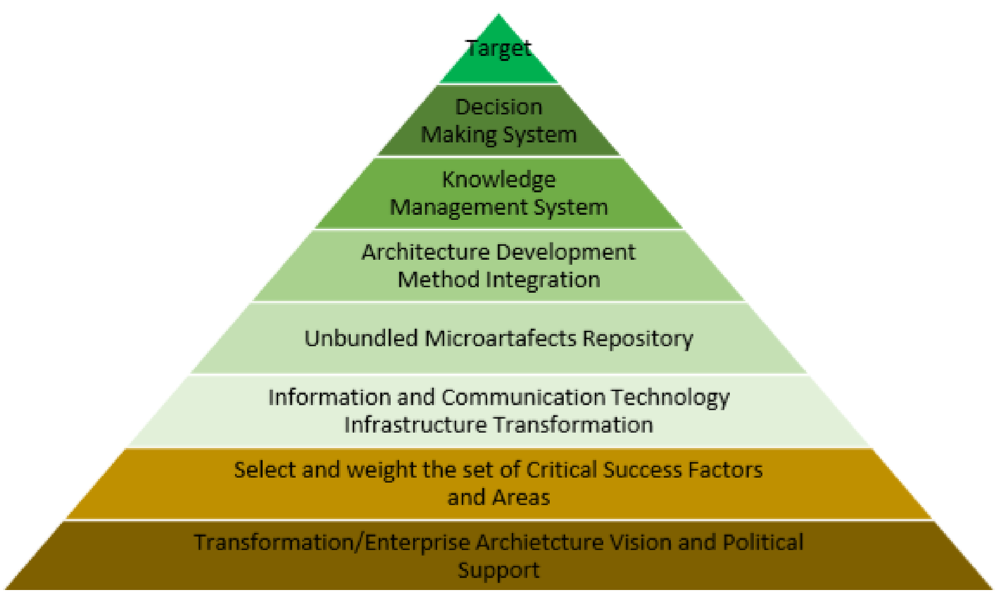
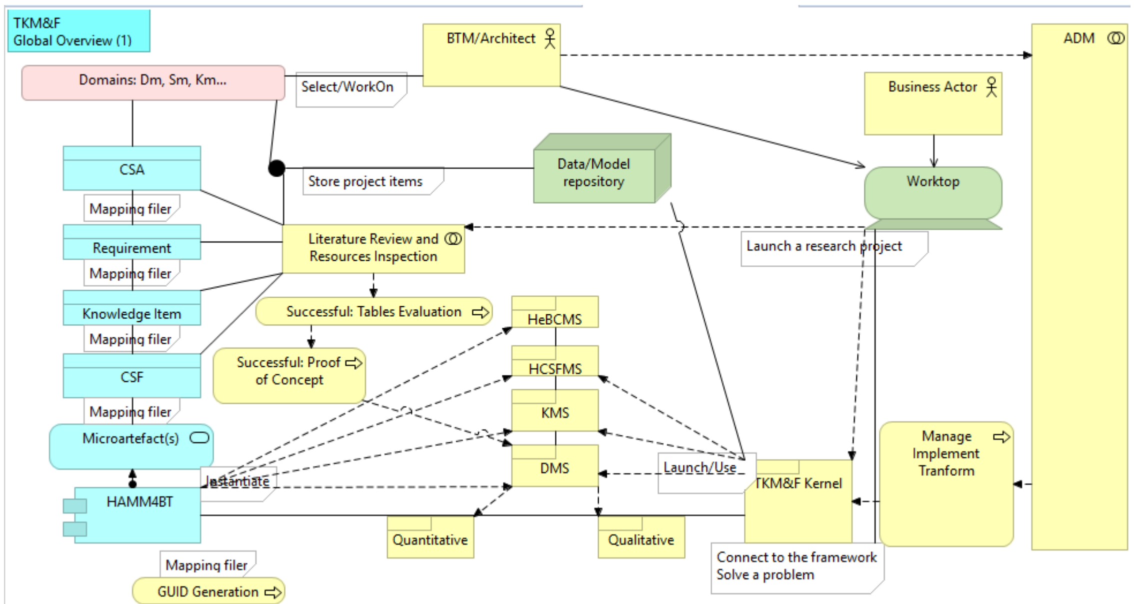


Figure 30. The framework's components and its mathematical model



FUTURE RESEARCH DIRECTIONS

The *TKM&F* future research efforts will focus on the holistic integration of the article's mentioned various fields to increase success of transformational initiatives in a cross-functional environment.

CONCLUSION

This research phase is part of a series of publications related to *Project*s, decision making systems and enterprise architectures. This research is based on mixed action research model; where critical success factors and areas are offered to help *Project* architects to diminish the chances of failure when building development and operation systems. In this article, the focus is on the HMMI's formalism that defines a structured inter-relationship of microartefacts decision making fields. HMMI decision making engineering concepts are an important factor for the business information system's evolution. The most important managerial recommendation that was generated by the previous research phases was that the business transformation manager must be an architect of adaptive business systems.

To avoid such a costly scenario, the author recommends performing the *Project* operations through multiple independent sub-projects, where the priority is to transform the information system, structure a mathematical model, decision making system and global architecture.

ACKNOWLEDGMENT

In a work as large as this research project, technical, typographical, grammatical, or other kinds of errors are bound to be present. Ultimately, all mistakes are the author's responsibility.

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KEY TERMS AND DEFINITIONS

HMMI: Holistic mathematical model.
Manager: Business transformation manager.
Project: Business transformation project.

Chapter 7
An Applied Mathematical Model for Business Transformation and Enterprise Architecture Projects:
The Holistic and Dynamic Knowledge Management System (H&DKMS)

ABSTRACT

This chapter presents the holistic and dynamic knowledge management system (H&DKMS) concept that is implemented in a proof of concept to prove the feasibility of the chapter using the book's HMM approach. The H&DKMS supports business transformation projects (BTP) and enterprise architecture projects (EAP) (simply project). The H&DKMS is supported mainly by an adopted fictious case from the insurance domain. The uniqueness of the proposed HMM promotes a holistic architecture and implementation model that supports complex case studies. The integrated knowledge management and decision-making process are used in a day-to-day business and technology problems solving. In this chapter, the proposed solution (or model) is supported by a real-life case of business transformation methodology in the domain of H&DKMS that in turn is based on the alignment of various standards and avant-garde methodologies.

INTRODUCTION

This book on transformation projects is a conclusion of many years of research and development that proposes a an Holistic Mathematical Model (HMM) and its influence on knowledge management integration (Trad & Kalpić, 2018a; Trad & Kalpić, 2018b). This chapter presents the HMM based knowledge management system that is the result of research on business case studies, business transformations, applied mathematics, software modelling, business engineering, financial analysis and global enterprise architecture. This chapter is based on an authentic and proprietary research method that is supported

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by an underlining mainly qualitative holistic reasoning model module (Trad & Kalpić, 2017a, 2017b, 2017c, 2017d; Gunasekare, 2015). The proposed HMM based knowledge management system presents an empirical process that is mainly based on the beam-search, like heuristic decision-making process that use a natural language environment that can be easily adopted by the project teams (Myers, Pane, & Ko, 2004; Kim & Kim, 1999; Della Croce & T'kindt, 2002). This chapter presents the Holistic & Dynamic Knowledge Management System (H&DKMS) concept that is implemented in a proof of concept to prove the feasibility of the chapter using the book's HMM approach. The H&DKMS supports Business Transformation Projects (BTP) and Enterprise Architecture Projects (EAP) (simply *Project*).

The H&DKMS is supported mainly by an adopted fictious case from the insurance domain (Jonkers, Band & Quartel, 2012a). The uniqueness of the proposed HMM promotes a holistic architecture and implementation model that supports complex case studies (Farhoomand, 2004). The integrated knowledge management and decision making process are used in a day to day business and technology problems solving. In this chapter the proposed solution (or model) is supported by a real-life case of business transformation methodology in the domain of H&DKMS that in turn is based on the alignment of various standards and avant-garde methodologies.

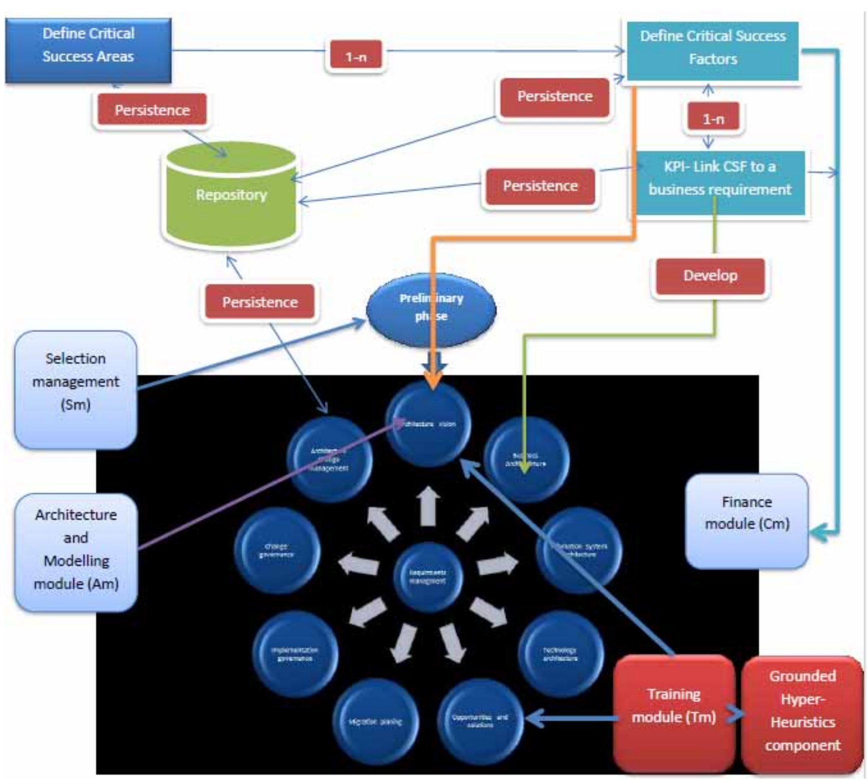
BACKGROUND

This chapter's background combines Knowledge Management (KM), applied mathematical model, enterprise architecture, heuristics/ mathematical models, technology management, business transformation and business engineering fields. Building a H&DKMS based on a Decision Making System (DMS) should be the major strategic goal for business companies (Trad & Kalpić, 2018a, 2018b), as shown in Figure 1 (Lanubile, Ebert, Prikladnicki, & Vizcaíno, 2010; Cearley, Walker, & Burke, 2016; Thomas, 2015).

Figure 1. Technology Trends (Cearley, Walker, Burke, 2016)

The proposed H&DKMS concept is: 1) holistic and cross-functional; 2) engineering and reasoning engine that contains basically Global Software Engineering (GSE) modelling techniques; 3) qualitative research methods that manage sets of factors; and 4) a framework that can be used by any type of *Project*. The authors based their Research and Development Project (RDP) method on intelligent neural networks driven development, where both methods resemble to the human empiric brain processing that is very much influenced by the authors' previous works and more specifically by the chapter related to the Knowledge and Intelligence Driven Development (KIDD) (Trad & Kalpić, 2018a). The H&DKMS concept is business and technology driven one and is agnostic to any specific application and business environment, as shown in Figure 2. The H&DKMS is founded on a unique research framework that in turn is based on the industry architecture standard, the Architecture Development Method (ADM) (The Open Group, 2011a). Enterprise Architecture (EA) is a methodology used to develop *Projects*, requirements, architecture, intelligence modules, knowledge modules and its technology software engineering components. The Business Transformation Manager (BTM) or an enterprise architect can integrate a H&DKMS in the global architecture and its underlying software modelling of a *Project* to support the DMS system (Trad & Kalpić, 2017b, 2017c; Thomas, 2015; Tidd, 2006). This H&DKMS proposal's goal is to deliver recommendations for managing aligned GSEs with synchronised KM and DMS. The applied research methodology is based on an extensive cross-functional literature review, a qualitative methodology and on a proof of concept for the proposed hypotheses. In a holistic knowledge management and software architecture, the *Manager*'s role is important and his or her (for simplicity, in further text – his) decisions are aided by using factors within the HMM subsystem. A large set of factors

Figure 2. The research framework's concept (Trad & Kalpić, 2016a)



can influence such an HMM, like: a) the role of the knowledge management subsystem; b) enterprise business critical success factors; c) enterprise budget and resources; d) DMS capabilities; e) audit and technological conditions; f) financial predispositions; and g) security, financial and legal control mechanisms using a collaborative tools for GSE (Lanubile, Ebert, Prikladnicki, Vizcaíno, & Vizcaino, 2010). A systems approach is the optimal choice to model such a H&DKMS (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a). In this chapter, many of the ACS resources are used to facilitate its reading. As shown in Figure 2, the decision model interacts with the external world via an implemented framework to manage the H&DKMS's factors and that is this chapter's focus.

Adapting simplistic agilization methodologies to the underlined islands of technologies is not enough and the main problem can arise due to the lack of company's holistic synchronized agility approach, that can be insured by the H&DKMS' Pattern that is this work's focus (Thomas, 2015; Cearley, Walker & Burke, 2016).

FOCUS OF THE ARTICLE

Developing and integrating *projects* using methodologies generate strategic and valuable knowledge and in order that knowledge creates value, it has to be architected and managed. The Trad Kalpić Methodology and Framework (*TKM&F)* enables the archiving and the reuse of *Project* experiences. Through its meta-model, it supports design and architecture of H&DKMS and offers recommendations on how to implement knowledge management in in the transformed enterprise (Meneses-Ortegon & Gonzalez, 2016). The H&DKMS offers a real-life case for detecting and processing an enterprise knowledge management model for global business transformation, knowledge management systems, global software engineering, global business engineering and enterprise architecture KM requests (Trad & Kalpić, 2018a; Trad & Kalpić, 2018b). This GSE subsystem is a design driven development model that offers a set of possible solutions in the form of architecture, method, patterns, managerial and technical knowledge item(s) (or recommendations), coupled with an applicable framework. The proposed academic, executive and technical recommendations are to be applied by the business environment's knowledge officers, architects, analysts and engineers to enable solutions to knowledge-based global software engineering paradigms' development and maintenance. Actual archaic KMs are managed as separate black-boxes that are isolated silos where their internal and external components create a messy hairball that is called the enterprise's Information and Communication Systems (ICS) (Desmond, 2013). The H&DKMS can be used to present the feasibility of the implementation of the HMM for *Project*s in a variety of application fields, like: 1) *Projects*; 2) business engineering projects; 3) enterprise architecture; and 4) other ... This book chapter's authors based their research model mainly on intelligent neural networks which can execute specific calls to quantitative modules and is supported by ICS driven development models, where both disciplines, applied mathematics and ICS models are complementary, due to the use of many existing industry standards, like for example the ADM (The Open Group, 2011a; Tidd & Bessant, 2009). The HMM holistic concept is mainly business driven and is agnostic to a specific business environment's technical internals. As shown in Figure 1, it has been decided by the authors that this genuine research framework should be founded on artificial intelligent artefacts that in turn are based on existing technology standards (Johnson & Onwuegbuzie, 2004). The *Manager* or an enterprise architect can integrate an HMM based DMS in the H&DKMS to support recommendations (Trad & Kalpić, 2017b, 2017c, 2018a, 2018b; Tidd, 2006). To achieve this precise goal, the applied research methodology applied in this book's chapter is based on a mixed methodology (Easterbrook, Singer, Storey, & Damian, 2008). For a successful integration of the H&DKMS, the *Project's* team's role is crucial to select and evaluate the right Critical Success Factors (CSF) that are essential for the *Project's* implementation. Selecting a huge set of possible CSFs, can negatively influence such *Project*s. A holistic system approach is the optimal choice to implement an H&DKMS (Simonin, Bertin, Traon, Jezequel & Crespi 2010; Daellenbach & McNickle, 2005; Trad & Kalpić, 2017d). The proposed framework interacts with business users by means of a graphical user interface in order to manage the CSFs and launch the reasoning process. Building an H&DKMS based PoC and the related set of heterogeneous project modules can be very complex and problematic; the main problem can arise due to the H&DKMS's technical complexity, based on a jungle of used gadgets. The current book's chapters try to prove, using a H&DKMS, the credibility of the chapter's Research Question (RQ).

THE RESEARCH PROCESS

This research is a pioneering work in the field and it tries to link the Mathematical Model (MM) to all levels of the *Project* and to the underlying infrastructure and qualification by using a H&DKMS (Trad & Kalpić, 2018a, 2018b; Agievich, 2014). This is achieved by using a H&DKMS that is based on the RDP's case study. *Projects* are very risky and have a very high failure rate and one of the concrete reasons is that these projects lack a cross-functional and holistic coordination. That is why the authors would like to contribute to enhance the success rate of such projects by presented a methodology, framework and related factors (Tidd & Bessant, 2018).

Critical Success Areas, Factors and Knowledge Management

Critical Success Area (CSA) is a set of Critical Success Factors (CSF) where the CSF is a set of Key Performance Indicators (KPI), where each KPI corresponds to a single *Project* requirement and/or knowledge feature. For a given problem, an enterprise architect can identify the initial set of CSFs for the H&DKMS. Hence the CSFs are important for the mapping between the knowledge constructs, organisational items (Peterson, 2011). Therefore, CSFs reflect performance areas that must meet strategic BTP goals and defined constraints. Measurements are used to evaluate performance in each of the CSA sets, where CSFs can be internal or external to the environment; like: 1) knowledge item or gap analysis is an internal CSF; and 2) decisions making in real time and in minimal time is also an internal one. Once the initial set of CSFs has been identified, then the BTP can use the H&DKMS to propose a knowledge item. The proposed H&DKMS delivers a set of knowledge items, recommendations and solutions for an aligned architecture that is part of the *TKM&F* (Trad & Kalpić, 2018a, 2017b, 2017c).

The Applied Research Framework

The KMS defines an alignment strategy of the *Project* knowledge that should manage and enrich the enterprise's knowledge storage libraries that are modelled by the ADM (Lankhorst, 2009; Trad & Kalpić, 2018d, 2018e). The used HMM can be applied to various types of *Projects* and other general projects and the KMS is a part of the Knowledge management module (Km) and the Decision module

(Dm), that in turn are parts of the research framework. In this book's chapter, the authors propose a set of KMS managerial and technical recommendations on how a reusable real-world framework should be implemented in form of a PoC (Trad 2018a, 2018b, 2018c, 2018d).

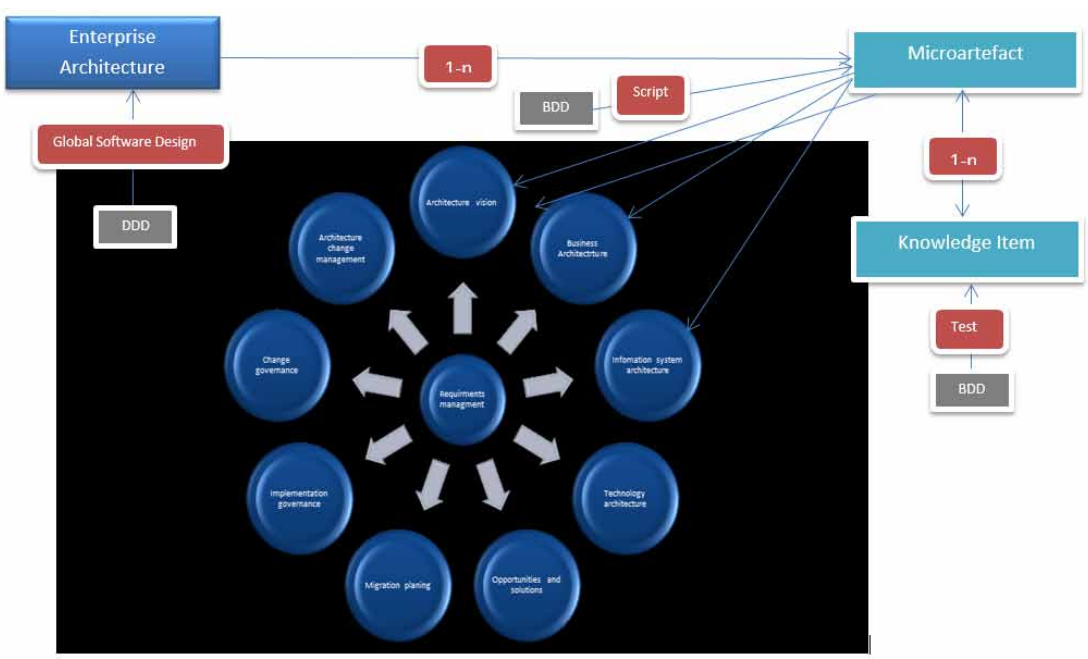
This chapter and the resultant experiment are also a part of the Selection management, Architecture-modelling, Control-monitoring, Decision-making, Training management, Project management, Finance management, Geopolitical management, Knowledge management, Implementation management and Research management Framework (SmAmCmDmTmPmFmGmKmImRmF, for simplification reasons, in further text the term *TKM&F* will be used). The Trad Kalpić Methodology & Framework (*TKM&F*) is not a black-box product to be applied as-is, it is rather an enterprise architecture strategy, recommendations and vision that each enterprise should implement by itself. This book's chapter's RQ is: "Can a holistic and dynamic knowledge management system be used to support the implementation of decision making systems', business transformation projects' and enterprise architecture projects' future components?".

A common holistic objective of this book on business transformation and enterprise architecture projects in these domains is to deliver solution patterns and recommendations by proposing a real world framework named the *TKM&F*, after the authors who own the totality of copyright; where for this book IGI Global holds the copyright, and these two objects are distinct and different. This RQ was formulated after an extensive literature review.

The Research's Literature Review

The outcome is that very little scholar or even general literature and research resources exist on the selected subject. The authors consider their work as a pioneering one; the most relevant H&DKMS information found in literature was that there is a gap, between *Projects* and H&DKMSs (Syynimaa, 2015). In the

Figure 3. The implementation environment that enables knowledge management



RDP and in all its related artefacts, the authors use many of their own referenced and accepted works, because, they consider that this (or these) topics are somehow ignored and not sufficiently researched; and that their work is an original pioneering work that is based mainly on empirical engineering disciplines.

Empirical Engineering Research Model

This research book's chapter is based on an empirical engineering research approach (Johnson & Onwuegbuzie, 2004; Easterbrook, Singer, Storey, & Damian, 2008). It uses an authentic mixed method (where mixed research is a simplistic synonym) that can be considered as a natural complement to conventional qualitative and quantitative research methodologies, to deliver empirical pragmatism concepts as a possible holistic approach for mixed methods research. Empirical validity checks if the research work is acceptable as a contribution to existing scientific knowledge, this book's chapter's researchers want to convince the valuable readers that this book's chapter's recommendations and the related PoC are valid. A controlled experiment or a PoC is a software prototype of a testable hypothesis where one or more CSFs (or independent variables) are processed to evaluate their influence on the model's dependent variables. Controlled experiments or proof of concepts permit to evaluate with precision the CSFs and if they are related, whether the cause–effect relationship exists between these CSFs. The H&DKMS is business-driven and is founded on a research framework that is presented using a business case (The Open Group, 2011a).

Review's Critical Success Factors

The *Projects* starts with the first phase called the feasibility phase to check if the whole *Project* makes sense. Based on the HKMs literature review and related evaluation activities, the most important extracted CSFs that are used and evaluated using the following rules:

- References should be credible and are estimated by the authors; the notions of official ranking is less important and ignored, because of the fact that ego-concentration of lobbying of closed circles of influence; we often the same institutions and individuals. By references it is meant the origins found in various types of literature and other CSF related resources, while the credibility of these references is estimated by Key Performance Indicators (KPI) that is related to requirements: 1) the authors' academic and professional experiences that adds to 20% of the whole estimation value; 2) statistical checkers like Gartner, Forester and others, that is 20% of the whole estimation value; 3) various company's and specialists surveying that is 20% of the whole estimation value; 4) CSF related code/application sources' [2]prototyping that is 20% of the whole estimation value; and 5) simulation in the PoC and frequency that is 20% of the whole estimation value.
- *Projects* like mergers are the result of organisational changes in companies to act as a single enterprise with consolidated resources and business interests; and its success is measured by the CSFs valuation, hence the literature references presented in the previous point.
- Applied modelling language should be limited in order to make the *Project* manageable and not too complex. Whether it is usable can be estimated from literature review or from own working experience or firm references like Gartner.

- The ADM is considered to be mature and it has been in use for more than ten years and that it has been reported as successful; the interest in using TOGAF is very high and its ADM kernel is about 90% (Alm & Wissotzki, 2015; Kotusev, 2018). Unfortunately that does not mean that *Projects* are successful and in fact their success rate is very low, serious publications present less than 10% success rate (Mintzberg, 1994).
- The ADM is appropriate for any project's local conditions and manages the *TKM&F's* iterations.
- If the aggregations of all the *Project's* CSA/CSF tables is positive and exceeds the defined minimum the *Project* continues to its PoC or can be used for problem solving.

The main reason that methodologies are not used in a holistic manner to achieve organizational alignment, centralized DMS and KMS (Syynimaa, 2015). This work is based on empirical engineering models.

Research Works

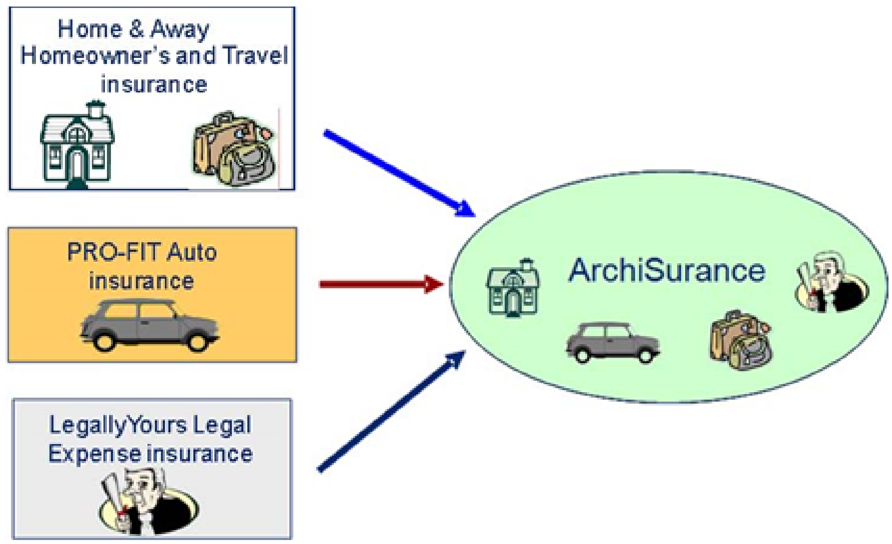
This research book's chapter like all other research works that are the related to this RDP follow and have the same construct that looks as follows:

- An introductory part that explains the overall subject.
- The R&D part that explains the research concept.
- The Applied Case Study (ACS) and PoC (Trad & Kalpić, 2018c) parts that specifies the specific business topic to be researched.
- The Information and Communication System (ICS), ADM, KMS, DMS and CSF parts that present these sections in the work's specific RQ context.
- A specialized part, like in this case the H&DKMS' section that presents the literature review and synthesis of the main topic.
- Each table contains a table of selected and weighted CSFs.
- The PoC, conclusion and recommendations that summarizes and concludes the research work.
- This book's Resource Management System cluster, found in Part V.

THE BUSINESS CASE AND BUSINESS ENGINEERING

H&DKMS is a fictitious ACS that has been developed by the Open Group as a reference study and that is why the authors have decided to use it. The Open Group's ACS presents the possibilities to implement *Project*s; using ArchiMate its modelling language. The H&DKMS is related to and insurance company named ArchiSurance. ArchiSurance resulted from the merger of three independent insurance enterprises. H&DKMS describes the *Project* and a set of transformation scenarios. This H&DKMS is used throughout the book's chapters as the basis of a PoC. This Book's H&DKMS illustrates the realistic use of the ArchiMate in the context of The Open Group's Architecture Framework's (TOGAF). The H&DKMS concerns the insurance company ArchiSurance that is the result of a merger of three previously independent companies based in different metropolitan areas (Trad & Kalpić, 2018c). The case uses an architecture modelling environment and language.

Figure 4. The result of a merger of three insurance companies (Jonkers, Band & Quartel, 2012)



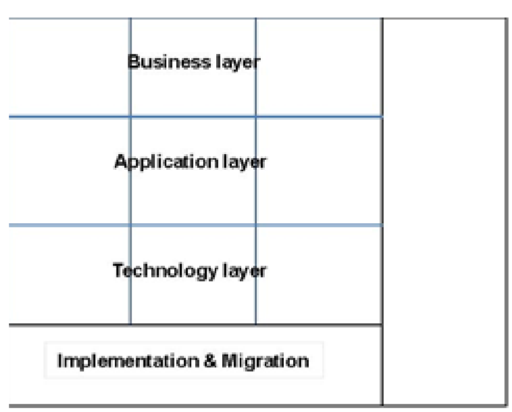
The Architecture Modelling Language

Figure 5., shows architecture modelling language, like ArchiMate, layers of intervention and it provides a standardized representation for *Project* models to support development cycles (Beauvoir & Sarrodie, 2018). It understands core language that can be used to describe the actual situation (business, information systems, and technology architectures, as well as their mapping-relationships) that are used in the ADM.

The Architecture Development Method

This RDP focuses on the design of transformations and EA models that support H&DKMS' integration that was mainly motivated by the many failure rates as well as the lack of credible sources for *Projects'* H&DKMS integration. This RDP presents that the influence of ICS's infrastructure does not assure a

Figure 5. The ArchiMate levels of usage (Jonkers, Band & Quartel, 2012)



successful implementation of a KMS, therefore there is a need for a holistic approach to implement a KMS. In the actual age of intelligence, knowledge, economy and technology; there is a need for a dynamic H&DKMS, and for management of corporate intellectual assets. The implementation of a H&DKMS using ICS is one of this most important CSF that can influence the enterprise's business sustainability (Lusa & Sensuse, 2011). Figure 6, shows the ADM's most important phases that can be used to define viewpoints and communicate different characteristics of a *Project* model. The ADM implements *Project* architectures, while ArchiMate focuses on a language to implement KMS and generic microartefacts (The Open Group, 2011a; The Open Group, 2011b).

Figure 7, shows how the architecture core language is linked to the ADM that can be used to define *Projects'* and H&DKMS' viewpoints and their ability to communicate the different characteristics of a *Project* model.

At the beginning of a *Project*, the ADM's Preliminary Phase defines the main motivational context of the probable H&DKMS challenges.

The Business Case Study's Critical Success Factors

Based on the literature review process, the most important business case's CSFs that are used and evaluated.

As shown in Table 1, the result's aim is to prove or justify the H&DKMS' business case that is based on the global *Project's* ACS and how it can be used with a modelling language for a proof evaluating of *Project'*s H&DKMS. The next CSA to be analysed is the holistic MM's integration.

The Research Section's Link to the Applied Mathematical Model

This section's deduction is that the applied mathematical model is crucial for the RDP's credibility, where it is the basis for its EA structure.

Figure 6. The architecture development methods' phases (Jonkers, Band & Quartel, 2012)

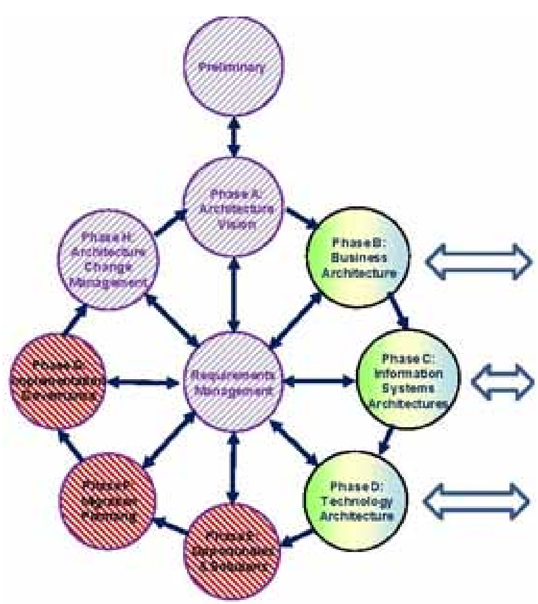


Figure 7. The ArchiMate and methods interaction (Jonkers, Band & Quartel, 2012)

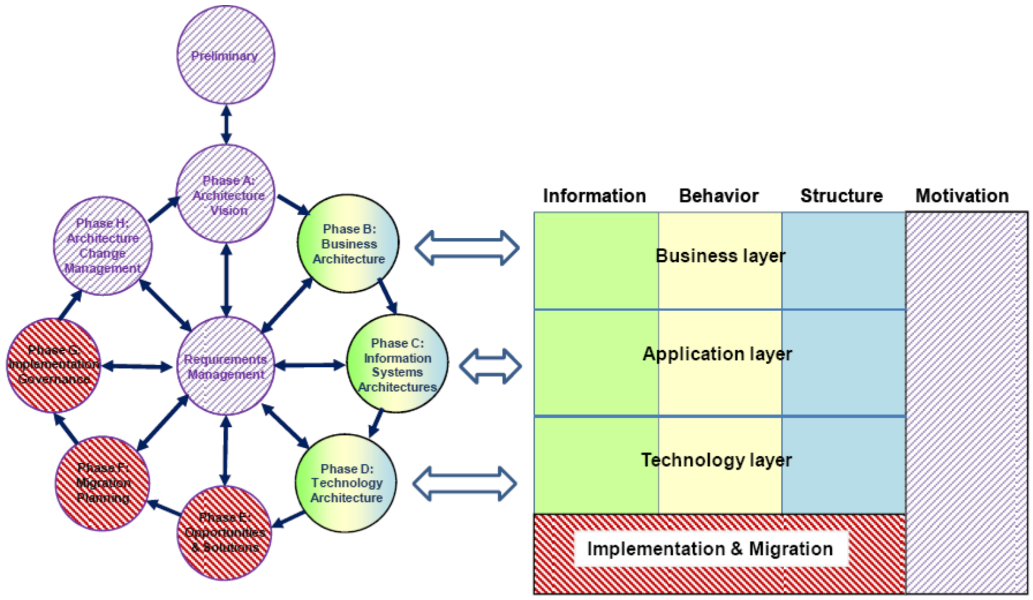


Figure 8. The architecture development method's phases (Visual Paradigm, 2019)

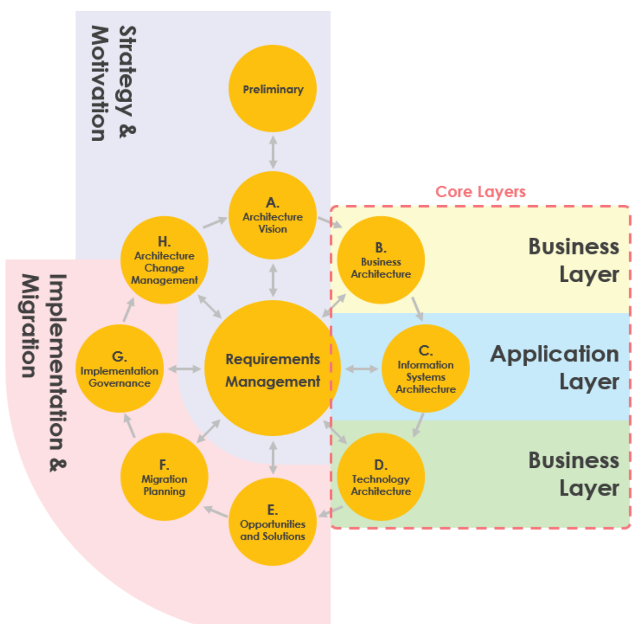


Table 1. The applied case study's critical success factors that have an average of 9.50

Critical Success Factors	KPIs	Weightings
CSF_BusinessCase_References	Credible_ACS_Related	From 1 to 10. 10 **Selected**
CSF_BusinessCase_Merger	Successful_Done	From 1 to 10. **10 Selected**
CSF_BusinessCase_ModellingLanguage	Limited_Integrated	From 1 to 10. 9 **Selected**
CSF_BusinessCase_ArchitectureDevelopmentMethod	Integrated	From 1 to 10. 9 **Selected**

THE APPLIED MATHEMATICAL MODEL'S USAGE

The Model's Basics

The *Project* and the underlying H&DKMS have a major precondition and that is, that the traditional business environment has to undergo a total and successful unbundling process of the whole environment's services and scenarios The RDP offers a mathematical model, the HMM that is an abstract model containing a Mathematical Language (ML) that can be used to describe, transform and implement the behaviour of any business system and its H&DKMS (Goikoetxea, 2004). The HMM that is presented in Figure 9, to the reader in a simplified form, to be easily understood on the cost of a holistic exact formulation of the architecture's vision.

As shown in Figure 9, the sum symbol $\sum$ indicates summation of all the relevant elements called set members. The proposed model should be understood in a broader sense, more like related sets and unions. The proposed HMM enables the possibility to define *Project*s as a model; using CSFs weightings and ratings.

The selected corresponding weightings to: CSF ϵ { 1 … 10 }; are integer values.

Figure 9. The applied mathematical model's nomenclature (Trad, & Kalpić, 2017a)

AMM

mcRequirement	= KPI	(1)
CSF	= $\sum$ KPI	(2)
CSA	= $\sum$ CSF	(3)
Requirement	= $\sum$ mcRequirement	(4)
(e)neuron	= action + mcIntelligenceArtefact	(5)
mcArtefact	= $\sum$ (e)neurons	(6)
mcEnterprise	= $\sum$ mcArtefact	(7)
(e)Enterprise	= $\sum$ mcEnterprise	(8)
mcArtefactScenario	= $\sum$ mcArtefactDecisionMaking	(9)
IntelligenceComponent	= $\sum$ mcArtefactScenario	(10)
OrganisationalIntelligence	= $\sum$ IntelligenceComponent	(11)
AMM	= ADM + OrganisationalIntelligence	(12)

The selected corresponding ratings to: CSF ϵ { 0.00% … 100.00% } are as floating point percentage values.

A weighting is defined for a CSF and a rating for a KPI.

A Quantitative-Qualitative Research Mixed Model

Quantitative Research Model

The *TKM&F* qualitative research module enables a holistic systematic approach to researching a problem, RQ, factor or phenomenon in given *Project* environment situation (Gast, 2010). It offers an RDP capacities to recommend actions and solutions (Lincoln & Guba, 1985). A problem, RQ, factor or phenomenon are examined in iterations relating breadth and depth, using heuristics/beam search, which is specialized for unknown problems or the ones are in a preliminary phase or first iterations (Babbie, 1989). The solutions or recommendations are offered in the form of reports of professional or academic experiences (Capaldi & Procter, 2005). The qualitative research module processed solutions or recommendations are generated by experiments/PoCs, specialists interviews, direct professional observations, processing and analysis of *Project* artifacts, credible documents from for example Gartner or Forster and reference records, visual materials or personal mixed experiences (Denzin & Lincoln, 1994). The solutions or recommendations are delivered with the aim of formulating hypotheses outcomes.

Qualitative Research Model

The *TKM&F* qualitative research module enables a specific quantitative analysis and a precise focus on proving or disproving RQ, problem or hypotheses in a cause-effect manner by applying a detailed and precise processing of pre-defined variables; CSFs in the RDP (Shuttleworth, 2008). The *TKM&F* qualitative research module input data streams(s) consists of sets of numbers that are collected from sets generated by using designed/structured and approved/validated data object-collection modules and statistically processes. The *TKM&F* qualitative research module results are used to generalizade for a given qualitative node and can be applied to other qualitative tree node that gives the ability to analyse the cause and effect; as well as offering solutions or recommendations, even make proactive estimations (Leung, 2015). The *TKM&F* qualitative research module input data streams(s) can be fed from experiments/PoCs, surveys, interviews with precise questions (Kelley & Clark, 2003).

The Applied Transformation Mathematical Model

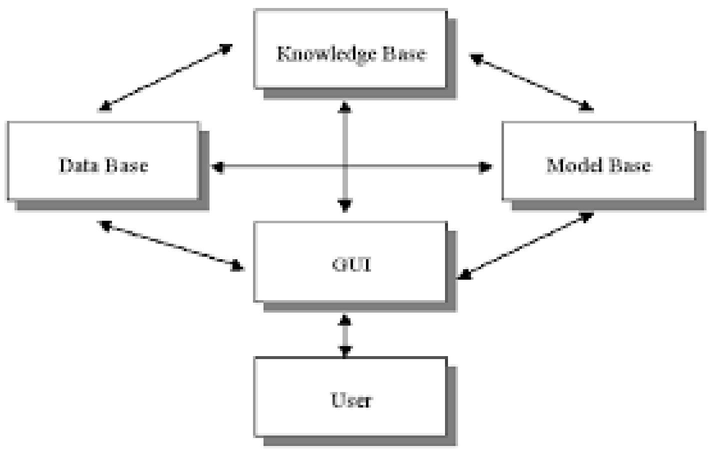
A holistic HMM is a part and the skeleton of the *TKM&F* that uses microartefacts to support just-in-time requests to the H&DKMS. The H&DKMS components and interfaces, as shown in Figure 10, are based on a light version of the ADM.

The HMM that can be modelled after the following formula for the Transformation Mathematical Model (TMM) that abstracts the BTP:

(HMM):

$$AMM = Weigthing_1 * AMM\_Qualitative + Weigthing_2 * AMM\_Quantitative. \quad (1)$$

Figure 10. The decision making system's just in time execution and its components



HMM = ∑ AMM for an enterprise architecture's instance. (2)

(TMM):

TMM = ∑ HMM instances. (3)

The objective function of the TMM's formula can be optimized by using constraints and with extra variables that need to be tuned using the HMM. The variable for maximization or minimization can be, for example, the BTP success, costs or some other objective (Dantzig, 1949; Sankaralingam, Ferris, Nowatzki, Estan, Wood & Vaish, 2013). For this PoC the success will be the main and only constraint and success is quantified as a binary 0 (failure) or 1 (success), where the objective function definition will be:

Minimize risk TMM. (4)

The TMM is the combination of an EAP, BTP methodologies and a holistic mathematical model that integrates the enterprise organisational concept, information and communication technologies (Lazar, Motogna & Parv, 2010).

Framework's Applied Mathematical Model Integration

A generic *Project* model and its kernel ADM are the base of this R&D and they are the basics of its *TKM&F.* The authors want to propose a mathematical model to represent the *TKM&F* global architecture and solve its integration problems. The literature review has shown that existing research resources on *Project* topics, as a mathematical model, are practically inexistent. This pioneering research work is cross-functional and links all the BTP's microartefacts to BTPs and enterprise architecture method (Agievich, 2014).

Table 2. The critical success factors that have an average of 9.33

Critical Success Factors	KPIs	Weightings
CSF_MM_Integration	StableTested	From 1 to 10. **9 Selected**
CSF_MM_TMM	VerifiedModel	From 1 to 10. **10 Selected**
CSF_MM_ADM	Synchronized	From 1 to 10. **9 Selected**

The Mathematical Model's Integration Critical Success Factors

Based on the literature review process, the most important mathematical model's CSFs that are used are selected by the *Manager* and evaluated by the *TKM&F* in the following table:

As shown in Table 2, the result's aim is to prove or justify that it is complex but possible to implement a mathematical model as the base structure of a *Project*. Today, the proposed model is stable and totally applicable. The next CSA to be analysed is the holistic management of the ICS system.

The Research Section's Link to the Information and Communication Technology

This section's deduction is that the ICS's environment's unbundling is a crucial process for the business environment and for the RDP's credibility.

THE KMS' INTEGRATION IN THE INFORMATION AND COMMUNICATION TECHNOLOGY SYSTEM

Many business and ICS standards exist to support the iterative *Project* unbundling process of a traditional business (Tidd & Bessant, 2009). Unfortunately, the actual archaic methodologies and ICS environments are silo-like and cannot support an agile *Project*.

The Unit of Work

Defining a microartefact granularity and responsibility for a *Project* is a complex process; added to that, there is the complexity in implementing the "1:1" mapping and classification of the discovered microartefacts. The applied design concept uses standard design methodologies like the TOGAF's ADM. This proposed design and mapping concepts are supported by a set of the *TKM&F's* microartefacts where its internal HMM ML consists of implementing microartefacts to dynamically evaluate compound expressions, according to the HMM principles. (Neumann, 2002). Defining the unit of work, serves as a concrete microartefact that can be represented by a class diagram, where mapping supports the interoperability between all the BTP's microartefacts that are compatible with the following standards:

- Knowledge management XML standard to import and export knowledge items (Feljan, Karapantelakis, Mokrushin, Liang, Inam, Fersman & Souza, 2017).

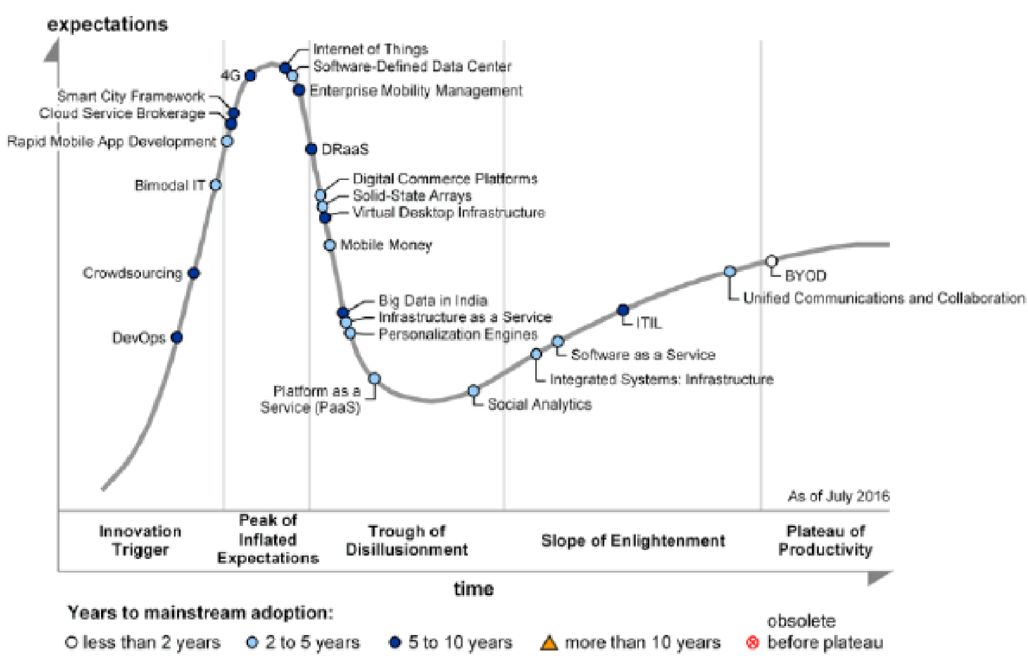
- The Unified Modelling Language's (UML) and the System Modelling XML (SysML) for the design of the H&DKMS microartefacts.
- Design patterns and their XML interfaces for the structural design of the H&DKMS microartefacts.
- The Project Management XML (PMXML) for the project coordination of the H&DKMS microartefacts.
- The Service Oriented Architecture XML (SoaML) and the Web Services XML (WSDL) for the communication between the H&DKMS microartefacts.
- The Business Process Modelling Notation (BPMN) and the Business Process Execution Language (BPEL), can be used for the design of the H&DKMS microartefacts.
- The client-side frameworks to build dynamic front-ends using a lifecycle development process.

Holistic Qualification Procedures

Many types of problems may cause a *Project* to fail, these problems are justified by the human behavioural aspects translated into para-psychology.

Figure 11 shows actual immaturity of development, qualification and operations for *Projects* that still are in an infancy age. Tools for implementation environments are still confronted with serious project issues. These problems show that usual tools are still immature for large enterprise intelligent applications and hence for H&DKMSs (Gartner, 2016).

Figure 11. The decision making based systems' evolution (Gartner, 2016)



Modelling and Patterns

The H&DKMS pattern expresses a structural concept or schema for *Projects'* implementations: 1) it offers a set of predefined knowledge and intelligence templates to instantiate items; 2) it describes their responsibilities and content of knowledge artefacts known as items; 3) it defines the software artefacts for these KMS' modules; 4) it defines a KMS engineering model; and 5) it includes the description of the relationships between the different H&DKMS templates. H&DKMS components support the *Project* by offering knowledge microartefacts to handle various types of knowledge and intelligence endpoints. The usage of knowledge and intelligence endpoints provides some of the mechanisms needed to make H&DKMS tuneable with CSFs.

Knowledge Management Resources, Artefacts and Factors

The *TKM&F's* mapping concept is used to relate and assemble the *Project's* resources. This concept is used to manage autonomic H&DKMS' microartefacts' instances in all of the implementation phases; and it is based on an iterative model that maps all the H&DKMS' microartefacts to CSFs (The Open Group, 2011a). The H&DKMS has to identify the initial set of CSFs to be used, as shown in Figure 12.

The Information and Communication Technology's Critical Success Factors

Based on the literature review process, the most important H&DKMS' CSFs that are used are evaluated to the following:

As shown in Table 3, the result's aim is to prove or justify that it is complex but possible to implement a H&DKMS and the ICS system. The next CSA to be analysed is the holistic management of the ADM.

Figure 12. The knowledge management subsystem

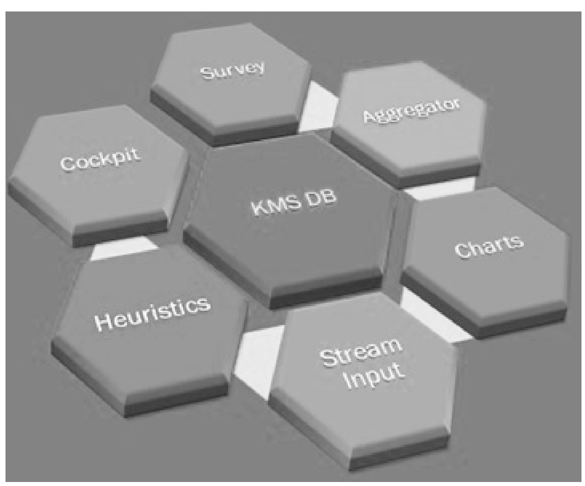


Figure 13. The knowledge management storage component

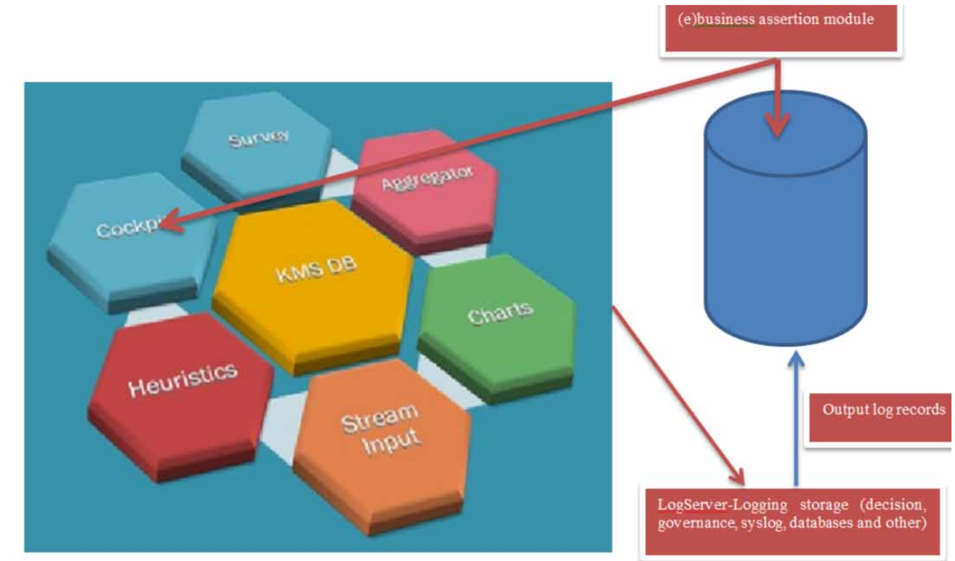


Table 3. The critical success factors that have an average of 9.5

Critical Success Factors	AHMM enhances: KPIs	Weightings
CSF_ICT_IntegrationProcesses	Supported	From 1 to 10. **9 Selected**
CSF_ICT_Operations&Choreography	SimpleAutomated	From 1 to 10. **9 Selected**
CSF_ICT_DesignProcess	SimpleSupported	From 1 to 10. **9 Selected**
CSF_ICT_McLifecycle	ExistingProcedures	From 1 to 10. **10 Selected**
CSF_ICT_RAD	ExistingEnvironments	From 1 to 10. **10 Selected**
CSF_ICT_Tests	ExistingTests	From 1 to 10. **10 Selected**

The Research Section's Link to the Architecture Development Method

This section's deduction is that the ICS and other fields are dependent on an enterprise architecture paradigm and therefore the ADM is crucial for the development of the H&DKMS.

THE INTEGRATION WITH THE ARCHITECTURE DEVELOPMENT METHOD

The H&DKMS' integration with the ADM, enables the automation and the auto-generation of the knowledge and intelligence microartefacts. The ADM is a generic method and recommends a set of phases and iterations to develop the *Project*; it designs parts of the transformed system interfaces to other deliverables from other frameworks.

Architecture Phases

In this section the authors present ADM's phases and the H&DKMSs implications (Visual Paradigm, 2019):

- The preliminary phase prepares the business enterprise for a successful H&DKMS integration and defines its main H&DKMS.
- The architecture vision and business architecture phases define the H&DKMS models constraints and objectives; validate the business capabilities and create the Statement of Architecture Work (SAW).
- The information system architecture phase develops the H&DKMS' ICS architecture paradigm.
- The technologies architecture phase, develops the H&DKMS's technology architecture and its baselines.
- The requirements management and tests phases, testing and validation are applied to all the build microartefacts and mapped to the requirements.

The Architecture Development Method Critical Success Factors

Based on the literature review process, the most important ADM's CSFs that are used are evaluated to the following:

As shown in Table 4, the result tries to prove or justify that it is possible to integrate and automate the ADM. The next CSA to be analysed is the holistic management of the DMS.

The Research Section's Link to the Architecture Development Method

This section's deduction is that the KMS (or H&DKMS) can be built on an unbundled ICS system and a holistic ADM and the H&DKMS is the central nervous system of the *Project's* intelligence pool.

Table 4. The critical success factors that have an average of 9.0

Critical Success Factors	AHMM enhances: KPIs	Weightings
CSF_ADM_IntegrationProcesses	StandardSupported	From 1 to 10. **8 Selected**
CSF_ADM_Phases	Supported	From 1 to 10. **10 Selected**
CSF_ADM_Requirements	MappingAutomated	From 1 to 10. **9 Selected**

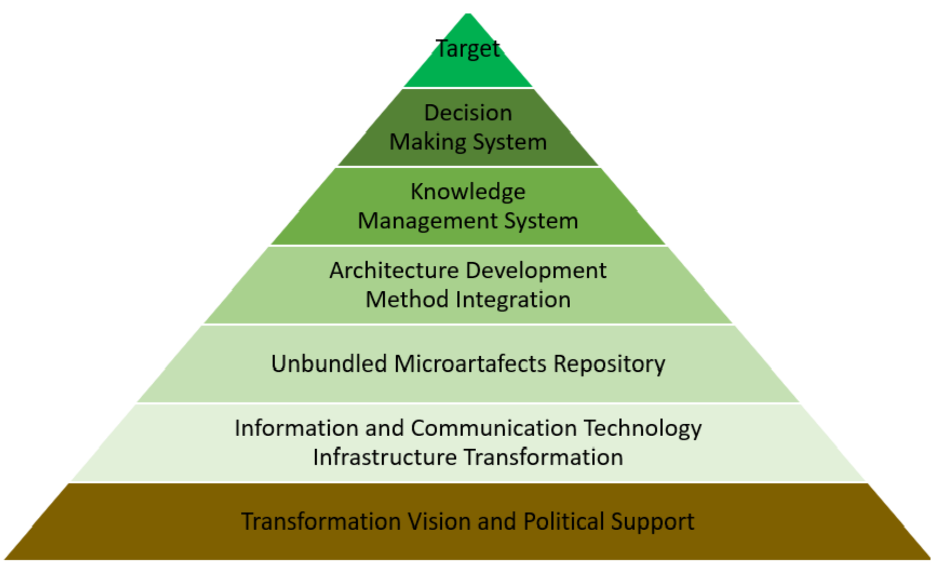
THE HOLISTIC KNOWLEDGE MANAGEMENT SYSTEM

The Knowledge Management Basics

The H&DKMS concept is based on a set of multiple coordinated knowledge management patterns that correspond to various just-in-time knowledge microartefacts that are based on a complex transformation concept as shown in Figure 14 (Cearley, Walker, & Burke, 2016).

Knowledge microartefacts are responsible for the manipulation and intelligence, which are holistic and empiric human mental capabilities that coordinate and control various processing activities, combining reflex, information management and processing. Related and networked information coordination manages knowledge patterns, data, extracts and correlates them in space and time to detect heuristic patterns to deliver various types of problem solving (Gardner, 1999). These H&DKMS patterns and microartefacts and their underlying mechanics are used to generate sets of factors' weightings for possible actions that are called knowledge/intelligence microartefacts that are the stub of the DMS and the *TKM&F*. Weightings' concept enables the H&DKMS patterns and microartefacts to build a knowledge subsystem that delivers answers in the form of knowledge values known as items. In many cases, fast change requests may generate an important set of corresponding knowledge solutions that can be ambiguous and make H&DKMS' actions uncertain and complex to implement. The H&DKMS is responsible for a rational heuristic approach for enterprise knowledge extraction. The H&DKMS' concept is based on a holistic systemic approach to use all the *TKM&F's* microartefacts (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a). A successfully integrated H&DKMS can give a company the most important competitive business advantages that may insure its future and it is not a secret that intelligent knowledge microartefacts are the basis of any successful *Project* (Trad, 2018a; Trad, 2018b; Trad, 2018c). Major research and advisory firms like Gartner, confirm that knowledge services will leverage business ICSs'

Figure 14. The Project's development pyramid



components from various enterprise departments, as shown in Figure 15. Gartner confirms also that services are the dominating business enablers for Fortune 500 companies that need dynamic business knowledge and intelligence support (Clark, Fletcher, Hanson, Irani, Waterhouse & Thelin, 2013).

Major characteristics of such a H&DKMS internal system are:

- Predict and offer ICS system feasible solutions.
- Predict and design business system's fallout feasible and stable solutions.
- Select the weakest platform in the *Project* as a target; and align the architectures.
- Use different languages to support different features to build knowledge microartefacts.

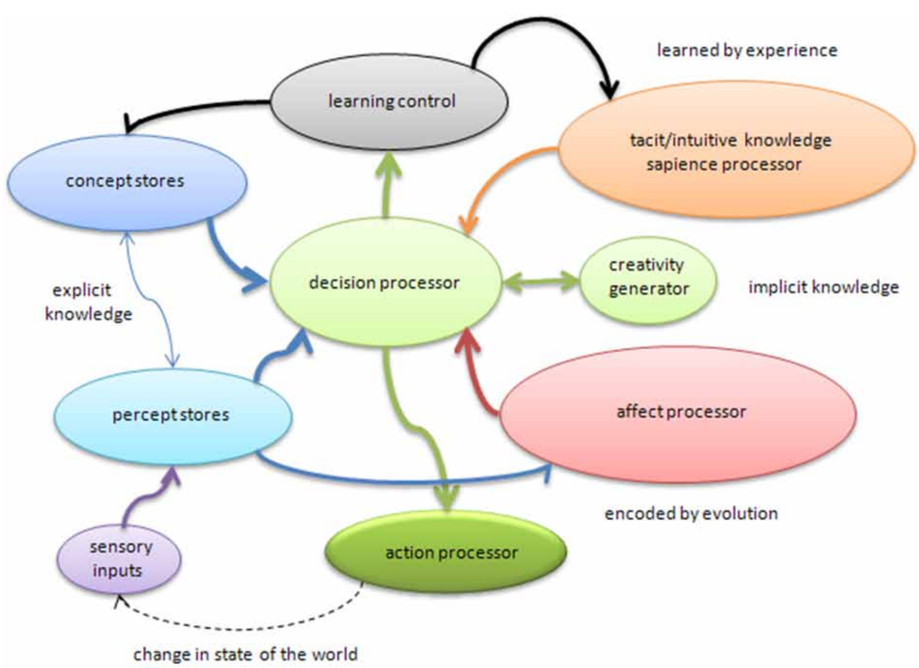
Knowledge Microartefacts

The knowledge microartefact contains a mapping concept in XML format that insures the interoperability between all the H&DKMS microartefacts; these resources can conform to the following standards like the Architecture XML (ArchiXML) format to interchange between various *Project* phases. A H&DKMS pattern expresses a fundamental structural concept or schema for the *Project's* implementation.

The Holistic Knowledge Access Management

A H&DKMS is managed by the *TKM&F*, where the enterprise's KMS officer configures the types of KM microartefacts to be involved; these microartefacts are orchestrated by the HMM actions to deliver possible information. The H&DKMS actions map to the various processes, which are responsible for the

Figure 15. The neural network enterprise architecture component tree (Clark, Fletcher, Hanson, Irani, Waterhouse, & Thelin, 2013)



implementation of mechanisms needed to deliver the software support. The H&DKMS pattern is implemented in all of the *Project's* components and the implementation of H&DKMS' mechanisms should be able to deliver the requested knowledge items; such a set of actions can be modelled and managed by the HMM (The Open Group, 2011a; Trad & Kalpić, 2017a, 2017b, 2017c).

The Knowledge Management Success Factors

Based on the literature review, the most important knowledge CSFs that are used are:

The Modules Chained Link to the Intelligence Support or Decision System

The KMS' integration result prove that it is possible to implement an H&DKMS that can be the major part of the future DMS.

THE INTEGRATION WITH THE DECISION MAKING SYSTEM

Complex Decision Systems

This RDP is about cross-functional complex *Project*s' management that refers to the transformation of classical domains like decision making, knowledge management, mathematical systems, systems analysis and global systems engineering; which are supported by the HMM formalism. Complex decision systems' holistic management is an approach for building complex business systems using a central decision process (Daellenbach & McNickle, 2005).

The Decision Making Process

The HMM based DMS, where any *Project* team member can configure the types of microartefacts and CSFs to be used; these microartefacts are orchestrated by the HMM's choreography engine. The HMM based DMS' actions map to the various ICS system's mechanisms to deliver the needed actions. The HMM instance is in all of the *Project*'s processes; such a set of actions is modelled and presented in this chapter's experiment or a proof of concept (The Open Group, 2011a; Trad & Kalpić, 2017a; Trad & Kalpić, 2017b; Trad & Kalpić, 2017c).

Table 5. The critical success factors that have an average of 10.0

Critical Success Factors	AHMM4BT enhances: KPIs	Weightings
CSF_KMS_Integration	FullySupported	From 1 to 10. **10 Selected**
CSF_KMS_Patterns	Implementable	From 1 to 10. **10 Selected**
CSF_KMS_AccessManagement	StandardIntgeration	From 1 to 10. **10 Selected**

The Decision Making System's Critical Success Factors

Based on the literature review process, the most important decision making system's CSFs that are used are evaluated to the following:

As shown in Table 6, where the Decision Making Process (DMP) result tries to prove or justify that it is complex but possible and even mature to implement a DMS using the HMM formalism and that will be presented in the H&DKMS section.

The Research Section's Link to the Proof of Concept

This chapter's deduction is that the PoC is crucial to prove this chapter's credibility and based on the six tables that this RDP has generated.

THE PROTYPE'S INTEGRATION WITH BUSINESS AND ARCHITECTURE TRANSFORMATION SCENARIOS

The H&DKMS PoC implementation uses the default ACS, as this experiment's business case. The ACS is an insurance management system that has an archaic KMS, a mainframe, claim files service, customer file service. The ACS manages, registers, accepts, valuates and invoices claims activities. The demo application uses the *TKM&F* for the ACS and PoC implementation (Trad & Kalpić, 2018c).

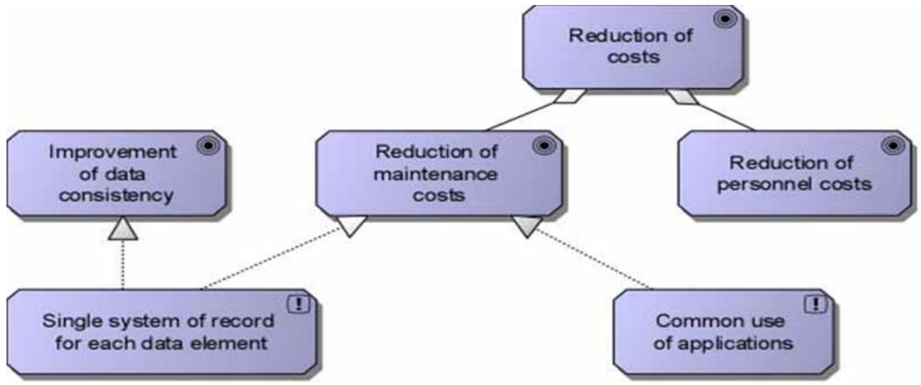
Application Portfolio Rationalization Scenario and Data Unification

For the H&DKMS implementation, the ArchiSurance ACS is used; due to the merger, the business system's landscape has become siloed, what results in major data and knowledge redundancy, functional overlap and archaic integration, using multiple formats and technologies. For this PoC, a holistic approach is tested to present H&DKMS access. The technical infrastructure must be simplified to improve data and hence knowledge quality, as shown in Figure 16. The isolated back-office servers are replaced by a common date-server cluster. To ensure business knowledge servicing and continuity a fail-over line of servers is implemented.

Table 6. The critical success factors that have an average of 10

Critical Success Factors	AHMM4T enhances: KPIs	Weightings
CSF_DMS_ComplexSystemsIntegration	FullySupported	From 1 to 10. **10 Selected**
CSF_DMS_KMS	IntegrationEnabled	From 1 to 10. **10 Selected**
CSF_DMS_DMP	IntgeratesAsKernel	From 1 to 10. **10 Selected**

Figure 16. Transformation goals (Jonkers, Band & Quartel, 2012)



Setup of the Method's Phases

The H&DKMS's implementation phases' setup looks as follows:

- Phase A or the Architecture Vision phase, establishes an architecture effort and initiates an iteration of the architecture development cycle by setting its scope, constraints, and goals.
- Phase B or the Business Architecture phase shows how the *Project*'s target architecture realizes the key KM subsystem requirements and related CSFs.
- Gap Analysis phase shows and uses the Application Communication Diagram, as shown in Figure 17 which shows the modelled target application landscape. Where BRIMS is an internal subsystem.
- Phase D or the Target Technology Architecture and Gap Analysis phase shows the KMS infrastructure.
- Phases E and F, Implementation and Migration Planning; the transition architecture, proposing possible intermediate situation.

The Proof of Concept

This chapters' PoC is implemented using the *TKM&F* and is based on the HMM formalism, the DMS and on an internal initial set of CSFs that serve as an example for this chapter. The CSFs' values are presented in Tables 1 to 6. These CSFs have bindings to specific *Project* and H&DKMS resources, where the HMM formalism was designed using ML microartefacts, object oriented and enterprise architecture methodologies and related tools. The HMM based H&DKMS processing model represents the relationships between this knowledge requirements, *Project's* microartefacts (or building blocks), global unique identifiers and the six defined CSAs, as shown in Figure 19.

The PoCs are achieved by using the development environment and the research framework's, *TKM&F* client's interface that is shown in Figure 20. From the *TKM&F* client's interface the ML development setup and editing interface can be launched.

Once the development setup interface is activated, the natural language programming interface can be launched to implement the needed microartefact scripts to process the defined three CSAs. These scripts

Figure 17.

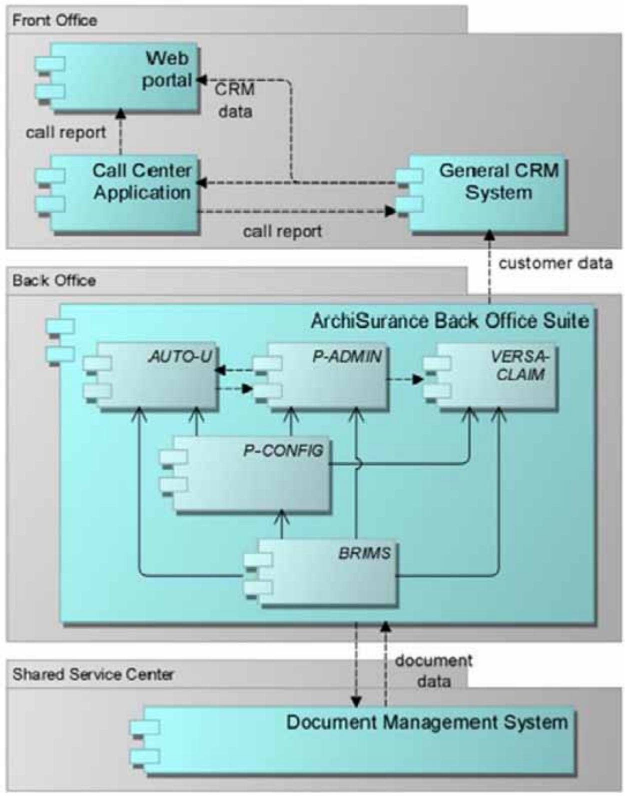


Figure 18. Goals and principles (Jonkers, Band & Quartel, 2012)

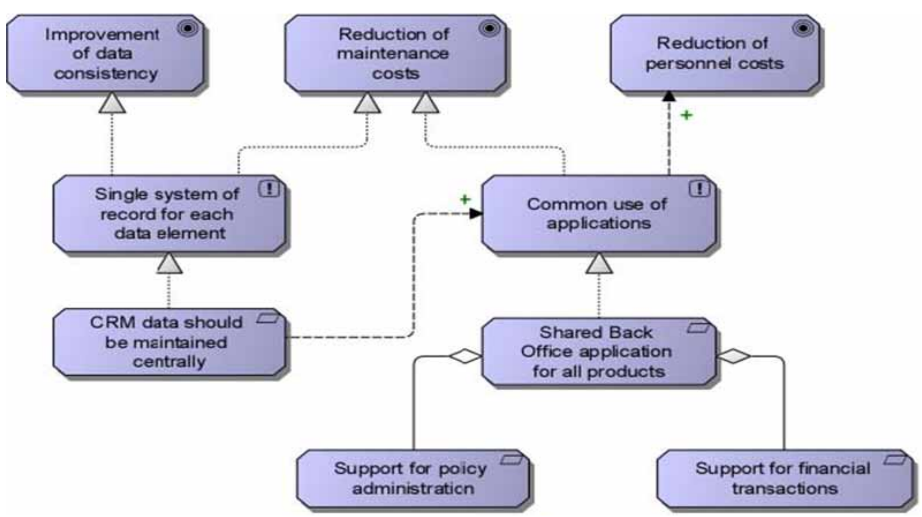


Figure 19. The TKM&F's interaction with the Manager as client

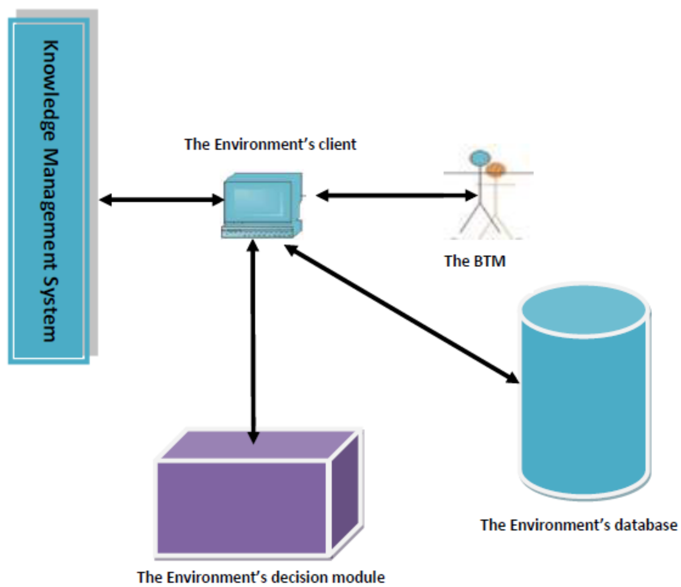
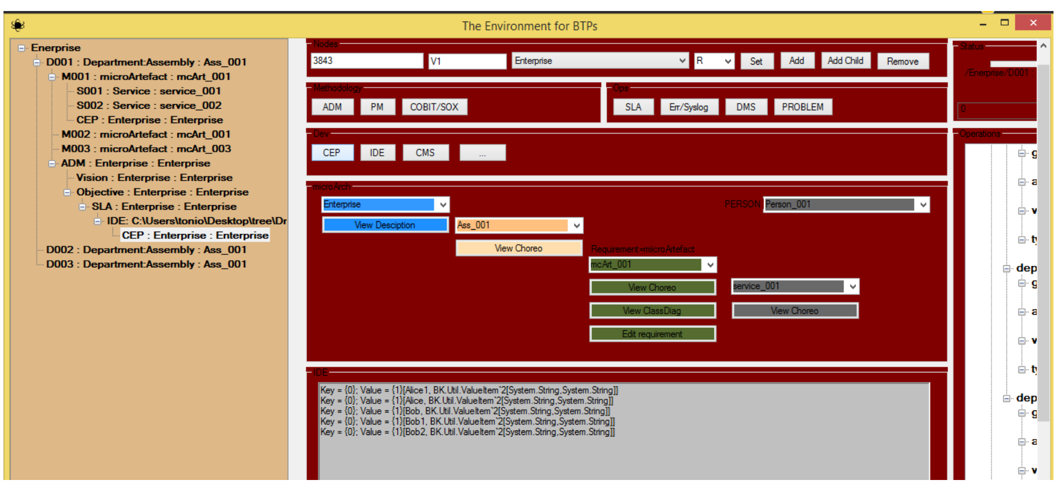


Figure 20. The TKM&F's development setup interface



make up the kernel knowledge system and the HMM set of actions that are processed in the background. The HMM uses a knowledge database that automatically generates decision making actions which make calls to DMS, that manages the edited mathematical language script and flow, as shown in Figure 21.

This research's instance of the HMM and its related CSFs were selected as demonstrated in the chapter related to the holistic management of CSFs (Trad & Kalpić, 2018f) , and shown in Figure 22.

Once the KM microartefact is ready, the CSF and natural language programming files are configured as demonstrated in the chapter related to the holistic management of CSFs (Trad & Kalpić, 2018f) and shown in Figure 23.

Figure 21. The edited mathematical language script and flow

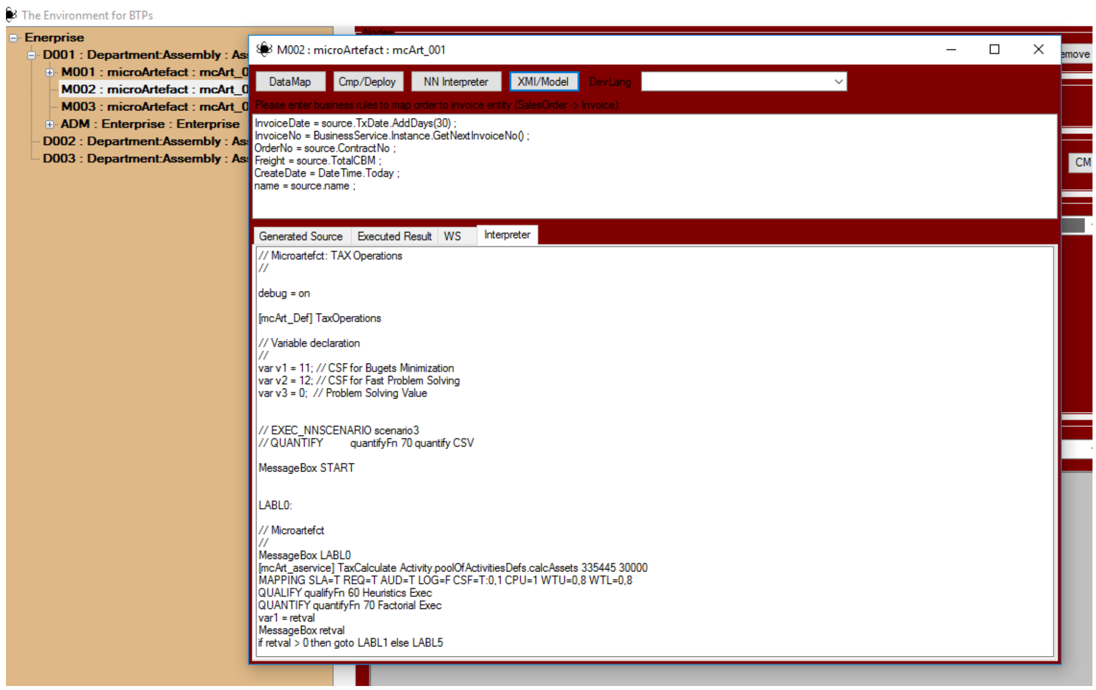


Figure 22. The heuristics tree configuration

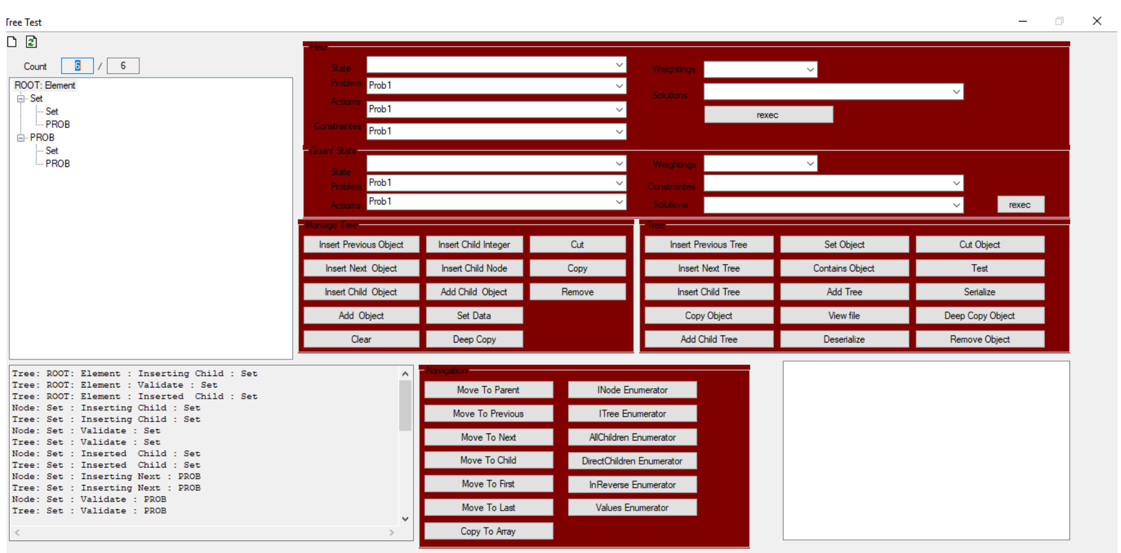
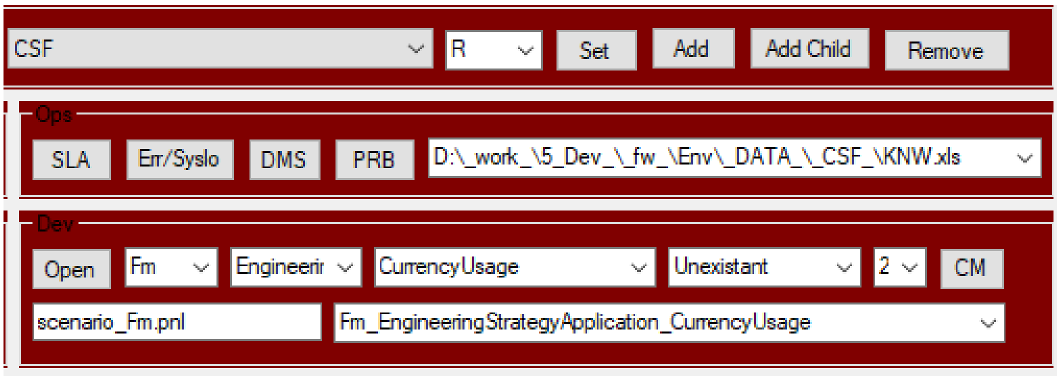


Figure 23. The critical success factor's configuration (Trad & Kalpić, 2018f)



After the factor's configuration, a node is selected from the model's tree as shown in Figure 24, for this Figure it is important to refer to the end of chapter's abbreviation list.

Afterwards the H&DKMS graphical user interface is launched and the requested knowledge item is loaded, as shown in Figure 25 the process is fairly long and the H&DKMS asks the user to be patient.

The requested knowledge item is ready and can be synthesized using the menu, as shown in Figure 26 the H&DKMS was loaded in a French configured system and the dialog box asks to load/open or save the file.

Figure 24. Node selection

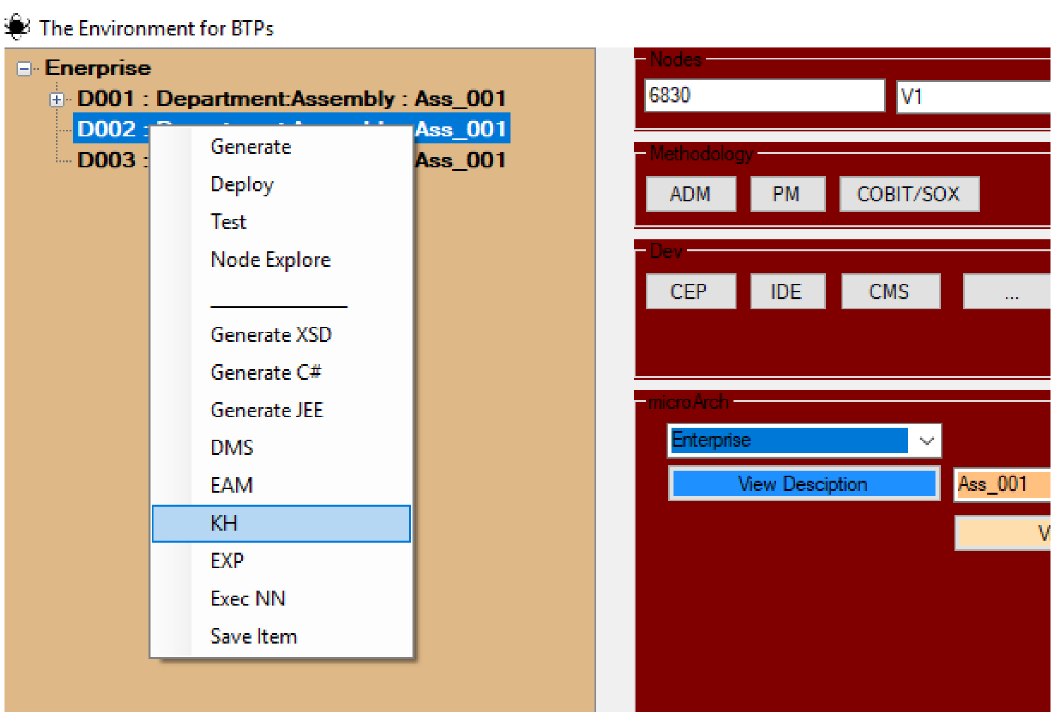


Figure 25. Knowledge system graphical user interface

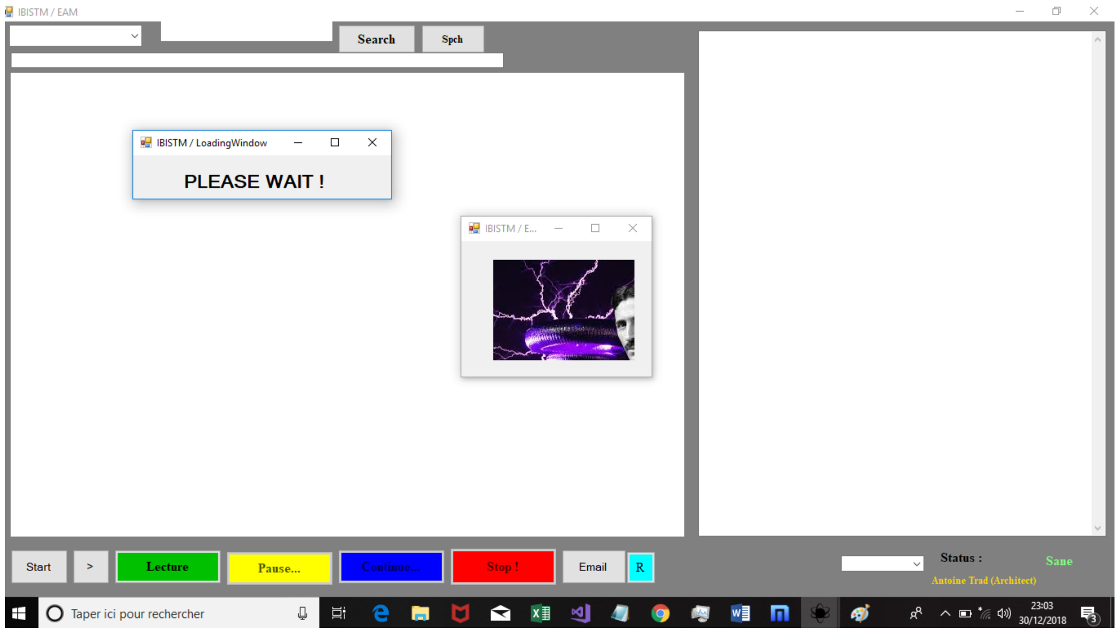


Figure 26. Knowledge item ready to be used

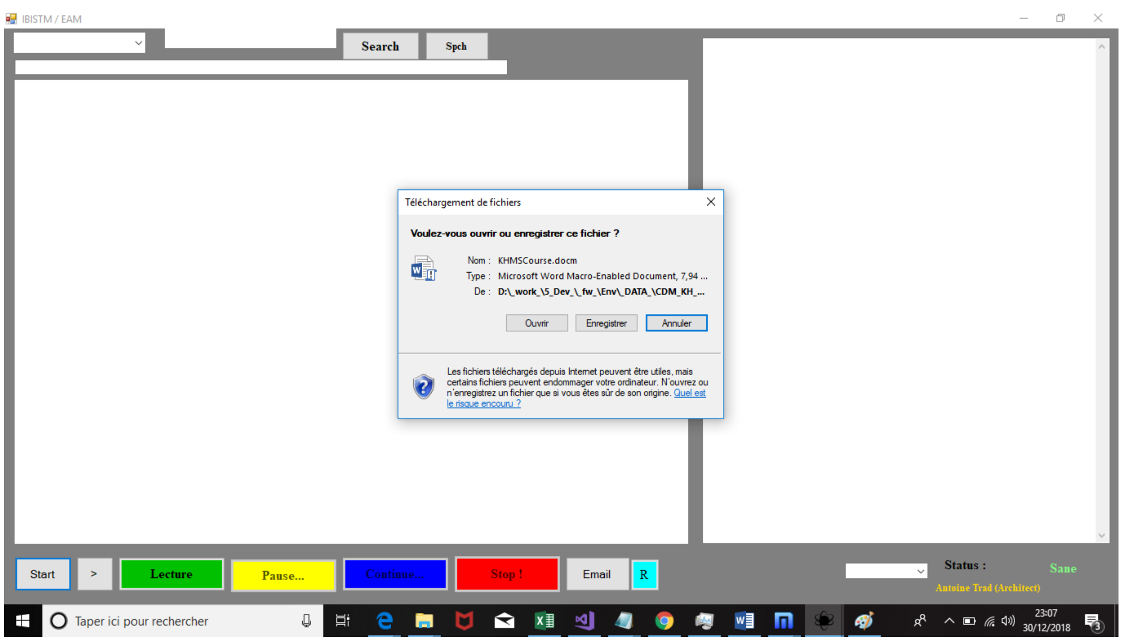


Table 7. The holistic knowledge management system research's outcome

CSA Category of CSFs/KPIs	Influences transformation management	Average Result
The Applied Case Study Integration	CredibleStable	From 1 to 10. 9.50
The Usage of the Architecture Development Method	FullyIntegrated	From 1 to 10. 9.00
The Information and Communication Technology System	Transformable	From 1 to 10. 9.50
The Mathematical Model's Integration	Applicable	From 1 to 10. 9.33
The Decision Making System	Implementable	From 1 to 10. 10.00
The Holistic Knowledge Making System	Implementable	From 1 to 10. 10.00

In this book's chapter's six tables and the result of the processing of the H&DKMS, as illustrated in Table 7, shows clearly that the HMM based H&DKMS can be used for KMS projects. HMM is not an independent component and is bonded to all the *Project*'s overall risk architecture, hence there is a need for a holistic approach.

For the *TKM&F* and hence the HMM, the main constraint to implement the H&DKMS is that CSAs for simple R&D components, having an average result below 8.5 will be ignored. In the case of the current PoCs, an average result below 7.5 will be ignored. As shown in Table 7, this fact keeps the CSAs (marked in green) that helps to make this work's conclusion; and drops the ones in red. It means that the H&DKMS based on the HMM formalism for global integration are mature and can be used. Of course, there are some minor difficulties integrating the HMM in *Project* and transformations must be done in multiple transformation sub-projects, where the first one should try to transform the information system, as the basis for the enterprise business systems.

SOLUTION AND RECOMMENDATIONS

Because of very high score, above 9, Table 7 shows that an HMM based H&DKMS implementation is not a risky transformation and that today the *TKM&F* is ready and the only methodology and framework that can in parallel construct BTPs, EAPs, MMs, KMS, DMS and business engineering projects. In this article that is related to the H&DKMS transformation projects, the authors propose the following set of architecture, technical and managerial recommendations:

- Define a cross-functional and unique H&DKMS to be used all the *Project*s PoCs.
- Use a standard enterprise architecture methodology to model the H&DKMS.
- Select the H&DKMS' CSFs and CSAs.
- Unbundle the enterprise system to deliver the needed H&DKMS' microartefacts library.
- Model the H&DKMS' ICS system based on the microartefacts concept.

- Design a kernel knowledge model and implement a holistic KMS that interfaces the DMS and the CSF management system.
- A H&DKMS concept must be established and tried for its feasibility.
- A *Project* must build a global knowledge management concept that is a part of the DMS.
- Enormous efforts must be applied to integrate underlying ICS system to support the knowledge management. Here the main problem is alignment because software blocks are silos in general.
- H&DKMS should replace traditional obsolete knowledge management systems.
- The architecture development method's integration in a business system enables the automation of all its knowledge and decision activities.
- The *Project* must be separated in multiple transformation projects, where the first one should attempt to transform the information system and the global architecture.

FUTURE RESEARCH DIRECTIONS

The research project's future efforts will focus on the various functional languages environments that can be used in transformational initiatives in a cross-functional environments.

CONCLUSION

This research is based on a mixed action research model; where critical success factors and areas are offered to help BTP architects to diminish the chances of failure when building knowledge systems. This research chapter is part of a series of publications related to applied mathematical models, *Project*s, decision making systems and enterprise architectures. This research chapter is based on mixed action research model; where critical success factors and areas are offered to help *Project* architects to diminish the chances of failure when building transformation projects. In this chapter, the focus is on the H&DKMS that defines a central knowledge system to be used throughout the book. The HMM based knowledge management is an important factor for the business information system's evolution and maintenance. The most important managerial recommendation that was generated by the previous research phases was that the business transformation manager must be an architect of adaptive business systems.

In this chapter and in general, the book's PoCs are based on the CSFs' binding to a specific research resources (or requirements) and the internal reasoning model that represents the relationships between this research's concepts, requirements, microartefacts and CSFs. The final result clearly implies that the proposed H&DKMS to verify each chapter (or research question) is credible and can be used. To support such complex experiments, the authors recommend performing the *Project* implementation operations through multiple independent sub-projects (or PoCs), where the priority is to transform the information system, structure a mathematical model, decision making system and global architecture, as described in this book's chapters. H&DKMS describes a structured inter-relationship development of various knowledge fields and the implementation of knowledge artefacts and mechanisms. The H&DKMS component's global engineering is an important factor for the business information system's evolution. The PoC was based on the CSFs' binding to a specific research resources and the reasoning model represents the relationships between this research's requirements, microartefacts and the CSFs. The result implies that an attempt of transformation is dangerously prone to failure. To avoid this scenario, we recommend to perform the *Project* through multiple independent transformation projects, where the task of the first ones is to transform the information system and global architecture.

ACKNOWLEDGMENT

In a work as large as this research project, technical, typographical, grammatical, or other kinds of errors are bound to be present. Ultimately, all mistakes are the authors' responsibility. Nevertheless, the authors encourage feedback from readers identifying errors in addition to comments on the work in general. It was our great pleasure to prepare this work. Now our greater hopes are for readers to receive some small measure of that pleasure.

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KEY TERMS AND DEFINITIONS

ADM: Architecture development method.
BTP: Business transformation project.
CMS: Costumer management system.

CSA: Critical success area.
CSF: Critical success factors.
DMS: Decision-making system.
EA: Enterprise architecture.
EAP: Enterprise architecture project.
H&DKMS: Holistic and dynamic knowledge management system.
HMM: Holistic mathematical model.
ICS: Information and communication system.
KH: Know how.
KM: Knowledge management.
KMS: Knowledge management system.
Manager: Business transformation manager.
ML: Mathematical language.
Project: Business transformation project.
RDP: Research and development project.
RQ: Research question.
TKM&F: Trad Kalpić methodology and framework.
TOGAF: The Open Group's architecture framework.

Chapter 8
An Applied Mathematical Model for Business Transformation:
The Holistic Business System's Risk Assertion (HBSRA)

ABSTRACT

The authors propose to use the holistic business system's risk assertion (HBSRA). The HBSRA supports a central decision-making system (DMS), projects, and enterprise architecture projects (EAP). The proof of concept (PoC) is based on applied business case from the insurance domain, where the central point is the transformation process of a traditional insurance enterprise into an agile and automated business enterprise. Such projects are managed by business transformation managers (manager or simply managers) who are supported with a methodology and a framework that can support and estimate the risks of implementation of projects. The manager is responsible for the implementation of the complex background of projects and during its implementation phase.

INTRODUCTION

In this book's chapter the authors presents the Holistic Mathematical Model for Business Transformation (HMM; in some of the chapter's resources the reader may encounter the term AHMM4BT which refers to the HMM) for assessing the risks of failure that is based on Critical Success Factors (CSFs) (Trad & Kalpić, 2018a, 2018b). This chapter is based on a unique mixed research method that is supported by a mainly qualitative research module (Trad & Kalpić, 2017a, 2017b, 2017c, 2017d; Gunasekare, 2015). The HMM for business risks assertions uses a natural language development environment that can be adopted by any Business Transformation Project or simply *Project;* and for that goal the authors propose to use the Holistic Business System's Risk Assertion (HBSRA) (Myers, Pane, & Ko, 2004; Neumann, 2002). The HBSRA supports a central Decision Making Systems (DMS), *Projects* and Enterprise Architecture Projects (EAP).

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The Proof of Concept (PoC) is based on applied business case from the insurance domain (Jonkers, Band & Quartel, 2012a; Trad, 2013), where the central point is the transformation process of a traditional insurance enterprise into an agile and automated business enterprise. Such *Projects* are managed by Business Transformation Managers (simply *Manager* or *Managers*); who are supported with a methodology and a framework that can support and estimate the risks of implementation of *Projects*. The *Manager* is responsible for the implementation of the complex background of *Projects* and during its implementation phase, the HBSRA supports him or her (for simplicity, in further text – him) in a just-in-time manner (Trad & Kalpić, 2016b). The “r” prefix does not stand just for the common risk management but for a distributed and holistic system’s risk assertion approach that identifies this works background.

BACKGROUND

Projects involve the complete digitization of value chains and business processes automation and enables that a traditional enterprise creates new business models and hence financial excellence. Transformed enterprises like Cisco Systems, Dell Computer and many others report important financial gains due to *Projects* (Barua, Konana, Whinston, & Yin, 2001). This research is considered as a pioneering one and actually or even unfortunately, there is not any adaptable risk concept for *Projects*. A holistic HBSRA and DMS can be also used for *Projects* in maintenance and production phases which comes after the finalization of the implementation phase. This research phase’s background is related to risk evaluation of *Projects* using CSFs that are managed by the Trad Kalpić Methodology and Framework (*TKM&F*), as shown in Figure 1 (Trad & Kalpić, 2018f). CSFs are selected from various Business areas like business processes, accountancy, enterprise skills….

In this chapter the authors present a set of HBSRA managerial recommendations and this chapter combines business fields, Knowledge Management (KM), HMM, Enterprise Architecture (EA), information technology management, business transformation and other business engineering fields. Integrating a HBSRA should be a fundamental strategic goal for *Projects* (Trad & Kalpić, 2018a; Trad & Kalpić, 2018b; Cearley, Walker, Burke, 2016), where Figure 2 is fundamental for the whole research project and it is used in the whole book; where Dm stands for Decision making...

The proposed HBSRA integration concept is: 1) holistic; 2) uses a risk management engine; 3) interfaces various *Project* fields; and 4) the *TKM&F* can be used by *Projects*. The authors based their Research and Development Project (RDP) method on intelligent neural networks (Trad & Kalpić, 2018a). The HBSRA integration concept is agnostic to any specific application and electronic/distributed Business field, as shown in Figure 3, and is based on the Architecture Development Method (ADM) (The Open Group, 2011a).

EA is central to implement *Projects,* where the *Manager* or an enterprise architect can use the HBSRA for *Projects* (Trad & Kalpić, 2017b, 2017c; Thomas, 2015; Tidd, 2006). In *Projects*, the *Manager*’s role is important and his actions are supported by the HBSRA (Lanubile, Ebert, Prikladnicki, Vizcaíno, & Vizcaino, 2010).

A holistic systems approach is the optimal choice to model such a HBSRA (applied to Holistic e-Business/Commerce Management Systems or HeBCMS), as shown in Figure 4, where the decision model interacts with the external world via an implemented framework to manage CSFs (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a).

Figure 1. The research framework's concept (Trad & Kalpić, 2016a)

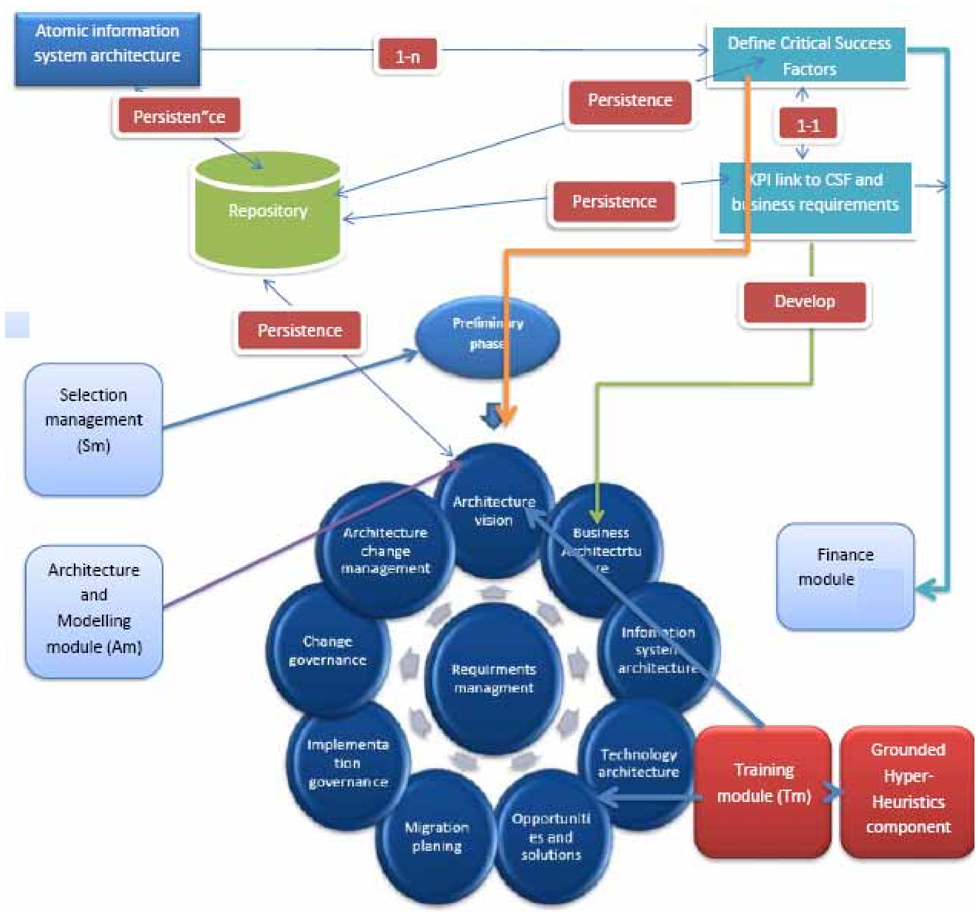


Figure 4. Business management system

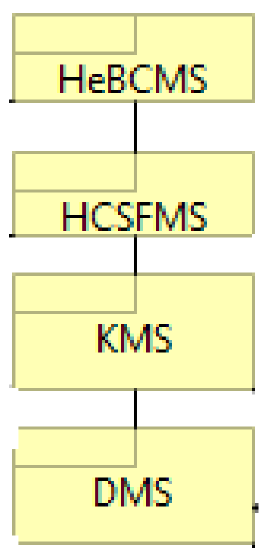


Figure 2. The research framework's interaction/flow (Trad, 2018a)

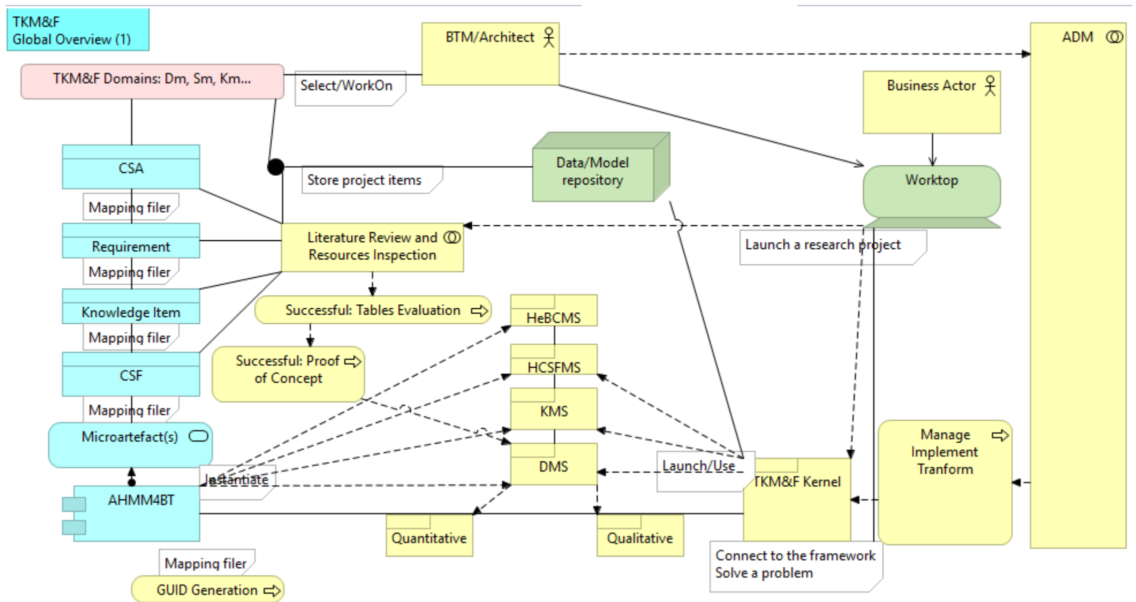
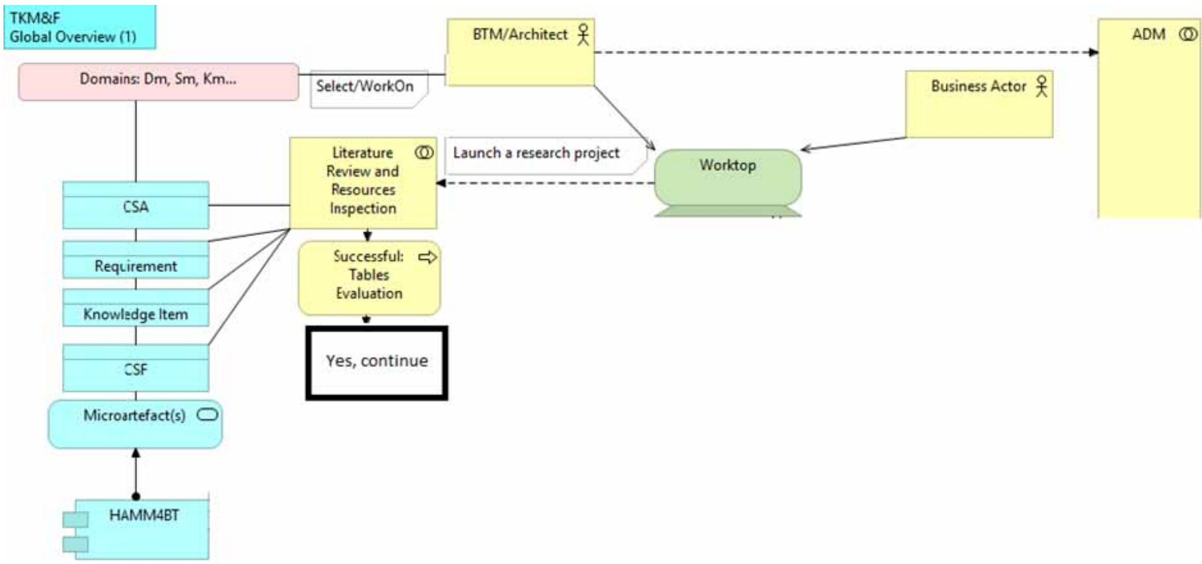


Figure 3. The research framework's architecture method's interface (The Open Group, 2011a)

Projects are difficult to implement, because of their holistic nature, where the big part of complexity is met in its technical implementation phase (Watt, 2014; Gudnason & Scherer, 2012). The *TKM&F* can be applied to all *Projects* Business models (Joseph, 2014). Business refers to any business conducted using different types of electronic media; where the most common form is the business that makes its business transactions and revenue via the World Wide Web that is based on internet technologies (e-business, 2014). The development and evolution of business related fields like web based commerce are a fundamental

Figure 5. Interaction with factors



factor for any economy. Business related fields added significant savings in the building of business infrastructures where they are also an enabler for DMS and support quicker response to market requests. Market requests known as transactions are essential for all business related interactions (Kalpić, 2011). The technical implementation phase is the major cause of high failure rates in *Projects*. That is why the *Manager*s' skills should encompass knowledge of: 1) business and commerce processes' architectures; 2) Business services' technologies; 3) real-time unbundling of Business and commerce environments (Willaert, 2001); 4) agile *Project* management; 5) implementation and integration business services; 6) organizational behaviour and engineering; 7) management sciences methodologies; 8) enterprise or enterprise 2.0 architectures and their integration in concrete *Project's* implementation phases (Platt, 2007). The actual hype of enterprise 2.0 in the Business organizations is a buzz word introduced by the Harvard Business School in 2006; they describe the usage of Web 2.0 and Web 3.0 technologies in transformed enterprises in order to increase productivity and efficiency. Therefore, the authors highly recommend a qualified technocrat's profile (Farhoomand, 2004) for the *Manager*; who needs to be assisted by a DMS (Trad & Kalpić, 2013c). *Projects* lack a holistic aspect that is assured by the HBSRA - that is this work's focus (Thomas, 2015; Cearley, Walker & Burke, 2016; Trad & Kalpić, 2016b).

FOCUS OF THE ARTICLE

The *TKM&F* supports the HBSRA for use in *Projects* (Meneses-Ortegon & Gonzalez, 2016) that had been developed by the authors. HBSRA recommendations can be applied by *Manager*s, architects, analysts and engineers, where archaic *Projects* are silos and it is impossible to implement a stable Information and Communication Systems (ICS) for the *Project* (Desmond, 2013). The HBSRA can be used to evaluate the risk and status of *Projects* in different Business domains (The Open Group, 2011a; Tidd & Bessant, 2009; Tidd & Bessant, 2018). As shown in Figure 2, the *TKM&F* is based on business services or microartefacts (Johnson & Onwuegbuzie, 2004; Trad & Kalpić, 2017b, 2017c, 2018a, 2018b; Tidd, 2006). The *TKM&F's* applied research methodology is based on a mixed methodology (Easterbrook, Singer, Storey, & Damian, 2008). For a successful integration of the HBSRA, the *Project's* team's role is to support the implementation and a holistic system approach is the optimal choice to implement an HBSRA (Simonin, Bertin, Traon, Jezequel & Crespi 2010; Daellenbach & McNickle, 2005; Trad & Kalpić, 2017d). The current book's chapter tries to prove, the HBSRA' integration feasibility through a Research Question (RQ).

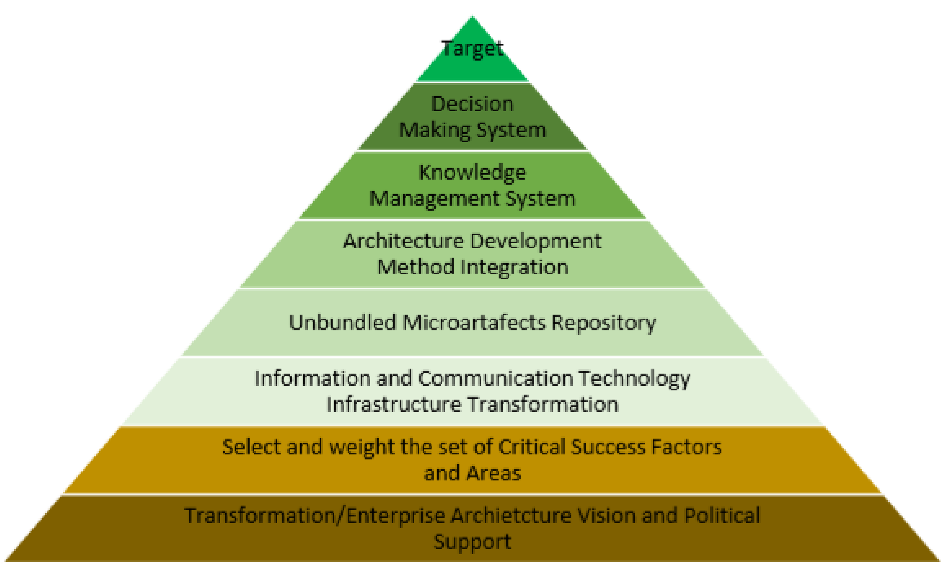
THE RESEARCH PROCESS

The reported high and even constantly increasing failure rates (Bruce, 1994) in RDPs despite many years and efforts in the field of transformations, astonished the authors. Failures are probably due to the complexity encountered during the implementation phase of the *Project* (Capgemini, 2009). The *TKM&F* is unique and pioneering endeavour, which recommends linking the Mathematical Model (MM) to all levels of the transformation process, as shown in Figure 6 (Trad & Kalpić, 2018a, 2018b; Agievich, 2014). *Projects* are risky and a concrete reason is the lack of a holistic coordination. That is why the authors propose the use of HBSRA and CSFs (Tidd & Bessant, 2018).

Critical Success Areas, Factors and Items

The HBSRA promotes the transformation using Critical Success Area (CSA) as a set of CSFs where the CSF is a set of Key Performance Indicators (KPI), where each KPI corresponds to a single *Project's* item that can be a transaction, requirement or feature, to which corresponds a column in each evaluation table. For a specific vision's goal, requirement or problem, an *Manager* or enterprise architect can

Figure 6. Presents levels of project's interaction (Trad & Kalpić, 2017b; Trad & Kalpić, 2017c)



identify a CSF, which is important to map the *Project's* items (Peterson, 2011). The HBSRA is based on CSAs that are used in various levels, where: 1) each CSA corresponds to a distinctive *Project's* domain, like for example, auditing; 2) each CSF maps to a set of requirements; and 3) each KPI corresponds to a *Project's* requirement (Farhoomand, 2004); as shown in Figure 6. For an effective selection of the HBSRA' default CSFs, there is a need for a detailed (re)search process (Putri & Yusof, 2009; Peterson, 2011;Trad & Kalpić, 2018f).

The Applied Research Framework

The *TKM&F* defines an alignment strategy of the *Projects* that use an architecture formalism like the ADM (Lankhorst, 2009; Trad & Kalpić, 2018d, 2018e). The HBSRA can be applied to various types of *Projects,* what is a part of the *TKM&F*. This chapter proposes a set of HBSRA managerial and technical recommendations (Trad 2018a, 2018b, 2018c, 2018d), and is a part of the Selection management, Architecture-modelling, Control-monitoring, Decision-making, Training management, *Projects* management, Finance management, Geopolitical management, Knowledge management, Implementation management and Research management Framework (SmAmCmDmTmPmFmGmKmImRmF, for simplification reasons, in further text the already mentioned term *TKM&F* will be used). The *TKM&F* is not a black-box product, it is rather an enterprise methodology, architecture, Strategy, recommendations and vision that each enterprise should implement by its own *Projects*. This book's chapter's RQ is: "Can a holistic business risk assertion and management system support a transformation project". The *TKM&F* is owned in its totality and copyrights by the authors; where for this chapter IGI holds the Global copyright, but it does not encompass the *TKM&F*. This chapter's RQ was formulated after an extensive literature review. The *TKM&F* delivers: 1) an *Project* support by using patterns; and 2) a set of managerial recommendations; where the *Manager* manages the complex technical implementation phase of *Projects* (CapGemini, 2007, 2009). The implementations of Internet-based resources in *Projects* require specific enterprise and business architecture and business strategy knowledge. The authors have based their *TKM&F* on the main fact that only around 12% of business organizations successfully terminate innovation-related *Projects* (Tidd & Bessant, 2009). It is known that enterprises that are successful in managing *Projects* outperform other companies in growth and financial performance (Tidd, 2006). Therefore, there is an essential need for in-depth research on the HBSRA support, especially on DMS' integration. The main risk for *Projects* is the finalization cycle, when oversimplified the implementation phase can becomes disastrous (Farhoomand, 2004). The *TKM&F* focuses on the influence of the applied EA method and skills that are needed to implement a complex *Project*; where such *Projects* integrate avant-garde technology components and atomic business microartefacts. (Trad & Kalpić, 2016b). The benefits can be recognised in the terms of: 1) continuous business growth; 2) Business microartefacts automation; 3) corporate sustainability; and 4) net financial advantage (Tidd, 2006).

The Research Literature Review

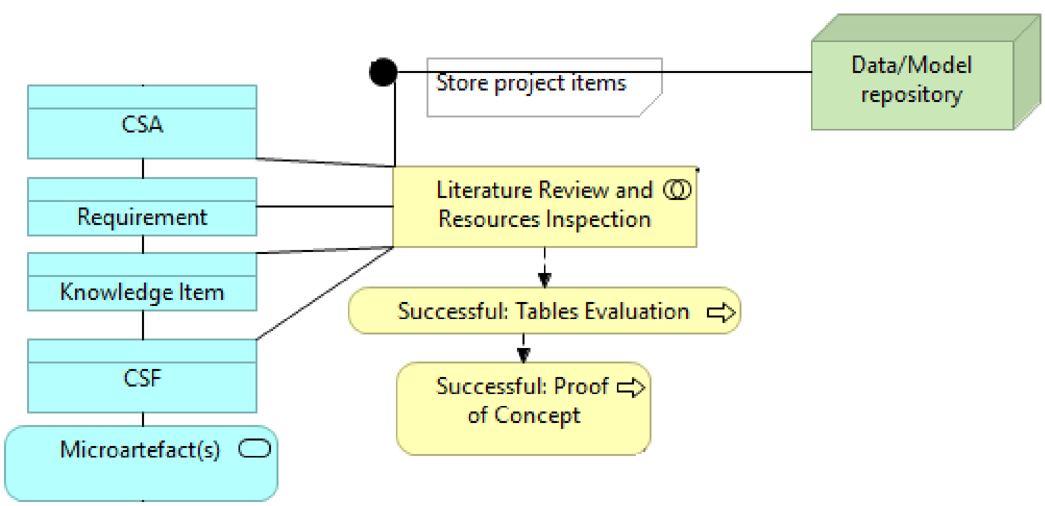
The *TKM&F's* supports the *Manager* in the process of modelling during the implementation phase and the authors have proved the existence of a multi-dimensional knowledge gap as well as the need for a real world framework like the *TKM&F* to support the continuous transformation processes (Trad & Kalpić, 2013b; Santa Cruz University, 2011*;* Trad & Kalpić, 2016b). As already mentioned, this chapter's RQ is focused on HBSRA and the outcome is that very little scholar or even general literature and research resources exist on the related subject and its holistic aspects. Therefore, the authors consider their work as unique and a pioneering one; the most relevant information found in literature was that there is an immense gap; by the gap the authors refer to inexistent or very insufficient. Using CSFs in HBSRA integration is a complex task (Kilmann, 1995).

Review and Check of the Critical Success Factors

As shown in Figure 7, the *Projects* start with the first phase, to verify the CSFs, called the feasibility phase to check if the whole undertaking makes sense. Based on the HBSRA literature review and related evaluation processes, the most important extracted CSFs are used and evaluated, using the following rules (Trad & Kalpić, 2018f):

- References should be credible and are estimated by the authors and follow a classification supported by the HCSFMS.
- *Projects* like mergers are the result of organisational changes in companies in order to make them act as a single enterprise with consolidated resources and business interests.
- Applied modelling language should be limited in order to make the *Projects* manageable and not too complex.
- The ADM is considered to be mature because it has been in use for more than ten years and it has been reported as successful; the interest in using the Open Group's Architecture Framework (TOGAF) is very high and its ADM kernel is about 90% average of satisfaction of usage (The Open Group, 2011a; Alm & Wissotzki, 2015; Kotusev, 2018). Unfortunately, that does not mean that *Projects* are successful and in fact their success rate is very low; serious publications report less than 10% success rate (Mintzberg, 1994; Trad & Kalpić, 2014e).
- The ADM is appropriate for any project's local conditions and it manages the *TKM&F's* iterations.
- If the aggregation of all the *Project's* CSA/CSF tables is positive and exceeds the defined minimum, the *Projects* continues to its PoC or it can proceed to solve the problem.

Figure 7. The factors evaluation process



The main reason why methodologies are not used in a holistic manner to achieve organizational alignment, is the need for centralized DMS and KMS (Syynimaa, 2015); where this work is based on empirical engineering models.

Empirical Engineering Research Models

This chapter is based on an empirical engineering research approach (Johnson & Onwuegbuzie, 2004; Easterbrook, Singer, Storey, & Damian, 2008), and uses an authentic mixed method that can be considered as a natural complement to conventional qualitative and quantitative research methodologies (Della Croce & T'kindt, 2002). The HBSRA is business-driven and is a part of the *TKM&F*; it is presented using a business case (The Open Group, 2011a; Trad & Kalpić, 2018f).

Research Works

All the RDP activities follow the construct:

- Integration of the previous work parts like IGI's chapter on Business projects risk management (Trad & Kalpić, 2018f).
- An introductory part that explains the overall research subject, *Projects*.
- The research part that explains the RDP's concept.
- The business case or Applied Case Study (ACS) and PoC (Trad & Kalpić, 2018c).
- The ICT, ADM, KMS, DMS and CSA/CSF parts that influence on the RQ's context.
- A specialized part, like in this chapter the HBSRA, that is presented as the main research focus.
- Evaluation tables, present in each part, containing selected and weighted CSFs.
- The PoC, conclusion and recommendations parts that conclude the research work.

THE APPLIED BUSINESS CASE

Modelling the Business Case

HBSRA uses an ACS, developed by the Open Group as a reference study, it presents the possibilities to implement *Projects*' components; using a modelling environment (Beauvoir & Sarrodie, 2018). The HBSRA is related to an insurance company named ArchiSurance that resulted from the merger of three insurance enterprises. CSFs define and tune the actions needed to ensure the success of the *Projects;* initially CSFs had been used in the domains of data analysis and business analysis (Trad & Kalpić, 2018f).

Integrating Factors

A CSF is measurable and mapped to a weighting that is roughly estimated in the first iteration and then tuned through the following ADM iterations (Morrison, 2016). By mapping the authors refer to link various *Projects* artefacts. The proposed HBSRA delivers a set of CSFs for an aligned *Projects,* which is a part of the *TKM&F* (Trad & Kalpić, 2018a, 2017b, 2017c). The HBSRA is used by *Projects* and its transformation scenarios and is the basis of this book's chapter PoC. The HBSRA uses CSFs in the context of a transformation process using TOGAF and its ADM (The Open Group, 2011a; The Open Group, 2011b; The Open Group, 2011c).

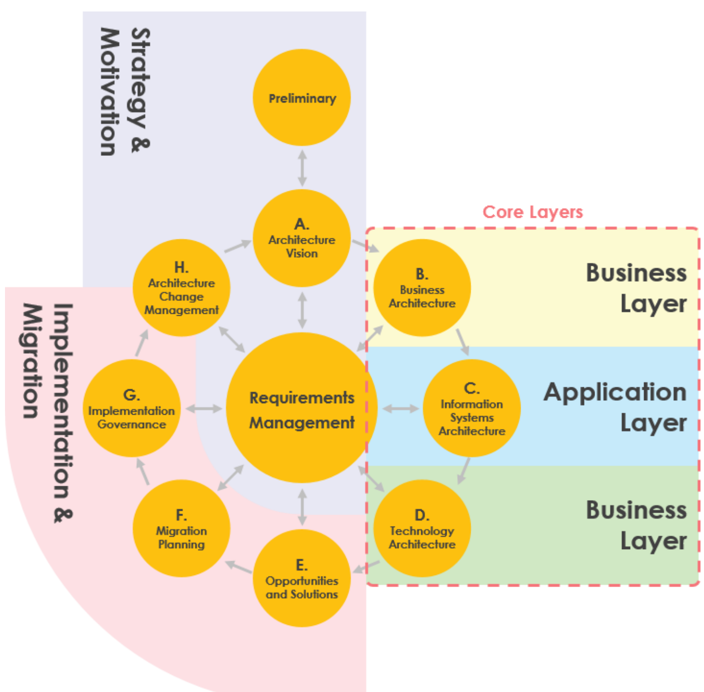
The Architecture Development Method

This RDP focuses on the design of *Projects'* integration and presents the influence of HBSRA. In the actual age of distributed intelligence, complexity, knowledge, economy and technology, there is a need for dynamic HBSRA and ADM to supports *Projects* and related fields like legal aspects (Gardner, 1999; Lusa & Sensuse, 2011).

Business/Commerce Transaction Law

As commerce has taken off in all global business organizations which are participating in current exponential expansion without decreasing revenues, the issues of regulations and legal acts arise. Lately, there has been a worldwide hyper-evolution in the development and implementation of regulation and business law. Business law is especially applied in the areas of contracts, taxation and commercial conflicts. Global business law and taxation gives the experts insights and a framework for support to practitioners involved in business transactions and global integration. The notions of jurisdictions and regulations depend on the contract's dispositions and the applied business law. Legal and other regulations play an important role and they differ in various regions (Penn & Arias, 2009).

Figure 8. The architecture development method's phases (Visual Paradigm, 2019)



Business and Commerce Transformation

The HBSRA offers a pattern that includes a hyper-heuristics tree that supports a wide class of problem types (Markides, 2011; Heracleous, 2011), and it is a major business benefit (Vella, Corne, & Murphy, 2009), where the *TKM&F*'s decision tree offers a set of solutions. This tree can be also represented as an implementation of Business Process Models (BPM). Such a solution is optimal, because the *TKM&F* knowledge is stored in the business information system (Trad, Kalpić & Fertalj, 2002; Trad & Kalpić, 2014d). The *TKM&F's* parts must synchronize with the ADM phases that are shown in Figure 9.

The Critical Success Factors in the Applied Business Case Study

Based on the CSF literature review process, the important business case's CSFs are used and evaluated as explained in chapter related to the Holistic Critical Success Factor Management System (HCSFMS) (Trad & Kalpić, 2018f).

As shown in Table 1, the result's aim is to prove or justify whether the HBSRA's integration is feasible and that is can be used with the *TKM&F* for the PoC. The next CSA to be analysed is the HMM's integration.

The Research Section's Link to the Holistic Mathematical Model

This section's deduction is that the applied mathematical model is crucial for the RDP's credibility; and is the basis of the HBSRA structure.

Figure 9. Business architecture phases (The Open Group, 2014b)

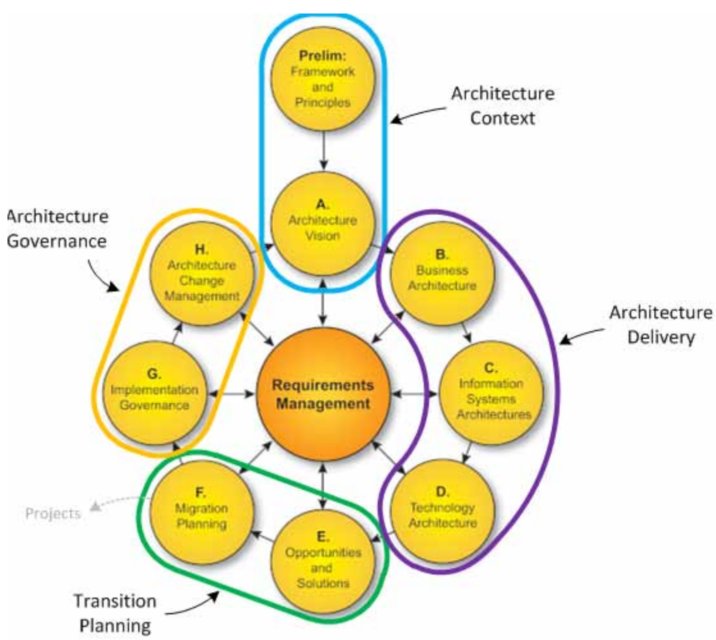


Table 1. The applied case study's critical success factors that have an average of 8.86

Critical Success Factors	HMM - KPIs	Weightings
CSF_HBSRA_Modelling	Complex_NeedsUnbundling	From 1 to 10. **08 Estimated**
CSF_HBSRA_Factors	Complex_Classification	From 1 to 10. **08 Estimated**
CSF_HBSRA_References	Limited_Silos	From 1 to 10. **08 Estimated**
CSF_HBSRA_ArchitectureDevMethod	Integrated	From 1 to 10. **10 Estimated**
CSF_HBSRA_Technologies	UniquePlatform	From 1 to 10. **09 Estimated**
CSF_HBSRA_Governance	Advanced	From 1 to 10. **09 Estimated**
CSF_HBSRA_Transformation_TKM&F	NoDifference	From 1 to 10. **10 Estimated**

valuation

THE HOLISITC MATHEMATICAL MODEL'S USAGE

The Basic Element

Sets of CSFs defines the initial algorithm nodes that are identified as vital for successful targets to be reached and maintained and is the HMM's basics element that is needed for the *Projects* to measure its success or failure (Morrison, 2016).

The Mathematical Model's Basics

The *TKM&F* offers a CSF based HMM that is an abstract model containing a proprietary Mathematical Language (ML) that can be used to script, transform and implement the behaviour of the HBSRA (Goikoetxea, 2004). The HMM nomenclature that is presented in Figure 10, to the reader in a simplified form, to be easily understood on the cost of a holistic formulation of the model.

As shown in Figure 10:

- The abbreviation "mc" stands for micro; like microservices or the smallest elment.
- A rating is defined for a KPI and a weighting for a CSF.
- The symbol $\sum$ indicates summation of weightings/ratings, denoting the relative importance of the respective set members (e.g. Rating (or KPI), Weighting (or CSF)) selected as relevant.
- The selected corresponding ratings to: KPI ϵ { 0.00% … 100.00% } are floating point percentage values in ascending importance.
- The selected corresponding weightings to: CSF ϵ [1 … 10]; are integer values in ascending importance. The symbol U̲ indicates sets union.
- The proposed HMM enables the possibility to define *Project* as a model; using CSFs weightings and ratings.

Figure 10. The applied mathematical model's nomenclature (Trad & Kalpić, 2017a)

AMM4BT

rncRequirement	= KP I	(1)
CSF	= Σ KPI	(2)
CSA	= Σ CSF	(3)
Requirement	= ∪ rncRequirement	(4)
(e)neuron	= action+ rncInteligenceArtefact	(5)
mcArtefact	= ∪ (e)neurons	(6)
rncEnterprise	= ∪ mcArtefact	(7)
(e)Ellterprise	= ∪ rncEnterprise	(8)
mcArtefactScenario	= ∪ mcArtefactDecisionMaking	(9)
IntelligenceComponent	= ∪ mcArtefactScenario	(10)
OrganisationalIntelligence	= ∪ InteligenceComponent	(11)
AMM4BT	= ADM+ OrganisationalIntelligence	(12)

A Quantitative-Qualitative Research Mixed Model

Quantitative Research Model

The *TKM&F* qualitative research module enables a holistic systematic approach to research a problem, RQ, factor or phenomenon in given *Project* environment situation (Gast, 2010). It offers RDP capacities to recommend actions and solutions (Lincoln & Guba, 1985). A problem, RQ, factor or phenomenon are examined in iterations relating breadth and depth, using heuristics/beam search, which is specialized for unknown problems, or the ones in a preliminary phase or in first iterations (Babbie, 1989). The solutions or recommendations are offered in the form of reports of professional or academic experiences (Capaldi & Procter, 2005). The solutions processed in the qualitative research module or recommendations are generated by experiments/PoCs, specialists interviews, direct professional observations, processing and analysis of *Project* artefacts, credible documents from for example Gartner or Forster and reference records, visual materials or personal mixed experiences (Denzin & Lincoln, 1994). The solutions or recommendations are delivered with the aim of formulating hypotheses outcomes.

Qualitative Research Model

The *TKM&F* qualitative research module enables a specific qualitative analysis and a precise focus on proving or disproving RQ, problem or hypotheses in a cause-effect manner by applying a detailed and precise processing of pre-defined variables; CSFs in the RDP (Shuttleworth, 2008). The *TKM&F* qualitative research module input data streams(s) consists of sets of numbers that are collected from sets generated by using designed/structured and approved/validated data object-collection modules and statistical processes. The *TKM&F* qualitative research module results are used to explain and direct a given tree node; these results can be applied to another qualitative tree node that gives the ability to analyse the cause and effect; as well as offering solutions or recommendations, even make proactive estimations (Leung, 2015). The *TKM&F* qualitative research module input data streams(s) can be fed from experiments/PoCs, surveys, and/or interviews with precise questions (Kelley, Clark, Brown, & Sitzia, 2003).

The Applied Mathematical Model's Structure

A holistic HMM for *Projects* has a composite structure that can be viewed as follows:

- The static view, has a similar static structure like the relational model's structure that includes sets of CSAs/CSFs that map to tables and the ability to create them and apply actions on these tables; in the case of HMM that are Business microartefacts and not tables (Lockwood, 2018).
- The behavioural view, comprises actions designed using a set of mathematical nomenclature;, the implementation of the HMM is in the internal scripting language; used also to tune CSFs (Lazar, Motogna, & Parv, 2010).
- As the skeleton of the *TKM&F* that uses Business microartefacts' scenarios to support just-in-time *Projects* requests.

The Applied Business Transformation Mathematical Model

The HMM that can be modelled after the following formula for the Business Transformation Mathematical Model (BTMM) that abstracts the *Projects*:

$$\text{iHMM} = \text{Weigthing}_1 * \text{iHMM\_Qualitative} + \text{Weigthing}_2 * \text{iHMM\_Quantitative}. \quad (1)$$

Where the iHMM, is an HMM instance in one of the ADM's iterations.

$$\text{HMM} = \sum \text{iHMM for an enterprise architecture's instance.} \quad (2)$$

(BTMM):

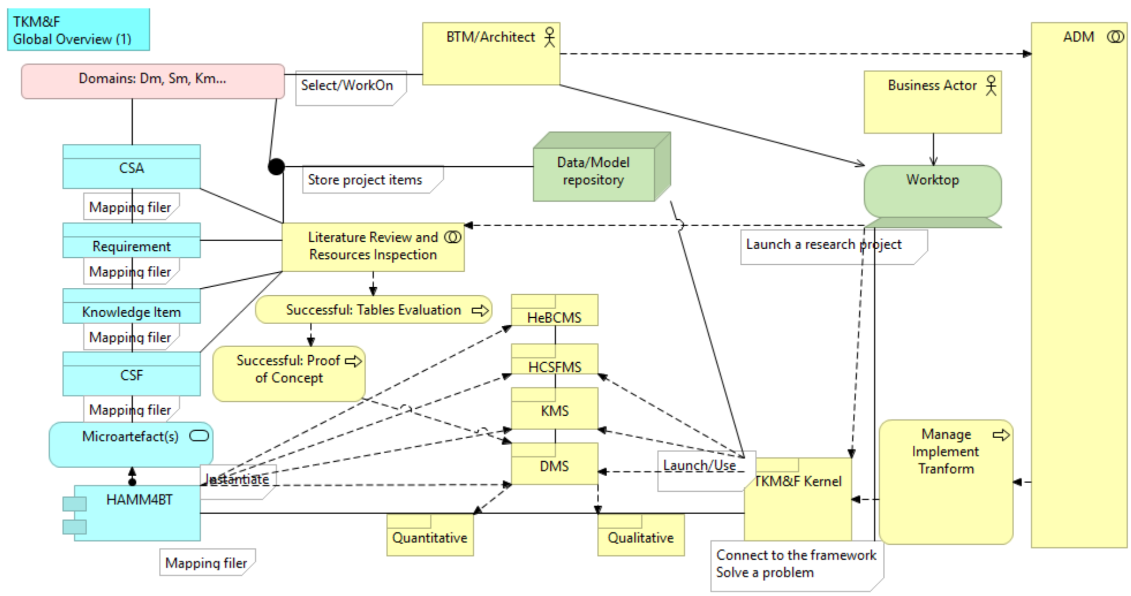
$$\text{BTMM} = \sum \text{HMM instances.} \quad (3)$$

The objective function of the BTMM's formula can be optimized by using constraints and with extra variables that need to be tuned using the HMM. The variable for maximization or minimization can be, for example, the *Projects* success, costs or other CSFs (Dantzig, 1949; Sankaralingam, Ferris, Nowatzki, Estan, Wood, & Vaish, 2013). For this PoC the success will be the main and only constraint and success is quantified as a binary 0 or 1. Where the objective function definition will be:

$$\text{Minimize risk BTMM.} \quad (4)$$

The minimization is related to a goal function. The BTMM is the combination of an *Project* methodologies and a holistic mathematical model that integrates the enterprise organisational concept, information and communication technologies (Lazar, Motogna & Parv, 2010).

Figure 11. The framework's components and its mathematical model



As shown in Figure 11, the HMM is a part and is the skeleton of the *TKM&F* that uses Business microartefacts' scenarios to support HBSRA requests.

The HBSRA components interface the DMS and KMS, as shown in Figure 12 to manage and map CSFs to intelligent items. An instance of the HMM is created at the *Project's* initialization phase and takes care of the logical interaction of various elements. As mentioned and shown in Figure 12, if the aggregations of all the *Project's* CSA/CSF tables exceed the defined minimum, the *Project* continues to its PoC or can be used for problem solving using the heuristic algorithm with punctual calls to quantitative methods. The *Project's* initialization phase generates the needed CSFs and hence creates the types of problems and actions to be solved.

Framework's Holistic Mathematical Model Integration

The HMM is a part and is the skeleton of the *TKM&F* that uses Business microartefacts' scenarios to support HBSRA requests, to estimate the risk. A *Project* and its kernel ADM are the base of this RDP and they are the basis of its *TKM&F.* The authors want to propose the HMM to represent the *TKM&F* architecture and solve its integration problems (Agievich, 2014).

The Holistic Mathematical Model's Integration Critical Success Factors

Based on the literature review and on the resultant CSF evaluation phase, the most important HMM's CSFs that are used are evaluated to the following table:

As shown in Table 2, the result's aim is to prove or justify that HMM is mature and possible to structure an *Project's* case and how it can be used with the *TKM&F* and its HBSRA for the next phase, the PoC. The next CSA to be analysed is the holistic management of the ICT system.

Figure 12. The decision making interface

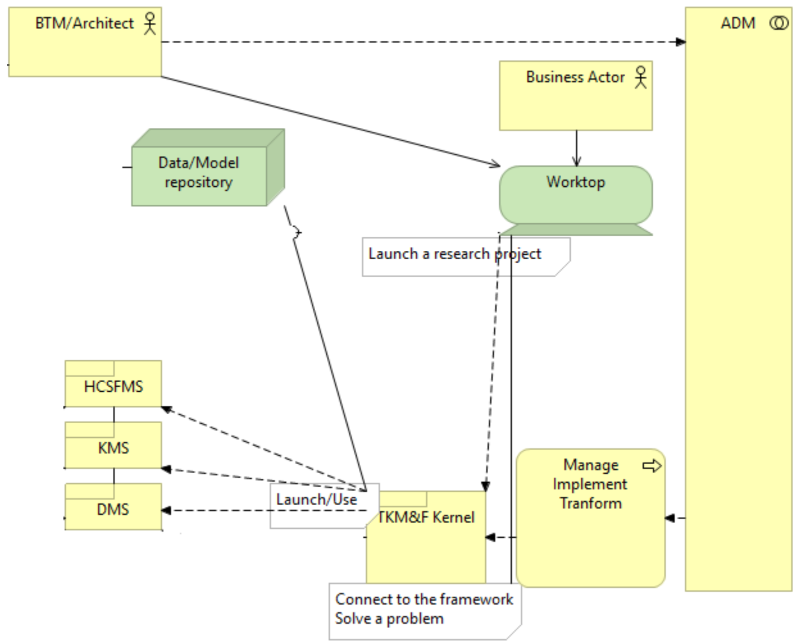


Table 2. The critical success factors that have an average of 9.00

Critical Success Factors	HMM - KPIs	Weightings
CSF_HMM_TKM&F_Integration	StableTested	From 1 to 10. **09 Estimated**
CSF_HMM_InitialPhase	RobustTestedl	From 1 to 10. **10 Estimated**
CSF_HMM_PoCPhase	StableTested	From 1 to 10. **10 Estimated**
CSF_HMM_Qualitative&Quantitative	Complex	From 1 to 10. **07 Estimated**
CSF_HMM_Final_BTMM	VerifiedModel	From 1 to 10. **09 Estimated**
CSF_HMM_ADM_Integration	Synchronized	From 1 to 10. **09 Estimated**

valuation

The Research Section's Link to the Information and Communication Technology

This section's deduction is that the ICT's environment's unbundling is a crucial process for the business environment.

THE KMS' INTEGRATION IN THE INFORMATION AND COMMUNICATION TECHNOLOGY SYSTEM

Distributed Unit of Work

Microartefact granularity and responsibility for a given business or technical scenario is a complex undertaking; added to that there is the implementation of the "1:1" mapping and classification of the transformed microartefacts, as shown in Figure 13. The EA concept uses methodologies like the TOGAF's ADM that supports a set of the *TKM&F's* and HBSRA (Neumann, 2002).

Business Processe Models

Business transformation models are supported by the *TKM&F* to support holistic and inter-connected models to creating value, as shown in Figure 14.

Figure 13. The framework's microartefact interactions

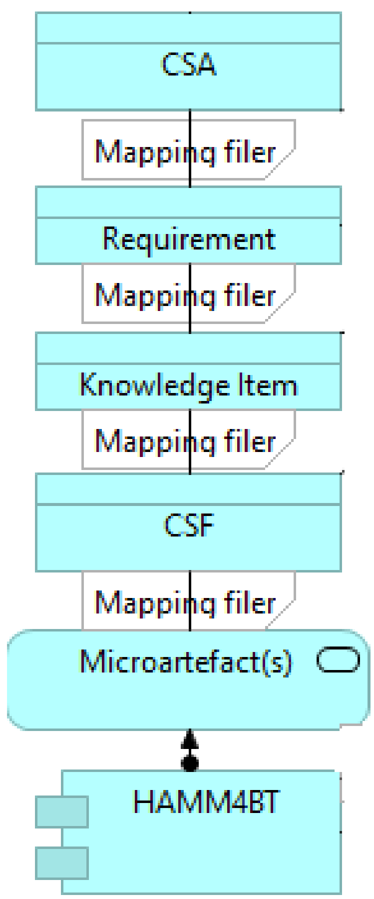
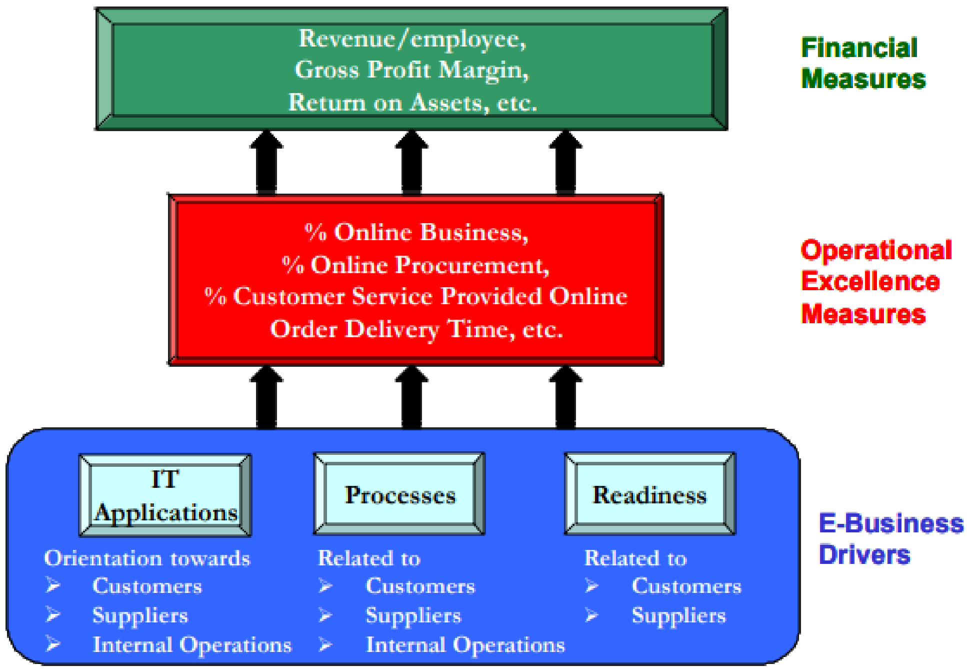


Figure 14. The value model (Barua, Konana, Whinston, & Yin, 2001)



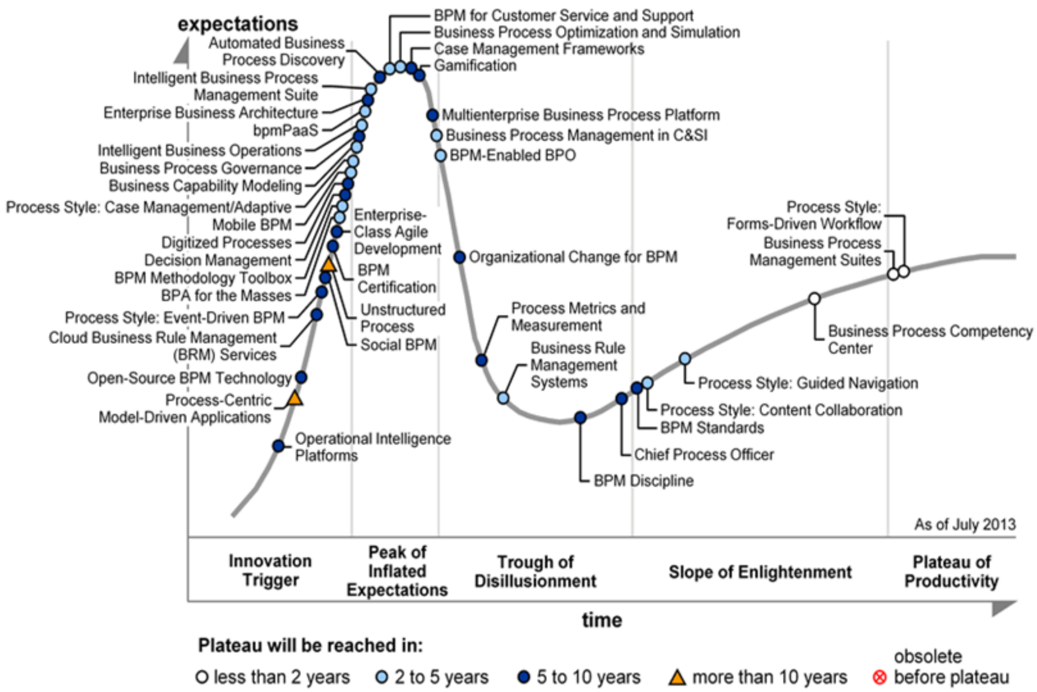
Projects must focus on Business models as a strategic CSF (Keen & Qureshi, 2006), where the TKM&F supports a model-driven extensible Markup Language (XML) transformation to XML Metadata Interchange (XMI) format to incorporate a validation capability. Different Business models are then merged into a target model (Chang, Chen & Lei, 2007). The *TKM&F* supports *Manager*s decisions and inter-enterprise cognitions that are shared also by stakeholders. Relating to a historical case study of Nokia's corporate *Project*, which proved highly successful, where Businesses models where the base (Aspara, Lamberg, Laukia, & Tikkanen, 2011).

As shown in Figure 15, the role of BPM is a dominant business standard, this illuminates from the aspect of hype cycle of the current transitional status of BPM evolution and defines a new standard of innovation. Figure 15. shows also the extent to which the Gartner Inc. believes that each hype cycle's entry would enable the enterprise to achieve sustainable benefits within the planned *Project's* budget (Gartner, 2012).

Business Standards

To manage agile *Project's* complexity in its implementation phase, an adequate mapping concept must integrate Business standards (OASIS, 2014); that is the main principle and recommendation for the capability (and risk) based strategy. The strategy is enabled by the establishment of an ADM based iterative model that can map all the *Projects* artefacts in a linear "1:1" manner (The Open Group, 2011b). The proposed HBSRA embeds microartefact patterns to be used by any type of *Project*. Microartefacts are classified and interconnected using interoperability standards. The application of structured simplicity can be achieved by the application of the "1:1" mapping rules that are based on microartefacts and business

Figure 15. Hype cycle for business process management (Gartner, 2012)

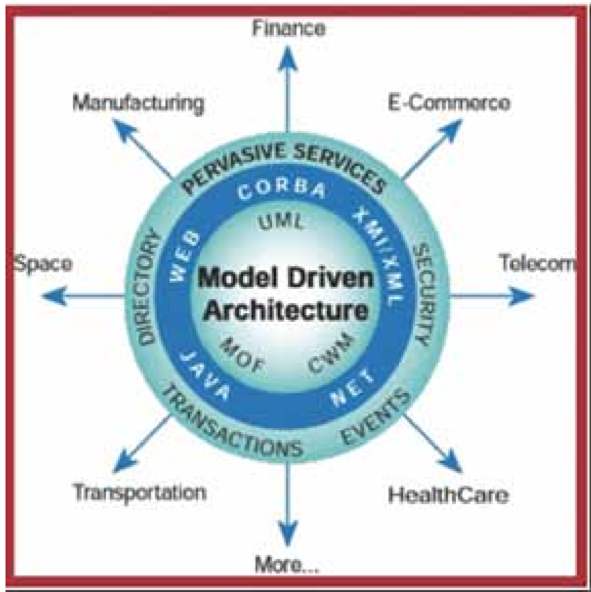


requirements alignment (Fowler, 2014). The *TKM&F* holistic concept integrates major standards and the major issue is, how to keep the *Project* feasible with so many types of microartefacts and methodologies, knowing that *Projects* have restrictive budgets and must insure an iterative model. A possibility is the use of a pseudo bottom-up approach, which is strongly recommended by the authors.

Today, standards are operational and we can even talk of a standard proliferation (Desfray, 2011). These standards and tooling environments support the *Projects* through an iterative pseudo-bottom-up approach, as shown in Figure 16. By pseudo, the authors refer to simultaneous management of top-down architecture and modelling vision processes that are tightly dependent on the bottom-up unbundling activities.

The iterative pseudo bottom-up approach may help an Business company to easily integrate various and global business/commerce ecosystems that support their inter-operability with the global economy using an adapted *Project* strategy and vision (The Open Group, 2011b). The theory and concept of design patterns suggest that implementers must be able to reuse proven components that emerge from the best architecture & modeling practices in order to solve generic *Project's* implementation requirements. Patterns promote the concept of building and solution blocks. Microartefact patterns can be used as the future *Project* building and solution blocks. It is recommended that *Projects* should apply a microartefacts driven development. The scope's difficulty and complexity lie in an architecture capability framework, which would synchronize the business vision with the enterprise's business capabilities (Trad & Kalpić, 2015b).

Figure 16. The iterative architecture development process (The Open Group, 2014a)



Without the use of HBSRA patterns, an *Project* can: 1) have poor performance; 2) lack scalability; and to 3) become un-usable and un-maintainable. Added to that, some architects have the tendency to reinvent the wheel when attempting to implement an architecture template for various types of *Projects* and that creates redundant artefacts (Taleb & Cherkaoui, 2012). HBSRA patterns can create reusable designs that can be mapped to different types of *Projects*.

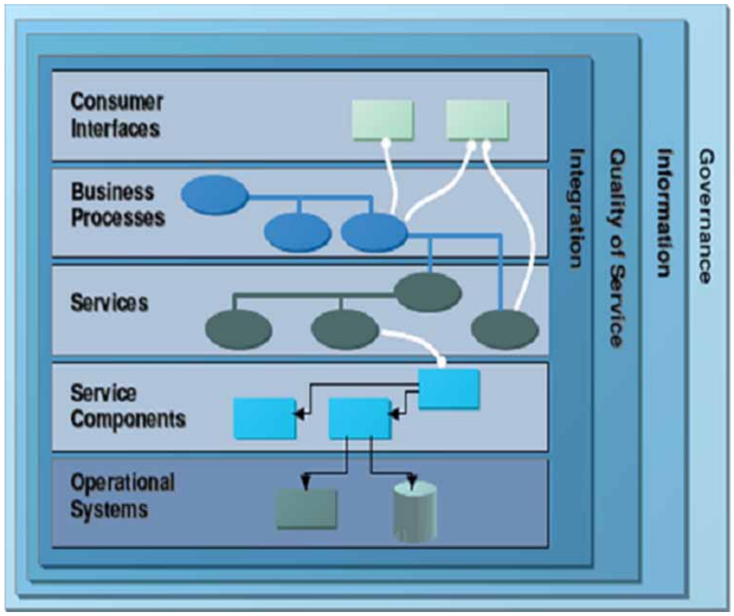
Business Services Strategy

The *TKM&F's* pseudo bottom-up approach is based on Service Oriented Architecture (SOA) concept that is described in Capgemini's SOA framework that defines a standardization strategy, methodology and productivity environment. Capgemini's framework outlines a SOA service directory for vertical Business solutions, as shown in Figure 17. The *TKM&F* proposes to upstream *Project* activities using web services choreography. These services are classified in a specialized resources directory. The *TKM&F* recommends the adoption of a light variant of TOGAF where its atomic business services approach provides the conceptual and logical viewpoints for the integration of services across various Business domains, information flows, application and technology layers (Gartner, 2005).

Business Security

The *TKM&F* and HBSRA define a vision on how to protect resources from attack by: 1) localizing gaps in the infrastructures of partners; 2) including a review of detection, assessment, hardening techniques, and real-time security solutions blocks, to be integrated in order to provide life-cycle security solutions; 3) blocking cumulative effects of orchestrated attacks that have devastating form of financial damage; 4)

Figure 17. Business system's consumer integration (The Open Group, 2014a)



defining an enterprise security strategy to analyse the infrastructure and locate potential weaknesses; 5) building a robust defence; 6) integrating security in transactions; and 7) applying holistic qualification procedures (Clark, 2002).

Holistic Qualification Procedures

Many types of problems and events may cause an *Project* to fail, these problems are frequently justified by the human behavioural aspects translated into para-psychology finger-pointing strategies that result from senseless instinctive Business Schools rejection and marginalisation of concrete sciences.

Figure 18, shows the evolution of intelligent systems and the actual immaturity of design, development, qualification and operations for *Projects* that still are in an infancy age, or simply chaotic. Tools for implementation environments are still confronted with serious project issues. These problems show that archaic tools are inappropriate for large enterprise intelligent systems and the authors recommend the use HBSRA CSF based patterns (Panetta, 2016).

Factor Patterns

A HBSRA pattern, that is managed in the *TKM&F* repository; these patterns express a structural concept for Business data item structure. The pattern provides the following: 1) it offers a set of predefined items for structural, knowledge and intelligence templates to instantiate microartefact scenarios; 2) it describes their responsibilities, relationships and content; 3) it helps to define complex relationships between *Project's* microartefacts; 4) it defines a default CSA and CSF sets model; and 5) simplifies the CSF table evaluations.

Figure 18. The decision making based systems' evolution (Panetta, 2016; Gartner, 2013).

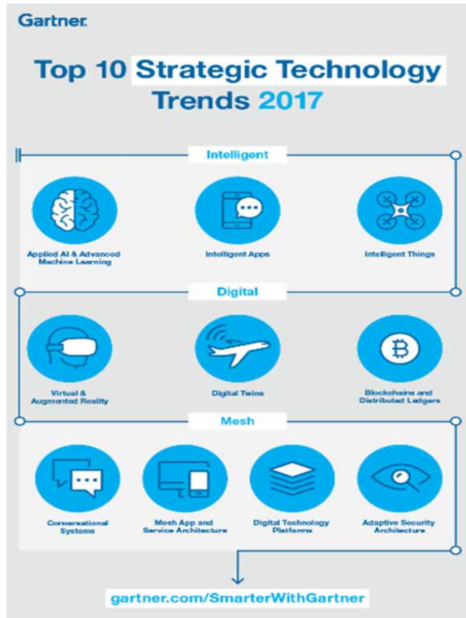
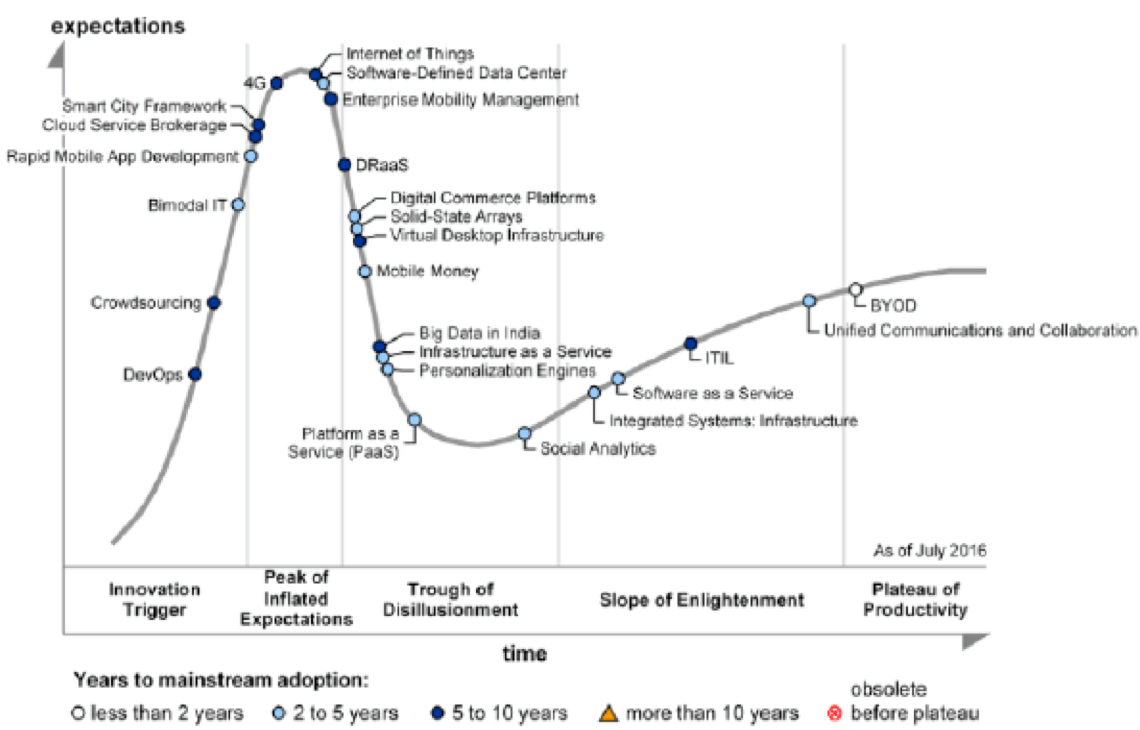


Figure 19. The maturity of development methodologies



The *TKM&F* repository components support the *Projects* by offering default CSF sets to handle various types of *Project's* resources using development and operations methods, as shown in Figure 19.

Resources, Artefacts and Success Factors

The *TKM&F's* repository maps and relates the selected CSFs to various types of *Project's* resources, like architecture models, microartefacts and requirements; as shown in Figure 20, it can deliver an interface to the KMS. This mapping concept associates CSFs, resources and microartefact scenario instances in all of the implementation phases of the ADM (The Open Group, 2011a). The HBSRA manages the CSFs and mappings in the *TKM&F's* repository and identifies the initial set of CSAs/CSFs to be used.

The Information and Communication Technology's Critical Success Factors

Based on the literature review and factors' evaluation, the most important ICT's CSFs that are used are evaluated to the following:

As shown in Table 3, the result's aim is to prove or justify that it is possible to implement a HBSRA, which interacts with the ICT system that enables the next CSA to be analysed, which is the integration of the ADM.

The Research Section's Link to the Architecture Development Method

This section's deduction is that the ICT and other fields are dependent on an EA paradigm and therefore the ADM is crucial for the integration of the HBSRA.

Figure 20. The knowledge management subsystem

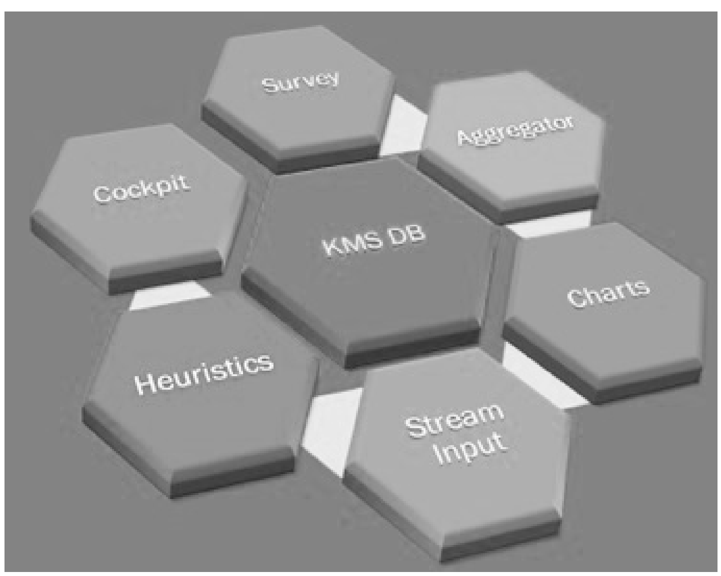


Table 3. The critical success factors that have an average of 9.00

Critical Success Factors	HMM - KPIs	Weightings
CSF_ICT_IntegrationProcesses	MatureSupported	From 1 to 10. **09 Estimated**
CSF_ICT_Operations&Choreography	SimpleAutomated	From 1 to 10. **09 Estimated**
CSF_ICT_DesignProcess	SimpleSupported	From 1 to 10. **09 Estimated**
CSF_ICT_McLifecycle	ExistingProcedures	From 1 to 10. **10 Estimated**
CSF_ICT_RAD_BPM	ComplexEnvironments	From 1 to 10. **08 Estimated**
CSF_ICT_Tests	ExistingTests	From 1 to 10. **10 Estimated**
CSF_ICT_StorageRepository	Supported	From 1 to 10. **08 Estimated**
CSF_ICT_Mapping	Supported	From 1 to 10. **09 Estimated**
CSF_ICT_HBSRA_StandardsIntegration	Supported	From 1 to 10. **09 Estimated**
CSF_ICT_HBSRA_Strategy	Supported	From 1 to 10. **10 Estimated**
CSF_ICT_HBSRA_Security	Supported	From 1 to 10. **08 Estimated**

valuation

THE INTEGRATION WITH THE ARCHITECTURE DEVELOPMENT METHOD

The HBSRA' integration with the ADM, enables the automation of the *Projects* artefacts management and evaluation. The ADM is a generic method and recommends a set of phases and iterations to develop the *Projects*; it designs parts of the transformed system interfaces and other deliverables also with other internal and market frameworks.

Architecture Phases

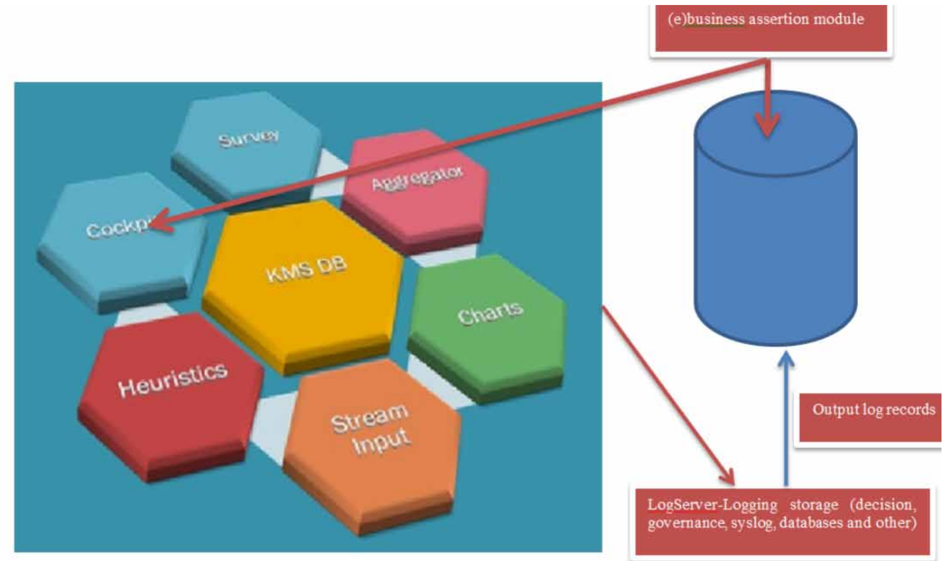
As shown in Figure 21, the ADM manages the *Project's* development iterations; in this section the authors present ADM's phases and the HBSRAs interactions (Visual Paradigm, 2019):

- The preliminary phase selection of the relevant CSFs and interactions.
- The architecture vision and business architecture phases interactions.
- The information system architecture phase's interactions.
- The technologies architecture phase's interactions.
- The requirements management and tests phase's interactions.

Business Architecture

The *TKM&F* uses business standards that include EA frameworks, BPM, microartefacts interoperability… The mentioned Business standards are managed by the *TKM&F*, which delivers added value and robustness to *Project*s (Chaffey, Ellis-Chadwick, Johnston, & Mayer, 2008). The proposed *TKM&F*'s EA capabilities help in establishing an architecture principal guideline that defines the *Project*'s initial phase and vision; which is based on a "just-enough" architecture the ADM (The Open Group, 2011b).

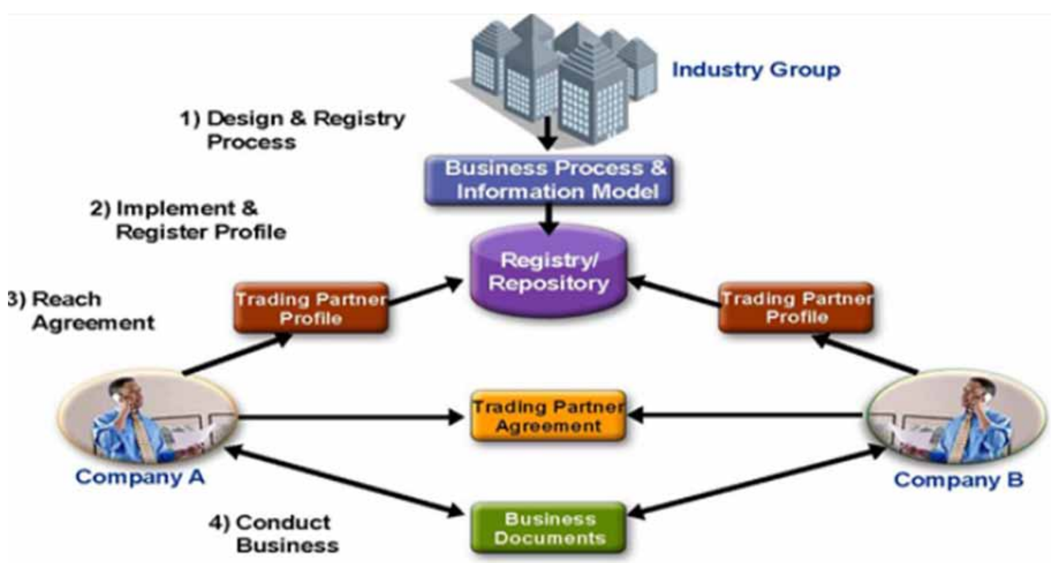
Figure 21. The architecture method's interaction



In order to move towards a "just-enough" Business architecture that is known as the target or final interaction architecture as shown in Figure 22, where the important adjacent domains are clearly shown (OASIS 2006: seol.net 2014).

The *TKM&F* recommends to first align: 1) the business enterprise's traditional architecture vision (as shown in Figure 23); 2) the Business architecture principles; and 3) standards management to support EA (as shown in Figure 24). The traditional business architecture layers that are shown in Figure

Figure 22. The business/commerce interaction architecture (OASIS, 2006)



23, represent a silo model of the fundamental four components. These four components are very hard to melt down into an agile enterprise and holistic architecture. In fact, they represent a hairball of unstructured autonomous islands that contain heterogeneous business and technology entities. Moving to a standardized EA would be the first step towards a manageable Business architecture. From such a model the *Manager* must transform the environment into a well-organized directory of microartefacts (Trad & Kalpić, 2015a).

EAs building and solution blocks are implemented to solve a group of issues within an *Project*, which needs a precise set of architecture principles to integrate various types of architecture blueprints, as shown in Figure 24. These building and solution blocks can be considered as *Project*'s deliverables. The dimensions of an applied EA are used to design the scope and boundaries of the future Business system. That includes the level of detail, architecture domain, technologies, tools, etc… (The Open Group, 2011b).

The Architecture Development Method Critical Success Factors

Based on the literature review and CSF evaluation process, the most important ADM's CSFs are evaluated to the following:

As shown in Table 4, the result tries to prove or justify that it is possible to integrate and automate the ADM's interaction with the *TKM&F*; and the next CSA to be analysed is the holistic management of the risk based KMS.

The Research Section's Link to the Electronic Knowledge Management System

This section's deduction is that the HBSRA can be integrated in the *Projects* and a holistic ADM and the HBSRA is for KMs and DMSs; or any other intelligence based systems like the risk based KMS.

Figure 23. Traditional business architecture (The Open Group, 2014a)

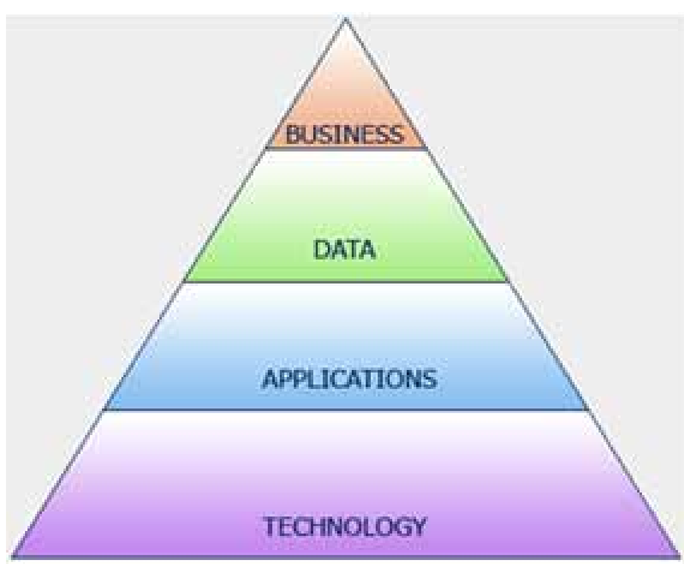


Figure 24. Integration of architecture artifacts (The Open Group, 2014a)

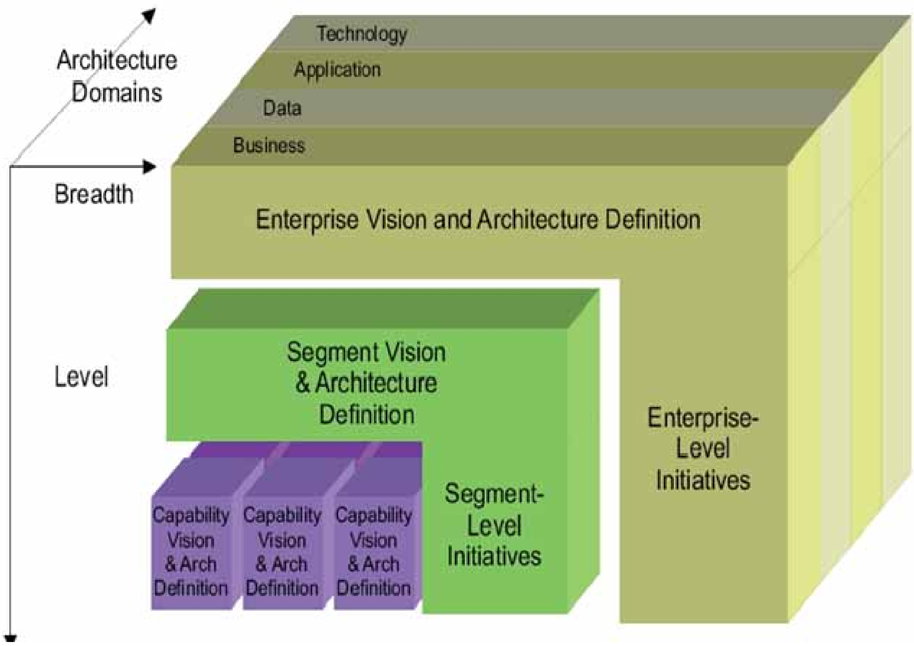


Table 4. The critical success factors that have an average of 9.20

Critical Success Factors	HMM - KPIs	Weightings
CSF_ADM_CSF_Initialization&Setup	MatureStatus	From 1 to 10. **10 Estimated**
CSF_ADM_IntegrationProcesses	StandardSupported	From 1 to 10. **08 Estimated**
CSF_ADM_Phases	Supported	From 1 to 10. **10 Estimated**
CSF_ADM_Requirements	MappingAutomated	From 1 to 10. **09 Estimated**
CSF_ADM_HBSRA_Architecture_Interface	Supported	From 1 to 10. **09 Estimated**

valuation

THE HOLISTIC RISK BASED KNOWLEDGE MANAGEMENT SYSTEM

For a holistic risk based KMS (rKMS) the goal is basis to manage information items in a holistic management concept that offers also the possibility to access distributed knowledge; where the objectives are associated with the CSFs that can abstract success or failure (Rockart, 1979). In the 21st century rKMS is of ultimate strategic importance for the management of the traditional knowledge resources in *Projects*. In traditional environments many and various knowledge management accesses exist and are a barrier for rKMS and Business strategies (Malhotra, 2000).

The Holistic Risk Knowledge Management

The rKMS uses the HBSRA that links the Business system to one or risk Knowledge Items (rKI); where rKIs and microartefact scripts are responsible for the manipulation of intelligence and control various knowledge processes. The rKMS supports the HBSRA underlying mechanics to manage rKI microartefacts. The HBSRA is responsible for access and rKI's extraction, using holistic systemic approach (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a). A successfully integrated HBSRA with an rKMS can give a company important competitive business advantages that may insure its future (Trad, 2018a; Trad, 2018b; Trad, 2018c; Clark, Fletcher, Hanson, Irani, Waterhouse & Thelin, 2013).

The Holistic Knowledge Strategy

As shown in Figure 25, rKIs map to CSFs and microartefact(s) and are classified in specific CSAs. A HBSRA concept expresses a fundamental structural *Project's* concept for the rKMS/rKI implementation; which enables a holistic approach to knowledge access and its mapping to CSFs.

A HBSRA is managed by the *TKM&F*, where the *Manager* or enterprise architect configures rKMS/rKI items, The HBSRA concept is implemented in all of the *Project's* components and it enables the delivery of the requested rKIs (The Open Group, 2011a; Trad & Kalpić, 2017a, 2017b, 2017c). Strategy is an architecture roadmap to select tools and design solutions for *Projects*, which is related to the overall enterprise strategy. Strategy's purpose is to identify benefits from rKMS and to implement technology concepts that support the efficiency of the Business processes (Alhawamdeh, 2007), as shown in Figure 26.

Figure 25. The decision making system's main components

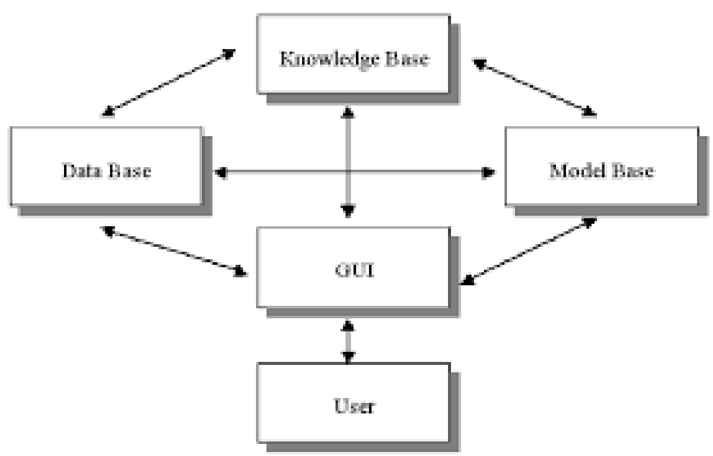
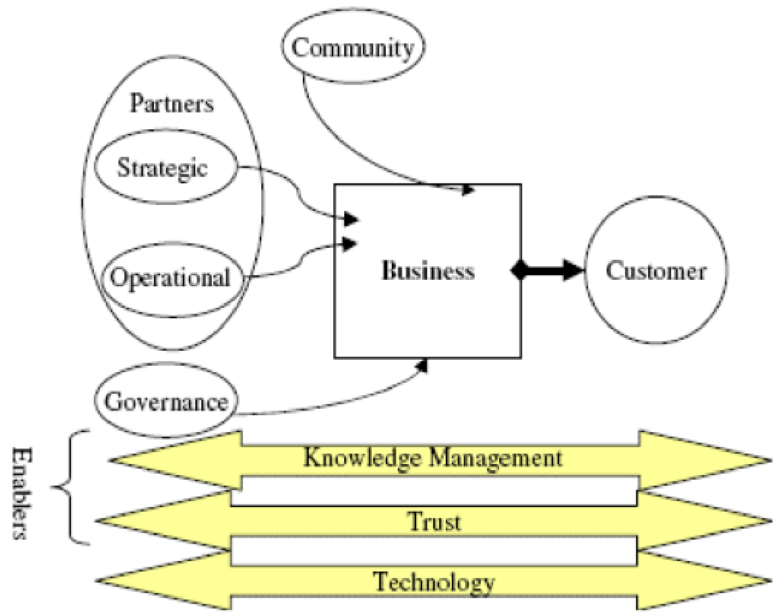


Figure 26. Knowledge management and the business environment



The Risk Knowledge Management Success Factors

Based on the literature review, the most important knowledge CSFs that are used are:

The Modules Chained Link to the Intelligence Support or Decision System

The rKMS' integration result proves that it is possible to implement an HBSRA to interface the risk based DMS.

Table 5. The critical success factors that have an average of 9.20

Critical Success Factors	HMM - KPIs	Weightings
CSF_rKMS_ICTIntegration	FullySupported	From 1 to 10. **10** _**Estimated**_
CSF_rKMS_rKI_Mapping	ComplexToImplement	From 1 to 10. **08** _**Estimated**_
CSF_rKMS_Patterns	Implementable	From 1 to 10. **10** _**Estimated**_
CSF_rKMS_HBSRA_Integration	Implementable	From 1 to 10. **09** _**Estimated**_
CSF_rKMS_AccessManagement	StandardIntgeration	From 1 to 10. **09** _**Estimated**_

valuation

THE INTEGRATION WITH THE RISK BASED DECISION MAKING SYSTEM

Critical Success factors

CSFs can be applied in the (Trad & Kalpić, 2014b): 1) selection of the business resources; 2) EA implementation strategy; 3) risk based DMS (rDMS) engine; and 4) training needs definition in order to estimate the status of an *Project* and to decide whether to stop it or not. In such cases a general rule can be applied: … *Project* team that cannot design the solution or cannot manage the unbundling process in the implementation phase, has insufficient capacity to successfully complete it (Chaffey, Ellis-Chadwick, Johnston, & Mayer, 2008).

Complex Decision Systems

The consequent economic crises have shown the need for risk prediction and assessment in business, where discarding this fact will surely have damaging consequences on *Projects*. That implies that the analysis and management of risk is one of the important pre-requisites to ensure the success of an *Project*. The *TKM&F* integrates risk management and performs the analysis using a rDMS (Hussain, Dillon, Chang, & Hussain, 2010). The HBSRA interfaces the rDMS that is aimed for complex *Projects* and is supported by the HMM formalism. DMS' holistic management is an approach for building Business systems using a central decision process (Daellenbach & McNickle, 2005).

A Risky Process

*Project*s are very risky and as shown in Figure 29, the risks levels are very high at about 70%, when using radical transformations (Malhotra, 2000).

rKMS' and the rDMS' integration in *Projects,* has gained importance and is a key CSF that evaluates the traditional problems a business may face with intelligent systems, and that can damage the strategy of enterprises. The *Manager* is the one who must manage the decision making process (Malhotra, 2000).

The Decision Making Process

In the HBSRA based rDMS', *Project*s team members can select and tune types of CSAs and CSFs to be processed. The selected CSFs are orchestrated by the HMM's choreography engine that is the base of the DMS (The Open Group, 2011a; Trad & Kalpić, 2017a, 2017b, 2017c). The *TKM&F*'s interfaces the rDMS that uses an empirical problem-solving algorithm that is used in the case when an optimization algorithm approach is impractical or when the problem is too complex and multi-dimensional (Dictionary, 2014). The rDMS can be considered as the major managerial benefit that has resulted from this RDP and uses a grounded hyper-heuristics that is a qualitative problem solving component (Wes, 2001; Trad & Kalpić, 2015a). The DMS is founded on a hyper-heuristics decision model that offers the possibility to choose the optimal solutions to cope with complex *Project*s. This approach should also be capable to solve the encountered problems in a just-in-time manner. These *Project*s problems require a specific set of skills, especially for the final and the very difficult implementation phase (Trad & Kalpić, 2013a).

Figure 27. Risks in Business transformations (Malhotra, 2000)

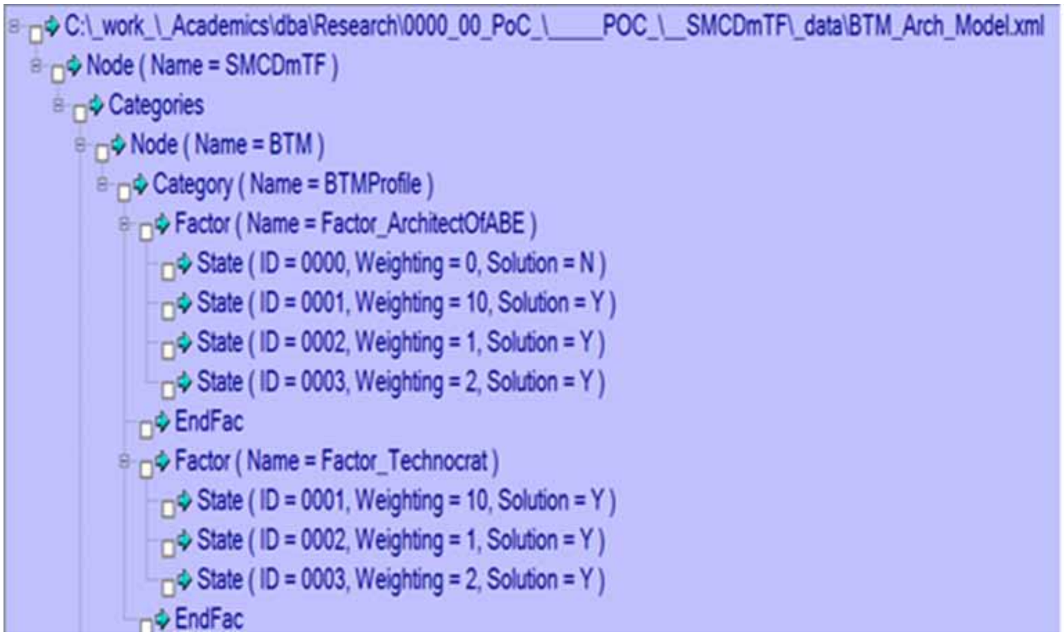
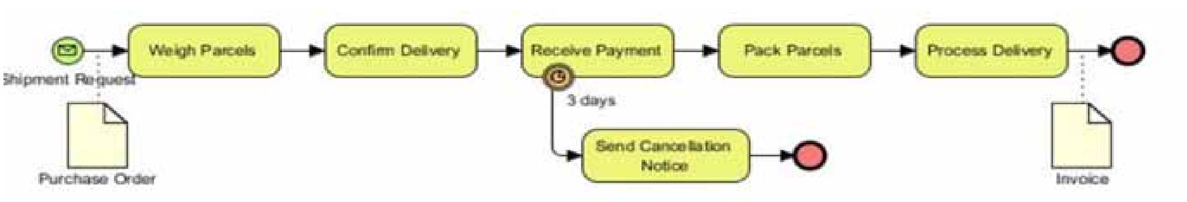


Figure 28. A view on the framework's tree solution nodes (Trad & Kalpić, 2013a; Trad, 2018a)

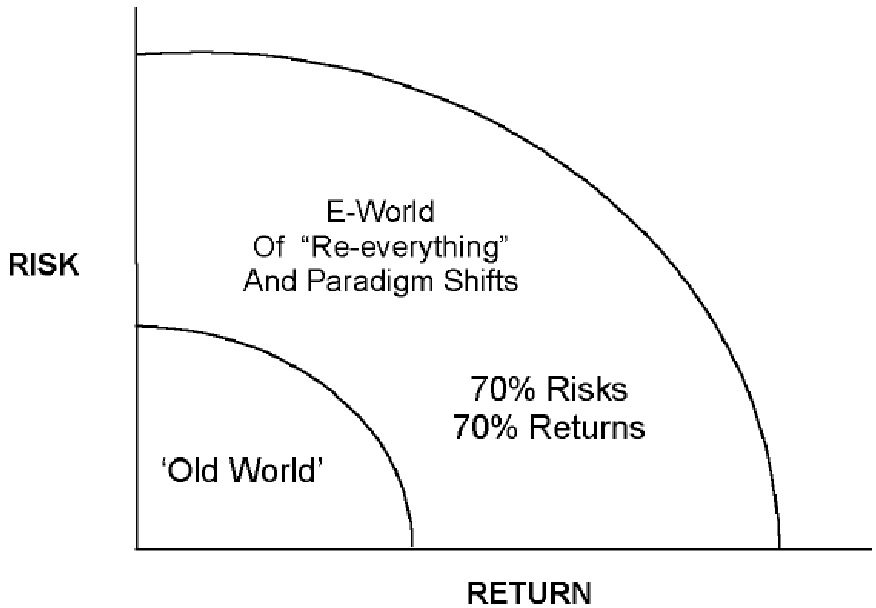


Projects have an immense potential to improve the competitiveness of Business environments. A rDMS in Business is a software engine that enhances the user's ability to make decisions (e-commerce, 2014). The *TKM&F* presents a new approach for rDMS's integration which can be applied by the transformation of existing decision support, by using Business technologies. Business technologies are the fastest growing field and they can be applied to coordinate, control and prototype the DMS. The *TKM&F* improves the existing decision support of an enterprise (Sreka & Slaninova, 2012; Trad & Kalpić, 2015b). The *TKM&F's* decision tree that is shown in Figure 27, is based on a qualitative grounded hyper-heuristics concept that is a beam search model which uses the results from the previous quantitative module that use transactions.

Business Transactions

A successful *Project* depend on the execution of robust transactions with a high rate of successful terminations. As shown in Figure 28 the integration of various technologies will make transactions robust, automated and they can be managed by various endpoints of the enterprise's distributed architecture (Desfray, 2011).

Figure 29. Choreography of a robust transaction using business process management (Visual Paradigm, 2014)



The various Business models of an commerce, like the business-to-business (B2B), business-to-consumer (B2C) and consumer-to-consumer (C2C) are today stable models. These models need delimiters to be closely bound to the supplier who is linked to the Business flow. Therefore, there is a need for a multi-end transactional model that minimizes the dependencies between the various parties. The commerce transaction connection must be established between the consumer and the end supplier with minimal risks (Jin, K. & Zhu, J., 2011; Trad, 2014).

Business/Commerce Transaction Valuation

The commerce economy is an important CSF of the global economic growth in the recent years. Many financial, business, manufacturing enterprises and service companies are implementing commerce solutions to respond to the challenges of the global/holistic interconnected and automated economy. Due to increasing dependencies and ever faster return on investment, the returns of transaction cost and benefit accounting have become very important, even more interesting than the traditional business and commercial enterprises returns. transactions reduce the transactions costs that include: 1) search costs; 2) costs of processing transactions (e.g. invoices, purchase orders and payment schemes); and 3) cost in trading processes (Xiaohong, 2011). The cost of transaction ratio can be integrated in the *Project* as a critical success factor with the highest weighting.

The Decision Making System's Critical Success Factors

Based on the literature review and evaluation processes, the most important DMS's CSFs that are used are evaluated to the following:

Table 6. The critical success factors that have an average of 9.5

Critical Success Factors	HMM - KPIs	Weightings
CSF_DMS_ComplexSystemsIntegration	Supported	From 1 to 10. **09 Estimated**
CSF_DMS_HBSRA_Interfacing	Supported	From 1 to 10. **09 Estimated**
CSF_DMS_rKMS_Interfacing	IntegrationEnabled	From 1 to 10. **10 Estimated**
CSF_DMS_DMP	IntgeratesAsKernel	From 1 to 10. **10 Estimated**
CSF_DMS_HolisticApproach	Supported	From 1 to 10. **08 Estimated**

valuation

As shown in Table 6, the result tries to prove or justify that it is possible and even mature to implement a holistic and distributed DMS using the HMM formalism and that will be presented in the HBSRA section.

The Research Section's Link to the Proof of Concept

This chapter's deduction that selects and evaluates the CSFs, is based on the six tables that this RDP has generated, and the following phase is the PoC's implementation.

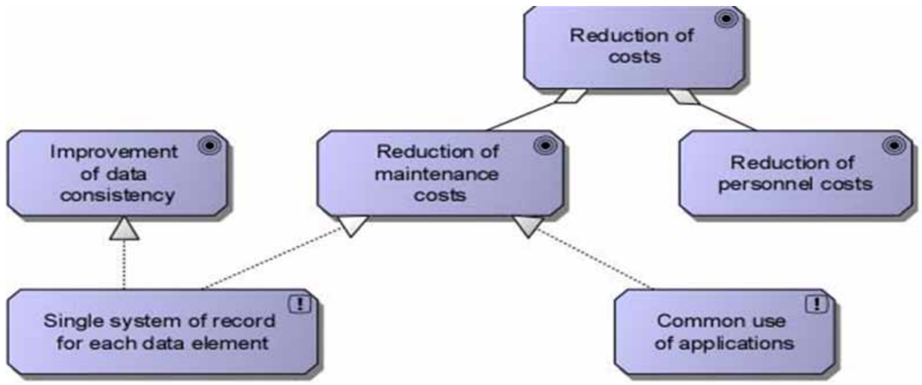
THE PROTYPE'S INTEGRATION

HBSRA supports *Projects* and is used in the ACS/PoC that uses the default book's ACS, as this experiment's case (Lebreton, 1957; Ronald, 1961; Spencer, 1955). The ACS is an insurance management system that is based on an archaic information system, a mainframe, claim files service, customer file service. The ACS manages claims activities where the demo application uses the *TKM&F* for the ACS/PoC implementation (Trad & Kalpić, 2018c). The *Project* major achievement is the introduction of compound services based microartefacts.

Application Portfolio Rationalization Scenario, Data Unification

In this PoC's implementation, the ArchiSurance ACS is used; due to the merger, the old business system's landscape has become siloed, that results in increased data and code, knowledge redundancy, functional overlap and archaic integration using multiple formats and technologies. For this PoC, a holistic approach is tested to structure the pool of microartefacts using a repository of services. The repository structure must be transformed to improve data storage and the common use of applications bias Services quality/robustness, as shown in Figure 30, which displays the base sets of CSAs.

Figure 30. Transformation goals (Jonkers, Band & Quartel, 2012)

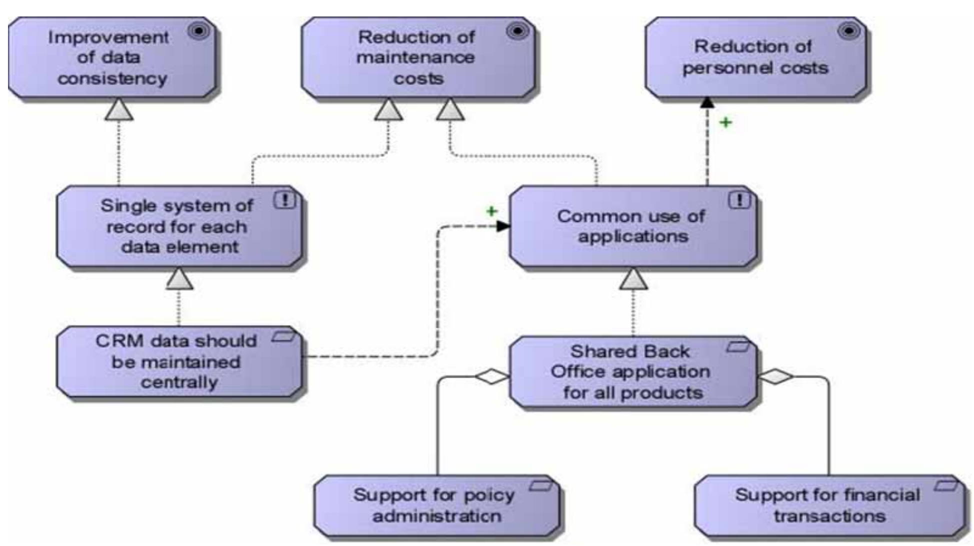


The Architecture Method's Phases' Setup and Business Factors

The HBSRA's implementation phases' setup looks as follows:

- phase A or the Architecture Vision phase, establishes an architecture; as shown in Figure 31.
- Phase B or the Business Architecture phase shows how the *Project's* target architecture realizes the key *Project's* requirements.
- Phase C or the Gap Analysis phase shows and uses the Application Communication Diagram, which shows the modelled target application landscape.
- Phase D or the Target Technology Architecture and Gap Analysis phase shows the final *Project's* infrastructure.
- Phases E and F, Implementation and Migration Planning; the transition architecture, proposing a possible intermediate situation and evaluates the *Project's* status.

Figure 31. Goals and principles (Jonkers, Band & Quartel, 2012)



The Proof of Concept

The chapters' PoC is implemented using *TKM&F* was also developed exclusively by the authors, who own the total copyrights. The PoC presents the HBSRA mechanics' that interface the DMS that uses the internal initial Business set of CSFs' that is an example for this chapter, is presented and evaluated in Tables 1 to 6 as shown in Figure 32.

The services based microartefacts have bindings/mappings to specific *Projects* resources like CSFs, as shown in Figure 33.

The used microartefacts are designed using EA methodologies and related tools. The HBSRA concept defines relationships between the *Projects* requirements and services based microartefacts (and CSAs/CSFs), using global unique identifiers, as shown in Figure 34.

The PoC is achieved by using the *TKM&F* client's interface that is shown in Figure 35; where the starting activity is to structure the organizational part.

Once the development setup interface is activated, the NLP interface can be launched to implement the needed microartefact scripts to process the defined six CSAs. After starting the *TKM&F's* graphical interface, the sets of CSFs are selected, as shown in Figure 36.

Then follows the CSF attachment to a specific node of the *TKM&F's* graphical tree, as shown in Figure 37; to link later the microartefacts.

From the *TKM&F* client's interface, the ML development setup and editing interface can be launched to develop the Business services to be used in microartefacts.

These scripts make up the intelligence basis and the HMM's instance set of actions that are processed in the background to support Business services to be used in microartefacts. The HMM uses Business services that are called by the DMS actions, which manage the edited mathematical language script and flow, as shown in Figure 39.

Figure 32. The TKM&F set of phases

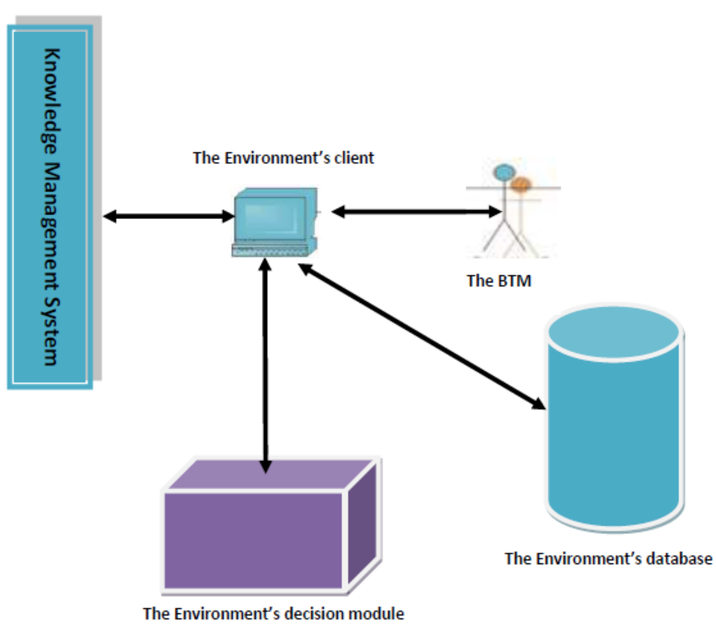


Figure 33. The TKM&F services based microartefacts concept

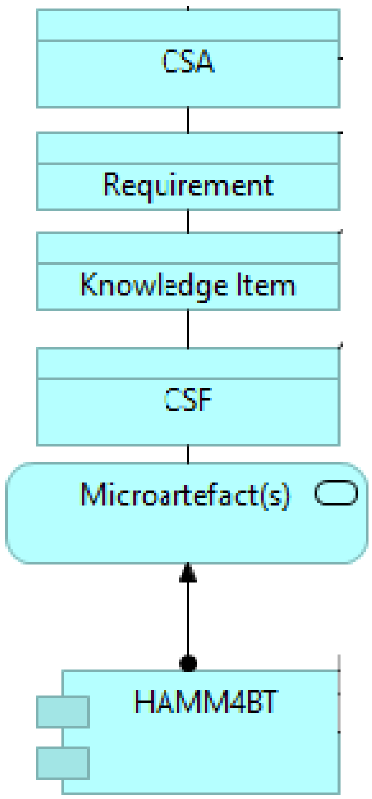


Figure 34. The TKM&F's global unique identifiers interaction

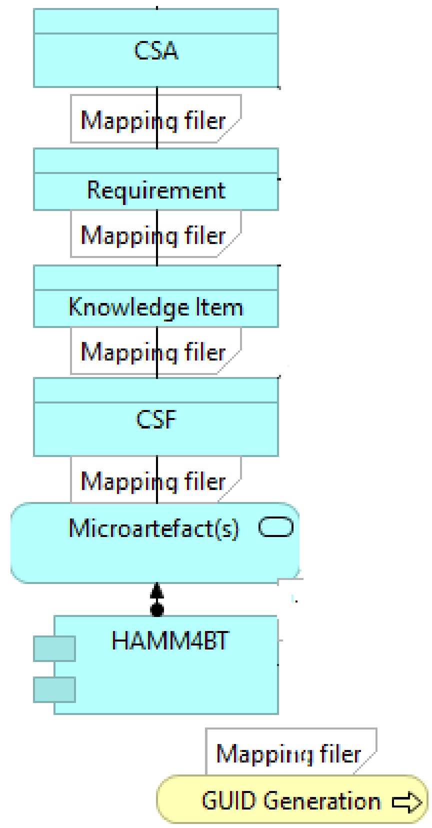


Figure 35. The TKM&F's client interaction

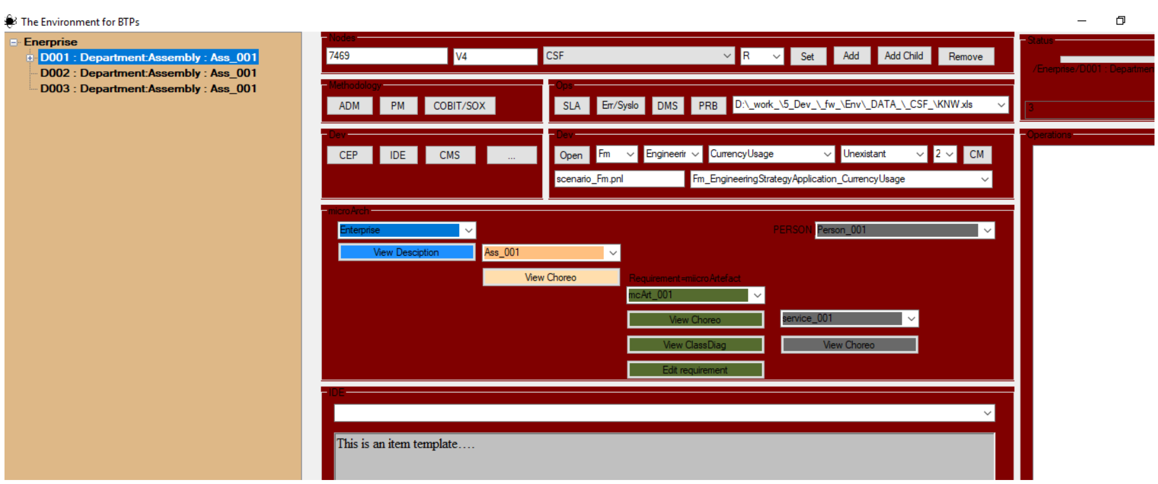


Figure 36. The TKM&F's factor setup interface

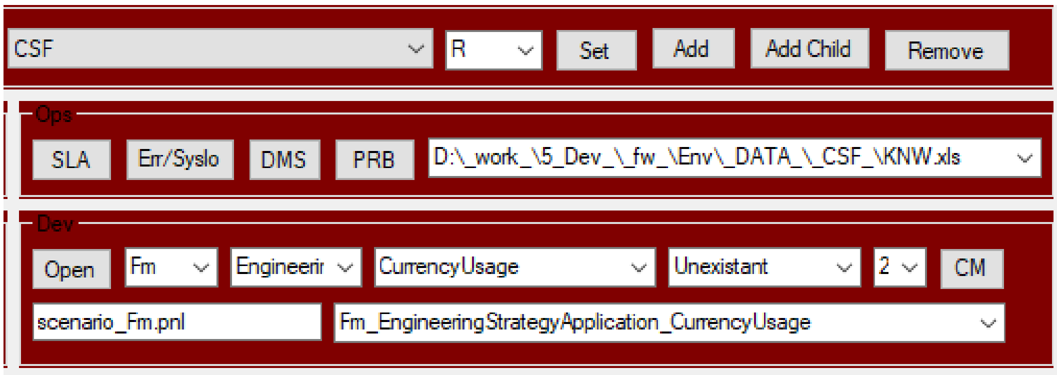


Figure 37. The TKM&F's factor setup interface

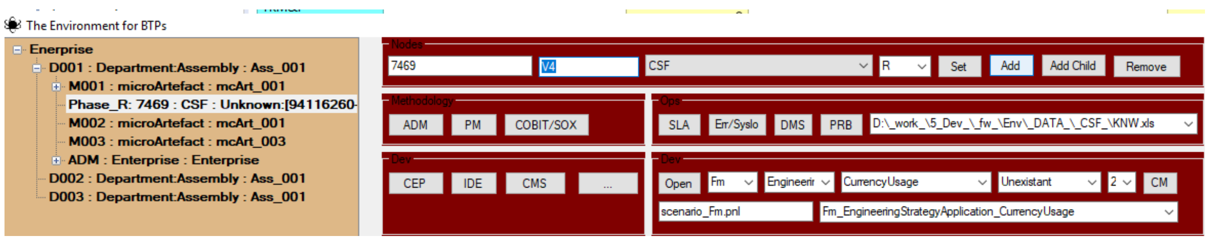


Figure 38. The edited mathematical language script and flow

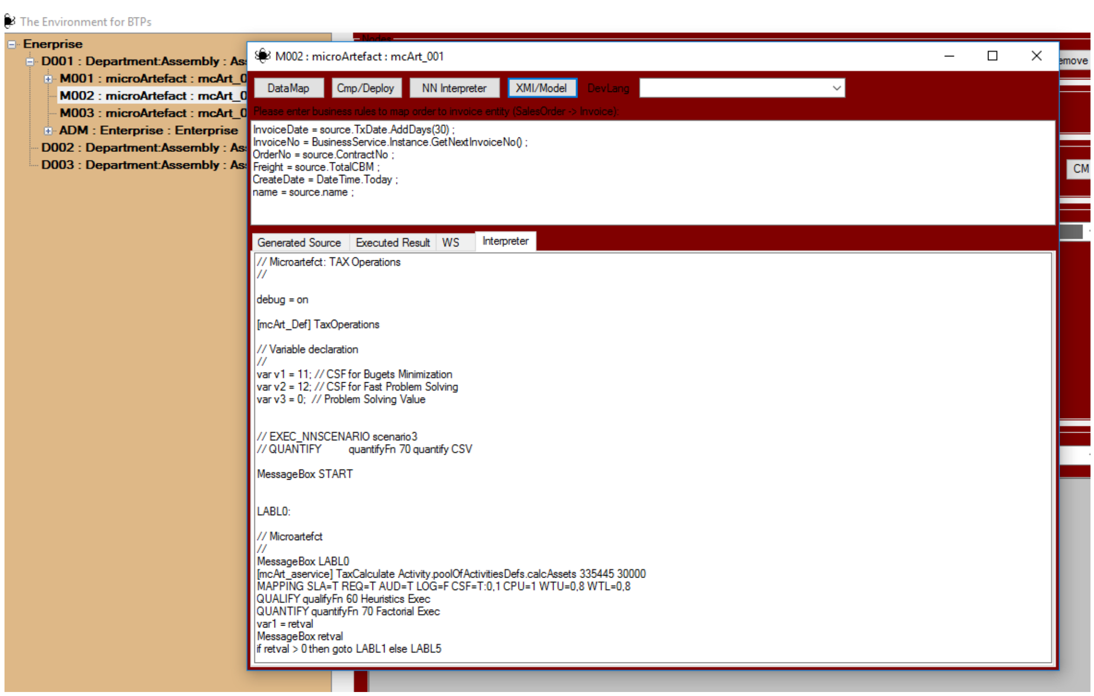
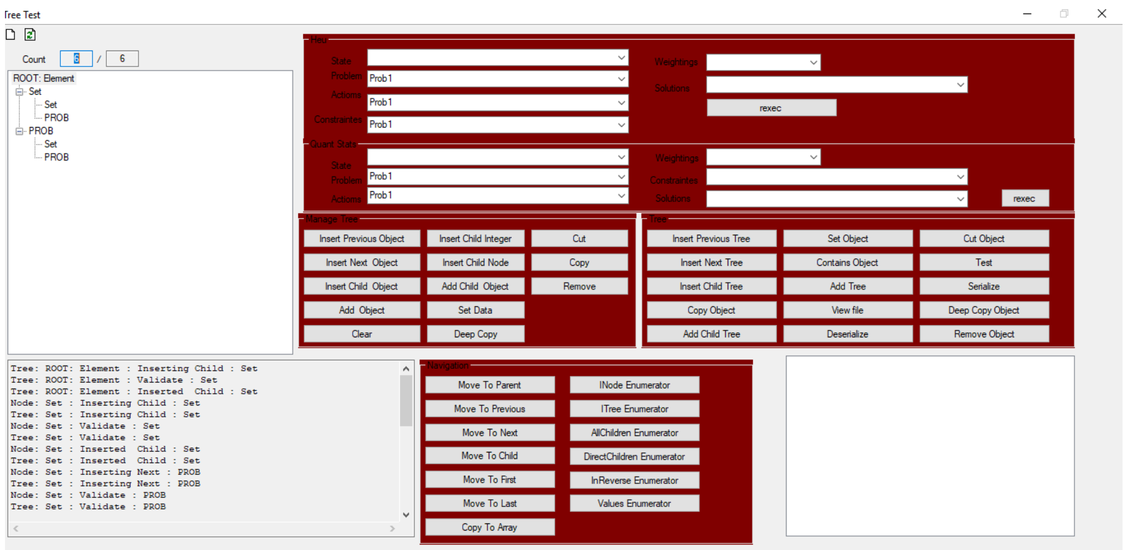


Figure 39. The heuristics tree configuration



This research's HBSRA instance, the HMM and its related CSFs were selected as demonstrated previously, and shown in Figure 40.

Once the microartefact is ready, the CSF and NLP files are configured as shown in Figure 40. In this chapter six tables and the result of processing of the first initial phase, as illustrated in Table 7, show clearly that the HBSRA can be used in *Projects*. HBSRA is not an independent component and is bonded to all the *Project's* overall architecture, hence there is a need for a holistic approach.

Figure 40. The TKM&F's components' interaction

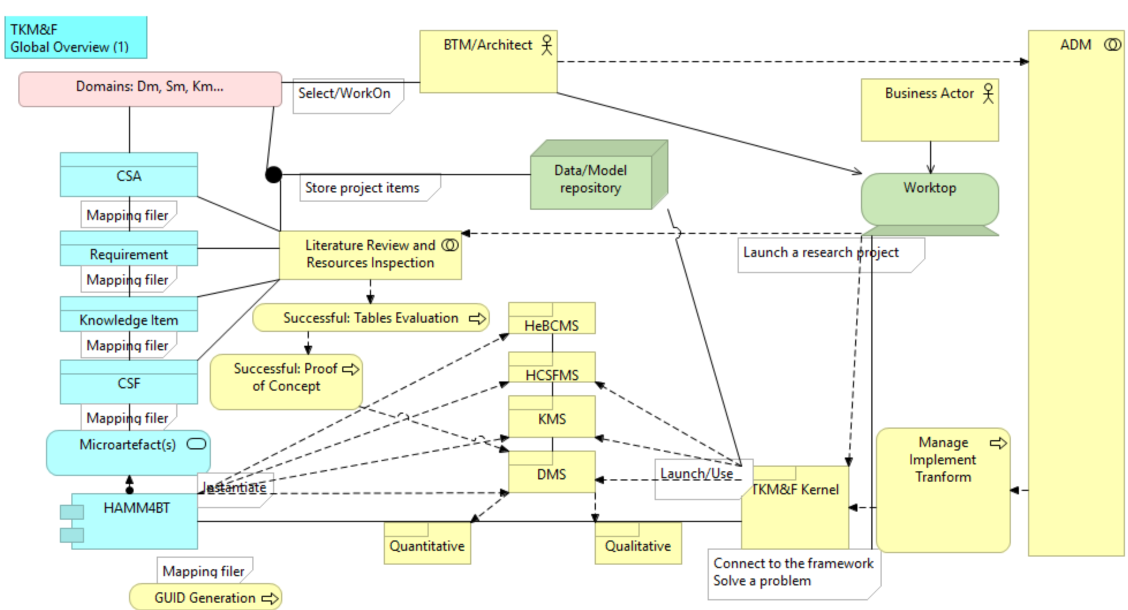


Table 7. The holistic factor management system research's outcome

CSA Category of CSFs/KPIs	Influences transformation management	Average Result
The Applied Case Study Integration	CredibleStable	From 1 to 10. 8.86
The Usage of the Architecture Development Method	FullyIntegrated	From 1 to 10. 9.20
The Information and Communication Technology System	Transformable	From 1 to 10. 9.00
The Mathematical Model's Integration	IsApplicable	From 1 to 10. 9.00
The Decision Making System	Implementable	From 1 to 10. 9.50
The Holistic Knowledge Making System	Implementable	From 1 to 10. 9.20

valuation

The *TKM&F* and hence the HMM's main constraint to implement the HBSRA is that CSAs for simple *Projects* components, having an average result below 8.5 will be ignored. In the case of the current CSF evaluation, an average result below 7.5 will be ignored. As shown in Table 7, this fact keeps the CSAs (marked in green) that helps to make this work's conclusion; and drops the ones in red. It means that the HBSRA integration is mature and can be used in all types of projects. Of course, there is complexity in integrating the HBSRA in *Projects* and the used transformation processes must be done in multiple transformation sub-projects, where the first one should try to transform the base enterprise Business services (or microartefacts) repository.

SOLUTION AND RECOMMENDATIONS

The managerial recommendations are needed for finding the solutions to enable the holistic management of the critical implementation phase. Because of very high score, above 9, Table 7 shows that the HBSRA implementation is not a risky transformation process and that today the *TKM&F* is ready and the only methodology and framework that can in parallel construct *Projects*, EAPs, MMs, rKMS, DMS' and Business engineering projects. The resultant technical and managerial recommendations are:

- A HBSRA concept must be established and tried to check its feasibility and it should replace traditional obsolete factors evaluation mechanisms.
- The architecture development method's integration in a HBSRA enables the automation of its interfaces.
- The *Projects* must be separated in multiple transformation projects, where the first one should attempt to transform the information system's services.

- Unbundle the enterprise's services and requirements to deliver the needed HBSRA's services classification. The *Project*'s technical implementation phase is the major cause of high failure rates in transformations, therefore there is a need for an optimal architecture pattern and a qualified *Manager*.
- The *Manager* must be an architect and a technocrat, who is capable of supporting and designing the transformation process of the Business environment (Trad & Kalpić, 2013b; Trad & Kalpić, 2014d; Farhoomand, Lynne, Markus, Gable & Khan, 2004).
- Setup the weighting and rating rules.
- Setup the mapping concept.
- Design a central HBSRA to be used in *Projects*.
- Select the HBSRA' CSFs, KPIs and CSAs.
- Use a standard enterprise architecture methodology to model the HBSRA. The *Manager* must have extensive experience in Business transformation projects: the *Project*'s implementation phase is the main cause of high failure rates (Neumeier, 2009; Capgemini, 2007; Capgemini, 2009).
- The *Manager* must be an agile project manager: who can implement a "very light version" of an enterprise architecture framework and of management of Business process models (Uhl & Gollenia, 2012).
- Use of Business process models: will enhance the management of knowledge and help in the Business transformation project's implementation phase (Trad & Kalpić, 2013a; Birudavolu & Nag, 2011).
- The *Manager* must have cross-functional skills (The Economist, 2000); such a person can be described as flexible and adaptable, capable of managing complexity. (Uhl & Gollenia, 2012; The Open Group, 2011b; The Open Group, 2011c).
- Define the interface to the rKMS and DMS. The Business transformation project needs to implement a decision making module that can be based on simple tools (Şeref, Ravindra, Ahuja & Winston, 2007).
- Integrate a robust Business/commerce transaction module, to optimize costs and benefits.
- Model the HBSRA' and microartefacts interaction; Apply the bottom-up approach to coordinate Business vision with the capability to finalize *Project*, what is achieved by the application of the optimal architecture vision roadmap.

HBSRA managerial recommendations, and the *TKM&F*, round up the approach needed for the complex implementation phase.

FUTURE RESEARCH DIRECTIONS

During the literature and resources review process the authors were negatively intrigued by the superficial and exclusively cost-oriented (or business outcome oriented) approach that is adopted by traditional businesses managers to manage *Projects*. The dominant influence of business schools raises the failure rate and should be replaced by engineering schools for forging of flexible and competent profiles. This research topic appears to be undiscovered and under-estimated, because many intangible values are ignored. The probable reason for such a de facto situation is the classical approach that is based on too much scoping of the research question and simplifying the research method to the level of marketing-like quantitative descriptive statistics taught in many business schools; which undermines the possibility of solving more complex problems and development of sophisticated decision systems. The future research and development process will continue to tune the *TKM&F* and will work more specifically on the decision module's evolution.

CONCLUSION

This RDP is based on the *TKM&F* unique mixed research model; where CSFs and CSAs are offered to help *Projects* managers and architects to minimize the chances of failure when transforming a business system. This chapter is part of a series of research works related to HMM, *Projects*, DMSs and rKMSs. This chapter is based on mixed research model; where CSAs/CSFs are offered to help *Projects* evaluate each *Projects* phase. In this chapter, the focus is on the HBSRA that defines a central factor pool to be used throughout the *Projects*. The most important managerial recommendation that was generated by the previous research phases was that the business transformation manager must be an architect of adaptive business systems.

The HBSRA component's global integration is an important element for the *Project's* success. The PoC was based on the CSAs/CSFs links to a specific *Projects* resources and the reasoning model evaluated the selected CSFs. The deduced result implies that an attempt of HBSRA based transformation can be successful.

There has been a lot of development and research work on the reasons for success or failure in *Projects*, but the authors propose to inspect the holistic aspects *Projects*. The managerial recommendations are offered to help *Manager*s to decrease the high failure rates and are a result of the resources review, surveys outputs, interviews, simulation and prototyping. The already published research and development publications have produced the following outcomes:

- Knowledge gap (in fact than a gap, such a concept does not exist), the research has proved the existence of a multi-dimensional knowledge gap that exists between traditional management skills and the needed skills for *Projects*' management (Trad & Kalpić, 2014d).
- An evolutionary mixed method was developed in order to create the initial *Manager*'s profile (Trad & Kalpić, 2014d).
- The actual business environments produce general profiles that can hardly cope with complexity of heterogeneous Business systems, as well as frequent and fast changes. These high frequency changes are mainly due to the hyper-evolution of technology and a tough business competition.
- The PoC proved the research feasibility and delivered the recommendations on how to select and support *Manager*s (Willaert, 2001).

The *TKM&F* supports the *Manager* by using the HBSRA pattern and delivers a set of managerial recommendations for *Projects*.

ACKNOWLEDGMENT

In a work as large as this research project, technical, typographical, grammatical, or other kinds of errors are bound to be present. Ultimately, all mistakes are the authors' responsibility. Nevertheless, the authors encourage feedback from readers identifying errors in addition to comments on the HBSRA and the *TKM&F* in general. It was our great pleasure to prepare this chapter and its experiment. Now our greater hopes are for readers to receive some small measure of that pleasure and support for his project.

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KEY TERMS AND DEFINITIONS

ADM: Architecture development method.
BPM: Business processes modelling.
CSA: Critical success area.
CSF: Critical success factor.
DMS: Decision-making system.
EA: Enterprise architecture.
EAP: Enterprise architecture projects.
HBSRA: Holistic knowledge-management system.
HMM: Holistic mathematical model.
ICT: Information and communication technologies.
KM: Knowledge management.
KMS: Knowledge management system.
Manager: Business transformation manager.
ML: Mathematical language.
MM: Mathematical model.
NLP: Natural language programming.
Projects: Business transformation projects.
RDP: Research and development projects.
RQ: Research question.
TKM&F: Trad Kalpić methodology and framework.
TOGAF: The Open Group's architecture framework.
XML: eXtensible mark-up language.

Chapter 9
A Holistic Applied Mathematical Model for Business Transformation:
The Holistic Intelligent Cities Design Concept (HICDC)

ABSTRACT

The HMM for intelligent cities transformation projects (iCTP) (or simply projects) uses a natural language development (and simulation) environment that can be adopted by any project and for that goal the authors propose to use the holistic intelligent cities design concept (HICDC). The HICDC is supported by a central decision-making system (DMS) and enterprise architecture (sub)projects (EAP). The proof of concept (PoC) is based on the resources collected on the city of Beirut, capital of Lebanon, where the central point is the transformation process of a war-torn city into a modern, agile (relatively, in respect to the region), civilized, and automated intelligent city. Such projects are managed by intelligent city transformation managers (iCTM).

INTRODUCTION

In this chapter the authors present a Holistic Mathematical Model (HMM) for business transformations, for assessing the risks of failure that is based on Critical Success Factors (CSFs) (Trad & Kalpić, 2018a; Trad & Kalpić, 2018b), which can be used in the context of intelligent (or smart) cities' urban design/architecture. This chapter is based on a unique mixed research method that is supported by a mainly qualitative research module (Trad & Kalpić, 2017a, 2017b, 2017c, 2017d; Gunasekare, 2015). The HMM for intelligent Cities Transformation Projects (iCTP) (*or simply Projects*) uses a natural language development (and simulation) environment that can be adopted by any *Project* and for that goal the authors propose to use the Holistic Intelligent Cities Design Concept (HICDC) (Myers, Pane, & Ko, 2004; Neumann, 2002).

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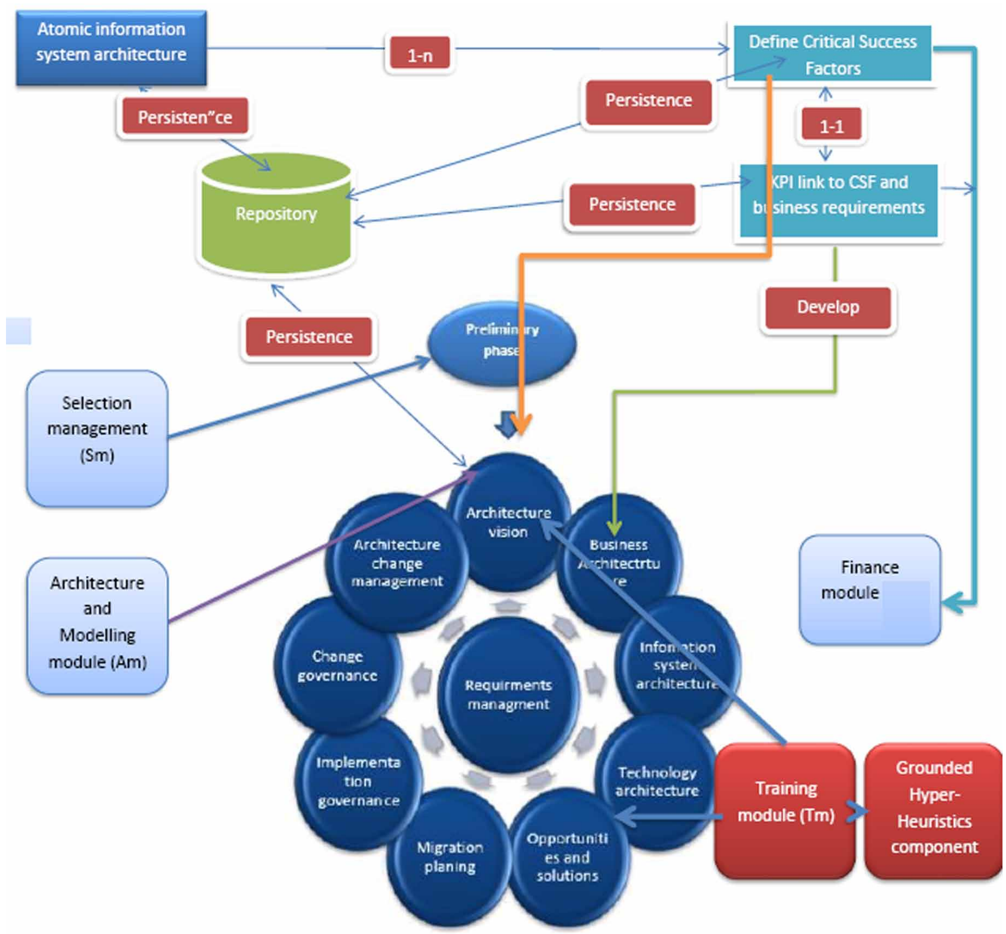
The HICDC is supported by a central Decision Making System (DMS) and Enterprise Architecture (sub)Projects (EAP). The Proof of Concept (PoC) is based on the resources collected on the city of Beirut, Capital of Lebanon; where the central point is the transformation process of a war torn city into a modern, agile, (relatively, in respect to the region) civilized and automated intelligent city. Such *Projects* are managed by intelligent City Transformation Managers (iCTM); who are supported with a methodology and a framework that can support and estimate the risks of implementation of such *Projects*. The iCTM is responsible for the implementation of complex *Projects*; the HICDC supports him or her (for simplicity, in further text – him) in a just-in-time manner (Trad & Kalpić, 2016b). The “i” prefix does not stand just for the common intelligent agile environments but for a distributed and holistic urban system’s approach that identifies this work’s background.

BACKGROUND

To include an iCTP and its holistic/distributed urban architecture subproject(s) in a city and a region like the Beirut metropolitan region, with evolution prospects to become a (relatively) smart city with an urbanized business and financial strategic planning process that will be needed to be thoroughly prepared to meet the current and future needs. A priority for this intelligent reorganization makes Beirut city and region ready to integrate the local, regional and global smart economies and smart cities in a sustainable and multicultural way (Trad, 2018e). Such an integration needs national-cultural, civic, financial engineering related urban planning, domotics (DOMus infOrmaTICS), risk mitigation and legal conforming basis and are even fundamental for its long-term strategy, multi-culture and business longevity. Actually, and probably because of the religious (ethnical), financial and political regional crisis, iCTP’s financial related risk and legal standards cannot be implemented easily. The presented facts can damage the urban transformation project and its urban architecture subprojects and that may disable the traditional urban environments to become a part of a more global one and to compete with the networked global exchange. An important factor in frequent urban transformation projects’ changes and iterations are the roles of the iCTP, politicians, factional leaders, finance analysts and urban architects, who should be supported by the optimal urban transformation framework that should include a global urban strategy model. This strategy model should be also capable of supporting the urban environment’s executive/government leaders, legal control and integration in a complex block-chained globalized world. To achieve this urban, cultural, financial and logistics integration strategy, Critical Success Areas (CSA) and CSFs must be used to evaluate possible pitfalls and risks, to audit, assert, govern, automate, trace, monitor and control the iCTP’s budget and status. The iCTP and its urban architecture subproject CSFs can be configured to manage the complexities in asynchronous event flows from local and international environments. Transformed urban environments’ strategy model must have support of a built-in automated controls capable of recognizing major changes and events.

Projects involve the complete digitization of urban processes, where automation enables new intelligent city models to optimize its finance. This research is considered as a pioneering one and actually or even unfortunately, there is not any adaptable risk concept for *Projects*. The HICDC can be used for *Projects* in design and maintenance phases which comes after the finalization of the implementation phase. This research phase’s background is related to risk evaluation of *Projects* using CSFs that are managed by the Trad Kalpić Methodology and Framework (*TKM&F*), as shown in Figure 1 (Trad &

Figure 1. The research framework's concept (Trad & Kalpić, 2016a)



Kalpić, 2018f). CSFs are selected from various intelligent city areas like urban processes, traffic, cultural, pollution, technology, human behaviour ….

In this chapter the authors present a set of HICDC managerial recommendations and this chapter combines various fields, like, Knowledge Management (KM), Applied Mathematical Models (AMM), urban and Enterprise Architecture (EA), information technology management, business transformation and other (e)engineering fields. Integrating a HICDC should be a fundamental strategic goal for *Projects* (Trad & Kalpić, 2018a; Trad & Kalpić, 2018b; Cearley, Walker & Burke, 2016), where Figure 2 is fundamental for the whole research project and it is used in the whole book; where Dm stands for Decision making.

The proposed HICDC integration concept: 1) is holistic; 2) uses a risk management engine; 3) interfaces various *Project* fields; and 4) provides that the *TKM&F* can be used by *Projects*. The authors based their Research and Development Project (RDP) method on intelligent neural networks (Trad & Kalpić, 2018a). The HICDC integration concept is agnostic to any specific application and intelligent city field, as shown in Figure 3, and is based on the Architecture Development Method (ADM) (The Open Group, 2011a).

Figure 2. The research framework's interaction/flow (Trad, 2018a)

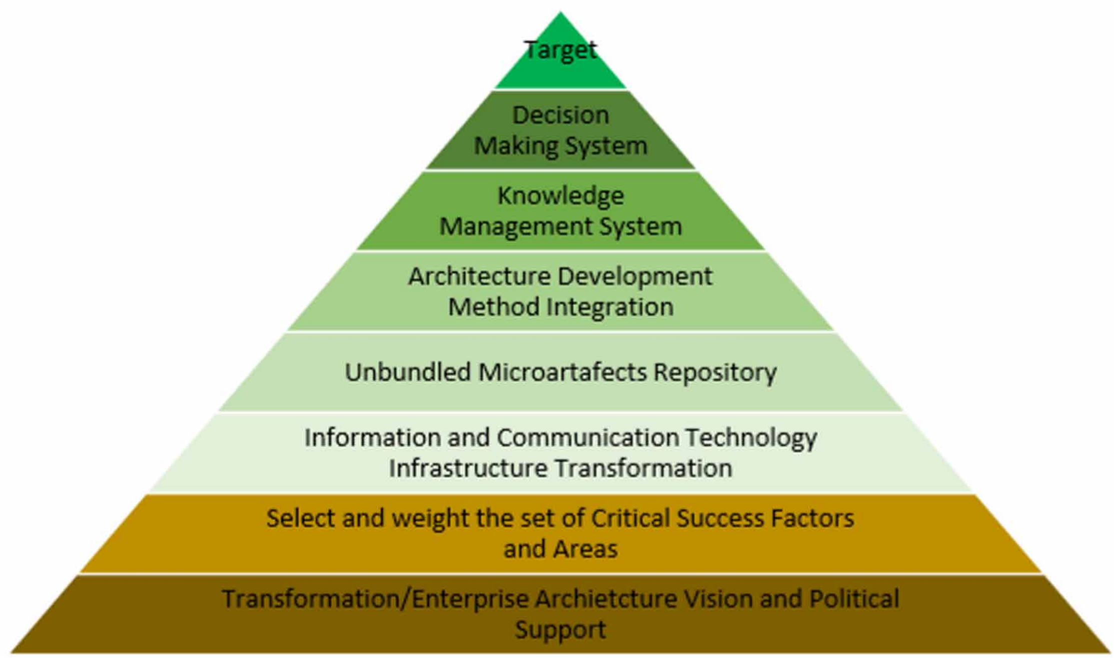
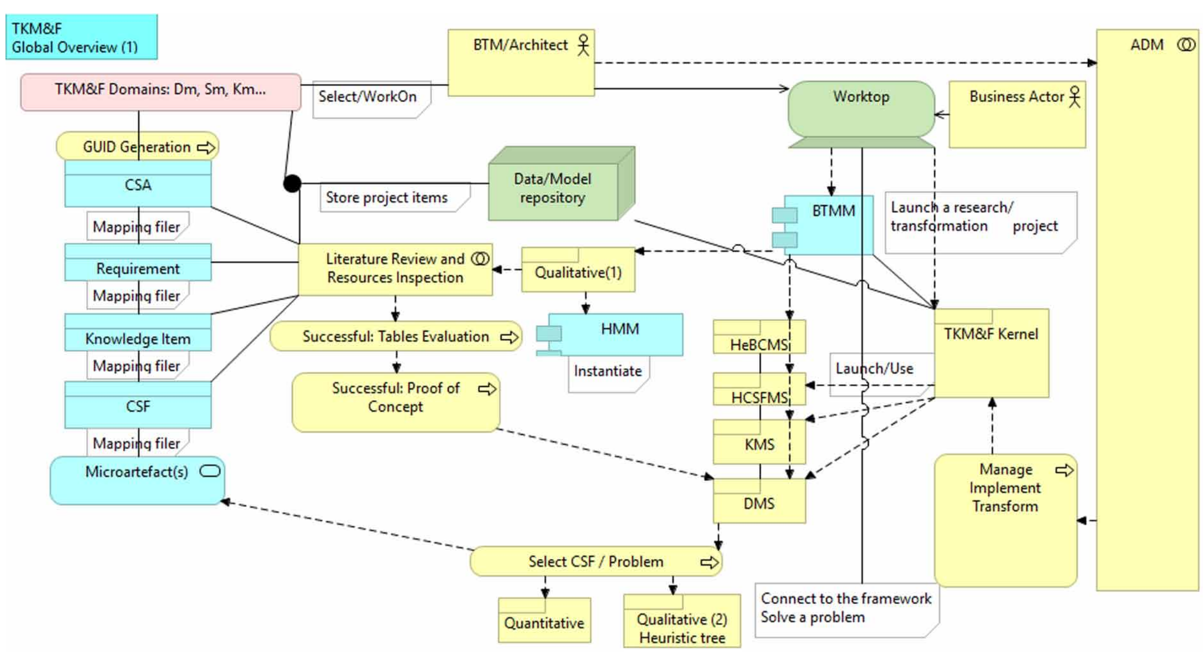


Figure 3. The research framework's architecture method's interface (The Open Group, 2011a).



EA is central to implement *Projects,* where the iCTM or an enterprise architect can use the HICDC for *Projects* (Trad & Kalpić, 2017b; Trad & Kalpić, 2017c; Thomas, 2015; Tidd, 2006). In *Projects*, the iCTM's role is important and its actions are supported by the HICDC (Lanubile, Ebert, Prikladnicki, Vizcaíno, & Vizcaino, 2010).

A holistic systems approach is the optimal choice to model such a HICDC, as shown in Figure 4, where the decision model interacts with the external world via an implemented framework to manage CSFs and uses the Holistic e-Business Concept Management System (HeBCMS) (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a). As shown in Figure 5 the CSF is important for the phase 1 that qualifies the needed CSF set and decides if there is a need for a PoC.

Projects are difficult to implement, because of their holistic nature, where the big part of complexity is met in its technical implementation phase (Watt, 2014; Gudnason & Scherer, 2012). The *TKM&F* can be applied to all *Projects* intelligent city models (Joseph, 2014). Intelligent city refers to any business conducted using different types of electronic media; where the most common form is the business that makes its transactions and revenue via the World Wide Web that is based on Internet technologies (e-business, 2014). The development and evolution of e-Business related fields like Business (and Financial) are a fundamental factor for any economy. Intelligent city related fields added significant savings in the building of business infrastructures where they are also an enabler for DMS and support quicker response to market requests. Market requests known as (e)transactions are essential for all intelligent city related interactions (Kalpić, 2011). The technical implementation phase is the major cause of high failure rates in *Projects*. That is why the iCTMs' skills should encompass knowledge of: 1) intelligent city and Business (and Financial) processes' architectures; 2) intelligent city services' technologies; 3) real-time unbundling of intelligent city and Business (and Financial) environments (Willaert, 2001); 4) agile *Project* management; 5) implementation and integration of intelligent city services; 6) organizational behaviour and engineering; 7) management sciences methodologies; 8) intelligent city or enterprise 2.0 architectures and their integration in concrete *Project's* implementation phases (Platt, 2007). The actual

Figure 4. Intelligent management system

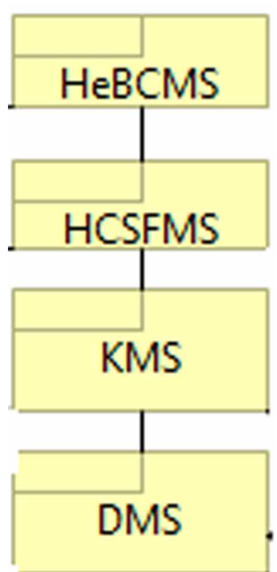
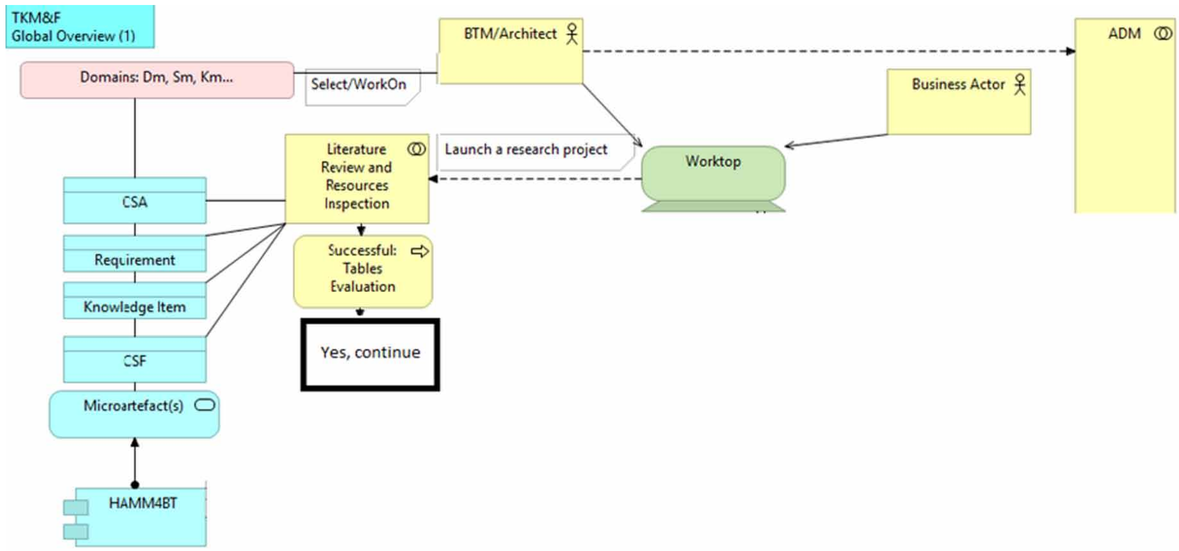


Figure 5. Interaction with factors



hype of enterprise 2.0 in the intelligent city organizations is a buzz word introduced by the Harvard Business School in 2006; they describe the usage of Web 2.0 and Web 3.0 technologies in transformed intelligent cities in order to increase productivity and efficiency. Therefore, the authors highly recommend a qualified technocrat's profile (Farhoomand, 2004) for the iCTM; who needs to be assisted by a DMS (Trad & Kalpić, 2013c). *Projects* lack a holistic aspect that is assured by the HICDC - that is this work's focus (Thomas, 2015; Cearley, Walker & Burke, 2016; Trad & Kalpić, 2016b).

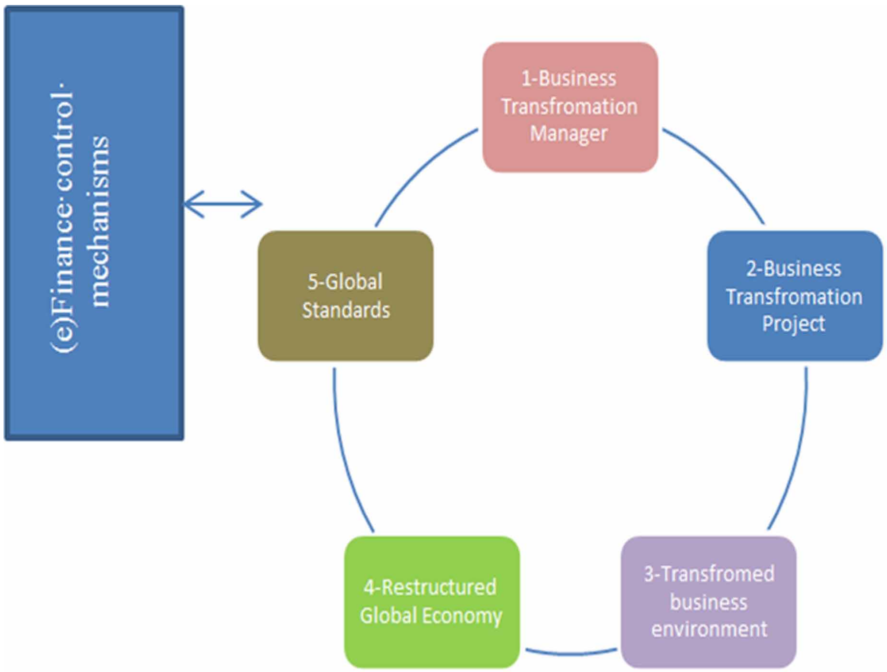
FOCUS OF THE ARTICLE

HICDC recommendations can be applied by *Project's* mangers and stakeholders (Desmond, 2013) that uses *TKM&F* microartefacts (Johnson & Onwuegbuzie, 2004; Trad & Kalpić, 2017b, 2017c, 2018a). The RDP is based on a mixed methodology and is unique (Easterbrook, Singer, Storey & Damian, 2008); where this chapters tries to prove the HICDC feasibility through an experiment and Research Question (RQ).

THE RESEARCH PROCESS

Projects failure rates are high and are constantly increasing (Bruce, 1994) . That is due to the complexity encountered in the implementation phase (CapGemini, 2009); to enhance the success rate, the authors propose the *TKM&F* that is unique and can be considered as a pioneering approach. *TKM&F* recommends linking a Mathematical Model (MM) to all levels of the *Project*, as shown in Figure 6 (Trad & Kalpić, 2018b; Agievich, 2014), including the CSF based HICDC (Tidd & Bessant, 2018).

Figure 6. Presents levels of project's interaction (Trad & Kalpić, 2017b, 2017c)



The Applied Research Framework

The HICDC can be applied to various types of *Projects* (Trad 2018c; Trad 2018d) and is a part of the Selection management, Architecture-modelling, Control-monitoring, Decision-making, Training management, *Projects* management, Finance management, Geopolitical management, Knowledge management, Implementation management and Research management Framework (SmAmCmDmTmPmFmGmKmImRmF, for simplification reasons, in further text the term *TKM&F* will be used). This book's chapter's RQ is: "Can a holistic intelligent cities design concept be used in urban transformation project(s)" (Trad, 2011a; Trad & Kalpić, 2011a).

The *TKM&F* is owned in its totality including copyright, by the authors; where this chapter is an IGI Global copyright and these two objects are distinct and different. This chapter's RQ was formulated after a literature review process.

The Research's Literature Review and Gap

The knowledge gap was acknowledged, mainly because the existing literature, on failure rates and on various methodologies treating *Projects*, offer practically no insight into a holistic approach to designing intelligent cities (Trad & Kalpić, 2013b, 2013c). This RDP inspects a holistic approach for the RQ, which is mainly based on the *TKM&F* that makes it unique.

The Research's Uniqueness

The uniqueness of this research promotes a holistic unbundling process, the alignment of standards and strategies to support *Projects* (Farhoomand, 2004). The uniqueness of this research project is based on its holistic approach that combines: 1) *Project*; 2) HMM; 3) software auditing, modelling and architecture; 4) business engineering; 5) financial analysis; 6) iCTM's profile; 6) holistic urban and EA; and 7) it offers a methodology and Framework.

Reviews and Check of the Critical Success Factors/Critical Success Areas

The HICDC promotes the transformation through the use of Critical Success Area (CSA) that contains a set of CSFs, where a CSF is a set of Key Performance Indicators (KPI), where each KPI corresponds to a single *Projects* requirement and/or an item that can be a profile requirement or skill that has a column in each evaluation table (Putri & Yusof, 2009; Peterson, 2011;Trad & Kalpić, 2018f). Where for each CSA an Excel Workbook (WB) is created and in which all its CSFs are stored. As shown in Figure 7, the WB has scripts in the background that are automated to calculate the weightings and ratings. This RDP proposes a standardized and automated manner to evaluate literature reviews. That is a structured evolution in regards to just the popular subjective simple reading methods that do not make any sense. If the automated literature review's evaluation (phase 1) is successful, only then the experiment is done.

As shown in Figure 8, a *Project* starts with the first phase called the feasibility phase to check the basic CSFs, to check if the *Project* makes sense; that is based on WB evaluation. Based on the HICDC literature review and related evaluation processes known as the Qualitative(1), the most important extracted CSFs that are used and evaluated using the following rules (Trad & Kalpić, 2018f):

- Stored WB references should be credible and are estimated by the authors and follow a classification supported by the CSF management system.
- *Projects* like mergers are the result of organisational changes in companies to act as a single enterprise with consolidated WB CSFs, resources and business interests.
- Applied modelling language should be limited in order to make the *Projects* manageable and not too complex.
- The ADM is considered to be mature if it has been in use for more than ten years and that it has been reported as successful to enforce the interest in using the ADM.
- The ADM is appropriate for any project's local conditions and manages the *TKM&F's* iterations and CSFs with WB tuning scripts.
- If the aggregations of all the *Project's* CSA/CSF WB tables/sheets are positive and exceed the defined minimum, the *Projects* continues to its PoC or can be used for problem solving.
- This evaluation concept will be applied to seven different CSAs that are presented in tables.

Figure 7. The factors and areas development workbook sheets

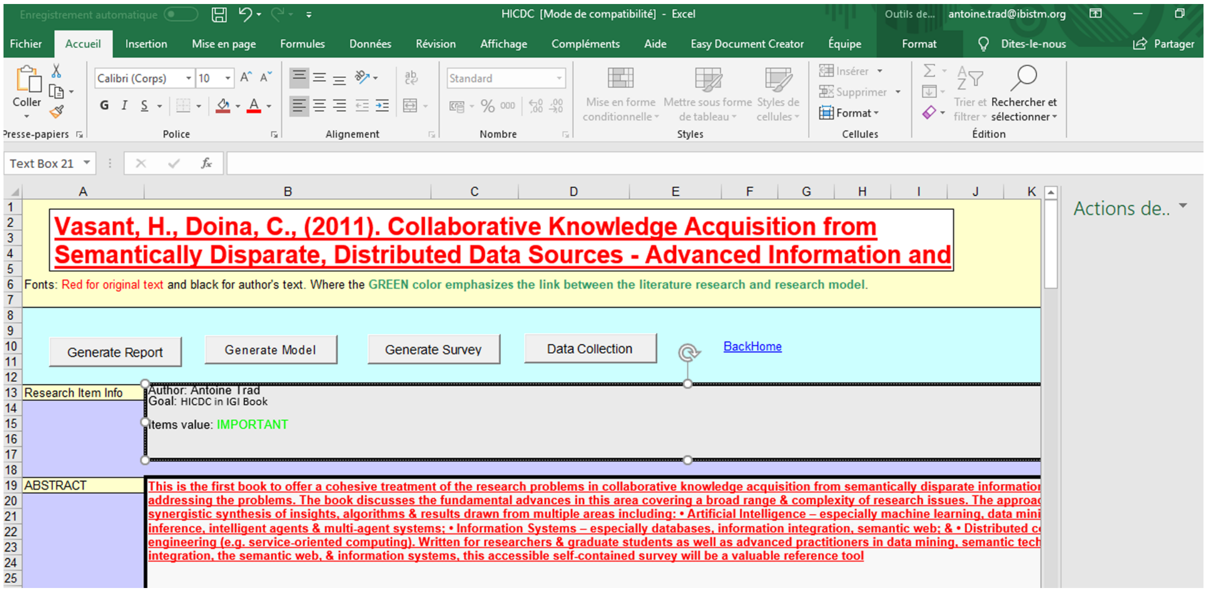
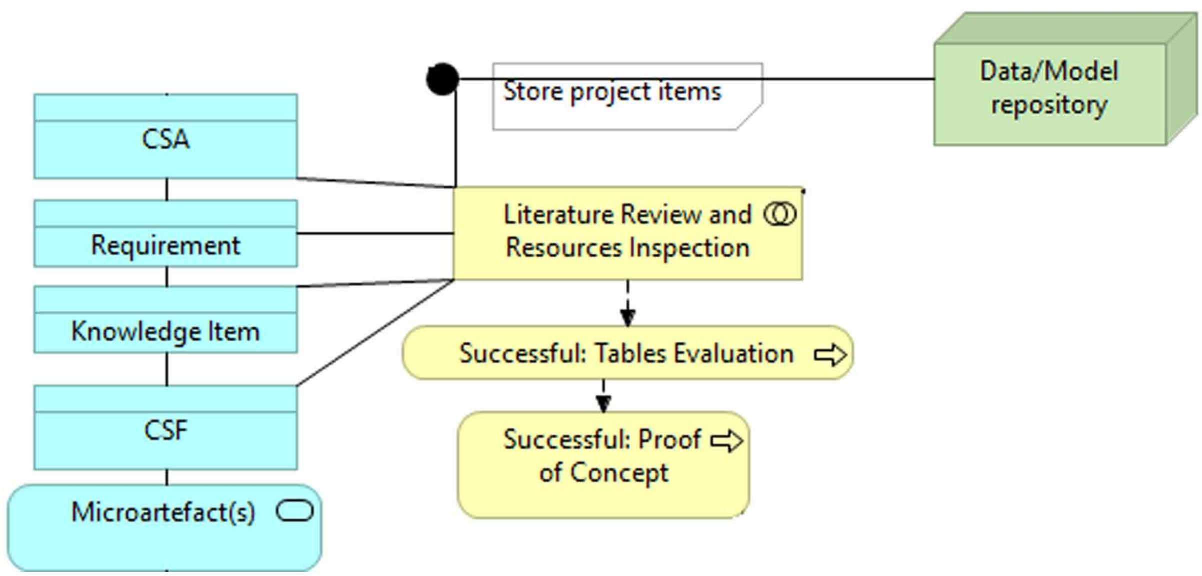


Figure 8. The factors interaction in the TKM&F



THE URBAN ARCHITECTURE CASE

Modelling Intelligent City's Case

HICDC uses an ACS, developed by the authors that is based on the literature reviews resources (Kassir, 2010) and the Open Group's reference study, it presents the possibilities to implement *Projects*' components; using a modelling environment (Beauvoir & Sarrodie, 2018). The HICDC is related to an ideal city model's CSFs that define and tune the actions needed to ensure the success of the *Projects;* initially CSFs had been used in the domains of data analysis, urban architecture and intelligent systems analysis (Trad & Kalpić, 2018f).

Integrating Critical Success Factors

A CSF is measurable and mapped to a weighting that is roughly estimated in the first iteration and then tuned through ADM iterations, to verify the HICDC feasibility; where a holistic business and urban/enterprise architecture CSFs are essential (Morrison, 2016; Felfel, Ayadi & Masmoudi, 2017). The main issue here is how to define what is really an intelligent/smart city; because this seems to be somehow a pejorative term. For example, is Zurich, which is considered the most intelligent/smart city, more intelligent than Athens or Palermo. If so, why? Knowing that the two latter cities have immense history and culture, but less high quality fast food services. The authors refer to intelligent, as an evolution in respect to the local context and reality; not to the commercial sense of the term. By the way, the very intelligent Zurich is the worldwide center of organized financial crime (DW, 2019).

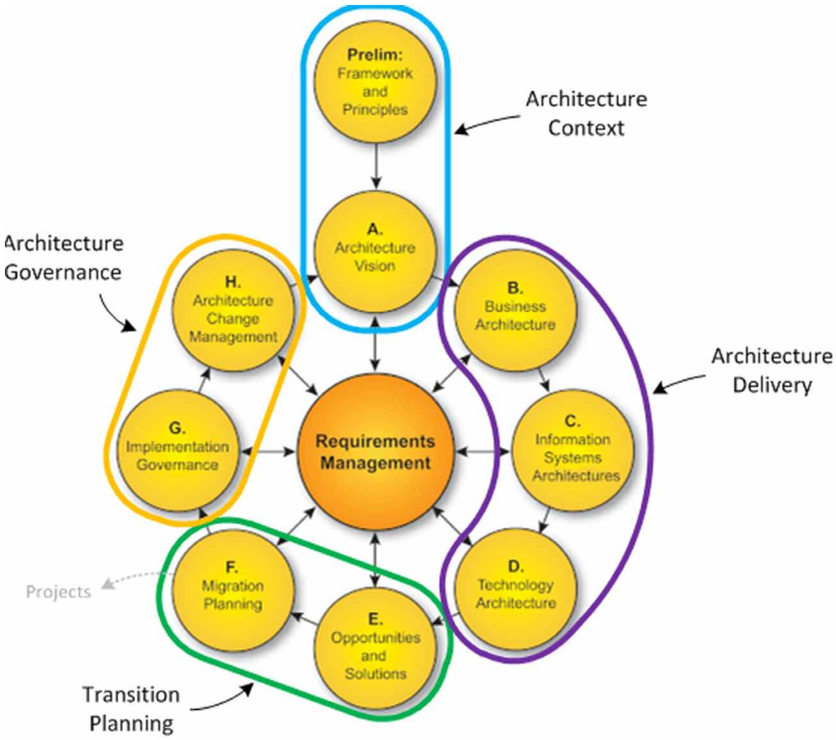
The Architecture Development Method and Projects

This RDP focuses on the HICDC to assist distributed intelligence, urban complexity, city knowledge access, local economy and urban technology/infrastructure (Gardner, 1999). HICDC includes a hyper-heuristics tree that supports a wide class of problem types, and it is a major benefit (Markides, 2011), where the DMS offers a set of recommendations (Trad, Kalpić & Fertalj, 2002; Trad & Kalpić, 2014d). The *TKM&F's* parts must synchronize with the ADM that are shown in Figure 8.

Business and Legal Framework

As global business has taken off in all cities which are participating in current expansion, the issues of regulations and legal acts arise. Lately, there has been a worldwide hyper-evolution in the development and implementation of regulation for internal business laws. Global business law and taxation give insights and a framework for support to cities to integrate. The notions of jurisdictions and regulations depend on the contract's dispositions and the applied intelligent city law. Legal and other regulations play an important role and they differ in various regions (Penn & Arias, 2009).

Figure 9. Business architecture phases (The Open Group, 2014b)



The Applied Case Study's Critical Success Factors

Based on the CSF review process that was presented in this article's section 'Reviews and Check of the Critical Success Factors/Critical Success Areas' and the 'Mathematical Model', the important business case's CSFs are used and evaluated as follows:

As shown in Table 1, the button 'valuation' will generate the results shown in columns 2 (KPIs) and 3 (weightings); where the script is launched as shown in Figure 10, where the *TKM&F* interfaces office word and excel tools using basic scripts.

In Table 1, the result's aim is to prove or justify that this section, the urban architecture case and how it can be used with the PoC. The next CSA to be analysed is the holistic MM's integration.

The Research Section's Link to the Applied Mathematical Model

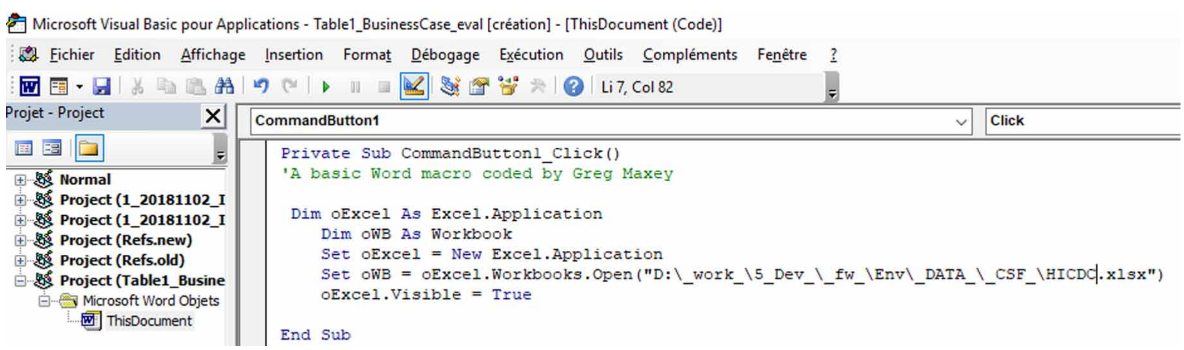
This section's deduction is that the applied MM is crucial for the RDP's credibility, where it is the basis for its mathematical model and structure.

Table 1. The applied case study's critical success factors that have an average of 5.75

Critical Success Factors	KPIs	Weightings
CSF_UrbanCase_Modelling	VeryComplex	From 1 to 10. **06 Selected**
CSF_UrbanCase_Factors	Complex_Classification	From 1 to 10. **08 Selected**
CSF_UrbanCase_References	VeryLimited	From 1 to 10. **05 Selected**
CSF_UrbanCase_ArchitectureDevMethod	IntegratedForProjectPart	From 1 to 10. **08 Selected**
CSF_UrbanCase_Technologies	RudemantoryStage	From 1 to 10. **04 Selected**
CSF_UrbanCase_Governance	Primitive	From 1 to 10. **09 Selected**
CSF_UrbanCase_Transformation_TKM&F	NoDifference	From 1 to 10. **03 Selected**
CSF_UrbanCase_Leading_Governance	ComplexImpossible	From 1 to 10. **03 Selected**

valuation

Figure 10. The word document script that interfaces the workbook and factors



THE APPLIED MATHEMATICAL MODEL'S USAGE

The Basic Element

The HICDC CSFs define the initial algorithm nodes that are identified as vital for successful targets to be reached and maintained and is the MM's basic element that is needed for the *Projects* to estimate its success or failure; using the exposed two phases (Morrison, 2016).

A Quantitative-Qualitative Research Mixed Model

A problem, RQ, CSF or phenomenon are examined in iterations relating breadth and depth, using heuristics/beam search, which is specialized for unknown problems or the ones that appear in a preliminary phase or first iterations. Then, the *TKM&F* qualitative research module input data stream(s) consist(s) of sets of numbers that are collected from sets generated by using designed/structured and approved/validated data object-collection modules and statistically processed by the researcher or analyst; where the selected qualitative method is selected by the user.

The Applied Mathematical Model's Structure

The HMM for HICDC has a composite structure that can be viewed as follows:

- The static view has a similar static structure like the relational model's structure that includes sets of CSAs/CSFs that map to tables and the ability to create them and apply actions on these tables; in the case of HMM that are intelligent city microartefacts and not tables (Lockwood, 2018).
- The behavioural view, comprises actions designed using a set of mathematical nomenclature, the implementation of the HMM is in the internal scripting language; used also to tune CSFs (Lazar, Motogna & Parv, 2010).
- As the skeleton of the *TKM&F* that uses intelligent city microartefacts' scenarios to support just-in-time HICDC requests.

The Static Mathematical Model

The HICDC uses a CSF based HMM that is an abstract model containing a proprietary Mathematical Language (ML) that can be used to automate, transform and implement the HICDC in an iCTP. The AMM nomenclature that is presented to the reader in Figure 11, in a simplified form, to be easily understood, on the cost of a holistic formulation of the model.

Figure 11. The applied mathematical model's nomenclature (Trad, & Kalpić, 2017a)

AMM4BT

rncRequirement	= KP I	(1)
CSF	= Σ KPI	(2)
CSA	= Σ CSF	(3)
Requirement	= $\underline{\bigcup}$ rncRequirement	(4)
(e)neuron	= action+ rncInteligenceArtefact	(5)
mcArtefact	= $\underline{\bigcup}$ (e)neurons	(6)
rncEnterprise	= $\underline{\bigcup}$ mcArtefact	(7)
(e)Ellterprise	= $\underline{\bigcup}$ rncEnterprise	(8)
mcArtefactScenario	= $\underline{\bigcup}$ mcArtefactDecisionMaking	(9)
IntelligenceComponent	= $\underline{\bigcup}$ mcArtefactScenario	(10)
OrganisationalIntelligence	= $\underline{\bigcup}$ InteligenceComponent	(11)
AMM4BT	= ADM+ OrganisationalIntelligence	(12)

As shown in Figure 11:

- The abbreviation (and prefix) “mc” stands for micro.
- The symbol $\sum$ indicates summation of weightings/ratings, denoting the relative importance of the set members selected as relevant. Weightings as integers range in ascending importance from 1 to 10.
- The symbol U̲ indicates sets union.
- The proposed HMM enables the possibility to define *Project* as a model; using CSFs weightings and ratings.
- The selected corresponding weightings to: CSF ϵ { 1 … 10 }; are integer values.
- The selected corresponding ratings to: CSF ϵ { 0.00% … 100.00% } are floating point percentage values. Weightings are shown in tables, second column and ratings in the third column.
- For some selected CSF, there is a predefined enumeration of KPIs or ratings, like for example: KPI ϵ { ImpossibleToIntegrate, VeryComplex, Complex, PossibleIntegration, Feasible }; the domain are constant strings of characters.

A weighting is defined for a HICDC CSF and a rating for a KPI; where the KPI is a rating for a given CSF and is one value taken out of an enumeration that is predefined. The first evaluation is in general very rough and through frequent ADM iterations it is tuned, because an iCTP takes more than 20 years.

Concerning the constructs (or formulas) containing the symbol U̲ are generated when the valuation button is pushed, like for example, for the CSF, CSF_UrbanCase_Modelling:

- REQ_UrbanCase_Modelling is linked and created for the associated requirement.
- mcArtefact_UrbanCase_Modelling is linked and created for the associated microartefact.

$$AMM = Weigthing_1 * Qualitative(2) + Weigthing_2 * Quantitative(2) \quad (1)$$

As shown in Figure 12, Qualitative(2) is the heuristics tree algorithm and $Weigthing_1$ and $Weigthing_2$ are tuned by the iCTP team and the presented nomenclature defines the AMM of the static part of the HMM. Quantitative(2), is any quantitative method.

The Applied Business Transformation Mathematical Model

The HMM can be modelled after the following formula for Business Transformation Mathematical Model (BTMM) that abstracts the *Projects*:

$$HMM = \sum AMM \text{ for an enterprise architecture's instance} \quad (2)$$

(BTMM):

$$BTMM = \sum HMM \text{ instances} \quad (3)$$

Where an instance is created for each iteration; the objective function of the BTMM's formula can be optimized by using constraints and with extra variables that need to be tuned using the HMM. The variable for maximization or minimization can be, for example, the *Project's* success, costs or another CSF. For the HICDC PoC the success will be the main and only constraint and success is quantified as a binary 0 or 1. where the objective function definition will be:

Minimize risk BTMM (4)

By minimize, the authors refer to the optimization of phase 1; and if it is successful, then phase 2 is launched to inspect and solve surging problems.

The BTMM is the combination of a *Project* methodologies and a holistic mathematical model that integrates the enterprise organisational concept, information and communication technologies (Lazar, Motogna, & Parv, 2010).

As shown in Figure 12, the HMM is a part and is the skeleton of the *TKM&F* that uses microartefacts' scenarios to support HICDC requests (Kim & Lennon, 2017).

The HICDC components interface the DMS and KMS, as shown in Figure 13, to evaluate, manage and map CSFs for selection activities; if the aggregations of all the *Project's* CSA/CSF tables exceeds the defined minimum the *Projects* continues to its second part, the HICDC PoC.

Framework's Applied Mathematical Model Integration

The *Project's* initialization phase generates the needed CSAs/CSFs and hence creates the HICDC patterns to be analyzed.

Figure 12. The framework's components and its mathematical model

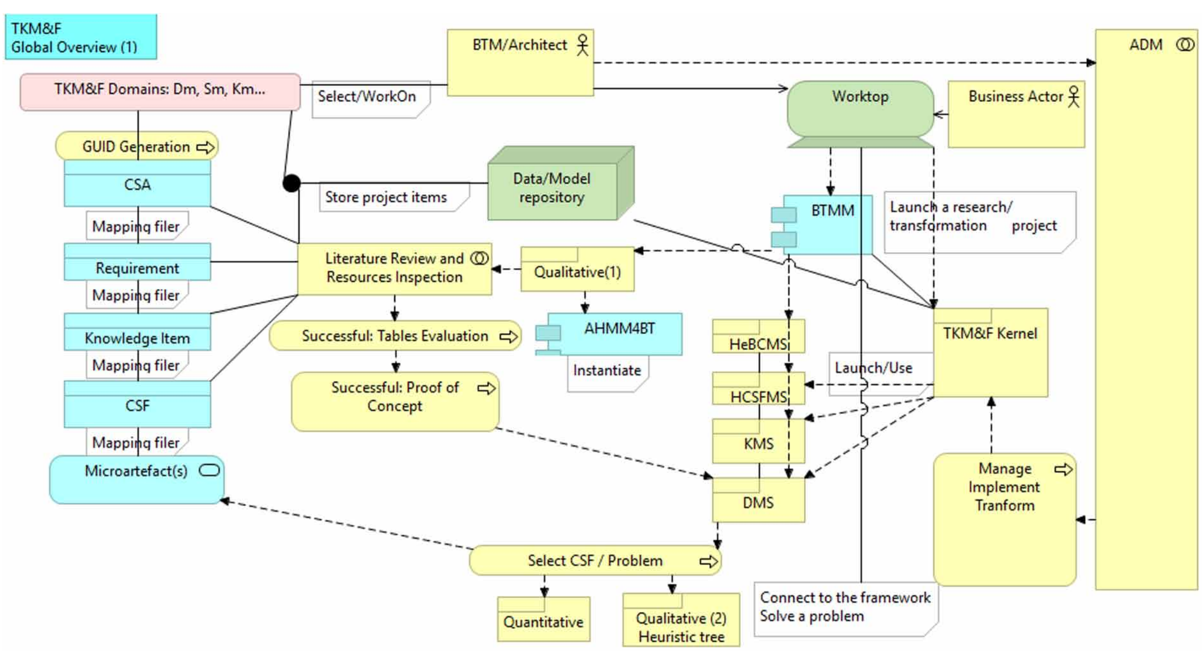
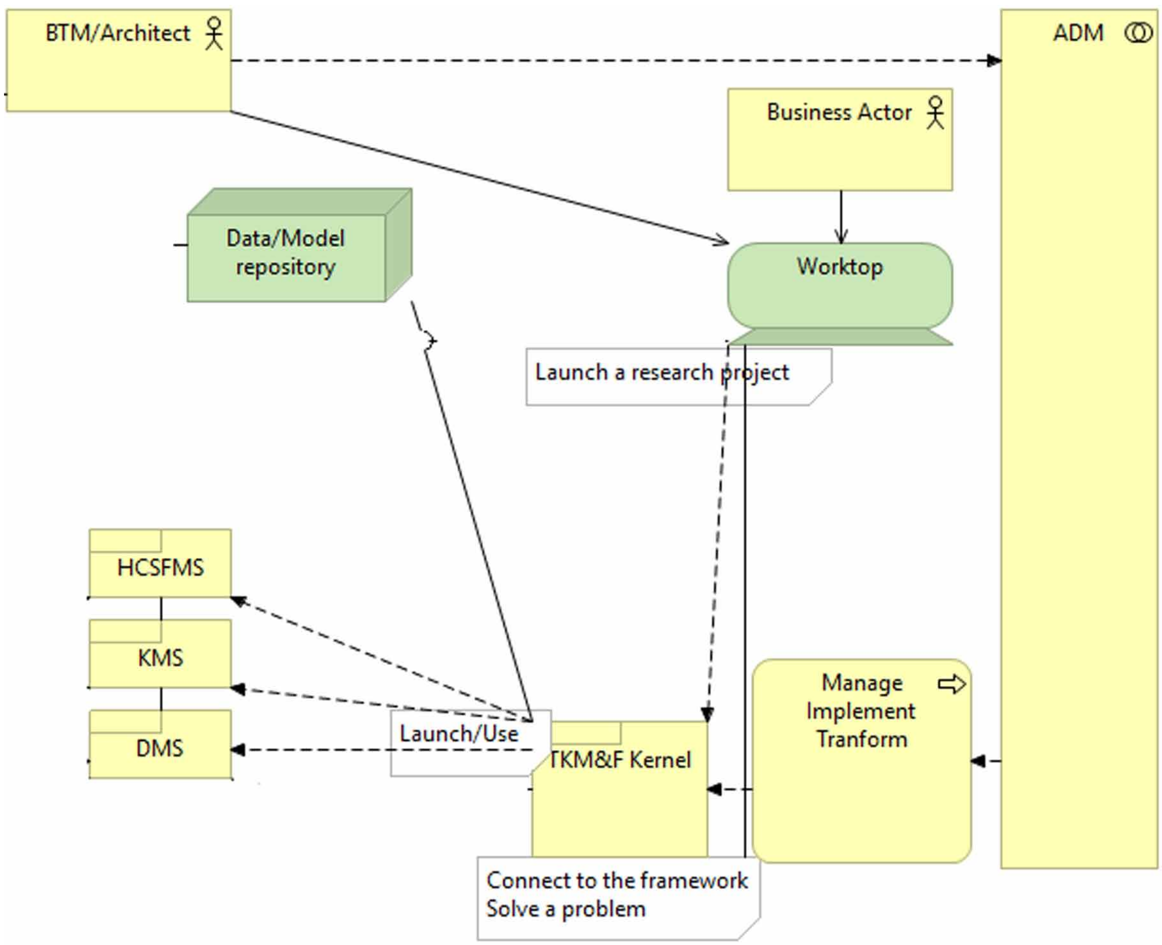


Figure 13. The decision making interface



The HMM is a part and is the skeleton of the *TKM&F* that uses microartefacts' scenarios to support HICDC instance requests (Agievich, 2014).

The Mathematical Model's Integration Critical Success Factors

Based on the HICDC review process the most important CSFs are evaluated as follows:

As shown in Table 2, the result's aim (6,14 is very low) is to prove or justify that HMM is mature and possible to be used for the HICDC integration; and cannot be used for the PoC. If though the result is fairly low, the next CSA to be analysed is the holistic management of the ICS.

The Research Section's Link to the Information and Communication System

This section's deduction is that the infrastructure and ICS unbundling processes are to be analysed, even though the results are deceiving.

Table 2. The critical success factors that have an average of 6.14

Critical Success Factors	KPIs	Weightings
CSF_AHMM4BT_TKM&F_Integration	Feasible	From 1 to 10. **07 Selected**
CSF_ AHMM4BT_InitialPhase	RandomUnsure	From 1 to 10. **05 Selected**
CSF_ AHMM4BT_PoCPhase	RandomUnsure	From 1 to 10. **05 Selected**
CSF_ AHMM4BT_Qualitative&Quantitative	Complex	From 1 to 10. **07 Selected**
CSF_ AHMM4BT_Final_BTMM	UnVerifiedModel	From 1 to 10. **05 Selected**
CSF_ AHMM4BT_ADM_Integration	Synchronized	From 1 to 10. **09 Selected**
CSF_ AHMM4BT_HPMS_Interfacing	UnStable	From 1 to 10. **05 Selected**

valuation

THE INFORMATION AND COMMUNICATION TECHNOLOGIES' INTEGRATION

Distributed Unit of Work

Microartefact granularity and responsibility definitions for HICDC scenarios is a complex undertaking; added to that there is the implementation of the "1:1" mapping and classification of the transformed microartefacts, as shown in Figure 14. The urban and EA concepts use methodologies like the TOGAF's ADM that supports the HICDC (Neumann, 2002) where various types of identifiers can be used.

Unique Identifiers Integration

Various types of identifiers can be used for HICDC, like radio frequency identifiers, phone numbers, visual/vocal recognition tags… to identify and monitor humans, animals, buildings, cars and other objects for various types of activities.

Processes, Patterns, Services and Models

iCTP is supported by the *TKM&F* to support inter-connected models that are including various domains, creating new values, as shown in Figure 15 (Kolbe, 2015). These models can be described using City Geography Markup Language (CityGML).

HICDC offers models supporting iCTMs decisions to achieve sustainable benefits within the planned *Project* in a standard way.

Intelligent City Standards

To manage agile *Projects*, an adequate mapping concept integrates mainly technology standards (OASIS, 2014) and is the main principle and strategy using a linear "1:1" manner; used to relate *Project*

Figure 14. The framework's microartefact interactions

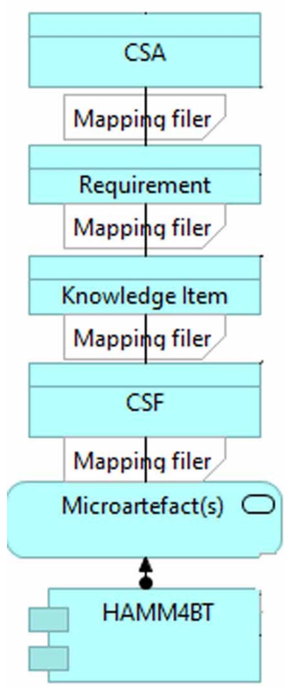
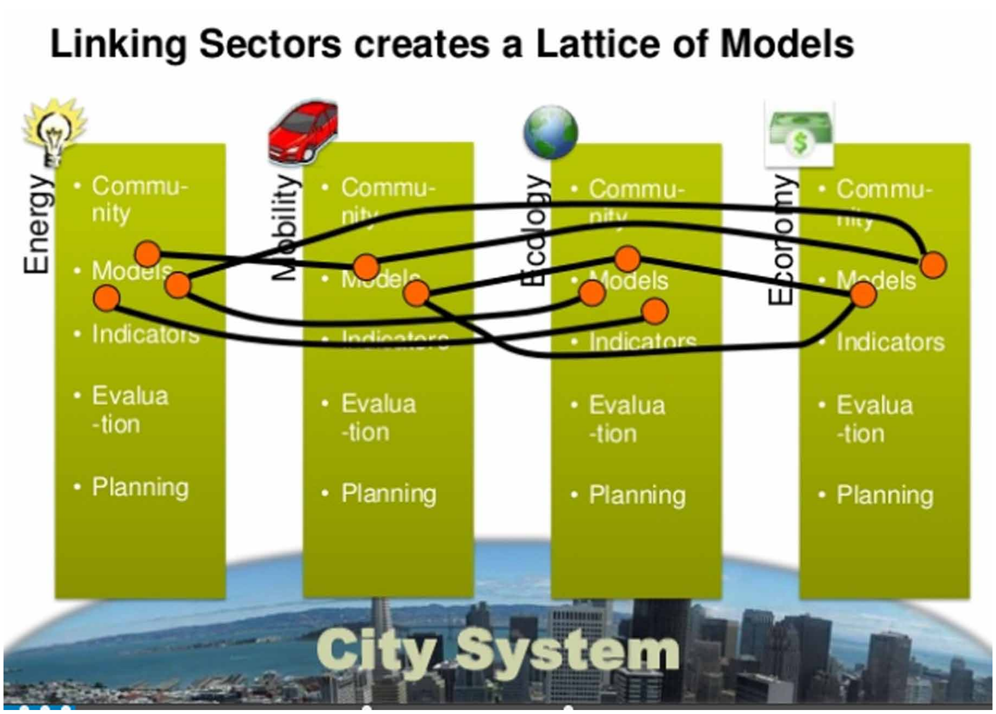


Figure 15. The iCTP model (Kolbe, 2015)



resources. The proposed standards have the following levels: 1) strategic; 2) process; and 3) technical (Lea, 2017); as shown in Figure 16.

These standards and tooling environments support the *Projects* through an iterative pseudo-bottom-up approach, as shown in Figure 17.

Without the use of HICDC, an iCTP can: 1) very probably have poor performance; 2) lack scalability; and 3) fail, become un-usable and un-maintainable.

Intelligent Services Strategy

The *TKM&F's* applies Service Oriented Architecture (SOA) concepts that use service directory for vertical HICDC solutions, as shown in Figure 18. The *TKM&F* recommends the adoption of a light variant of TOGAF where its atomic HICDC services approach provides the conceptual and logical viewpoints (Gartner, 2005).

Security

The *TKM&F* and HICDC define a global vision on city's security by applying holistic qualification procedures that englobes security concepts from many domains (Clark, 2002).

Traffic and Garage Management Systems

HICDC should support, agent-based architectures for intelligent traffic and parking management systems containing autonomous agents that perform decision support for real-time traffic management (Hernández, Ossowski, & García-Serranoa, 2002). These important and endemic problems have to be co-ordinated with a vast variety of other adjacent topics like the usage of the Internet.

Figure 16. The standard levels (Lea, 2017)

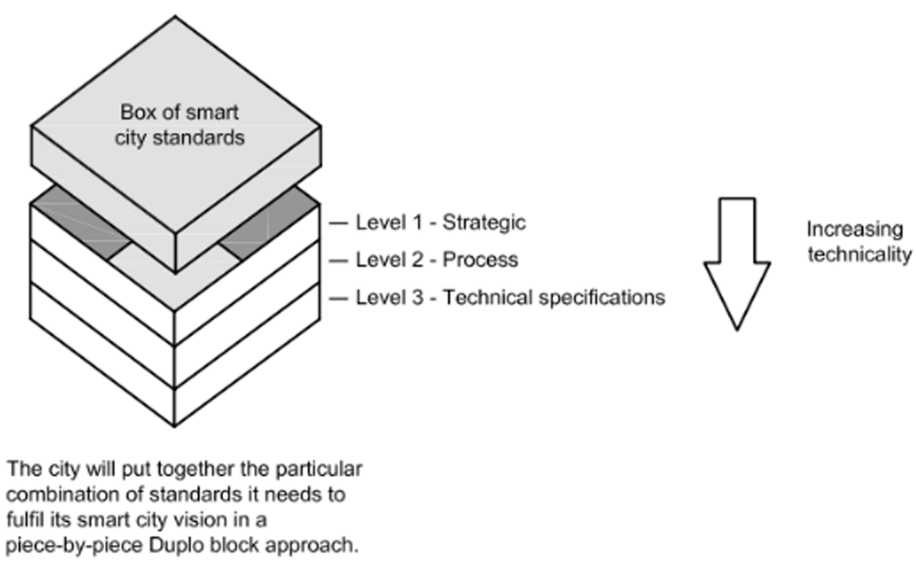


Figure 17. The iterative architecture development process (The Open Group, 2011a)

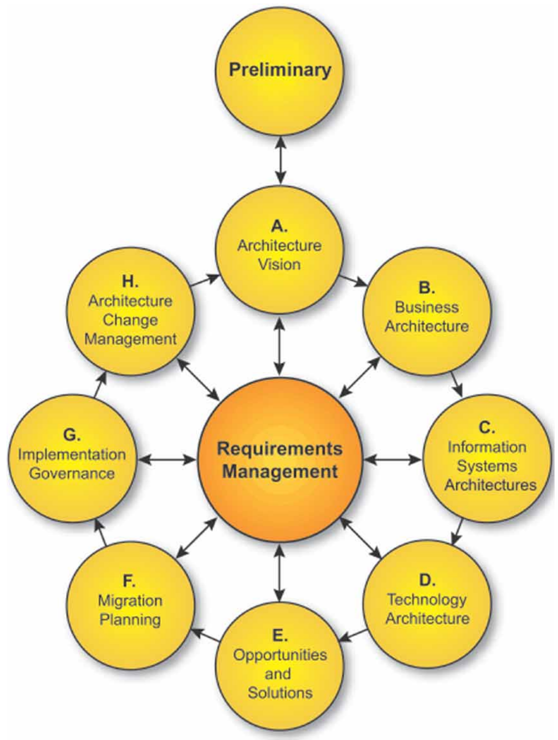
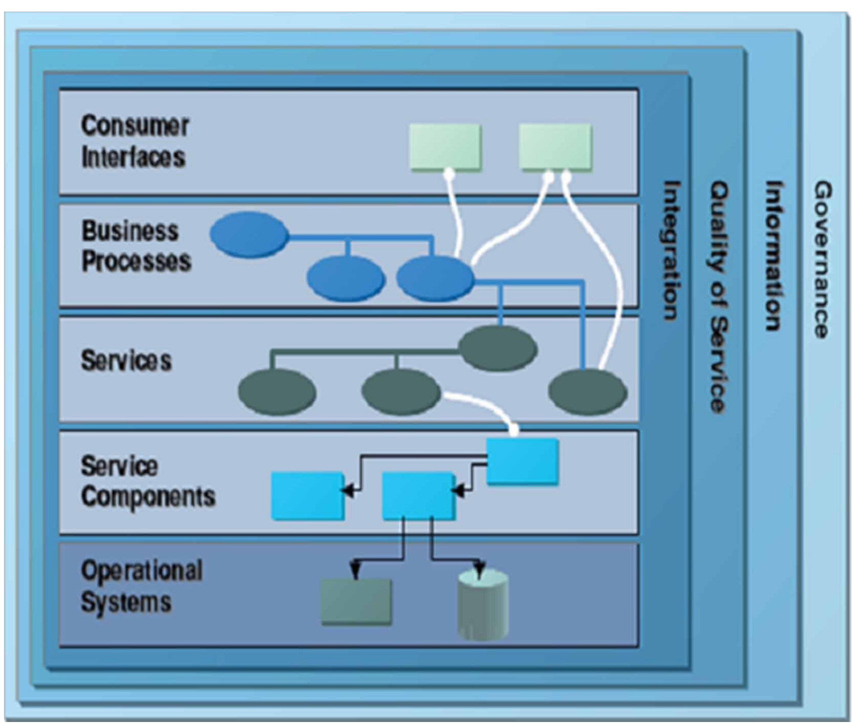


Figure 18. Service's integration (Gartner, 2005)



Internet of Things and Infrastructure Control

For smart cities, distributed communication, a standard from the Institute of Electrical and Electronic Engineers (IEEE) for an architectural framework for the Internet of Things (IoT) can be used. The standard is in its early stages and offers a reference model defining relationships among various IoT domains like, transportation, healthcare and many others… Domains are transformed to be used for the transition to smart cities, applying common architecture elements supporting complex domains, like finance (BSI, 2015).

Telecommunication and Roaming

IoT and mobile infrastructure have expanded to interconnect endpoints and cities, to create a virtual and holistic environment. In these virtually interconnected cities, standard applications, endpoints and mobile apps collaborate in real-time. City map for urban transport app have become standard utilities that englobe also data management tools that help handle feedback and incident alerts; such apps are interconnected with other tools like electronic finance apps and many other (Bradshaw, 2016).

Electronic Payments and Finance

iCTPs use technologies to transform the quality of life where automating economy and digitalization of financial services are fundamental by transforming customers' behaviour. The evolution of technologies-based services is un-linear in different countries. iCTPs need to transform banks to automate crucial financial services. The technology transformation of Deutsche Bank, Raiffeisen Bank, Hana-Bank and Bank Group are good examples for iCTPs (Makarchenko, Nerkararian & Shmeleva, 2016).

Figure 19. Internet supported services (BSI, 2015)

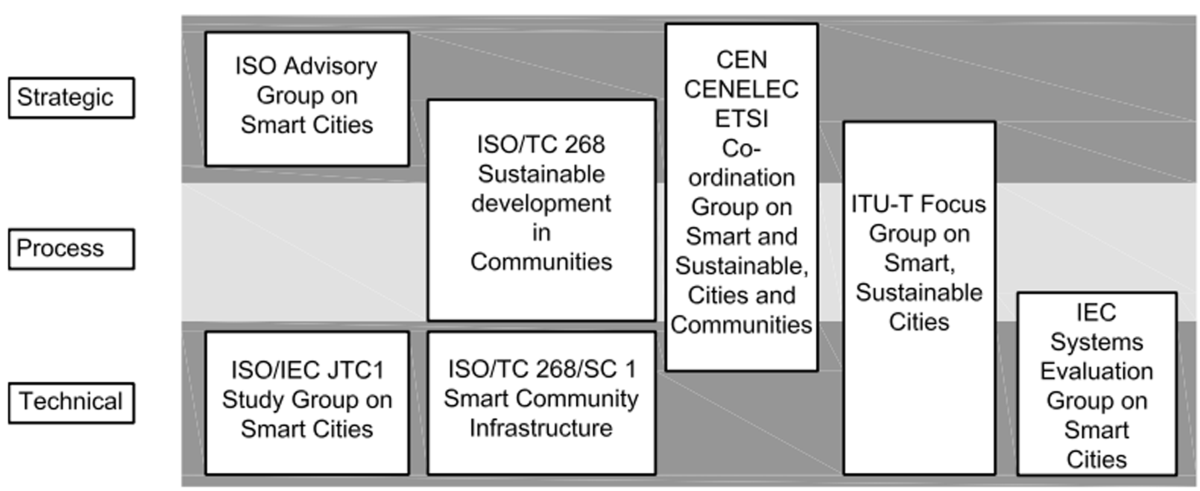


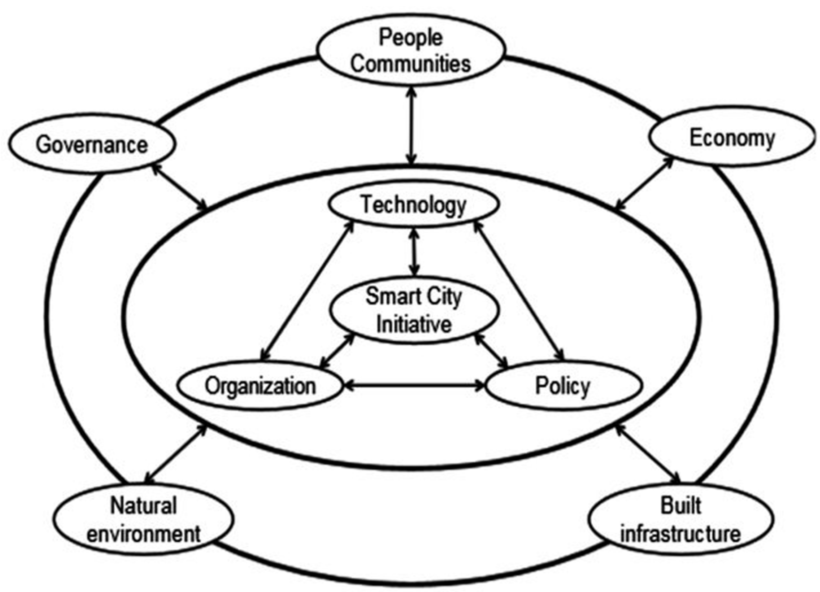
Figure 20. Financial services integration (Makarchenko, Nerkararian, & Shmeleva, 2016)

	Important	**Current** capability	Market lag
Mobile device payments	94%	44%	-50%
Market Lag	92%	24%	
Real-time analytics	90%	30%	-60%
Digital advisory service	83%	28%	-55%
Location-driven services	82%	19%	-63%
Offers via social media	78%	34%	-44%
Comparison services based on financial profile	76%	28%	-48%
Social media account management	72%	14%	-58%
Gamification	72%	15%	-57%
Digital personal assistant	67%	12%	-55%

Drones and City Airspace Slots

Drones were associated with combat objects, evolution has given the opportunity to be used in many civil and business fields and the most emerging area is their involvement in iCTPs. Drones and their slots are playing a key role in HICDC, offering patterns for a variety of domains, such as medical, finance, traffic, package delivery, policing-security, transport monitoring, firefighting and many other. There are many challenges, such as safety, security, terrorism threat, managing slots, legal regulations, power supply, pollution and privacy; especially in densely populated areas (Asghar, Alvi, Safi, & Khan, 2018).

Figure 21. Initiatives framework for smart city (Asghar, Alvi, Safi, & Khan, 2018)



Intelligent Buildings, Security and Construction Units (Domotics)

An intelligent reorganization of Beirut city, if possible, makes it ready to integrate the local, regional and global smart world, whatever that means; such an iCTP needs visceral domotics. Smart devices are exponentially increasing the need to interface iCTP data and functions. The hyper-evolution of new smart scenarios and applications make lives superficially easier but very chaotic. IoT is domotics main infrastructure supporting scalable building solutions; insuring the interoperability between natively incompatible domotics technologies, information infrastructure, software apps; it has progressed to support buildings automation. Domotics endpoints interact using Internet addresses (Miori & Russo, 2014).

Standard Information Technology Procedures

The evolution of intelligent systems and the actual immaturity of design, development, qualification and operations for *Projects* still are in an infancy age, or simply chaotic. Tools for implementation environments are still confronted with serious project issues. These problems show that archaic tools are inappropriate for large enterprise intelligent systems and the authors recommend the use of information technology concepts, such as:

- Patterns' concept expresses a structural concept for iCTP where it offers patterns to provide: 1) knowledge and intelligence templates to instantiate microartefact scenarios; 2) description of their responsibilities, relationships and content; 3) a help to define complex relationships; 4) definition of default CSA and CSF sets model; and 5) simplification of the CSF table evaluations.
- Resources, artefacts and factors, the *TKM&F's* repository maps relate the selected CSFs to various types of *Project's* resources, like architecture models, microartefacts and requirements.

The Information and Communication Technology's Critical Success Factors

Based on the literature review and factors' evaluation, the most important CSFs that are used are evaluated to the following:

As shown in Table 3, the results show that it is very complex to implement (lower then 8.5, is discarded). The next CSA to be analysed, which is the integration of the ADM.

The Research Section's Link to the Architecture Development Method

This section's deduction is that the ICS and other fields are dependent on an EA paradigm and therefore the ADM is crucial for the integration of the HICDC.

THE INTEGRATION WITH THE ARCHITECTURE DEVELOPMENT METHOD

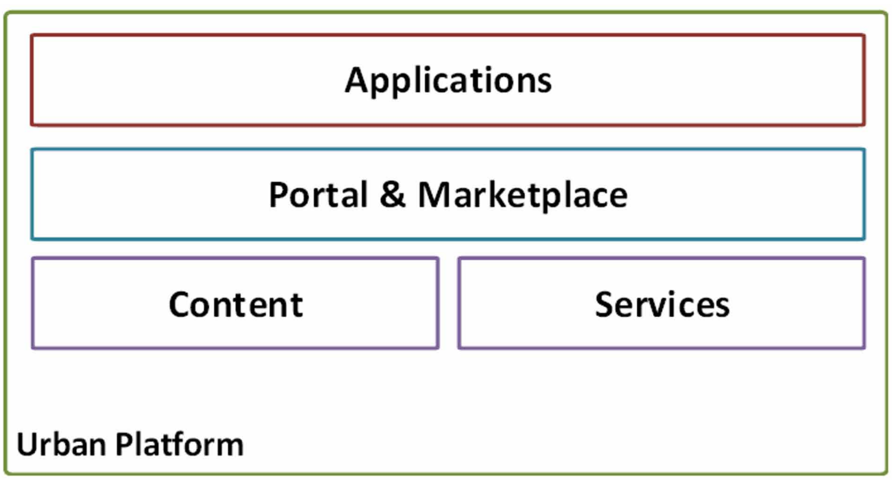
The HICDC' integration with TOGAF and ADM, enables the management and automation of *Projects* where the ADM is a generic method and recommends a set of phases and iterations to develop the *Projects*; it designs parts. As TOGAF is a framework, it can be integrated like in the case of ESPRESSO reference architecture for iCTPs (Cox, Parslow, De Lathouwer, Klien, Kempen, & Lonien, 2016).

Table 3. The critical success factors that have an average of 7.20

Critical Success Factors	AHMM enhances: KPIs	Weightings
CSF_ICS_UID_IntegrationProcessesModels	VeryComplex	From 1 to 10. **03 Selected**
CSF_ICS_Standards	InitialState	From 1 to 10. **05 Selected**
CSF_ICS_Services	Supported	From 1 to 10. **07 Selected**
CSF_ICS_Traffic	ExistingProcedures	From 1 to 10. **08 Selected**
CSF_ICS_IoT_Telecom	ComplexEnvironments	From 1 to 10. **08 Selected**
CSF_ICS_Finance	ExistingSupport	From 1 to 10. **09 Selected**
CSF_ICS_Drones	InitialState	From 1 to 10. **05 Selected**
CSF_ICS_Domotics	Supported	From 1 to 10. **08 Selected**
CSF_ICS_HPMS_StandardsIntegration	Supported	From 1 to 10. **09 Selected**
CSF_ICS_Procedures	Supported	From 1 to 10. **10 Selected**

valuation

Figure 22. Urban platform framework (Cox, Parslow, De Lathouwer, Klien, Kempen, & Lonien, 2016)



Reference Architecture and its Phases

The intended HICDC's reference architecture is to support iCTPs with an implementation- and vendor-agnostic concept with enhanced interoperable and standards blueprint. Technological and implementation agnostic concept promotes (Cox, Parslow, De Lathouwer, Klien, Kempen, & Lonien, 2016): 1) avoiding locked-in concepts; 2) integration of various urban platforms; 3) certification and compliancy; 4) modularity; and 5) market structure agnostic concept. The ADM manages the *Project's* development iterations and its interaction with the HICDCs.

The Intelligent City Architecture Blueprint

The *TKM&F* uses intelligent city standards that include EA frameworks, Business Process Models (BPM), microartefacts interoperability… The mentioned intelligent city standards are managed by the *TKM&F*, which delivers added value and robustness to *Projects*. The proposed *TKM&F*'s EA capabilities help in establishing an architecture principal guideline that defines the Project's initial phase and vision; which is based on a "just-enough" architecture the ADM (The Open Group, 2011a).

The Architecture Development Method Critical Success Factors

Based on the literature review and CSF evaluation process, the most important ADM's CSFs are evaluated to the following:

As shown in Table 4, the results show that it is very complex to implement (lower then 8.5, is discarded). The next CSA to be analysed, which is the integration of the KMS.

The Research Section's Link to the Electronic Knowledge Management System

This section's deduction is that the HICDC can be integrated with significant difficulties in *Projects* and a holistic ADM and the HICDC is suitable for KMS and DMS; or any other intelligence based systems like the uKMS.

THE HOLISTIC URBAN KNOWLEDGE MANAGEMENT SYSTEM

For an urban KMS (uKMS) the goal is to obtain the basis to manage information items using a holistic management concept that offers also the possibility to access distributed heterogeneous knowledge; where the knowledge items are associated with the CSFs (Rockart, 1979). In the 21st century uKMS is of ultimate strategic importance for the management knowledge in smart cities. In cities many traditional various knowledge management accesses exist and are a barrier for uKMS and iCTPs (Malhotra, 2005).

Table 4. The critical success factors that have an average of 7.80

Critical Success Factors	AHMM enhances: KPIs	Weightings
CSF_ADM_CSF_Initialization&Setup	Heteregunous&Complex	From 1 to 10. **06 Selected**
CSF_ADM_IntegrationProcesses	ExistsSupported	From 1 to 10. **07 Selected**
CSF_ADM_Phases	Supported	From 1 to 10. **09 Selected**
CSF_ADM_Requirements	MappingAutomated	From 1 to 10. **09 Selected**
CSF_ADM_HICDC_Architecture	Supported	From 1 to 10. **08 Selected**

valuation

The Holistic Urban Knowledge Management

The uKMS manages urban Knowledge Items (uKI); where uKIs and microartefact scripts are responsible for the manipulation of intelligence and control various iCTP's knowledge processes. The uKMS supports the HICDC underlying mechanics to manage uKI microartefacts; and is responsible for access and uKI's extraction, using holistic systemic approach (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a).

The Holistic Knowledge Strategy

As shown in Figure 23, uKMS contains identifiable data objects or uKIs that link city objects using a unique identifier (Cox, Parslow, De Lathouwer, Klien, Kempen, & Lonien, 2016). uKIs map to CSFs and microartefact(s) and are classified in specific CSAs. A HICDC concept expresses a fundamental structural *Project's* concept for the uKMS/uKI implementation; which enables a holistic approach to knowledge access and its mapping to CSFs.

The Knowledge Management Success Factors

Based on the literature review, the most important knowledge CSFs that are used are:

As shown in Table 5, the results show that it is possible to implement (higher than 8.5, is not discarded). The next CSA to be analysed, which is the integration of the urban DMS.

Figure 23. Intelligent city data and knowledge management (Cox, Parslow, De Lathouwer, Klien, Kempen, & Lonien, 2016)

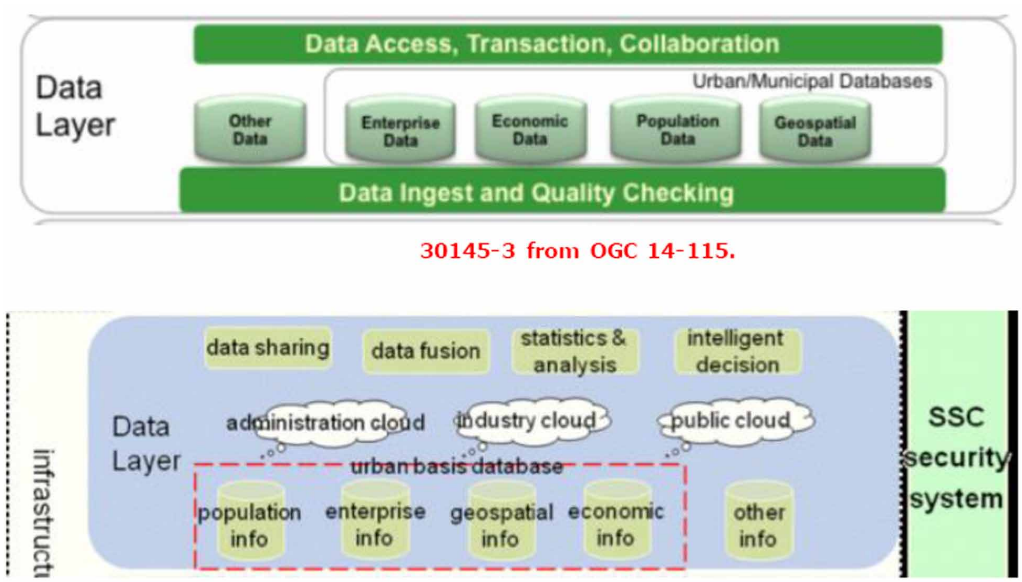


Table 5. The critical success factors that have an average of 8.67

Critical Success Factors	AHMM4BT enhances: KPIs	Weightings
CSF_uKMS_Infrastructure_Integration	Supported	From 1 to 10. **08 Selected**
CSF_uKMS_eKI_Mapping	ComplexToImplement	From 1 to 10. **08 Selected**
CSF_uKMS_Patterns	Implementable	From 1 to 10. **09 Selected**
CSF_uKMS_HICDC_Integration	Implementable	From 1 to 10. **09 Selected**
CSF_uKMS_HICDC_AccessManagement	StandardIntgeration	From 1 to 10. **09 Selected**

valuation

The Modules Chained Link to the Intelligence Support or URBAN Decision System

The uKMS' integration result proves that it is fairly difficult but possible to implement an HICDC to interface the urban DMS (uDMS).

THE INTEGRATION WITH THE DECISION MAKING SYSTEM

Critical Success Factors and Objectives

CSFs can be applied in the (Trad & Kalpić, 2014b): 1) selection of iCTP resources; 2) strategy; 3) uDMS engine; and 4) training needs. Where iCTPs have become in many countries, priorities and previewed budgets would be $135 billion by 2021 that will make iCTPs sustainable. Where the main objectives would be: 1) Livability; and 2) Workability; 3) Sustainability. As shown in Figure 24, various decision domains have enabled the integration of Artificial Intelligence (AI) (or complex decision systems) to support aspects of life; like robotics/automation, drones, and others (Vander Ark, 2018).

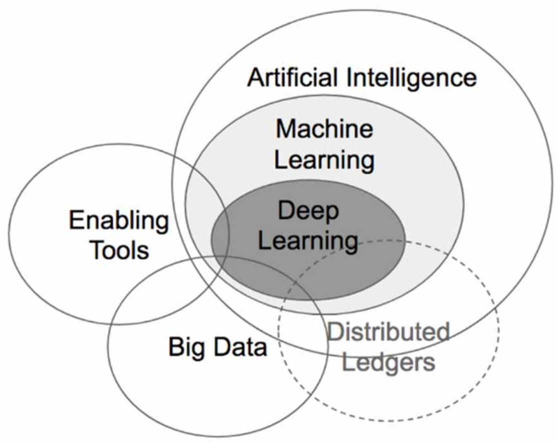
Complex Decision Systems

The aim of such systems is (Walker, 2019): 1) Helping administration to support people to use cities; 2) Improving infrastructure; and 3) Improving public security. These actions would improve economic situation. That implies that the analysis and management of risk is one of the important pre-requisites to ensure the success of a *Project*. The *TKM&F* integrates risk management and performs the analysis using a DMS (Hussain, Dillon, Chang, & Hussain, 2010).

An Extremely Long and Risky Transformation

Standard *Projects* are very risky, the risks levels are very high at about 70%; iCTP are even more risky, when using radical and long-term transformations (Malhotra, 2005).

Figure 24. Intelligent city decision domains (Vander Ark, 2018)



In the HICDC based DMSs, Projects team members can select and tune types of CSAs and CSFs to be processed. The selected CSFs are orchestrated by the HMM's choreography engine that is the base of the uDMS (The Open Group, 2011a; Trad & Kalpić, 2017a, 2017b, 2017c). The *TKM&F*'s interfaces the DMS that uses an empirical problem-solving algorithm that is used in the case when an optimization algorithm approach is impractical or when the problem is too complex and multi-dimensional.

The Decision Making System's Critical Success Factors

Based on the literature review and evaluation processes, the most important DMS's CSFs that are used are evaluated to the following:

As shown in Table 6, the results show that it is not possible to implement (lower than 8.5, is discarded). The next CSA to be analysed, which is the integration of the PoC.

Table 6. The critical success factors that have an average of 7.4

Critical Success Factors	AHMM4T enhances: KPIs	Weightings
CSF_DMS_ComplexSystemsIntegration	VeryComplex	From 1 to 10. **06 Selected**
CSF_DMS_HPMS_Interfacing	Supported	From 1 to 10. **09 Selected**
CSF_DMS_KMS_Interfacing	ComplexIntegration	From 1 to 10. **07 Selected**
CSF_DMS_DMP	IntgeratesAsKernel	From 1 to 10. **10 Selected**
CSF_DMS_HolisticApproach	VeryComplex	From 1 to 10. **06 Selected**

valuation

The Research Section's Link to the Proof of Concept

The DMS' integration result proves that it is fairly difficult but possible to implement an HICDC.

THE HOLISTIC INTELLIGENT CITY DESIGN CONCEPT

Historical Facts on Beirut

Beirut's original Semito-Phoenician name was Byrt which in Aramean, means a well (Fisk, 2011), a probably 10,000 years old city. The Grand Liban (French for *Great Lebanon*) was an artificial mixture of 22 minorities. Until 1975 it had an outstanding economy. In spite of time and consequent Middle Eastern geopolitical dramas, the Lebanon has preserved its mixed Westernized Semito-Phoenician heritage and has even been capable of enclosing other cultures like the Europeans, Arabs, Arameans, Assyrians, Armenians, Persians and Kurds to make it a unique and a complex culture that in the '70s became the cosmopolitan Beirut's *Style de Vie*. Its exposed cultural and ethnical mixture made Beirut a very attractive city and a leading financial hub. Beirut's financial predisposition attracted many institutions and personalities to create and promote their businesses (Trad, 2018e).

To conduct an iCTP for the extremely complex city of Beirut, that is a part of the predominantly Christian Mont-Lebanon region; there would be a need for an evolutionary process to become a dynamic smart and multi-cultural city. Such a process must be a long-term one that includes an urbanized strategic planning subprocess that has to be thoroughly prepared. The target iCTP must deliver a war prone strategy. Actually, and probably because of the geopolitical situation related risks such a concept cannot be implemented easily; but Hiram's Phoenician descendants are known to be masons (Trad, 2018a).

Hiram the Semito-Phoenician King of Tyre and Masons-The Origin of Organized Masonic Massive Constructions

The Semito-Phoenician Beirut is one of the most ancient cities in the world. The first historical reference to Beirut was found in the ancient Egyptian Tell el Amarna's works dating from the 15th century Before Christ (BC). In 2015, Beirut city was officially confirmed as a new wonder city (Wikipedia, 2017a). The Semito-Phoenician nature and affinity for commerce, hedonism and vast organized masonic construction that started with king Hiram, the Semito-Phoenician King of Tyre, remain the main quality of the modern Lebanese, one of such is Minister President, the late Rafic Hariri, who bewildered many by his ability to rebuild the seriously damaged capital city of Beirut and other parts of the Lebanon in record time that made Beirut again a regional hub and enabled it to regain its position in the global and Mediterranean spheres (Trad, 2018e; Zalloua, 2004).

Beirut's Architecture and Samir Kassir

Beirut stands at the crossroads of European and Mediterranean civilizations, for more than seven thousand years that is described in the works of Samir Kassir who delivered a reference book on Beirut, just before his assassination in 2005, by the Syrian killing squads. The squads that eliminated most of the Lebanese elite. Beirut, Kassir's book, is a tour de force that presents this city from its very ancient to modern times. Covering the influences of French/Latin/Crusade, Seleucid, Arab, Ottoman and European incarnations. Kassir vividly presents the spectacular growth of the cosmopolitan capital, in the nineteenth and twentieth centuries and its orchestrated destruction in 1975 by the Syrians; with the aim to improve Switzerland's financial situation (Trad, 2018e; Kassir, 2010).

From the Switzerland of the Middle-East to the Orient of Nowhere

Beirut's cosmopolite features with a unique ethnically diverse financial system where privileged by the constitution as a predominant liberal banking system that was designed by Michel Sursock. The idea of a financial Franco Lebanese entity melted down in front of a ruthless ethno-religious war; financed by the suspicious bankers and safe heavens. During the civil war from 1975 to 1991, directed anarchy reigned in Beirut. The city was ruled by militias who destroyed its banks, city centre and it suffered significant damage. The human casualties were enormous and the effect on the economy apocalyptic (Trad, 2018a).

An Innovation Jump-Starter

The 1991 Gulf War aligns Syria and the US, to invade Iraq; the Syrians gained the right to dismantle Lebanon and brought to power the late Rafic Hariri, a billionaire and masonic tycoon, who became a Prime Minister and who promised that Beirut will become a smart city (New Internationalist, 1994). In fact it did, but his giant efforts were crushed with his assassination in 2005 by the Syrian killing squads.

Post 1975 War Period

A Smart City

In order for Beirut to become a smart city, there is a vision to use technology to manage its assets that include, universities, schools, libraries, ports, transportation systems, hospitals, water/power plants, waste management, governance/law enforcement, and other services. Such HICDC must insure collecting data from the sensors and providing endpoints with services. Sensors are used to measure the readings for various kinds of data, then this data are analysed and displayed; like in the case of smart parking, which enables to find an empty parking location and to advise on traffic congestion. Such an infrastructure must be scalable and energy aware (El-Khoury, & Mohanna, 2016).

Locked-in

Beirut should avoid a political and technological locked-in situation but unfortunately its history and situation are the worst form of the locked-in.

Size of Cities

Beirut because of its size and predisposition and visceral problem has to probably unbundle the iCTP in separate sub projects to manage smaller entities.

Special Topics

Because of its very specific conflictual nature Beirut has to pay special attention to:

- Its specific diverse and cosmopolitan affinities.
- Integrate moderate robotization and automation.
- Domotics for smart buildings is very promising.
- Animal space and care is inexistent, and a lot of cultural work is to be done.
- Gas and oil fields have been discovered and would probably bring wealth; and many problems like pollution.
- Human behaviour is one of the most difficult things to be transformed.
- Transport and free objects (like bikes, cars) is inexistent or in a catastrophic status.
- Green space and sports, in these fields a lot has to be done, it is still in its early difficult stages.
- Internet and Wi-Fi that can be transformed, because it is based on private initiatives.
- Waste management, in a terrible state and is causing major problems.
- Pollution is a partial problem, because the city lies on the sea side and protected by very high mountains which divert the streams of toxic air.
- People with special needs, like elderly and handicapped need support. It is all on private and expensive basis.
- Social and medical services are all expensive and on private basis.
- Unifying information, using RSS feeds, exists in limited private use.
- Fast and hyper food chaos, causing many types of problems is not managed.
- Lebanon has an ultra-liberal economy model that counters iCTP as its main goals has uncommercial attitude and objectives.

The Holistic Intelligent City Design Concept Critical Success Factors

Based on the literature review and evaluation processes, the most important HICDC's CSFs that are used are evaluated to the following:

As shown in Table 7, the result shows that it is virtually impossible a HICDC but this means that there can be a rescoping of the RQ and focusing on the iCTM capabilities.

The Research Section's Link to the Proof of Concept

This chapter's deduction that selects and evaluates the CSFs, is based on the six tables that this RDP has generated, and the following phase is the PoC for HICDC's implementation.

THE PROTOTYPE'S INTEGRATION

The ACS is a concrete case of the reconstruction of Beirut by R. Hariri where the demo application uses the *TKM&F* for the PoC implementation (Trad & Kalpić, 2018c).

Table 7. The critical success factors that have an average of 7.9

Critical Success Factors	AHMM4T enhances: KPIs	Weightings
CSF_HICDC_SystemsIntegration	VirtuallyImpossible	From 1 to 10. **09 Selected**
CSF_HICDC_Architecture_Skills	HistoryCapacitiesPromising	From 1 to 10. **10 Selected**
CSF_HICDC_Leaders	ManagementEnabled	From 1 to 10. **09 Selected**
CSF_HICDC_DMP_Capacities	HumanlyCapable	From 1 to 10. **08 Selected**
CSF_HICDC_HolisticApproach	Supported	From 1 to 10. **08 Selected**
CSF_HICDC_TKM&F_Support	Complex	From 1 to 10. **05 Selected**
CSF_HICDC_RoleOfExperience	Rich	From 1 to 10. **09 Selected**
CSF_HICDC_ Skills	Exisiting	From 1 to 10. **09 Selected**
CSF_HICDC_ExistingStatus	Poor	From 1 to 10. **02 Selected**
CSF_HICDC_Domotics	Supported	From 1 to 10. **09 Selected**
CSF_HICDC_Geopolitics	Conflictual	From 1 to 10. **09 Selected**

valuation

The Architecture Method's Phases' Setup and intelligent city Factors

The HICDC's implementation phases' setup looks as follows:

- phase A or the Architecture Vision phase, establishes a roadmap.
- Phase B or the Business Architecture phase shows how the *Project's* targets roadmap realizes the key requirements.

The Proof of Concept

The chapters' PoC is implemented using *TKM&F* was also developed exclusively by the authors, who own the total copyrights. The PoC presents the HICDC mechanics that interface the DMS, which uses the internal initial iCTP set of CSFs' as an example for this chapter, is presented and evaluated in Tables 1 to 7. The services based microartefacts have bindings/mappings to specific *Projects* resources like CSFs, as shown in Figure 26.

The used microartefacts are designed using EA methodologies and related tools. The HICDC concept defines relationships between the *Projects* requirements and (e)Services based microartefacts (and CSAs/CSFs), using global unique identifiers, as shown in Figure 26.

The PoC is achieved by using the *TKM&F* client's interface that is shown in Figure 27; where the starting activity is to structure the organizational part.

Figure 25. The TKM&F services based microartefacts concept

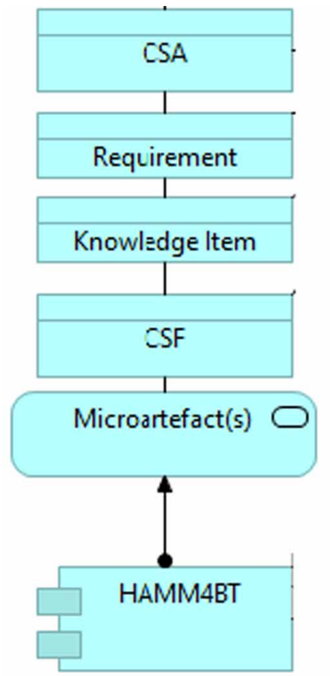


Figure 26. The TKM&F's global unique identifiers interaction (GUID)

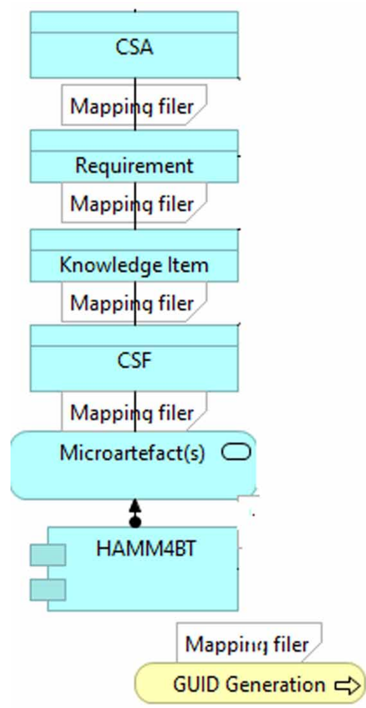
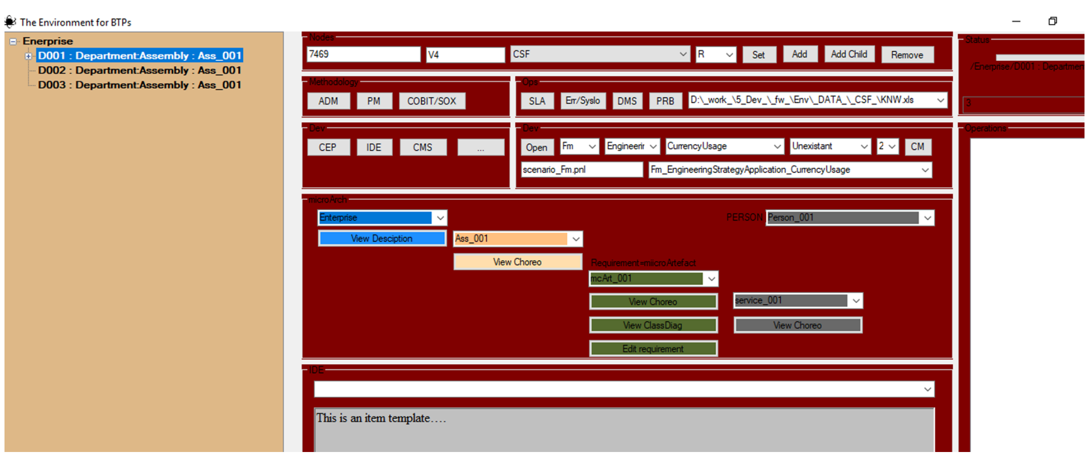
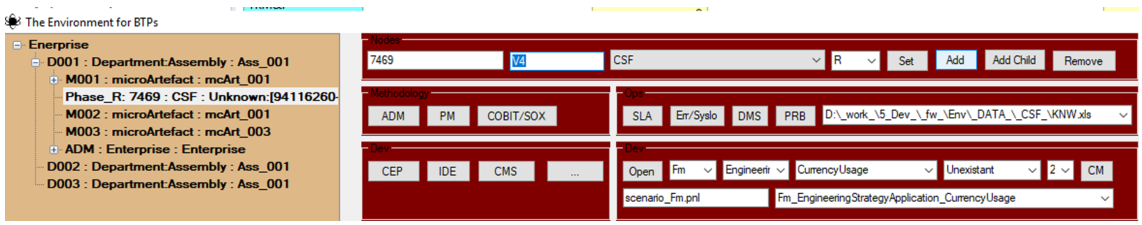


Figure 27. The TKM&F's client interaction



Once the development setup interface is activated, the NLP interface can be launched to implement the needed microartefact scripts to process the defined six CSAs. After starting the *TKM&F's* graphical interface, the sets of CSFs are selected. Then follows the CSF attachment to a specific node of the *TKM&F's* graphical tree, as shown in Figure 28; to link later the microartefacts.

Figure 28. The TKM&F's factor setup interface From the TKM&F client's interface



The ML development setup and editing interface can be launched to develop the intelligent city services to be used in microartefacts. These scripts make up the intelligence basis and the HMM's instance set of actions that are processed in the background to support intelligent city services to be used in microartefacts. The HMM uses intelligent city services that are called by the DMS actions, which manage the edited mathematical language script and flow. This research's HICDC instance, the HMM and its related CSFs were selected as demonstrated previously.

Once the microartefact is ready, the CSF and NLP files are configured; in this chapter six tables and the result of processing of the first initial phase, as illustrated in Table 8, show clearly that the HICDC can be used in *Projects*. HICDC is not an independent component and is bonded to all the *Project's* overall architecture, hence there is a need for a holistic approach.

The *TKM&F* and hence the HMM's main constraint to implement the HICDC is that CSAs for simple *Projects* components, having an average result below 8.5 will be ignored; these values are defined by the *Project's* team. In the case of the current CSF evaluation, an average result below 7.5 will be ignored. As shown in Table 8, the overall average is 7,27, this fact keeps the CSAs (marked in green) that helps to make this work's conclusion; and drops the ones in red. It means that the HICDC integration is not mature and cannot be used in all types of projects. Of course, the complexity in integrating the HICDC in *Projects* must be solved in multiple transformation sub-projects, where the first one should try to transform the basic intelligent city services repository.

SOLUTION AND RECOMMENDATIONS

The managerial recommendations are needed for finding the solutions to enable the holistic management of intelligent city. Because of the low score, Table 8 shows that the HICDC implementation is a very risky transformation process and that today the *TKM&F* can be used for *Projects*. The resultant technical and managerial recommendations are:

- A HICDC must be established and tried to check its feasibility.
- The ADM's integration in a HICDC enables the automation of its interfaces.
- The *Projects* must be separated in multiple transformation sub-projects.
- Unbundle the city's services to deliver the needed HICDC' services classification.
- The iCTM must be a strong leader.
- Setup the weighting and rating rules.
- Setup the mapping concept.
- Setup a central HICDC to be used in *Projects*.

Table 8. The holistic factor management system research's outcome is 7,27

CSA Category of CSFs/KPIs	Influences transformation management	Average Result
The Applied Case Study Integration	VeryComplex	From 1 to 10. 5.75
The Usage of the Architecture Development Method	IntegrationPossible	From 1 to 10. 7.80
The Information and Communication Technology System	TransformableWithDifficulties	From 1 to 10. 7.20
The Mathematical Model's Integration	VeryComplex	From 1 to 10. 6.14
The Decision Making System	TransformableWithDifficulties	From 1 to 10. 7.40
The Holistic Knowledge Making System	IntegrationPossible	From 1 to 10. 8.67
The Holistic IC Design Concept	IntegrationPossible	From 1 to 10. 7.90

Evaluate First Phase

- Select the HICDC' CSFs, KPIs and CSAs.
- An iCTM must be an agile project manager.
- Use of intelligent city process models is suggested.
- The iCTM must have cross-functional skills and a strong leadership.
- Define the interface to the uKMS and DMS. The iCTP needs to implement a DMS.
- Model the HICDC' and microartefacts interaction.

HICDC managerial recommendations, and the *TKM&F*, round up the approach needed for the complex iCTP.

FUTURE RESEARCH DIRECTIONS

This research topic appears to be undiscovered and very complex, because many intangible values are ignored, like schooling. The probable reason for such a de facto situation is the classical approach that is based on too much scoping of the research question and simplifying the research method to the level of marketing-like quantitative descriptive statistics taught in many business schools; which undermines the possibility of solving more complex problems and development of sophisticated decision systems. The future research and development process will continue to tune the *TKM&F* and will work more specifically on the decision module's evolution.

CONCLUSION

This RDP is based on the *TKM&F* unique mixed research model; where CSFs and CSAs are offered to help *Projects* managers and urban architects to minimize the chances of failure when implementing an iCTP. This chapter is part of a series of research works related to HMM, *Projects*, DMS and uKMS. This chapter is based on mixed research model; where CSAs/CSFs are offered to help *Projects* evaluate each *Projects* phase. In this chapter, the focus is on the HICDC that defines a central factor pool to be used throughout the *Projects*. The most important managerial recommendation that was generated by the previous research phases was that the iCTM must be a strong leader. The PoC was based on the CSAs/CSFs links to a specific *Projects* resources and the reasoning model evaluated the selected CSFs. The deduced result implies that an attempt of HICDC based transformation is very complex and needs a strong leader like Rafic Hariri. The managerial recommendations are offered to help iCTMs decrease the high failure rates. The already published research and development publications have produced the following outcomes:

1. Knowledge gap, the research has proved the existence of a multi-dimensional knowledge gap that exists between the complexity and the needed skills for *Projects*' management.
2. The Beirut rebuilding experience showed the need for very capable managers.
3. The PoC proved the research's method and delivered the recommendations on how to manage iCTMs.

The *TKM&F* supports the iCTM by using the HICDC pattern and delivers a set of managerial recommendations for *Projects*.

ACKNOWLEDGMENT

In a work as large as this research project, technical, typographical, grammatical, or other kinds of errors are bound to be present. Ultimately, all mistakes are the authors' responsibility. Nevertheless, the authors encourage feedback from readers identifying errors in addition to comments on the HICDC and the *TKM&F* in general. It was our great pleasure to prepare this chapter and its experiment. Now our greater hopes are for readers to receive some small measure of that pleasure and support for his project.

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KEY TERMS AND DEFINITIONS

ADM: Architecture development method.
CSA: Critical success area.
CSF: Critical success factor.
DMS: Decision-making system.
EA: Enterprise architecture.
EAP: Enterprise architecture projects.
HICDC: Holistic intelligent cities design concept.
HKMS: Holistic knowledge-management system.
HMM: Holistic mathematical model.
ICT: Information and communication technologies.
iCTM: Business transformation manager.
KM: Knowledge management.
KMS: Knowledge management system.
ML: Mathematical language.
MM: Mathematical model.
NLP: Natural language programming.
Projects: Business transformation projects.
RDP: Research and development projects.
RQ: Research question.
SOA: Service-oriented architecture.
TKM&F: Trad Kalpić methodology and framework.
TOGAF: The Open Group's architecture framework.
XML: eXtensible mark-up language.

Chapter 10
An Applied Mathematical Model for Business Transformation and Enterprise Architecture:
The Holistic Global Security Management System (HGSMS)

ABSTRACT

The business and societal transformation project (B&STP) of a modern business and global environment needs a well-designed holistic global security management system (HGSMS) that, in turn, depends on measurable success factors; these factors are used for the evolution of the transformation process. During the last decade, due to the global insecurity and financial crisis, the security strategies were not efficient. That is mainly due to the fact that businesses depend on security standards, law, cyber and information technology evolution, enterprise architecture, business engineering, and multilevel interoperability. They are restricted to blindfolded infrastructure security operations and/or martial like legal cases. Major B&STPs are brutally wrecked by various security violations that may cause a no-go decision. Most of such security misfits are used for internal politics, while highly important issues and teams' problems are simply ignored.

INTRODUCTION

They are restricted to blindfolded infrastructure security operations and/or martial-like legal cases. Major B&STPs are brutally wrecked by various security violations that may cause a no-go decision. Most of such security misfits are used for internal politics, while highly important issues and teams' problems are simply ignored. The most damaging fact is that business environments lose their transformational momentum, what can negatively affect their business sustainability and leave it open to security breaches and financial loses. Financial Technology (FinTech) is the latest technology buzzword that aims to change the traditional financial environment in the delivery of interactive financial services. In this chapter, the

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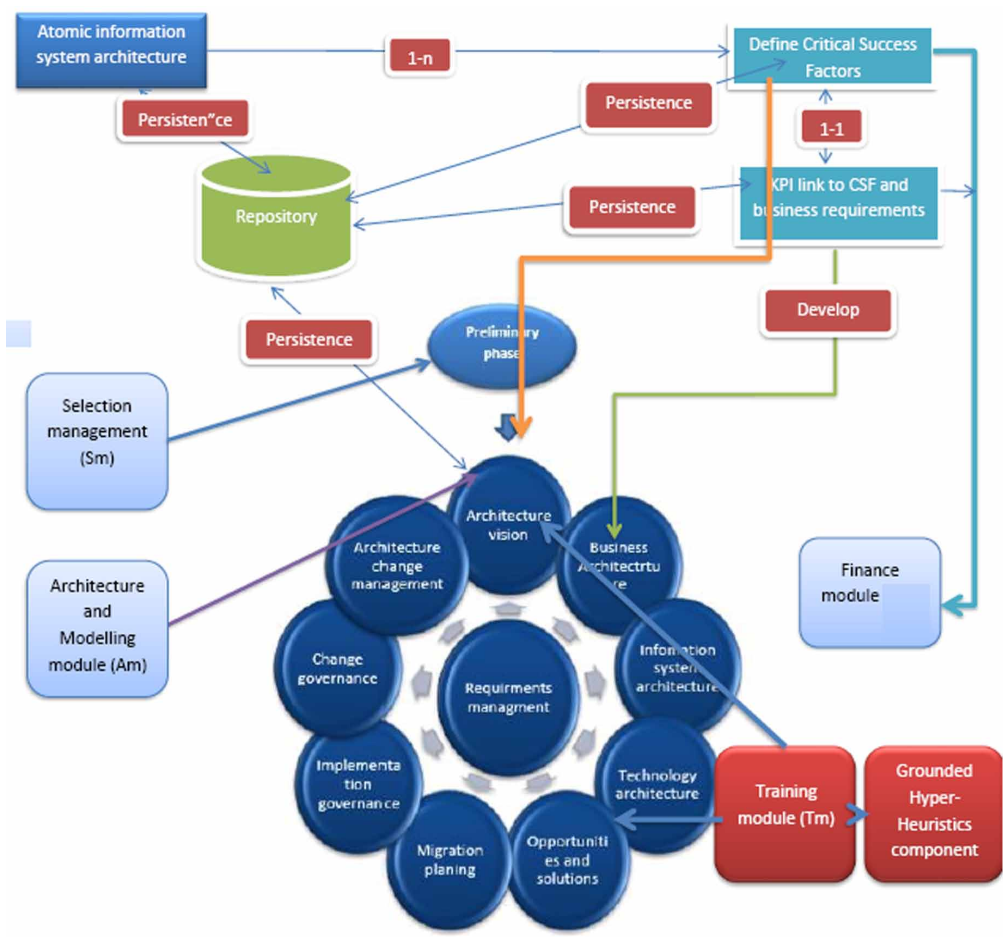
author proposes a set of managerial recommendations on how to avoid such critical situations. Today many security architectures exist, and even when very advanced, unfortunately they often follow a silo model.

This chapter's concept can support the cyberbusiness societal transformation process of the traditional business environment through the automation of all its security operations and their related business and organisational processes. Transforming a traditional security subsystem and the related archaic legal constraints is an important challenge, because of the probability that the security and legal team(s) resist to change. An HGSMS may provide the base for flexible governance, or other services for the future global business environment, in order to avoid the security-human dependency. This chapter's aim is to support Business and Societal Transformation Managers (B&STM) or enterprise architects (or simply *Managers)* in managing frequent changes to business environments and the integration of automated HGSMS procedures; to insure governance. To achieve this goal, the authors offer an HGSMS automation pattern that could support transformation processes. Security and governance controls for a business entity, regional body, government, or geopolitical entity is a set of interrelated activities from various domains like security architecture, governance auditors, financial engineering, geopolitical influence, governance and legal conformance. All that can be used to avoid financial crimes, business disruptions and corruption. Complex transformation initiatives must be coherent with the entity's business and security strategic planning goals; where the main strategic goal is to minimize the various types of criminal acts. Security/governance controls are the fuel of the entity's sustainable business growth and its integration in global economies. Security/governance control schemes can be supported by security and risk frameworks, standards, and legal controls that are necessary for the company's (or government entity's) business strategy that is based on a global security background (Trad & Kalpić, 2017a, 2017b). Security is mainly link to financial crimes that are related to global predators; who are even ready to hand desperate refugees to dangerous regimes, in order to plunder their richness (like the case of Switzerland in the 2nd World War) The (Frontline, 1996). The profile of a B&STM has become a central issue in managing societal transformations; where this article is mainly based on Farhoomand's work that describes three basic profiles: the Advocate, the Technocrat and the Samaritan (Farhoomand, 2004). The authors try to prove that the profile and a supporting mathematical model can be a combination of the three later profiles, strengthened by a holistic architect's approach and modelled using the Holistic Mathematical Model (HMM, used in all book chapters, where the reader might be confused with the alternative abbreviations, like the terms AMM4BT or HAMM4BT), used to support the selection and training of a B&STM; who is basically a leader and main architect of a B&STP. The HMM is based on Critical Success Factors (CSF) (Trad & Kalpić, 2018a, 2018b) and this chapter is based on a unique mixed research method that is supported by mainly qualitative research module (Trad & Kalpić, 2017a, 2017b, 2017c, 2017d; Gunasekare, 2015). The HMM application for B&STPs uses a natural language development environment and for that goal the authors propose recommendations that can be used, for example, by the global leaders (Myers, Pane, & Ko, 2004; Neumann, 2002). The HGSMS activities are supported by a central Decision-Making System (DMS), Knowledge Management System (KMS) and an Enterprise Architecture Projects (EAP). The Proof of Concept (PoC) is based on a business case from the insurance domain (Jonkers, Band, & Quartel, 2012a; Trad, 2013), where the central point is the feasibility or the origins of the B&STP or an EAP (or simply a *Project*). The PoC shows the analysis process of a B&STP and its capacity to transform or explain an event. *Projects* are managed by B&STMs, who are (or should be) supported with a methodology and a framework that can estimate (or analyse/explain) the risks of failure of a *Project*; at the same time, he should be capable of managing the implementation processes. The HGSMS supports B&STPs, who are responsible for analysing complex enterprise (geopolitical environments) (Trad & Kalpić, 2016b). The word analysis does not stand just for the simple inspection activity but for a holistic event analysis approach that identifies the B&STP's complex background.

BCKGROUND

In a holistic global security/governance architecture, the B&STM's role is important and his or her (for simplicity, in further text – his) decisions are aided by using factors within an implemented HMM. A large set of CSFs can influence the HMM, like: a) the role of the global security enforcement control by using HGSMS; b) global geopolitical factors; c) political and cultural setup; d) level of cross-functional skills; e) cyber and technological conditions; f) financial competition and financial greediness; and g) security, financial and legal control mechanisms. A systems approach is the optimal to model such controls (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a). As shown in Figure 1, the decision model interacts with the external world via an implemented framework to manage the security risks and that is this article's focus.

Figure 1. The research framework's concept (Trad & Kalpić, 2016a)



FOCUS OF THE CHAPTER

The Research Process

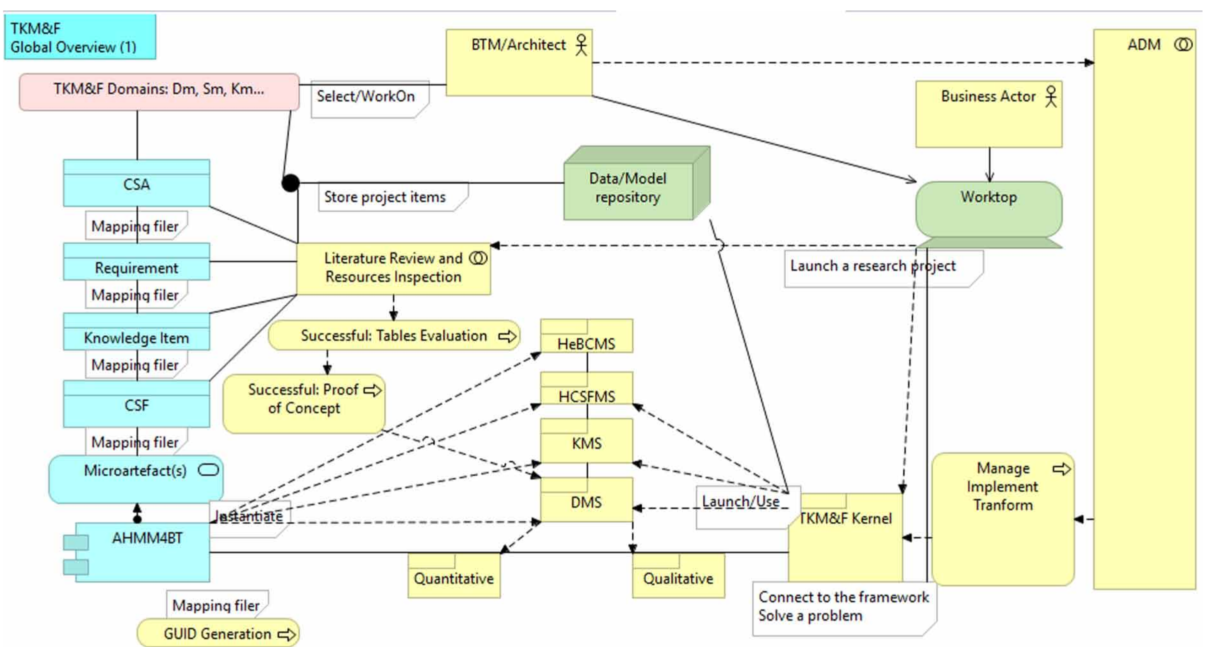
This research chapter uses the Trad Kalpić Methodology and Framework (*TKM&F*) which is specialized in *Projects* management (Bruce, 1994) that may face many difficulties, mainly due to the complexity encountered in the implementation phase (CapGemini, 2009); to enhance the success rate, the authors propose the *TKM&F* that is a unique framework and a pioneering approach. The *TKM&F* recommends linking a Mathematical Model (MM) to all levels of the *Project*, as shown in Figure 2 (Trad & Kalpić, 2018b; Agievich, 2014), including the CSF based HGSMS (Tidd & Bessant, 2018).

This research's main topic is related to B&STPs and the ultimate research question is: "Which business transformation manager characteristics and which type of support should be assured in the implementation phase of a business transformation project?" Decision making concepts based on critical success areas are their main research component.

Critical Success Areas, Factors and Decision Making

Critical Success Area (CSA) is a category of CSF where in turn a CSF is a set of Key Performance Indicators (KPIs), where a KPI corresponds to a single requirement or feature. For a given problem, a framework analyst must identify the initial set of CSFs to be used for the decision-making system. Hence the CSFs are the most important mapping/relation between the geopolitical construct, financial status, organisational predisposition and decision-making system; that supports HGSMS to detect for example

Figure 2. Presents levels of project's interaction (Trad & Kalpić, 2017b, 2017c)



the ecosystem of global financial crime (Peterson, 2011). The proposed HMM based HGSMS delivers a set of recommendations and solutions for the global security architecture that is a part of the *TKM&F* (Trad & Kalpić, 2017c, 2017d).

The Applied Research Framework

The B&STM or enterprise architect's security/governance design decisions can be made in a just-in-time manner by using outputs from various credible technology logging sources. The defined global security strategy should asses and govern global system security risks and at the same time legally assert or control the B&STP's resources that are formalized with an enterprise architecture blueprint. A research framework can support such an undertaking. Unfortunately, an immense set of archaic CSFs can influence such a process, like: 1) the influence of cyber security on *Projects*; 2) working with complex systems with a very strict legal frameworks; and 3) the holistic cyberlaw control mechanisms for such projects are non-existent or are too complex to implement. A global concept and the management of related global security/governance systems approach is optimal for such control mechanisms (Daellenbach & McNickle, 2005). In this research the focus is on the HGSMS that manages the B&STP's global security/governance. The HGSMS can be applied to many B&STPs and general fields in the *TKM&F* and it is a part of the Financial management module (Fm) and the Architecture and modelling module (Am). In this chapter the authors propose a set of HGSMS managerial recommendations and a reusable real-world module (Trad, 2017b; Trad, 2017c). The HGSMS component is managed by The Open Group's Architecture Framework (TOGAF) architecture development method's phases, where each architecture microartefact circulates through its phases. The architecture microartefacts contain their private set of Critical Success Factors. These CSFs (Peterson, 2011) can be applied to: a) select the important global security factors; b) detect the B&STP's security risks high points; c) estimate the actual risks status of the B&STP using the decision support system's interface; and to eventually take a decision on B&STP's continuation; d) control and monitor the needed HGSMS mechanisms; e) upgrade the B&STP's team global security skills; and f) support the architecture and project management activities. The HGSMS can be applied to various types of *Projects* (Trad 2018c; Trad 2018d) and is a part of the Selection management, Architecture-modelling, Control-monitoring, Decision-making, Training management, *Projects* management, Finance management, Geopolitical management, Knowledge management, Implementation management and Research management Framework (SmAmCmDmTmPmFmGmKmImRmF, for simplification reasons, in further text the term *TKM&F* will be used). The Framework or the *TKM&F* is composed of the mentioned modules, but the user can add his own modules. This chapter is a part of the research cluster that has produced many articles, literature reviews, usable items and research artefacts. In this chapter, the minimum of sections from previous works are reused for a better understanding of this complex subject. Therefore, this work can be considered as a pioneering one in the field of global architecture concepts. For this phase of research, the authors try to deliver their findings and recommendations to clarify the risks patchwork, using the mathematical model of a decision-making system that is based on critical success factors. For that purpose, this phase's research sub-question is: "What are the global risks of security on business or societal transformation projects?"

The *TKM&F* who is owned by its totality and copyrighted by the authors; where this chapter is an IGI Global copyright and these two objects are distinct and different. This chapter's RQ was formulated after a literature review process.

The Internal Research Decision Making System

The Decision Making System (DMS) is conceptually based on a mixed method, combining Action Research (AR), tree heuristics and directed quantitative analysis. The authors believe that qualitative and quantitative methods can be united in a single method. AR is applied in education research and this fact supports the B&STP's capability to build business intelligence microartefacts in a continuous learning process. This process inspects and learns from configurable intelligent microartefacts that are found in the DMS. The decision system is generic and can be applied to any business domain and is easily adaptable (Trad & Kalpić, 2017c; Peterson, 2011) and a second step, if needed, applies a precise quantitative analysis. A DMS must be managed by existing audit or governance frameworks, where the B&STM's acceptance of various types of risks is required. These risks are estimated by the B&STM, by using DMS actions to deliver solutions. The DMS actions map to the governance processes, found in TOGAF's phase G, which is responsible for implementation governance that adjusts the business view. DMS artefacts are implemented in all the B&STP components and the implementation of governance mechanisms should be able to identify various types of critical risks. They are to be managed (as CSFs), what might need many iterations to limit the risks, which can be modeled and managed by the HMM (The Open Group, 2011a).

The Mathematical Model in Research

The proposed HMM is domain agnostic and is not related to any specific methodology and contains a configurable reasoning module that uses CSFs sets and actions (Peterson, 2011); here the enterprise refers to a considered organisation. The applied HMM supports a microartefact based architecture, which uses a business-driven approach and uses also the Open Group's Architecture Development Method (ADM) (Trad & Kalpić, 2017b). The HMM takes into account the following CSAs:

- The security/governance concept.
- The information technology integration.
- The legal aspects.
- The financial background.
- The applied business/societal case.

THE APPLIED BUSINESS SOCIETAL CASE

Managing the Business Case

HGSMS uses an Applied Case Study (ACS), developed by the Open Group as a reference study, it presents the possibilities to implement *Projects*' components and is related to an insurance company named ArchiSurance (Trad & Kalpić, 2018f); in this chapter it is used to check the HGSMS.

Integrating Critical Success Factors in the Case Study

A CSF is measurable and mapped to a weighting that is roughly estimated in the first iteration and then tuned through ADM iterations, to verify the *B&STM* profile using the DMS; where the HGSMS' integration is essential (Felfel, Ayadi, & Masmoudi, 2017). The main issue here is how to define the background and selection aspects for such a profile; and how to interrelate the different business-enterprise architecture skills (KPMG, 2014).

The Architecture Development Method and Projects

This research project focuses on *Projects'* integration and presents the influence of HGSMS to improve governance. In the actual age of distributed intelligence, complexity, knowledge, economy and technology, there is a need for HGSMS to propose a governance mechanism (Gardner, 1999). HGSMS offers a pattern that includes a hyper-heuristics tree that supports a wide class of problem types, like localizing fraud (Markides, 201), where the DMS offers a set of *B&STP* anti-fraud recommendations. The *TKM&F's* parts, must synchronize with the ADM that are shown in Figure 3.

The Case Study's Critical Success Factors

Based on the CSF review and estimation processes, the ACSs CSFs that are used and evaluated, are presented in Table 1.

Figure 3. Business architecture phases (The Open Group, 2011a)

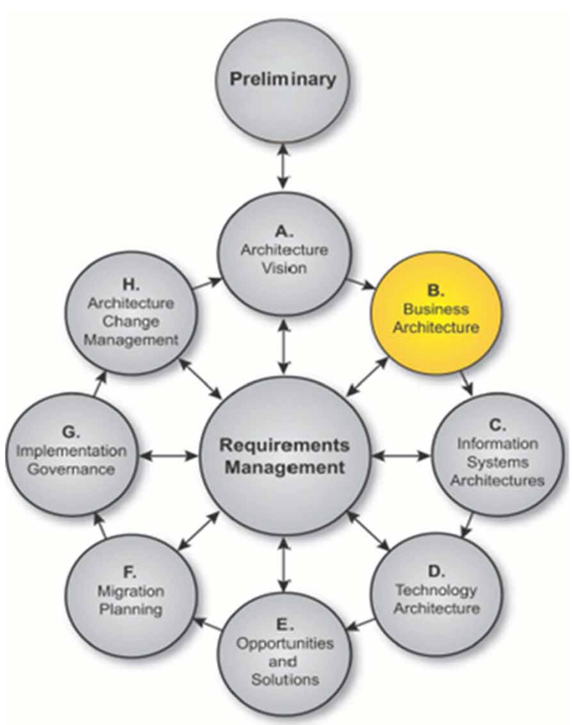


Table 1. The applied case study's critical success factors that have an average of 8.40

Critical Success Factors	HMM - KPIs	Weightings
CSF_ACS_Modelling_Implmentation	ComplexNeedsUnbundling	From 1 to 10. **07 Estimatec**
CSF_ACS_CSFs	ComplexClassification	From 1 to 10. **08 Estimatec**
CSF_ACS_References	LimitedSilos	From 1 to 10. **08 Estimatec**
CSF_ACS_ADM_Integration	Integrated	From 1 to 10. **09 Estimatec**
CSF_ACS_Technologies	UniquePlatform	From 1 to 10. **09 Estimatec**
CSF_ACS_Governance	Advanced	From 1 to 10. **08 Estimatec**
CSF_ACS_Transformation_TKM&F	NoDifference	From 1 to 10. **10 Estimatec**
CSF_ACS_Manager_Skills	ComplexProfile	From 1 to 10. **08 Estimatec**

valuation

As shown in Table 1, the result's aim is to prove or justify that the HGSMS' business case and how it can be used with the PoC; unfortunately, the results from Table 1 are deceiving, because they are under 8.5 (which the minimum) and the next CSA to be analysed is the HMM's integration.

The Research Section's Link to the Applied Mathematical Model

This section's deduction is that the HMM is important for the HGSMS implementation; where it is the basis for the *Project*.

THE HOLISTIC MATHEMATICAL MODEL'S APPLICATION

The Basic Element

The HGSMS CSFs define the initial processing nodes that are identified as vital/possible successful targets. Nodes need to be reached and maintained and they are the HMM's basic elements that are needed also for the *Projects* evaluations, whether they are successful or they failed (Morrison, 2016).

The Mathematical Model's Basics

The HGSMS uses a CSF based HMM that is an abstract model containing a proprietary Mathematical Language (ML) that can be used to automate, transform and implement the behaviour of the HGSMS. The HMM nomenclature that is presented in Figure 4 to the reader in a simplified form, to be easily understood on the cost of a holistic formulation of the model.

Figure 4. The applied mathematical model's nomenclature (Trad, & Kalpić, 2017a)

AMM4BT

rncRequirement	= KP I	(1)
CSF	= Σ KPI	(2)
CSA	= Σ CSF	(3)
Requirement	= U̲ rncRequirement	(4)
(e)neuron	= action+ rncInteligenceArtefact	(5)
mcArtefact	= U̲ (e)neurons	(6)
rncEnterprise	= U̲ mcArtefact	(7)
(e)Ellterprise	= U̲ rncEnterprise	(8)
mcArtefactScenario	= U̲ mcArtefactDecisionMaking	(9)
IntelligenceComponent	= U̲ mcArtefactScenario	(10)
OrganisationalIntelligence	= U̲ InteligenceComponent	(11)
AMM4BT	= ADM+ Organisationallntelligence	(12)

As shown in Figure 4:

- The abbreviation "mc" stands for micro.
- The symbol ∑ indicates summation of weightings/ratings, denoting the relative importance of the set members selected as relevant. Weightings as integers range in ascending importance from 1 to 10.
- The symbol U̲ indicates sets union.
- The proposed HMM enables the possibility to define *Project* as a model; using CSFs weightings and ratings.
- The selected corresponding weightings to: CSF ϵ { 1 … 10 }; are integer values.
- The selected corresponding ratings to: CSF ϵ { 0.00% … 100.00% } are floating point percentage values.

A weighting is defined for a HGSMS CSF and a rating for a KPI.

A Quantitative-Qualitative Research Mixed Model

A problem, RQ, CSF or phenomenon are examined in iterations relating breadth and depth, using heuristics/beam search, which is specialized for unknown problems or the ones that are in a preliminary phase or first iterations. Then, the *TKM&F* qualitative research module input data stream(s) consists of sets of numbers that are collected from sets generated by using designed/structured and approved/validated data, object-collection modules and statistically processes.

The Applied Mathematical Model's Structure

The HMM for HGSMS has a composite structure that can be viewed as follows:

- The static view has a similar static structure like the relational database model's structure.
- The behavioural view; these actions are designed using a set of mathematical nomenclature.
- The skeleton of the *TKM&F* that uses microartefacts' scenarios to support HGSMS requests.

The Applied Business Transformation Mathematical Model

The HMM can be modelled after the following formula for Business Transformation Mathematical Model (BTMM) that abstracts the *Projects*:

$$\text{iHMM} = \text{Weigthing}_1 * \text{iHMM\_Qualitative} + \text{Weigthing}_2 * \text{iHMM\_Quantitative} \quad (1)$$

$$\text{HMM} = \sum \text{iHMM for an enterprise architecture's instance} \quad (2)$$

The iHMM refers to an instance of the HMM for one ADM iteration.
(BTMM):

$$\text{BTMM} = \sum \text{HMM instances} \quad (3)$$

The objective function of the BTMM's formula can be optimized by using constraints and with extra variables that need to be tuned using the HMM. The variable for maximization or minimization can be, for example, the *Projects* success, costs or other CSF. For the HGSMS PoC, the success will be the main and only constraint and success is quantified as a binary 0 or 1. The objective function definition will be:

$$\text{Minimize risk BTMM} \quad (4)$$

The BTMM is the combination of a *Project* methodologies and a holistic mathematical model that integrates the enterprise organisational concept, information and communication technologies (Lazar, Motogna, & Parv, 2010).

As shown in Figure 5, the HMM is a part and is the skeleton of the *TKM&F* that uses microartefacts' scenarios to support HGSMS requests (Kim & Lennon, 2017).

The HGSMS components interface the DMS and KMS, as shown in Figure 6, to evaluate, manage and map CSFs for selection activities; if the aggregations of all the *Project's* CSA/CSF tables exceeds the defined minimum (which defined by the *Manager*), the *Projects* continues to its second part, the HGSMS PoC.

Framework's Applied Mathematical Model Integration

The *Project's* initialization phase generates the needed CSFs and hence creates the types profile issues to analyzed.

Figure 5. The framework's components and its mathematical model

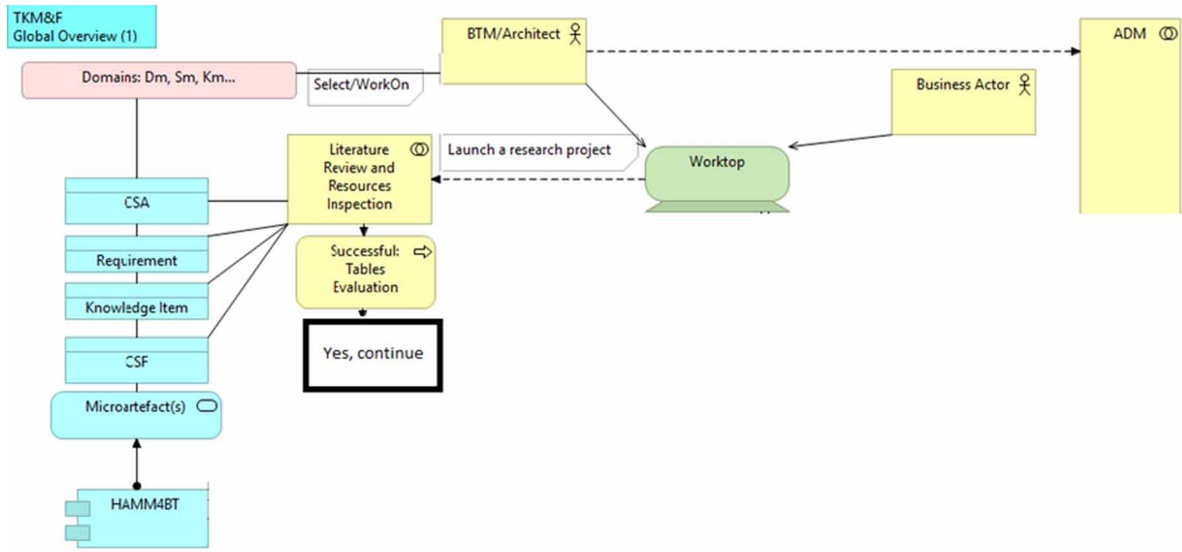
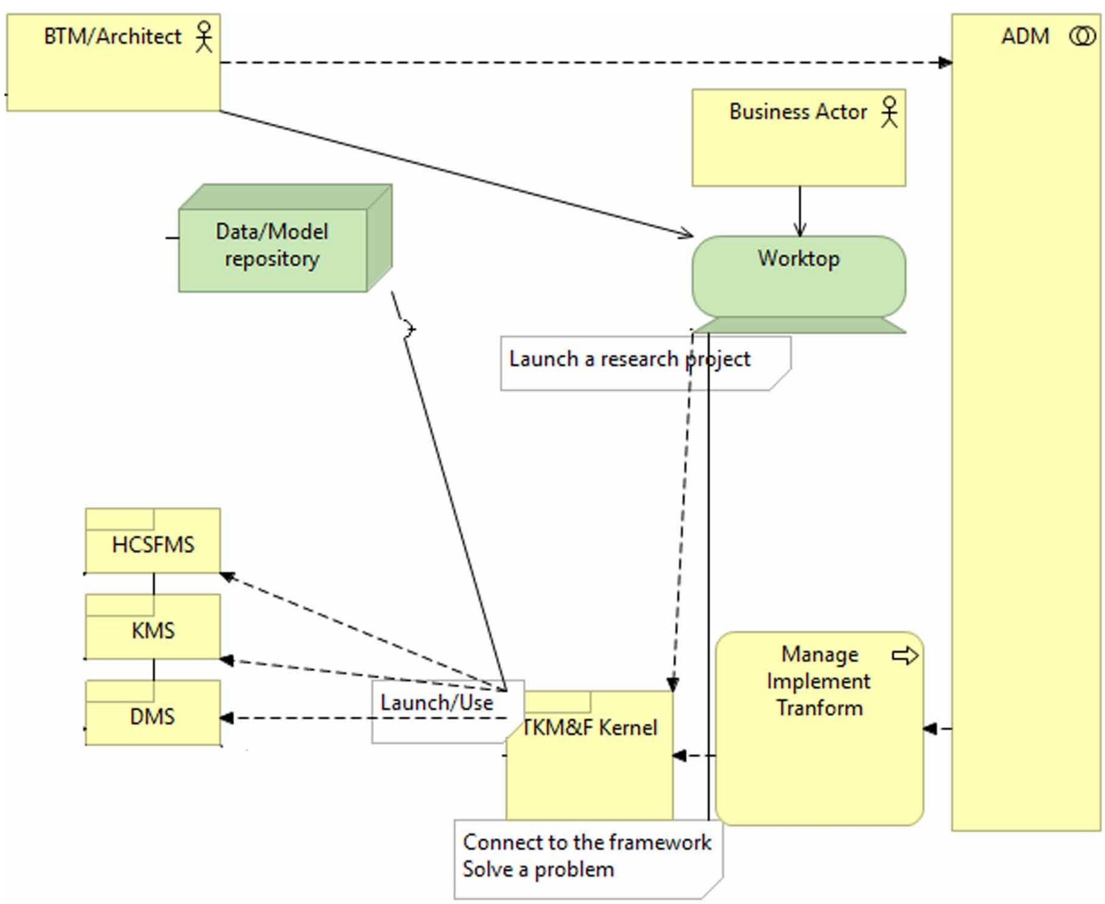


Figure 6. The HMM based decision making interface



The HMM is a part and is the skeleton of the *TKM&F* that uses microartefacts' scenarios to support HGSMS requests (Agievich, 2014).

The Mathematical Model's Integration Critical Success Factors

Based on the HGSMS review and estimation processes the most important HMM CSFs are evaluated as follows:

As shown in Table 2, the results prove that HMM is mature and possible to be used for the HGSMS and can be used for the PoC. The next CSA to be analysed is the holistic management of the Information and Communication System (ICS).

The Research Section's Link to the Information and Communication System

This section's deduction is that the ICS' unbundling is a crucial process for the target environments.

THE KMS's INTEGRATION IN THE INFORMATION AND COMMUNICATION SYSTEM

Distributed Unit of Work

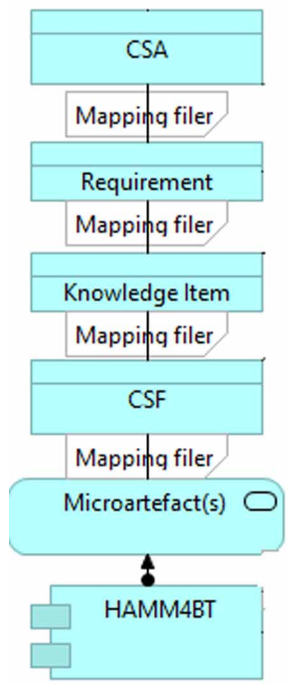
Microartefact granularity and responsibility for a given HMM scenario is a complex undertaking (Kim & Lennon, 2017); added to that there is the implementation of the "1:1" classification, mapping and classification of the transformed HGSMS microartefacts, as shown in Figure 7. The enterprise architecture concept uses methodologies like The Open Group's Architecture Framework's (TOGAF) ADM that supports a set of the *TKM&F's* and HGSMS (Neumann, 2002).

Table 2. The critical success factors that have an average of 8.60

Critical Success Factors	KPIs	Weightings
CSF_HMM_TKM&F_Integration	StableTested	From 1 to 10. **08 Estimated**
CSF_HMM_InitialPhase	RobustTested	From 1 to 10. **09 Estimated**
CSF_HMM_PoC_Phase	StableTested	From 1 to 10. **09 Estimated**
CSF_HMM_Qualitative&Quantitative	Complex	From 1 to 10. **07 Estimated**
CSF_HMM_Final_BTMM	VerifiedModel	From 1 to 10. **09 Estimated**
CSF_HMM_ADM_Integration	Synchronized	From 1 to 10. **09 Estimated**
CSF_HMM_HGSMS_Interfacing	StableTested	From 1 to 10. **09 Estimated**

valuation

Figure 7. The framework's microartefact interactions



HGSMS's Microartefact

HGSMS's microartefact is an instance of the building block that can interact with other B&STPs microartefacts in a traced and synchronized manner and uses TOGAF's ADM to assist it in the grouping of the needed services (The Open Group, 2011a).

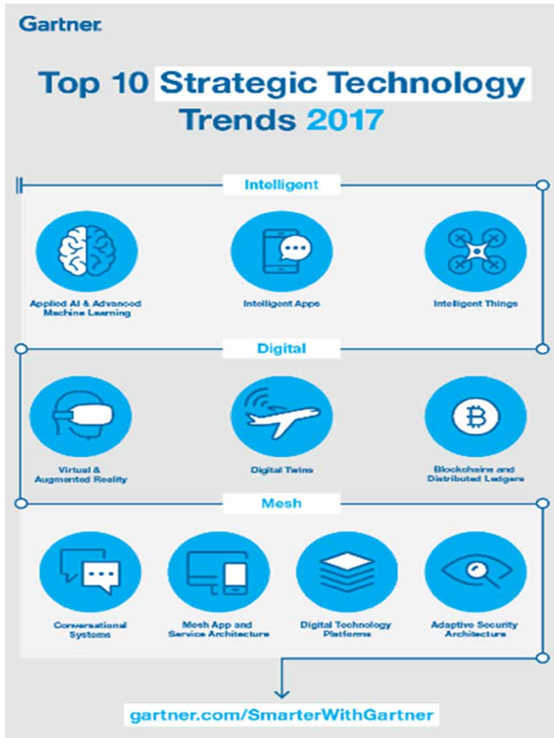
Architecture and Technology Standards

A B&STM must have the skills to manage agile *Projects* and their implementation phase; where an adequate mapping concept is used to integrate standards (OASIS, 2014); that is a recommendation. The strategy is enabled by the establishment of an ADM based iterative model that can map *Project's* microartefacts in a linear "1:1" manner (The Open Group, 2011a), as shown in Figure 3. The scope's difficulty and complexity lie in capability of a business environment to synchronize the *Project's* vision with its capabilities, throughout all the architecture phases (Trad & Kalpić, 2015b).

Project Strategy

The B&STP must be capable of integrating the *TKM&F* using a pseudo bottom-up approach, based on Service Oriented Architecture (SOA) concept that is described in Capgemini's SOA framework, as shown in Figure 8. The SOA concept includes security and governance mechanism (The Open Group, 2011b).

Figure 8. Services integration (The Open Group, 2011b)



Security Capacities

The HGSMS defines B&STM capabilities to protect the *Project* from attack by: 1) localizing gaps in the infrastructures of partners; 2) review of detection, and real-time security solutions; 3) blocking of cumulative attacks; 4) defining a security strategy to locate potential weaknesses; 5) building a robust defence; 6) integrating security in transactions; and 7) applying qualification procedures (Clark, 2002).

Holistic Qualification Procedures and Intelligent Systems

Figure 9, shows that actual immaturity of design, development, qualification and operations for *Projects* that still are in an infancy age, or simply chaotic. Environments for implementation are still confronted with serious *Project* issues. These problems show that archaic tools are still immature for *Projects* which need intelligent subsystems, like the DMS which supports the use of HGSMS (Gartner, 2013a; Gartner, 2013b).

Resources, Artefacts and Success Factors Management

The B&STP must be supported with the *TKM&F,* which contains a repository (which is also a KMS) that maps HGSMS CSFs to various types of *Project's* resources, as shown in Figure 10. This mapping concept associates CSFs, resources and microartefact scenario instances to HGSMS requests (The Open Group, 2011a).

Figure 9. The decision making based systems' trends (Gartner, 2013a; Gartner, 2013b)

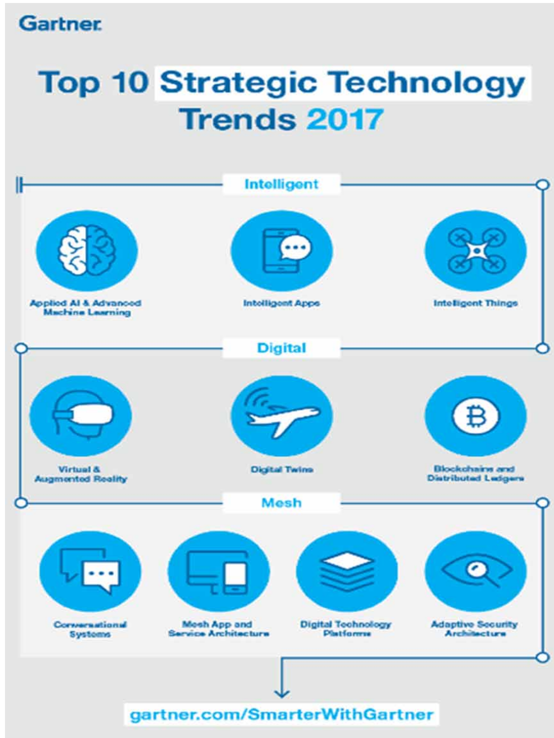
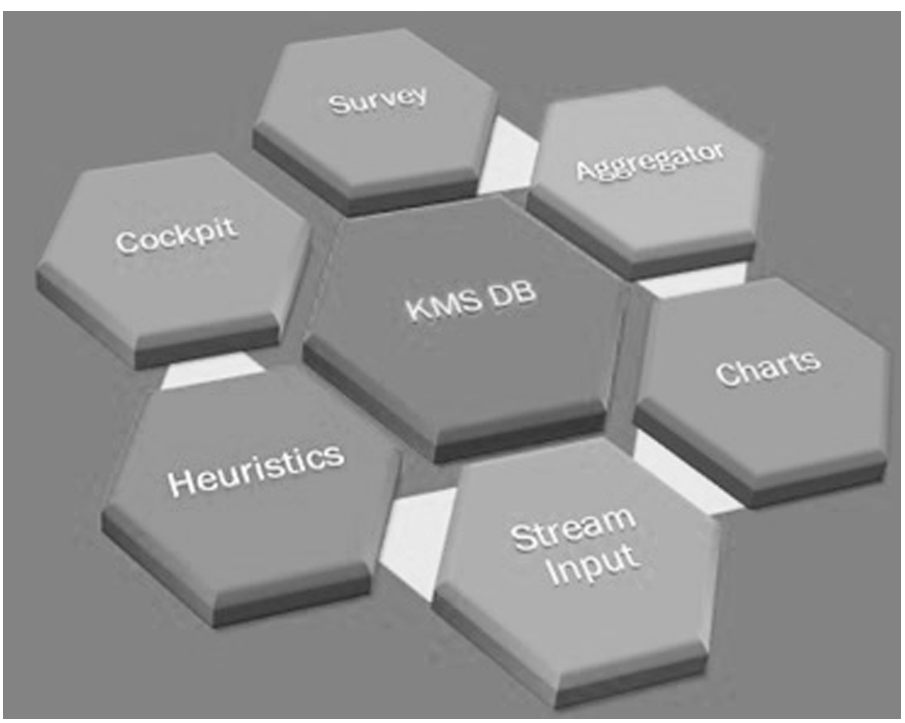


Figure 10. The knowledge management subsystem or the Project's repository



The Information and Communication System's Critical Success Factors

Based on the CSFs review and evaluation processes, the most important HGSMS ICS CSFs are estimated as follows:

As shown in Table 3, the result proves that it is possible to implement a HGSMS which interacts with the ICS; this fact enables the next CSA to be analysed, which is the integration of the ADM.

The Research Section's Link to the Architecture Development Method

This section's deduction is that the ICS and other fields are dependent on an architecture paradigm and therefore the ADM is a method for the integration of the HGSMS.

THE INTEGRATION WITH THE ARCHITECTURE DEVELOPMENT METHOD

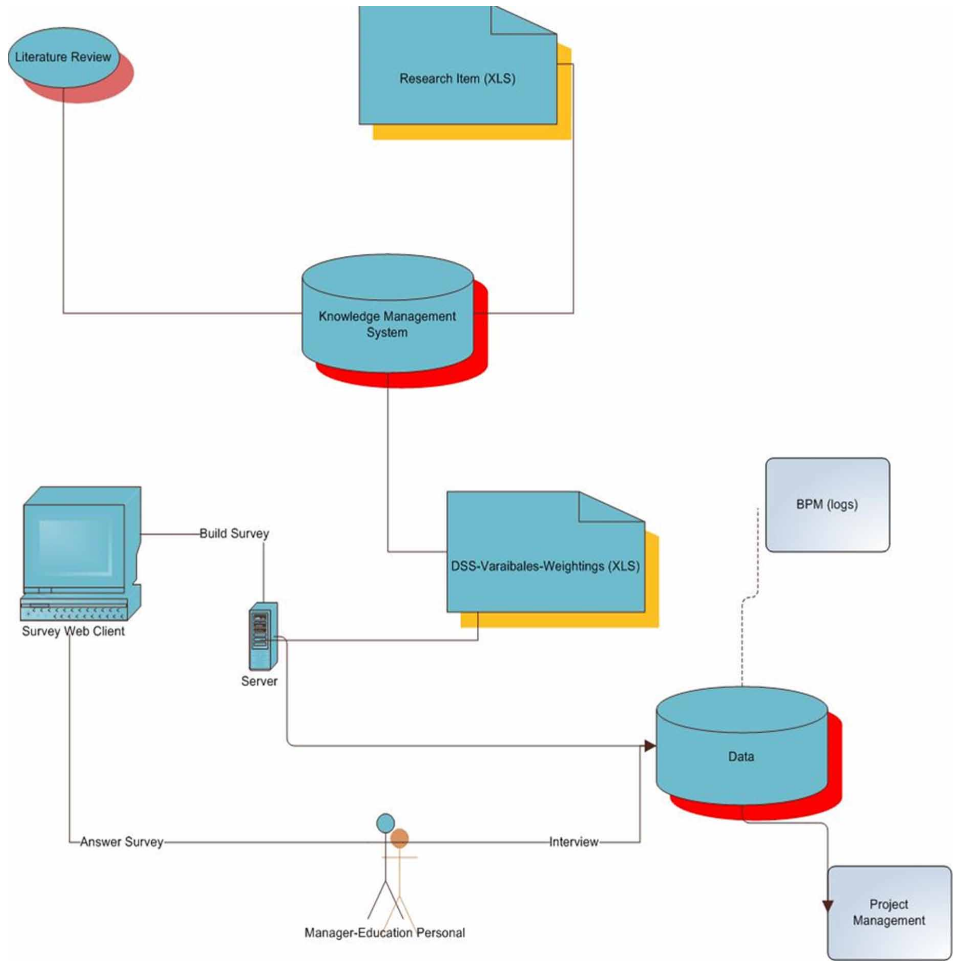
The ADM is a generic architecture method, which recommends a set of phases and iterations, to develop *Projects*. The ADM supports the design of the transformed system interfaces and other deliverables to interact with other internal (like the HGSMS) components. The HGSMS defines a set of basic enterprise architecture requirements for *B&STP* development; the solutions in the form of patterns can be stored in the *TKM&F* KMS database, as shown in Figure 11 (Trad & Kalpić, 2014e).

Table 3. The critical success factors that have an average of 8.78

Critical Success Factors	HMM - KPIs	Weightings
CSF_ICS_IntegrationProcesses	MatureSupported	From 1 to 10. **09 Estimated**
CSF_ICS_Operations&Choreography	SimpleAutomated	From 1 to 10. **09 Estimated**
CSF_ICS_DesignProcess	SimpleSupported	From 1 to 10. **09 Estimated**
CSF_ICS_McLifecycle	ExistingProcedures	From 1 to 10. **08 Estimated**
CSF_ICS_RAD_BPM&Services	ComplexEnvironments	From 1 to 10. **08 Estimated**
CSF_ICS_Tests	ExistingTests	From 1 to 10. **09 Estimated**
CSF_ICS_StorageRepository	Supported	From 1 to 10. **08 Estimated**
CSF_ICS_Mapping	Supported	From 1 to 10. **09 Estimated**
CSF_ICS_HGSMS_StandardsIntegration	Supported	From 1 to 10. **09 Estimated**
CSF_ICS_HGSMS_Strategy	Supported	From 1 to 10. **10 Estimated**
CSF_ICS_HGSMS_Security	Integrated	From 1 to 10. **08 Estimated**

valuation

Figure 11. The knowledge management system item



Unbundling

Global or holistic cyberbusiness agility is achieved by combining various methodologies that promote business and technological agility to be used on various levels of the B&STP to unbundle the existing business environment and glue its renovated parts using dynamic Internet microartefacts. Using a bottom-up approach, the B&STP team can design the optimal cyberbusiness technology integration concept that can handle various types of global security requirements to be used in the standard architecture development method.

Architecture Development Method's Integration

The ADM's integration in a B&STP enables the automation of all its activities, throughout all the ADM iterations. The ADM encloses security operations; where all their phases log information to a unified logging system.

Architecture Development Method Phases

The ADM manages the *Project's* development iterations; in this section the authors present, the ADM's phases and the HGSMS' interactions:

- The preliminary phase selects the relevant CSFs and interactions.
- The architecture vision and business architecture phases interactions.
- The information system architecture phase's interactions.
- The technologies architecture phase's interactions.
- The requirements management and tests phase's interactions.

The Business Architecture Phase

The B&STP must use the *TKM&F* to apply business and technology standards, to deliver added value and robustness to *Projects*. In order to move towards a just-enough business (and global) architecture that is known as the target or final interaction architecture as shown in Figure 12, where the related domains are shown (OASIS 2006).

The Architecture Development Method Critical *Success* Factors

Based on the literature review and CSFs' evaluation process, the most important ADM's CSFs are evaluated to the following:

As shown in Table 4, the result proves that it is possible to integrate and automate the ADM's interaction with the HGSMS; and the next CSA to be analysed is the holistic management of the KMS.

Figure 12. The business interaction architecture (OASIS, 2006)

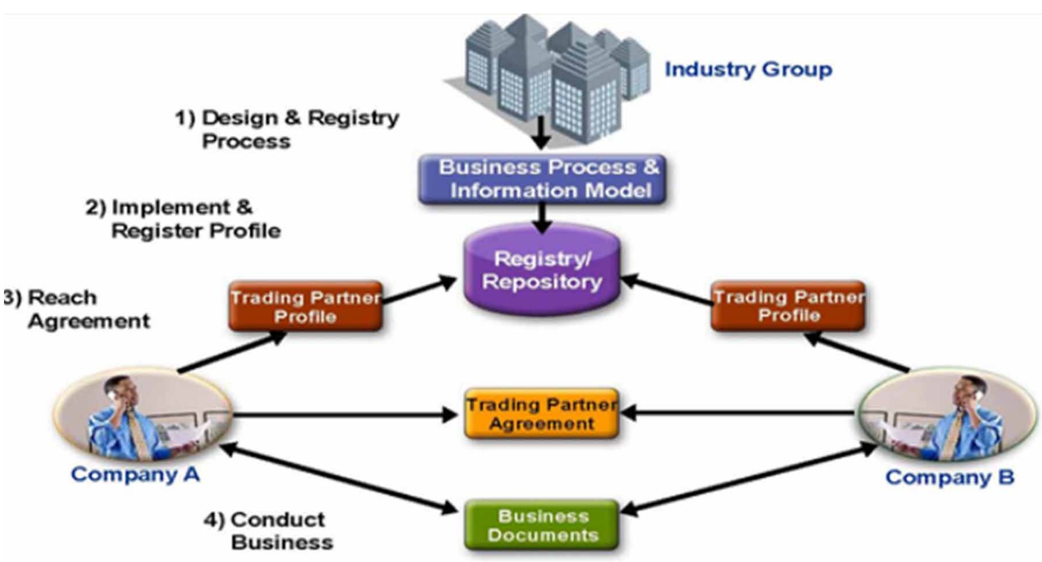


Table 4. The critical success factors that have an average of 9.40

Critical Success Factors	HMM - KPIs	Weightings
CSF_ADM_CSF_Initialization&Setup	MatureStatus	From 1 to 10. **10 Estimated**
CSF_ADM_IntegrationProcesses	StandardSupported	From 1 to 10. **08 Estimated**
CSF_ADM_Phases	Supported	From 1 to 10. **09 Estimated**
CSF_ADM_Requirements	MappingAutomated	From 1 to 10. **09 Estimated**
CSF_ADM_HGSMS_Architecture	FullySupported	From 1 to 10. **10 Estimated**

valuation

The Research Section's Link to the Global Knowledge Management System

This section's deduction is that the HGSMS can be integrated in the *Projects* and the ADM. Now follows the HGSMS interfacing the KMS.

THE GLOBAL KNOWLEDGE MANAGEMENT SYSTEM

The Global Knowledge Management

The *B&STM* must be capable of managing global Knowledge Items (gKI); where gKIs and microartefact scripts are responsible for the manipulation of intelligence and to control various knowledge processes. The KMS supports the HGSMS underlying mechanics to manage gKI microartefacts. The B&STM is responsible for designing gKI's extraction, using holistic systemic approach (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a). An HGSMS serves as an interface to the KMS to enable an efficient search process (Trad, 2018b).

The Holistic Knowledge Strategy

An HGSMS is the interface to the KMS/gKI, where sets of *B&STM* profiles are stored (Trad & Kalpić, 2017a, 2017b, 2017c). The interface strategy is included in the architecture roadmap and the B&STM must select tools for the KMS management.

The Global Knowledge Management Success Factors

Based on the literature review, the most important knowledge CSFs that are used are:

The Modules Chained Link to the Intelligence Support or Decision System

The KMS's integration results prove that it is possible to implement an HGSMS to interface the DMS.

Table 5. The critical success factors that have an average of 9.00

Critical Success Factors	HMM - KPIs	Weightings
CSF_KMS_ICS_Integration	FullySupported	From 1 to 10. **10 Estimated**
CSF_KMS_gKI_Mapping	ComplexToImplement	From 1 to 10. **08 Estimated**
CSF_KMS_Patterns	Implementable	From 1 to 10. **10 Estimated**
CSF_KMS_HGSMS_Integration	Implementable	From 1 to 10. **09 Estimated**
CSF_KMS_HGSMS_AccessManagement	StandardIntgeration	From 1 to 10. **09 Estimated**
CSF_KMS_HGSMS_ProfileMatching	ComplexToImplement	From 1 to 10. **08 Estimated**

valuation

THE INTEGRATION WITH THE DECISION MAKING SYSTEM

A Complex Process

The HGSMS's DMS logs are inputs from various subsystems and the inputs depend on the warning level. If the B&STP team signals a problem to be solved, then the DMS is activated to propose possible solution(s). HGSMS's underlined model includes microartefact scenarios of interactive atomic service actions. Atomic services make the integration flexible (Trad & Kalpić, 2017a). DMS's components support the B&STP by offering security microartefacts that are instances of the building blocks. *B&STP* is supported by the HGSMS's processing using the DMS. The DMS's results are presented as a set of possible solutions or possible *B&STM* profiles. The best solution proposes the right *B&STP* actions.

A Risky Process

HGSMS, KMS and DMS integration may face problems due to complex CSF evaluation process implying that the analysis and management of risk is one of the important pre-requisites to ensure the success of HGSMS activities. The HGSMS uses the DMS risk management capabilities.

The Decision Making Process

The decision-making process is supported by the HMM formalism that uses a holistic approach for delivering a set of *B&STP* possible solutions (Daellenbach & McNickle, 2005). The HGSMS is an interface the DMS, in which various solutions are offered by the choreography engine.

The Decision-Making System's Critical Success Factors

Based on the literature review and evaluation processes, the most important DMS's CSFs that are used are evaluated to the following:

Table 6. The critical success factors that have an average of 9.00

Critical Success Factors	HMM - KPIs	Weightings
CSF_DMS_ComplexSystemsIntegration	Supported	From 1 to 10. **09 Estimated**
CSF_DMS_HGSMS_Interfacing	Supported	From 1 to 10. **09 Estimated**
CSF_DMS_KMS_Interfacing	IntegrationEnabled	From 1 to 10. **10 Estimated**
CSF_DMS_DMP	IntgeratesAsKernel	From 1 to 10. **10 Estimated**
CSF_DMS_HolisticApproach	Supported	From 1 to 10. **08 Estimated**
CSF_DMS_Solutions_Acceptance	Supported	From 1 to 10. **08 Estimated**

valuation

As shown in Table 6, the result proves that it is possible and even mature to implement a holistic and distributed DMS using the HMM formalism and that will be presented in the HGSMS section.

The Research Section's Link to the Holistic Global Security

This chapter's deduction that selects and evaluates the CSFs, is based on the previous six tables that this research project has generated, and the following phase is the HGSMS.

THE HOLISTIC GLOBAL SECURITY MANAGEMENT SYSTEM

Basic Requirements

Global security is the state of a global system that can be prone to any type of danger or threat; where the B&STP must deliver a system that is designed to provide maximum security (Oxford Dictionaries, 2013). This section presents the CSFs that influence the HGSMS and this CSA tries to argue the various aspects of global security requirements. The global security depends on the following fields: 1) global cyber technologies; 2) national security requirements; 3) international security requirements; and 4) organizational security and governance requirements. Global security requirements are the most fundamental for an organization's survival and they enclose various subdomains; like:

- Infrastructure security requirements.
- ICS Security Requirements
- Business security requirements
- Enterprise security requirements
- Security frameworks.
- Governance frameworks.
- Cybersecurity Requirements.

Security Architecture

The optimal global security architecture should fit in the company's global enterprise architecture framework that in turn is based on best practices. The resultant global security architecture is a mixture of technical solutions, business engineering, and security concepts. TOGAF includes sub-frameworks like the Sherwood Applied Business Security Architecture (SABSA) to handle global security requirements (Unwin, 2013).

The Global Security Domains

Governance defines the interaction between various components and their cyber or information technology security that understands the security of:

- Data.
- Technology resources.
- Networks.
- Web and Internet infrastructure.
- Applications, development and operations.

Security Development and Operation Integration

Applications development and operations are coordinated by a secure development/operations (DevOps) process known as the SecDevOps. SecDevOps manages developers, operations and security B&STP members. The B&STP uses agile SecDevOps procedures to identify patterns for managing transformation requirements (Mees, 2017).

A Unified Control and Logging Subsystem

Global cyberbusiness platforms are not dedicated to any specific business environment and offer: 1) performance; 2) reliability; and 3) Cyber-security. These platforms are controlled and monitored in real-time using Unified Logging Subsystem (ULS) and are integrated to support the HGSMS. ULSs exist and are powerful monitoring subsystems that support presentation, sorting, and tuning. ULSs can be designed to analyse, collect and store HGSMS data from various B&STP microartefacts to support central decision-making logging system.

Financial Security

HGSMS can be used to promote global financial security, based on technological agility to unbundle the traditional environment and glue its transformed parts by using dynamic financial microartefacts. Using the *TKM&F*, the B&STP team can design the optimal global financial environment that can handle various types of financial and technology engineering risks or violations.

Finance and Technology

As already mentioned, FinTech is the technology that aims to change the traditional financial environment in the delivery of interactive financial services; which is promoted by suspicious banks like some suspicious financial institutions. The usage of intelligent (or suspicious) financial endpoints provides some of the technologies intended to make financial services open to many external (and unknown) endpoints. Although FinTech can be used to tackle financial cyber criminality (or maybe protect it), it seems that some countries that support massive financial crimes; like Switzerland would convert it into Financial Crime (FinCrim) (Cohen, 1997; The Frontline, 1996) are making the largest investment in these innovative technologies (Ravanetti, 2016); in fact destroying many lives, like the case of the 2nd World War refugees. FinTech evolution is transforming the usage of financial services using blockchains and Bitcoin-based technologies very probably for the mere goal of financial profit (Wikipedia, 2017a).

Blockchains and Bitcoin

Blockchain is the technology framework that supports cryptocurrency like the Bitcoin that supports exchange of currencies in a digital encryption form (PWC, 2017). FinTech automation causes the synchronization of various cyber finance services that need specific regulation and global security mechanisms, knowing that today the most important phenomena are cyber criminality as an emerging type of criminality and on the other hand, the apparent disappearance of traditional currencies; which is a source of massive financial crimes.

Currencies

With the rapid emergence of FinTech, blockchain technologies may dominate the leading financial giants and will cause the domination of Bitcoin-like media. This new media would lead to disappearance of leading currencies (it will just make it virtual); such an event would be a major problem for tracing financial fraud; and would make some more than cheerful. This scenario is not assured; a possibility that the bulb of cryptocurrencies might blow, should not be completely excluded.

FinTech as a Fraud Strategy

FinTech would make money more abstract and difficult to trace; individuals and institutions in countries that have the culture of extreme financial secrecy, financial brutality, crime and arbitral confiscation, would be tempted to use FinTech to obfuscate the origins of money. Paula Ramada estimated the amount of lost money due to the benchmark of interest rates debacle is estimated at $300 trillion in financial instruments, ranging from mortgages to student loans. Where a trillion represents 1 billion of billions (10^9x10^9) or 10^{18}. Therefore, a change or manipulation of a mere 0.1% has a damage of 10^{15} of euros per year; this is the mechanism that banks used to cover the decrease of loans and save their investments at the cost of ruining middle and lower-class households; whereby some banks got much richer (Ramada, 2013). FinTech would make such operations more embedded and abstract; so will UBS and CS plunder even more.

Legal Characteristics

HGSMS supports the environment's legal integration in the globalized network; to achieve this legal support, CSFs are used to assert and monitor the B&STP artefacts. The CSFs manage the differences in cyber business, societal and financial local and international regulations/laws. Complex cyber environments must have the capacity to proactively recognize erroneous cyber transactions and block them in the case they are managed from a region like for example Switzerland (Cohen, 1997; The Frontline, 1996).

Cyber Transactions' Security Constraints

The European commission defines a legislation to govern cyberbusiness and progress has been done in its assertion. European commission's member states have implemented and enforced business-engineering related national practices. Cyber transactions outcomes have to be continually legally asserted, traced, and their periodic summaries are reported to the executive management (Fu & Mittnight, 2015). Cyber activities are orthogonal to global security requirements, where the business environment roles define the responsibility for enterprise's or national resources. Management of the enterprise's or national legal interests, resources, and accesses, should be managed by global architect(s). Thus, the cyberbusiness/financial structure is an important consideration in the legal assertion and access management of cyber transaction's security. The regulation for the cyber transaction's security and law needs qualified time-stamps for robust (e)certification like those used in the European Union (European Union, 2014).

Cyber Transaction Law

Cyber transaction is influenced by the Uniform Law Commissioners who promulgated the Uniform Electronic Transactions Act in 1999. It is the first adaptable effort to prepare a cyberlaw for cyberbusiness. Many countries have adopted cyberbusiness regulations. The Uniform Electronic Transactions Act represents the first effort in providing some standardized rules to govern cyber transactions (The Uniform Law Commissioners, 2015).

Cyber Business/Finance Legal Integration

The integration of the business/financial engineering module is done with the use of the TOGAF's legal environment. This legal environment supports data protection laws, contract law, procurement law, fraud law and many other legislation domains to counter organized financial crimes; like the ones applied from the safe heavens.

The Financial Crime Model

Brutal dictators like neo-Nazi brigands have a special status in states where the ownership of substantial financial assets can remain anonymous; Nazi Germany was defeated but its wealth and the looted valuables are stored in safe heavens. Some third world dictators maintain strong financial relationship to banks in financial havens; mainly in safe Heavens. Some of these banks have even been established by criminals emerged from former wars like the Lebanese civil war. An example can be the notorious Francois Genoud (Brown, 2016). A country where the money cannot be transparently audited can provide security to dubious investors, although otherwise the same country may serve as role model of law obeying common citizens. Some of financial havens and their financial institutions have been the main leaders in worldwide financial scandals, misdeeds, and criminal acts including: a) the Libor manipulation; b) currency manipulations; c) credits manipulations; d) supporting arms dealing transactions; e) hijacking people's wealth; f) financial fraud; g) the subprime crisis; h) war victim wealth confiscation; i) tax evasion; j) drug dealing financial support; k) war support against future financial competitors; l) forced confiscations; m) drastic fines; and l) arms dealing (Trad, 2017a); the major problem with combating such a system is that some countries have a hermetically closed system, characterised by the following attitudes:

- Police and information services, blocking any attempt to pursue financial criminal acts.
- The legal system, ignoring any attempt to investigate financial criminal acts.
- Legal support too expensive, to discourage any action of law enforcing.
- Psychological harassment, to discredit investigators and demanders.
- Intolerance and discrimination, to block any foreign request.
- A powerful global network, to embed and hide various dubious operations.
- Financial guerrilla-like and hit and run tactics, to confiscate wealth.
- Occurrence of financial locked-in situations.

Some financial haven states, like mainly Switzerland, target to become leaders in FinTech, which is not very assuring; because FinTech should combat state criminality and enforce global security international law. The notion that a major leader in FinTech is Switzerland, is definitely not very assuring; because FinTech should combat state criminality and enforce global security international law (Cohen, 1997; The Frontline, 1996).

Cyber Security and International Law

Facts show that international law on global security is inefficient and agonizing. Advanced states are hesitant to integrate international law that is based on the emergence of non-government norm-making initiatives. States insist on their traditional central legal system that marginalizes the inter-state governance of cyberspace (Mačák, 2016).

The Holistic Global Security Management System's Concept Success Factors

Based on the literature review and evaluation processes, the most important security CSFs that were used are:

The Modules Chained Link to the Proof of Concept

This section's deduction is that the HGSMS feasibility depends on the results of the PoC.

Table 7. The security critical success factors average is 8.90

Critical Success Factors	HMM - KPIs	Weightings
CSF_HGSMS_BasicSystemsIntegration	Supported	From 1 to 10. **09 Estimated**
CSF_HGSMS_Architecture_Capacities	Supported	From 1 to 10. **09 Estimated**
CSF_HGSMS_ProfileRoles	ManagementEnabled	From 1 to 10. **09 Estimated**
CSF_HGSMS_DMP_ForProfileSearching	Intgerated	From 1 to 10. **10 Estimated**
CSF_HGSMS_HolisticApproach	Supported	From 1 to 10. **08 Estimated**
CSF_HGSMS_TKM&F_Support	Intgerated	From 1 to 10. **10 Estimated**
CSF_HGSMS_RoleOfExperience	Analyzable	From 1 to 10. **09 Estimated**
CSF_HGSMS_Implementation_Capacities	Auditable	From 1 to 10. **08 Estimated**
CSF_HGSMS_Financail_Capacities	Auditable	From 1 to 10. **08 Estimated**
CSF_HGSMS_Financail&Legal_Integration_Capacities	Supported	From 1 to 10. **09 Estimated**
CSF_HGSMS_ Financail&Legal_Tracing_Capacities	Supported	From 1 to 10. **09 Estimated**

valuation

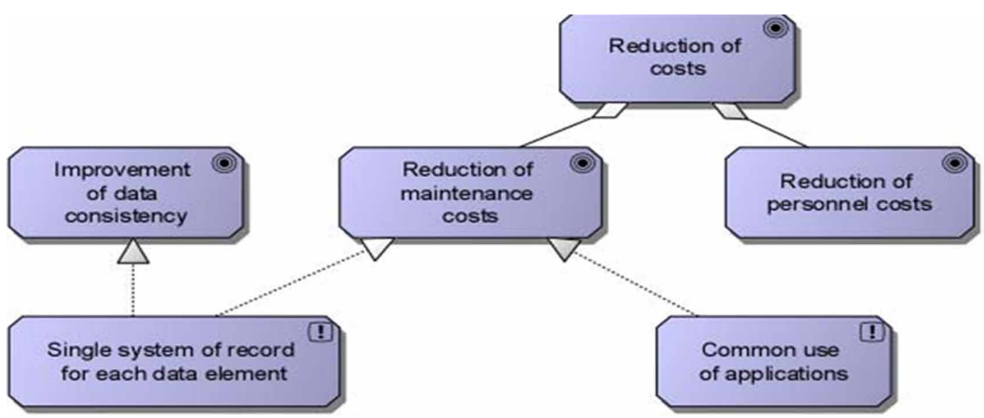
THE PROTYPE'S INTEGRATION

As it has already been described, the ACS is an insurance management system that has an archaic ICS, a mainframe, claim files service, customer file service; and will be used to prove the capacity of solving a complex problem.

Application Portfolio Rationalization Scenario, Data Unification

This PoC, uses the ArchiSurance ACS; to select the *B&STM* and uses a structured pool of CSFs to satisfy the HGSMS requirements, as shown again in Figure 13 that can be considered as the base sets of CSAs.

Figure 13. Transformation goals (Jonkers, Band & Quartel, 2012)



The Proof of Concept

The chapters' PoC is implemented using *TKM&F* was developed exclusively by the authors, who own the total copyrights. The PoC is based on the HMM's instance and the HGSMS interfaces the DMS that uses the selected CSFs', which are presented and evaluated in Tables 1 to 7. The required actions have mappings to *Projects* resources like CSFs, as shown in Figure 14.

The used microartefacts are designed using enterprise architecture methodologies and the HGSMS concept defines relationships between the HGSMS requirements and microartefacts, using global unique identifiers. The PoC is achieved by using the *TKM&F* client's interface that is shown in Figure 15; where the starting activity is to structure the organizational part.

Once the development setup interface is activated the Natural Language Programming (NLP) interface can be launched to implement the needed microartefact scripts to process the defined six CSAs. After starting the *TKM&F's* graphical interface, the sets of CSFs are selected, in this case for training B&STMs. Then follows the CSF attachment, for training B&STMs, to a specific node of the *TKM&F's* graphical tree; to link later the microartefacts. From the *TKM&F* client's interface the ML development setup and editing interface can be launched to develop the microartefacts that are related to the CSF, responsible for training B&STMs. These scripts make up the intelligence basis and the HMM's instance set of actions that are processed in the background to support services to be used in microartefacts. The HMM uses services that are called by the DMS actions, that manage the edited mathematical language script and flow, for training B&STMs, as shown in Figure 16.

This research's HGSMS instance, the HMM and its related CSFs, for solving B&STP problems, were selected as demonstrated previously, as shown in Figure 17.

Figure 14. The TKM&F microartefacts concept

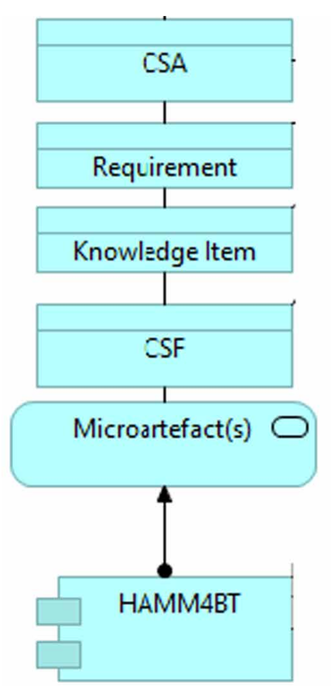


Figure 15. The TKM&F's client interaction

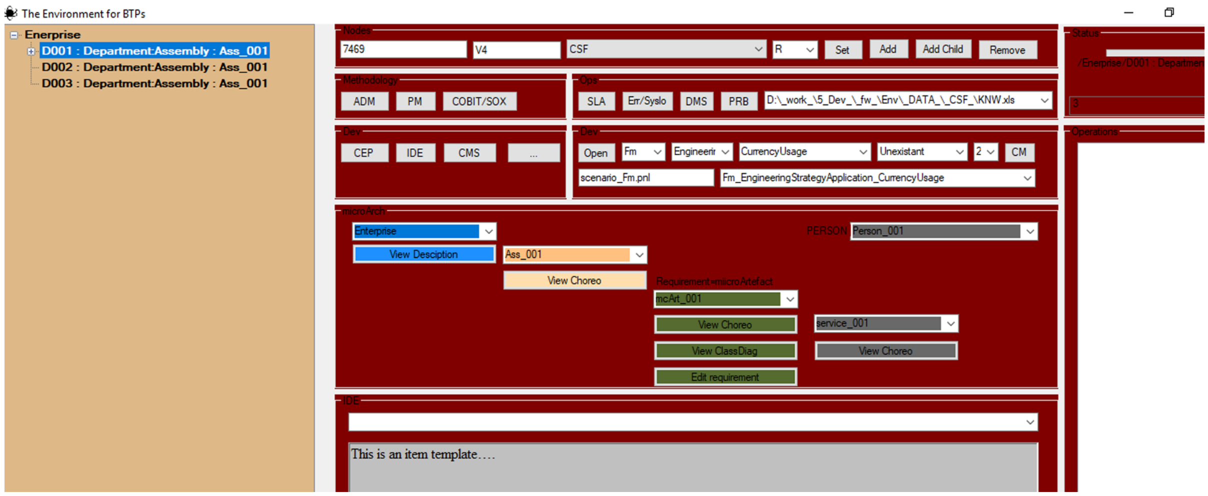
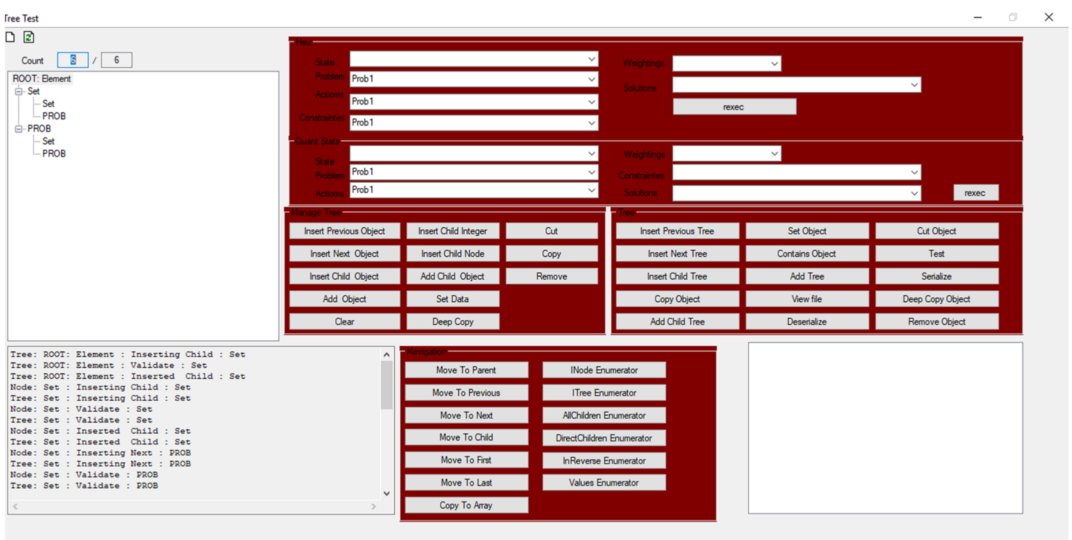


Figure 16. The heuristics tree configuration



Once the microartefact is ready, the CSF and NLP files are configures. In this chapter's seven tables and the result of the processing of the first initial phase, as illustrated in Table 8, shows clearly that the HGSMS can be used in *Projects*. HGSMS is not an independent component and is bonded to all the *Project's* overall architecture, hence there is a need for a holistic approach.

The *TKM&F* and hence the HMM's main constraint to implement the HGSMS is that CSAs for simple *Projects* components, having an average result below 8.5 will be ignored (this limit is set by the *Manager*). In the case of the current CSF evaluation an average result below 7.5 will be ignored (this limit is set by the *Manager*). As shown in Table 8, this fact keeps the CSAs (marked in green) that helps to make this work's conclusion; and drops the ones in red (this is not the case). The result is 8.90 (this

Figure 17. The TKM&F's components' interaction

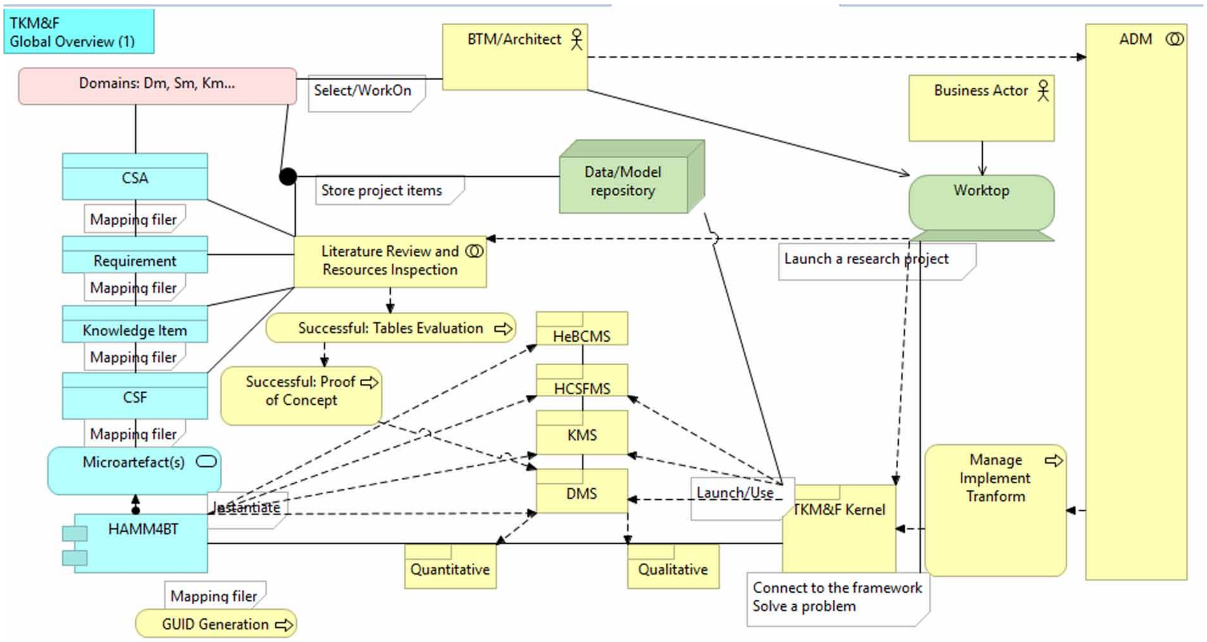


Table 8. The HGSMS research's outcome, is 8.90

CSA Category of CSFs/KPIs	Influences transformation management	Average Result
The Applied Case Study Integration	CredibleStable_Complex	From 1 to 10. 8.40
The Usage of the Architecture Development Method	FullyIntegrated	From 1 to 10. 9.40
The Information and Communication Technology System	Transformable	From 1 to 10. 8.78
The Mathematical Model's Integration	IsApplicable	From 1 to 10. 8.60
The Decision Making System	Implementable	From 1 to 10. 9.00
The Holistic Knowledge Making System	Implementable	From 1 to 10. 9.00
The Holistic Profile Management System	Implementable	From 1 to 10. 8.90

Evaluate First Phase

limit is higher than the defined 8.5) set by the *Manager*), it means that the HGSMS integration is mature and can be used in all types of *Projects, where* the complexity is integrating the HGSMS in *Projects* that must be done in multiple transformation sub-projects (small iterations), where the first one should try to define the *B&STP* goals.

SOLUTION AND RECOMMENDATIONS

The HGSMS CSFs are the result of the literature review (Phase 1) and are used in the hyper-heuristics research model. In this chapter, the focus is on the *B&STP* capabilities and feasibility prerequisites. These characteristics and prerequisites are needed to holistically manage the design of global security implementation phases. The research tries to define the optimal solutions; there has been a lot developed and written on enabling success in *Projects*, but the authors propose to inspect why *Projects* fail in the implementation phase. The score, above 8.5, shown in Table 8, proves that it is possible to implement HGSMS in *Projects*. In this chapter, the authors propose the following set of managerial recommendations:

- A B&STP must build a holistic architectural concept in order to support an efficient global security/governance.
- Important efforts need be applied to integrate underlying technology to support a huge number of cyber activities.
- Cyber technologies should replace traditional exchanges in order to improve productivity and to enforce in real-time HGSMS.
- Global security architecture should fit in the company's global enterprise architecture framework.
- The architecture development method's integration in a B&STP enables the automation of all its activities.
- Applications' development and operations are coordinated standard procedures.
- FinTech would make financial operations more embedded and abstract.
- Global businesses are orthogonal to global security requirements.
- Global transactions are influenced by local and international law.
- Avoid any form of financial collaboration with doubtful financial organizations.
- The B&STP must implement light version of an enterprise architecture framework and of management of process models.

Presented managerial recommendations, and the *TKM&F*, round up the HGSMS approach.

FUTURE RESEARCH DIRECTIONS

The *TKM&F* future research will focus on the evolution of the mathematical model's algorithms.

CONCLUSION

This research is based on mixed action research model; where critical success factors and areas are offered to help B&STP team. In this article, the focus is on HGSMS which is business-driven and describes a structured inter-relationship between the technical and procedural security solutions to support the long-term needs of business or organisation. The HGSMS components' holistic integration is an important factor for the organisation's evolution and assuring the design and implementation phase of a *Project* and its underlying HGSMS. There has been a lot developed and written on the success of *Projects*, but the authors propose to inspect why *Projects* and B&STPs fail in the complex implementation and integration phases of a *Project*. That is mainly due to the *Project* team(s) lack of knowledge in managing complex integration and implementation and the non-existence of adequate components and patterns, like the HGSMS. The most important findings in this RDP are: 1) The *TKM&F* based PoC, proved the approach and delivered the recommendations on how to integrate a HGSMS (Farhoomand, Lynne, Markus, Gable, & Khan, 2004) with a standard enterprise architecture framework. *TKM&F* proposes a set of recommendations on how to proceed with the *Projects* and its subsystems like the HGSMS and promotes the use of a holistic implementation that is "*a proven approach that unites all disciplines in an organization to collaborate together to enable disruptive change*" and where "…*a few things have become clear: business transformation leaders require technical skills to define comprehensive and complete technical solutions and equally important, also require skills to build consensus among all affected stakeholders*". In complex systems like the HGSMS, business-driven coordination and the information technology are used to glue the various *Project's* components (Uppal & Rahman, 2013). The authors' related published research and development publications have produced the following outcomes: 1) discovery of a knowledge gap; the research has proved the existence of a multi-dimensional knowledge gap that exists between traditional management skills and the needed skills for *Projects*' management (Trad & Kalpić, 2014d); 2) introduction of an evolutionary mixed method, developed in order to create the initial B&STM's profile (Trad & Kalpić, 2014d); 3) actual *Projects* management of complexity of heterogeneous business systems with standard accountancy techniques appear to be very limited; 4) highly frequent changes are mainly due to the hyper-evolution of technology and a tough competition, which can generate serious security problems; and 5) the PoC proved the HGSMS feasibility and delivered the recommendations on how to integrate it in a *Project*.

The most important managerial recommendation that was generated by the previous research phases was that the business transformation manager must be an architect of adaptive business systems. The PoC is based on the CSFs' binding to a specific research resources and the reasoning model represents the relationships between this research's requirements, microartefacts and the CSFs. The result is that global security, financial, architecture, knowledge, DMS and technology CSAs are very important for global security. The PoC was based on the CSAs/CSFs links to a specific *Projects* resources and the reasoning model evaluated, in Phase 1, the selected CSFs. The deduced result implies that an attempt of HGSMS-based transformation is possible but difficult. Switzerland's aggressive and brutal behaviour should be limited and monitored, because of its genetical plundering nature.

ACKNOWLEDGMENT

In a work as large as this research project, technical, typographical, grammatical, or other kinds of errors are bound to be present. Ultimately, all mistakes are the authors' responsibility. Nevertheless, the authors encourage feedback from readers identifying errors in addition to comments on the HGSMS and the *TKM&F* in general.

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KEY TERMS AND DEFINITIONS

ADM: Architecture development method.
CSA: Critical success area.
CSF: Critical success factor.
DMS: Decision-making system.
HMM: Holistic mathematical model.
ICS: Information and communication system.
KMS: Knowledge management system.
Manager: Business transformation manager.
Project: Business transformation project.
RDP: Research and development projects.
RQ: Research question.
TKM&F: Trad Kalpić methodology and framework.
TOGAF: The Open Group's architecture framework.

Chapter 11
An Applied Mathematical Model for Business Transformation and Enterprise Architecture:
The Resources Management Implementation Concept (RMIC)

ABSTRACT

This chapter presents the resources management implementation concept (RMIC)-based transformation projects to optimize resources creation/management in a transformed enterprise system, the result of research and development on 1) business resources case studies, 2) resources management, 3) business transformations, 4) applied mathematics/models, 5) software modelling, 6) business engineering, 7) financial analysis, 8) decision-making systems, 9) artificial intelligence (AI), and 10) enterprise architecture. The RMIC is based on an authentic and proprietary research method that is supported by an underlying mainly qualitative holistic reasoning module, which is an AI/empirical process that uses a natural language environment that can be easily adapted by the project teams.

This is an introductory chapter for a cluster of topics dealing with resource management systems. This cluster can be used in the context of various types of business, resources management and technical transformation projects. It is a result of many years of consequent research, architecture and development efforts, which in the authors' previous articles were labelled as based on a Holistic Mathematical Model (HMM), or on Applied Holistic Mathematical Model for Business Transformation (AHMM4BT). The HMM can be used as a basic and static structure of transformation and Enterprise Architecture (EA) projects. Resource management, transformation and EA projects, strongly influenced by information technology, can be designed and managed using Critical Success Factors (CSF) subsystem (Trad & Kalpić, 2018a, 2018b, 2018b). CSFs can be used to optimize the target organization's resource/wealth creation/management and integration in the form of a pattern (Putri & Yusof, 2009). This cluster's introductory chapter, presents the Resources Management Implementation Concept (RMIC) that is based on transformation concepts/patterns, used to optimize resources. The optimization process what consists

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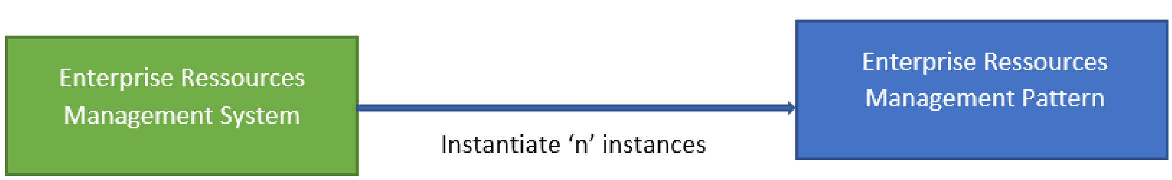
of: 1) an applied business resources case studies; 2) resources management; 3) business transformations; 4) applied mathematics/models; 5) software modelling; 6) business engineering; 7) financial analysis; 8) decision making systems; 9) artificial intelligence (AI); and 10) enterprise architecture.

INTRODUCTION

The RMIC is based on an authentic and proprietary research method that is supported by an underlying mainly qualitative holistic reasoning module; which is an AI/empirical process that uses a natural language environment that can be easily adapted by the project teams (Myers, Pane & Ko, 2004; Kim & Kim, 1999; Della Croce & T'kindt, 2002; Trad & Kalpić, 2017a, 2017b, 2017c, 2017d, 2019b; Gunasekare, 2015). The RMIC is implemented in a proof of concept for the feasibility of the chapter, using the HMM approach. The RMIC supports Business Transformation Projects and Enterprise Architecture Projects (EAP) (or simply *Projects*). This chapter and cluster are supported by an adapted fictious case from the insurance domain (Jonkers, Band & Quartel, 2012a). The uniqueness of the authors' proposed HMM implementation, promotes a holistic cohesive architecture and implementation model that supports complex resource systems integrations (Farhoomand, 2004). The intelligent Resources Management System (iRMS) and Decision Making System (DMS) are used in a day to day business, organisational and technology problems solving. In this chapter, the proposed solutions (or cluster's model) is supported by a real-life case of business transformation methodology in the domain of resources management that in turn is based on the alignment of various standards and avant-garde methodologies. The "i" prefix, which will be used later in this text, does not stand just for the common intelligent agile environments but for a distributed and holistic intelligent resource system's approach that identifies this works background; and "r" will stand for resources. This research project's main application fields are: 1) RMIC and RMS; 2) Enterprise Architecture; 3) Business Transformation Project; 4) Business Transformation Manager; 5) Applied Mathematical Model, 6) Neural Networks; 7) Holisms; 8) Risk Management; 9) Decision Making Systems; 10) Artificial Intelligence; 11) Knowledge Management Systems; and 12) Innovation. Using the scholar engine, in Google's search portal, in which the authors combined the previously mentioned keywords and key topics; the results have shown clearly the uniqueness and the absolute lead of the authors' methodology, research and works (Trad & Kalpić, 2019b). From this point of view and facts the authors consider their works on the mentioned topics as successful and useful; so the main topics will be introduced. HMM for *Projects* uses a natural language development (and simulation) environment that can be adopted by any *Project,* and for that goal the authors propose to use the RMIC that can be instantiated (in n instances) by an RMS, as shown in Figure 1 (Myers, Pane, & Ko, 2004; Neumann, 2002).

Figure 1. The relation between the resource pattern and resource management system



The RMIC is (or can be) supported by a central DMS/HMM and any type of Enterprise Architecture Projects (EAP) methodology. The Proof of Concept (PoC) is based on a concrete business case; where the central point is the transformation process of the existing legacy RMS into a modern and intelligent RMS (iRMS). Such *Projects* are managed by the Business Transformation Managers or an Enterprise Architecture Manager (simply a *Manager*); who are supported with a methodology and a framework that can support and estimate the risks of implementation of such *Projects*.

The RMS related research cluster is made up of four research chapters:

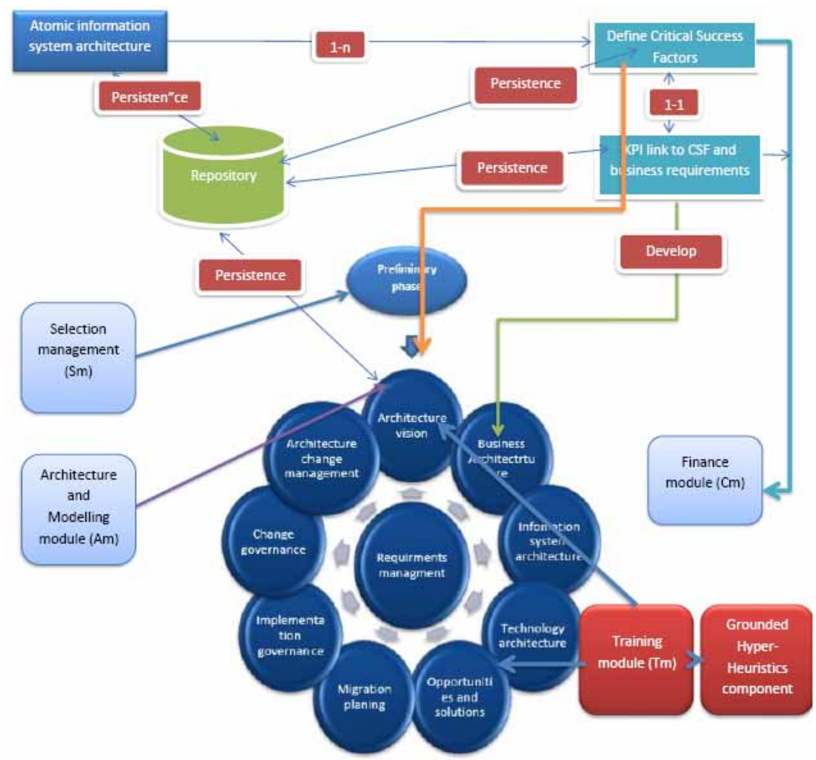
- The Resources Management Implementation Concept, which is this cluster's introductory chapter and is the current chapter.
- The Holistic Project Resources Management Pattern (HPRMP), which is a separate chapter.
- The Resources Management Proof of Concept (RMPoC), which is a separate chapter.
- The Resources Management Research Development Project (RMRDP), which is a separate chapter (Trad & Kalpić, 2019d).

The *Manager* is responsible for the implementation of complex *Projects* using HPRMP and RMRDP; the RMIC supports him or her (for simplicity, in further text – him) in a just-in-time manner where he should have a solid background in HPRMP/DMS based iRMS (Trad & Kalpić, 2016b).

BACKGROUND

An important factor in complex *Projects* and its subsystems, like the iRMS, are the roles of the *Manager*, EA and iRMS integrations' concept, which should be supported by the optimal transformation framework that ought to support a Global Resource Management Strategy (GRMS) model. The GRMS model should be also capable of supporting the *Project's* executives, auditors, legal control and integration in a complex block-chained globalized business world. To achieve these goals, resources management, technology components, cultural, financial and logistics integration strategy factors should be classified in Critical Success Areas (CSA) categories that contain CSFs that can be used to evaluate possible pitfalls and risks, to audit, assert, govern, automate, trace, monitor and control the iRMS and its interfaces (Putri & Yusof, 2009). The *Project* and its iRMS subproject CSFs can be configured to manage the complexities in asynchronous event flows from local and international eco-systems. A transformed iRMS must have support of built-in automated controls capable of recognizing major changes and requirements. *Projects* involve the complete digitization of iRMS processes, where automation enables new intelligent resources models to optimize their evaluation processes (Felfel, Ayadi & Masmoudi, 2017). This research is considered as a pioneering and unique one and actually or even unfortunately, there is no similar frameworks, what confirms it lonely lead; proposing a RMIC that can be used for *Projects* in general, for their design and maintenance phases, which come after the finalization of the implementation phase. This research phase's background is related to risk evaluation of *Projects* using CSF-based iRMS that are managed by the Trad Kalpić Methodology and Framework (*TKM&F*), as shown in Figure 2 (Trad & Kalpić, 2018f). CSFs are selected from various iRMS areas like resource categories, valuation, processes, technology, human skills …. and other. Dm stands for Decision making...

Figure 2. The research framework's concept (Trad & Kalpić, 2016a)



In this chapter, the authors present a set of RMIC that is the resources management cluster's introductory chapter's managerial, financial and technical recommendations that can be applied to various fields, like iRMS, Knowledge Management (KM), HMM, EA, information technology management, business transformation and other engineering fields. Integrating a RMIC and GRMS should be a fundamental and even strategic goal for *Projects* (Trad & Kalpić, 2018a; Trad & Kalpić, 2018b; Cearley, Walker & Burke, 2016).

The proposed RMIC presents the cluster and the usage of its main components that is based on: 1) a holistic approach, by interfacing various *Project* fields to access resources; 2) it uses AI, DMS and risk management engine(s); 3) manages resources; 4) applies factors and categories and resources tracking; and 4) it uses the *TKM&F's* capabilities and its pool of patterns (Taleb & Cherkaoui, 2012). The DMS, iRMS and the introductory RMIC are based on the authors' Research and Development Project (RDP) (Trad & Kalpić, 2019d) method that in turn is based on intelligent neural networks (Trad & Kalpić, 2018a) where the RMIC is agnostic to any specific application, technical or business domain, as shown in Figure 3, and is based on the Architecture Development Method (ADM) (The Open Group, 2011a), but it can use any existing architecture framework.

Any EA framework is central to implement *Projects,* where the *Manager* or an enterprise architect can use the RMIC for *Projects* iRMS' integration (Trad & Kalpić, 2017b, 2017c; Thomas, 2015; Tidd, 2006). In *Projects*, the *Manager*'s role is important, and his actions are supported by the RMIC to build a distributed web enterprise system, or a Holistic (e)Business/(e)Commerce Management System (HeBCMS) to be a frontend of the iRMS (Trad & Kalpić, 2019c; Lanubile, Ebert, Prikladnicki, Vizcaíno, & Vizcaino, 2010).

Figure 3. The research framework's architecture method's interface (The Open Group, 2011a)

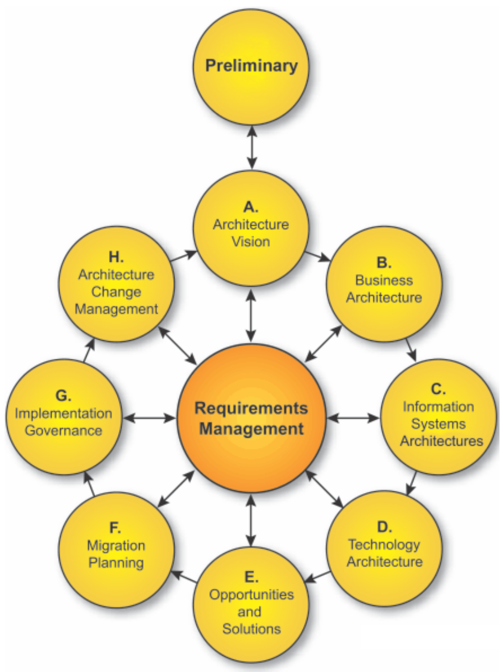
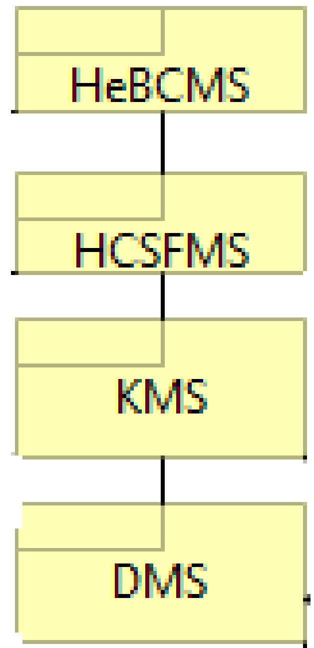
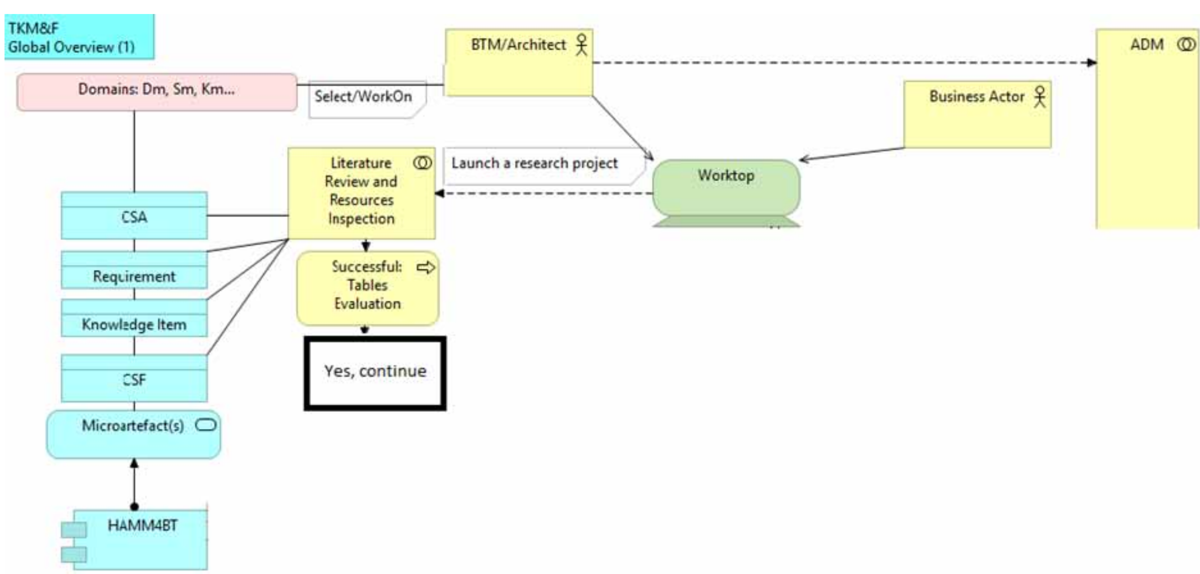


Figure 4. Intelligent management system that supports a distributed web enterprise system



A holistic systems approach is the optimal choice to model such a RMIC for an HeBCMS, as shown in Figure 4, where the DMS interacts with the external world via the *TKM&F* to manage CSFs (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a). As shown in Figure 5 the CSFs are important for the phase 1 that qualifies the needed CSF set and decides whether there is a need for a RMSPoC.

Figure 5. Interaction with factors



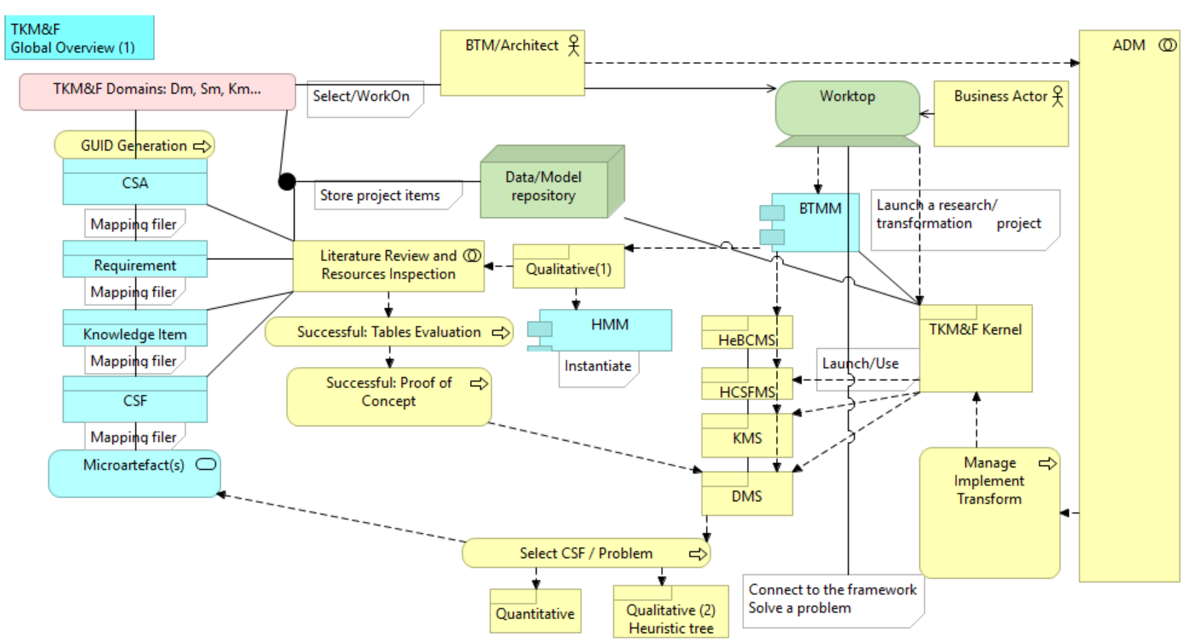
Projects and iRMSs are very difficult to implement, because of their holistic, archaically distributed and complex nature, where the big part of complexity is met in their classification, technical implementation and integration phases (Gudnason & Scherer, 2012). As shown in Figure 6, the *TKM&F* can be applied to all types of *Projects* including the iRMS' integration (Joseph, 2014).

The RMIC presents how to implement an iRMS which refers to any RMS that uses a HMM-similar structure or approach and assists business resources oriented transactions and uses access microartefact-based technologies (Sankaralingam, Ferris, Nowatzki, Estan, Wood, & Vaish, 2013). The development and evolution of iRMS is fundamental for any type of *Project*. The technical implementation phase is the major cause of high failure rates in iRMSs and *Projects* in general; mainly because of the lack of a holistic aspect that is the scope of the RMIC, what is this work's focus (Thomas, 2015; Cearley, Walker, & Burke, 2016; Trad & Kalpić, 2016b).

FOCUS OF THE ARTICLE

RMIC makes an introduction to all the research cluster related to iRMS; it proposes recommendations that can be applied by *Managers* and stakeholders (Desmond, 2013) that use *TKM&F* to manage and optimize resources. This cluster's RMSRDP, which is an instance of the base RDP, is based on a mixed methodology and it is unique (Easterbrook, Singer, Storey, & Damian, 2008); where this chapter tries to present an overview of the iRMS, using four chapters that are summarized in this RMIC chapter. The RMIC ties to roadmap the path to the iRMS' feasibility through an experiment and Research Question (RQ) using a research process.

Figure 6. The Trad-Kalpić Methodology and Framework's flow and interaction



THE RESEARCH PROCESS

Projects failure rates are high and were constantly increasing (Bruce, 1994) that is due to the complexity encountered in the implementation phase (CapGemini, 2009); to enhance the success rate, the authors propose the *TKM&F* that is unique and can be considered as a pioneering approach. *TKM&F* recommends linking the HMM to all levels of the iRMS that is in the target level, as shown in Figure 7 (Trad & Kalpić, 2018b; Agievich, 2014; Tidd & Bessant, 2018).

The CSF-based RMSRDP instance would use the DMS/AI subsystem and unbundling levels that are parts of the applied research framework, the *TKM&F* (Trad, 2013). As shown in Figure, the RMSRDP, coloured in brick-orange interfaces the cluster's various parts; include the RMSPoC that uses an Applied Case Study (ACS).

Figure 7. Levels of project's interaction (Trad & Kalpić, 2017b, 2017c)

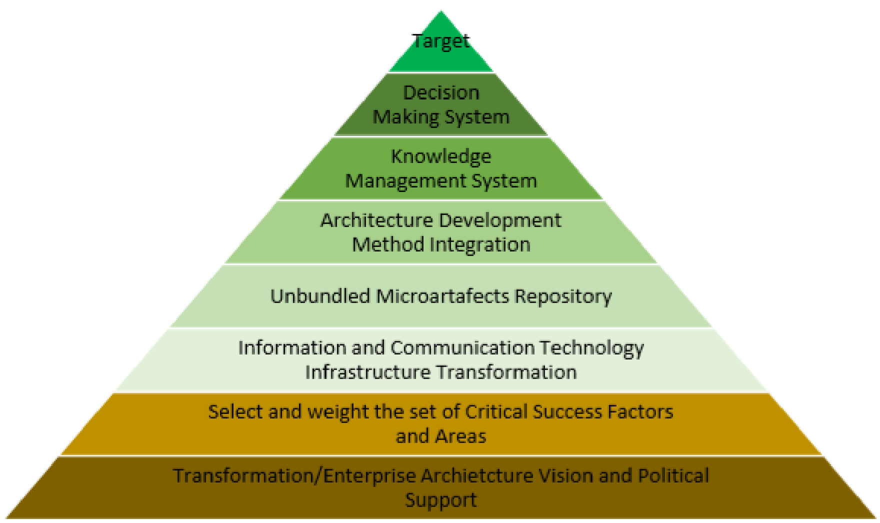
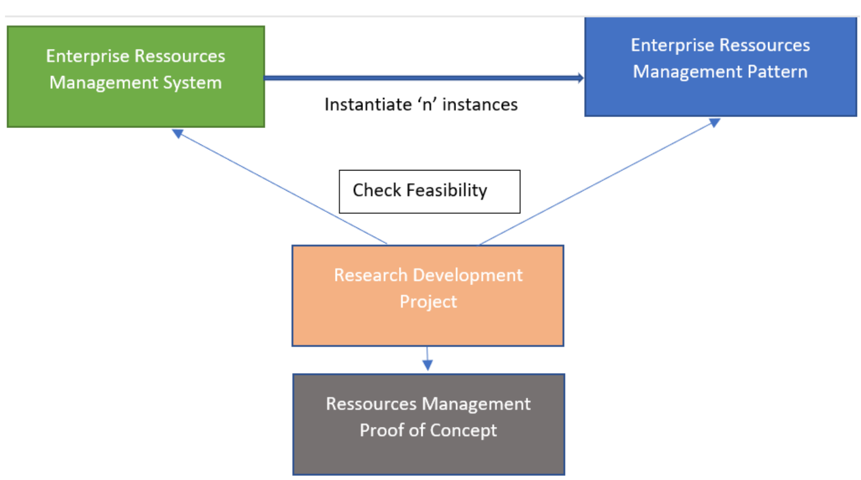


Figure 8. The research cluster parts or chapters



THE BUSINESS CASE

RMIC uses an ACS, developed by the Open Group as a reference study, it presents the possibilities to implement *Project*'*s* components and is related to an insurance company named ArchiSurance (Trad & Kalpić, 2018f); in this chapter it is used to check the iRMS feasibility in the RMSPoC. The iRMS, like actual avant-garde systems, uses Information and Communications Systems (ICS). Major characteristics of such a iRMS internal system are:

- Predict and offer ICT system feasible solutions.
- Predict and design iRMS' fallout feasible and stable solutions.
- Select the weakest platform in the iRMS as a target; and align the architectures.
- Use different languages to support different features to build resource microartefacts.

The Business Case Study's Critical Success Factors and Link to the Next Section

Based on the CSF review process, the important business case's CSFs that are used and evaluated by the internal motor and are presented in to an associated chapter entitled: *Business Transformation and Enterprise Architecture-The Resources Management Proof of Concept (RMPoC)* (Trad & Kalpić, 2019f). The next CSA to be analysed is the ICS.

THE INFORMATION AND COMMUNICATION TECHNOLOGIES' INTEGRATION

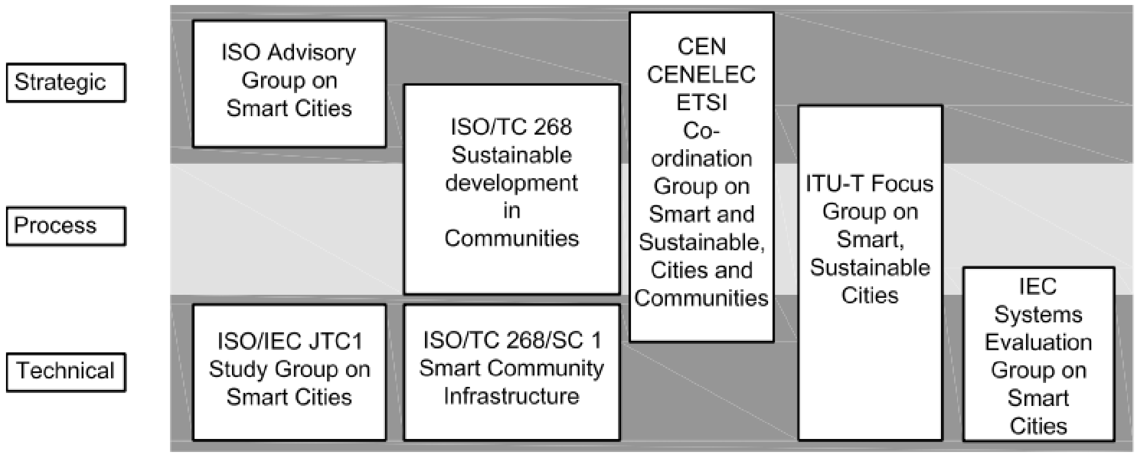
In this section presents this CSA in the sense of a literature review and the resultant CSFs will be defined in the RMSPoC.

Internet of Things, Telecommunication and Infrastructure Control-the Glue

For iRMS distributed communication, the minima communication is assured by a standard from the Institute of Electrical and Electronic Engineers (IEEE) for an architectural framework for the Internet of Things (IoT) can be used. The standard is in its early stages and offers a reference model defining relationships among various IoT domains like, transportation, healthcare and many others… Domains are transformed to be used for the transition to iRMS, applying common architecture elements supporting complex domains, like finance (BSI, 2015). Added to this standard, there is the service oriented architecture to support *TKM&F* microartefacts.

IoT, service oriented architecture and mobile infrastructure has expanded to interconnect various endpoints to the iRMS, to create a virtual and holistic environment. In these virtually interconnected iRMSs, standard applications, endpoints and mobile apps collaborate in real-time, using standard market technology procedures to make it inter-operable.

Figure 9. Internet supported services for smart systems (BSI, 2015)



Standard Information Technology Procedures

The evolution of intelligent ICSs and the actual enterprise architecture/design, development, qualification and operations for iRMS (*Projects* in general) are unstable and are still in an infancy age, or just simply chaotic. Tools for implementation environments are still confronted with serious implementation issues. These problems show that archaic tools are inappropriate for large enterprise intelligent ICS's development procedures and the authors recommend the use of information technology concepts, such as:

- Internal propriety patterns' concept, which expresses a structural concept for an iRMS where it offers patterns: 1) to provide knowledge and intelligence templates to instantiate microartefact scenarios to manage resources and assets; 2) to describe the scenarios' responsibilities, relationships and content; 3) to help defining complex relationships; 4) to define a default CSA and CSF sets for iRMS internal models; and 5) to automate the CSF table evaluations.
- Resources, artefacts and success factors, the *TKM&F's* repository maps relate the selected iRMS CSFs to various types of *Project's* resources, like assets, architecture models, microartefacts and requirements; that use existing RMS standards.

Resource Management System's Standards

To manage agile iRMS, an adequate mapping concept integrates mainly technology standards (OASIS, 2014) and is the main principle and strategy using a linear mapping, "1:1" manner. The proposed standards have the following levels: 1) strategic; 2) process; 3) algorithmic; and 4) technical. These standards and implementation/tooling environments support the iRMS through an iterative pseudo-bottom-up approach. Without the use of RMIC described cluster, as shown in Figure 8, an iRMS or *Project* subsystem, can: 1) very probably have poor performance and robustness; 2) lack scalability; 3) fail, become un-usable and un-maintainable; 4) fail to classify the resources; and 5) fail in producing a successful distributed unit of work or a microartefact concept.

Distributed Unit of Work as a Microartefact

Microartefact granularity and responsibility definitions for iRMS scenarios is a complex undertaking; added to that there is the implementation of the "1:1" mapping and classification of the transformed iRMS and other microartefacts. The resource and their EA concepts use methodologies like the TOGAF's ADM that supports the iRMS and other *Project* subsystems (Neumann, 2002) where various types of global identifiers can be used to make them signed and unique.

Defining a microartefact granularity and responsibility for an iRMS is a complex process; added to that, there is the complexity in implementing the "1:1" mapping and classification of the discovered microartefacts. The applied design concept uses standard design methodologies like the TOGAF's ADM (Kotusev, 2018). This proposed design and mapping concepts are supported by a set of the *TKM&F's* microartefacts where its internal HMM mathematical language that consists of implementing microartefacts to dynamically evaluate compound expressions, according to the HMM principles (Neumann, 2002). Defining the unit of work, serves as a concrete microartefact that can be represented by a class diagram, where mapping supports the interoperability between all the *Project*'s microartefacts that are compatible with the following standards:

- iRMS knowledge management eXtensible Mark-up Language (XML) standard to import and export knowledge items (Feljan, Karapantelakis, Mokrushin, Liang, Inam, Fersman, & Souza, 2017).
- The Unified Modelling Language's (UML) and the System Modelling XML (SysML) for the design of the iRMS microartefacts.
- Design patterns and their XML interfaces for the structural design of the iRMS microartefacts.
- The Project Management XML (PMXML) for the project coordination of the iRMS microartefacts.
- The Service Oriented Architecture XML (SOAML) and the Web Services XML (WSDL) that can be used for the communication between the iRMS microartefacts.
- The Business Process Modelling Notation (BPMN) and the Business Process Execution Language (BPEL), can be used for the design of the iRMS microartefacts.
- The client-side frameworks to build dynamic front-ends using a lifecycle development process.

Unique Identifiers Integration

Various types of identifiers can used for resource items, like the generated global unique identifiers, to identify and monitor business environments resources.

Processes, Patterns and Models

iRMS is supported by the *TKM&F* to enable inter-connected resource patterns from various domains, creating new values. These models can be described also using Business Intelligence Markup Language (BIML) (Folinas, 2007). The *TKM&F* offers patterns to support *Manager*s decisions to achieve sustainable benefits within the planned iRMS in a standard way, using intelligent microartefacts.

Intelligent Microartefacts Integration and Strategy

The *TKM&F's* mapping concept is used to relate and assemble the iRMS and *Project's* resources. This concept is used to manage autonomic *TKM&F's* microartefacts' instances in all the implementation phases; and it is based on an iterative model that maps all the *TKM&F's* microartefacts to CSFs (The Open Group, 2011a). The *Project* has to identify the initial set of CSFs to be used. The *TKM&F* applies Service Oriented Architecture (SOA) concepts that use service directory for vertical iRMS solutions, as shown in Figure 10, as an underlying support. The *TKM&F* recommends the adoption of a light variant of TOGAF, where its atomic services approach provides the conceptual and logical viewpoints, comprising security (Gartner, 2005).

Security

The *TKM&F* and the iRMS define a global vision on security by applying holistic qualification procedures that englobes security concepts from many domains, including financial security concepts (Clark, 2002).

Electronic Payments and Finance

Projects and its subsystems, like the iRMS, use technologies to transform an iRMS where automating and digitalization of financial services are fundamental in transforming the legacy resources system. The evolution of technologies-based services is un-linear in different business environments. *Projects*

Figure 10. Service's integration (Gartner, 2005)

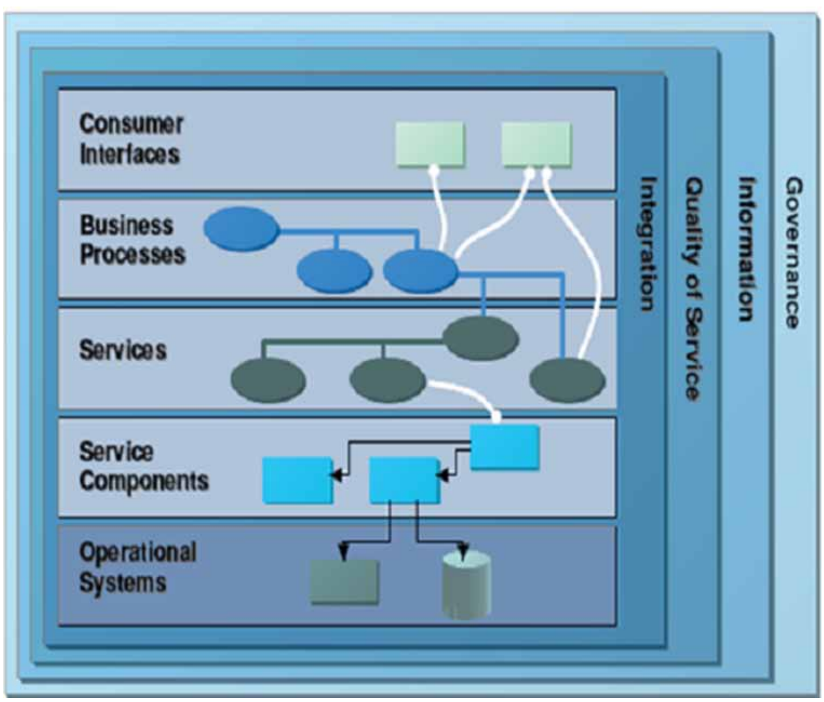


Figure 11. Financial services quantification (Makarchenko, Nerkararian, & Shmeleva, 2016)

	Important	**Current** capability	Market lag
Mobile device payments	94%	44%	-50%
Market Lag	92%	24%	
Real-time analytics	90%	30%	-60%
Digital advisory service	83%	28%	-55%
Location-driven services	82%	19%	-63%
Offers via social media	78%	34%	-44%
Comparison services based on financial profile	76%	28%	-48%
Social media account management	72%	14%	-58%
Gamification	72%	15%	-57%
Digital personal assistant	67%	12%	-55%

need to transform the interaction with banks to automate crucial iRMS financial services, managing the assets part. The technology transformation of Deutsche Bank, Raiffeisenbank, Hana-Bank and Bank Group are good examples for *Projects* (Makarchenko, Nerkararian, & Shmeleva, 2016).

Intelligent Static Resources

An intelligent reorganization of a *Project* and its subsystems including the iRMS, if possible, makes it open to integration with various eco-systems, including local, regional and global smart world, whatever that means; such an iRMS needs important automation capacities. The usage of smart devices is exponentially increasing and so the need to interface iRMS for data and functions requirements. The hyper-evolution of AI-based scenarios and applications is supposed to make iRMS very flexible. IoT and Internet protocols make automation the main infrastructure for scalable iRMS solutions; insuring the interoperability between various RMSs that use natively incompatible automation technologies, information infrastructure, software apps; by use of models and patterns (Miori & Russo, 2014).

Modelling And Patterns

The iRMS pattern (HPRMP), expresses a structural concept or schema for iRMS implementations: 1) it offers a set of predefined HPRMP templates to instantiate iRMS; 2) it describes their responsibilities of resource microartefacts; 3) it defines the software interfaces for the iRMS' modules; 4) it defines a iRMS engineering and enterprise architecture model; and 5) it includes the description of the relationships between the different iRMSs. iRMS components supporting the *Project* by offering items to handle various types of resources endpoints. The usage of endpoints provides some of the mechanisms needed to make iRMS tuneable with CSFs (Trad & Kalpić, 2019e).

The Information and Communication Technology's Critical Success Factors and Link to the Next Chapter

Based on the CSF review process, the important business case's CSFs are used and evaluated by the internal engine and are presented in an associated chapter entitled: *Business Transformation and Enterprise Architecture-The Resources Management Proof of Concept (RMPoC)* (Trad & Kalpić, 2019f). The next CSA to be analysed is the holistic management of the ADM.

THE INTEGRATION WITH THE ARCHITECTURE DEVELOPMENT METHOD

The iRMS' integration with TOGAF and ADM, enables the management and automation of resources items where the ADM is a generic method and recommends a set of phases and iterations to develop the *Projects subsystems*; using different phases.

Reference Architecture and its Phases

The intent of the iRMS reference architecture is to support *Projects* by an implementation and vendor- agnostic concept with enhanced interoperable and standards blueprint. Technological and implementation- agnostic concept promotes: 1) avoiding locked-in concepts; 2) integrating various resource management platforms; 3) certification and compliancy with resources and assets audit methodologies; 4) modularity of resource structures; and 5) market structure agnostic concept. The ADM manages the iRMS' development iterations and its interaction with the iRMS.

The Unit of Work and Enterprise Architecture

In this section the authors present the ADM's phases and the RMICs implications (Visual Paradigm, 2019):

- The preliminary phase prepares the business enterprise for a successful iRMS integration.
- The architecture vision and business architecture phases define the iRMS model's constraints and objectives; validate the business capabilities and create the Statement of Architecture Work (SAW).
- The information system architecture phase develops the iRMS' ICT architecture paradigm.
- The requirements management and test phases, testing and validation are applied to all the built microartefacts and mapped to the resource management requirements.

Resource Management System's Architecture Blueprint

The *TKM&F* uses iRMS standards that include EA frameworks, business process management, microartefacts interoperability… The mentioned iRMS standards are managed by the *TKM&F* and HPRMP, which delivers added value and robustness. The proposed *TKM&F*'s EA capabilities help in establishing an architecture principal guideline that defines the *Project*'s initial phase and vision; which is based on a "just-enough" architecture in the ADM for the iRMS (The Open Group, 2011a).

The Architecture Development Method (ADM) Critical Success Factors and Link to the Next Section

Based on the CSF review process, the important business case's CSFs that are used and evaluated by the internal motor and are presented in to an associated chapter entitled: *Business Transformation and Enterprise Architecture-The Resources Management Proof of Concept (RMPoC)* (Trad & Kalpić, 2019f). The next CSA to be analysed is the resources KMS.

THE HOLISTIC RESOURCES KNOWLEDGE MANAGEMENT SYSTEM

For a resource KMS (rKMS) the goal is basis to manage resource's information items using a holistic management concept that offers also the possibility to access distributed heterogeneous knowledge; where the knowledge items are associated with a specific CSF (Rockart, 1979). Modern rKMS is of ultimate strategic importance for an iRMS (Malhotra, 2005).

The Resource Knowledge Management Basics

The rKMS concepts are based on a set of multiple coordinated resource knowledge items that correspond to various just-in-time resource's access microartefacts (Cearley, Walker, & Burke, 2016). Resource access microartefacts are responsible for the manipulation and processing, which are holistic and empiric. Related and networked resource information coordination manages knowledge patterns, data, extracts and correlates them in space and time to detect heuristic patterns to deliver various types of advising or primitive problem solving (Gardner, 1999). These iRMS (or resource management) microartefacts and their underlying mechanics are used to generate sets of factors' weightings for possible actions that are called resource knowledge/intelligence microartefacts that are the stub of the rKMS. The RMIC is responsible for a rational heuristic approach for enterprise resource extraction. The RMIC's concept is based on a holistic systemic approach to use all the iRMS microartefacts (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a).

Resource Knowledge Microartefacts

The resource microartefact contains a mapping concept in XML format that insures the interoperability between all the iRMS and rKMS microartefacts; these resources can conform to standards, like the Architecture XML (ArchiXML) format to interchange between various *Project* phases and external systems. An iRMS pattern (or HPRMP) uses a fundamental structural concept or schema for interfacing rKMS implementations.

The Holistic Resource Knowledge Access Management

An iRMS, is basically managed by the *TKM&F*, where the enterprise's KMS officer configures the types of resources' KM microartefacts to be involved; these microartefacts are orchestrated by the HMM's instance actions, are used to deliver possible resources-related information or an advise on what action to take. The rKMS related actions map to the various internal processes, which are responsible for the implementation of mechanisms needed to deliver iRMS support. The rKMS interfaces are implemented in all of the iRMS components and the implementation of iRMS' mechanisms should be able to deliver the requested resource knowledge items or advise; such a set of actions can be modelled and managed by the HMM's internal language (The Open Group, 2011a; Trad & Kalpić, 2017a, 2017b, 2017c).

The Holistic Resource Knowledge Management

The rKMS manages resource Knowledge Items (rKI); where rKIs and microartefact scripts are responsible for the manipulation of intelligence and to control various rKMS processes. The rKMS supports the RMIC underlying mechanics to manage rKI microartefacts; and is responsible for access and rKI's extraction, using holistic systemic approach (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a).

The Holistic Resource Knowledge Strategy

rKIs map to CSFs and microartefact(s) and are classified in specific CSAs. The HPRMP expresses a fundamental structural *Project's* concept to interface the rKMS/rKI implementation; which enables a holistic approach to resource access and its mapping to CSFs.

The Knowledge Management Success Factors

Based on the CSF review process, the important business case's CSFs that are used and evaluated by the internal engine are presented in an associated chapter entitled: *Business Transformation and Enterprise Architecture-The Resources Management Proof of Concept (RMPoC)* (Trad & Kalpić, 2019f). The next CSA to be analysed is the resources DMS.

THE INTEGRATION WITH THE DECISION MAKING SYSTEM

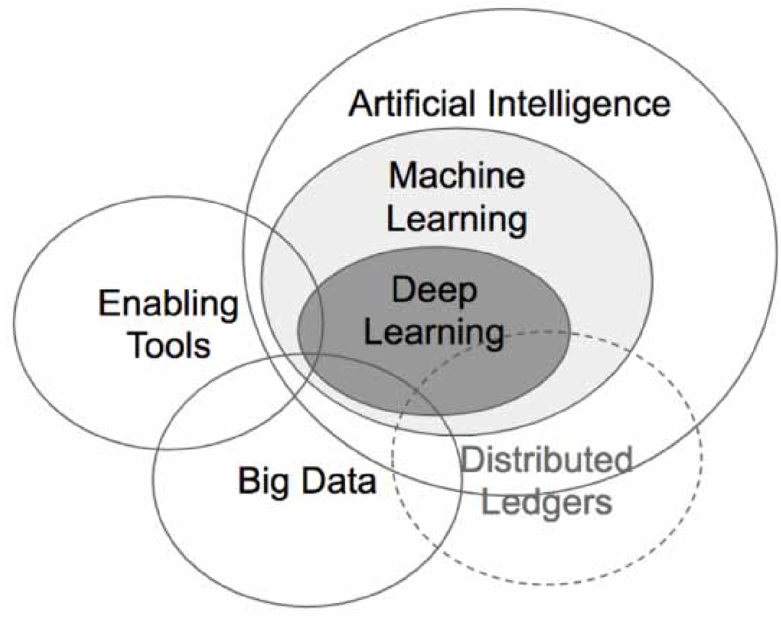
Critical Success Factors and Objectives

CSFs can be applied in the (Trad & Kalpić, 2014b): 1) selection of *Projects* and the legacy systems resources; 2) a global strategy of resources management; 3) iRMS and DMS engine's processing; and 4) iRMS training and auditing needs. The main objectives would be: 1) traceability; 2) liveability; and 3) workability; 4) sustainability; and 5) performance and security. As shown in Figure 12, various decision domains have enabled the integration of Artificial Intelligence (AI) (or complex decision systems) to support iRMS (Vander Ark, 2018).

Complex Resource Decision Making Systems

This RMSRDP is about cross-functional complex iRMS management that refers to the transformation of classical domains like resources/asset management, decision making, resource management, mathematical systems, systems analysis and global systems engineering; which are supported by the HMM formalism and instances; making research activities relevant to *Projects* (Markides, 2011). Complex decision systems' holistic management is an approach for an iRMS using a central decision process

Figure 12. Intelligent resources management decision domains (Vander Ark, 2018)



(Daellenbach & McNickle, 2005). The aim of such iRMSs is: 1) to help administration of complex ones; 2) improving communication, technology, performance and infrastructure; and 3) improving security. These actions would improve economic situation. That implies that the analysis and management of risk is one of the important pre-requisites to ensure the success of an iRMS implementation. The *TKM&F* integrates iRMS risk management and performs the analysis using a DMS/AI procedures (Hussain, Dillon, Chang, & Hussain, 2010).

An Extremely Long and Risky Transformation Process

Standard *Projects* (and iRMS) are very risky, the risk levels are very high at about 70%; *Projects* and their subsystems, are even more risky when using radical and long transformations (Malhotra, 2005).

In the iRMS based DMS, *Project's* team members can select and tune types of CSAs and CSFs to be processed. The selected CSFs are orchestrated by the HMM instances choreography engine that is the base of the DMS (The Open Group, 2011a; Trad & Kalpić, 2017a, 2017b, 2017c). All *TKM&F* subsystems including the iRMS, interface the DMS that uses an empirical problem-solving algorithm, which is used in the case when an optimization algorithm approach is impractical or when the problem is too complex and represents a multi-dimensional decision making process (Hernández, Ossowski &García-Serranoa, 2002).

The Resources Decision Making Process

In the HMM (i.e. AI) based resources DMS (rDMS), where any *Project* team member can configure the types of microartefacts and CSFs to be used, these iRMS microartefacts are orchestrated by the HMM's choreography engine. The HMM based rDMS' actions map to the various ICS's (and external) mechanisms to deliver the needed problem-solving actions; to optimize resource planning (Moon, 2007). The HMM instance is in all of the *Project*'s subsystems and processes (including the iRMS); such a set of actions is modelled and presented in this chapter's experiment or a PoC, the RMSPoC (The Open Group, 2011a; Trad & Kalpić, 2017a, 2017b, 2017c, 2019e).

The Decision Making System's Critical Success Factors and the Link to the Next Section

Based on the CSF review process, the important business case's CSFs that are used and evaluated by the internal engine are presented in an associated chapter entitled: *Business Transformation and Enterprise Architecture-The Resources Management Proof of Concept (RMPoC)* (Trad & Kalpić, 2019f). The next CSA to be analysed is the iRMS.

THE INTELLIGENT RESOURCES MANAGEMENT SYSTEM

A Cervical Approach

What is interesting, is that in our age of bookkeeping dictatorship, resources are simply very tangible assets; where taking the suspicious bookkeepers that would only be *Geld* (German, for money or cash), well it is probably cultural, where they see *Schnell Geld* in everything. But unfortunately, in complex domains where an extreme need for cervical capacities is totally antagonistic to very propagated Suspicious Bookkeepers Mentality (SBM); where *Projects* are stopped because a SBM's *Führer*, or because of a financial risks. A known case is the ridiculous *Swissair* grounding, where this excellent consortium was simply liquidated by a SBM's manager (Trad & Kalpić, 2019g; DW, 2019); probably *Swissair* was too diverse and cosmopolitan which had to be destroyed; this signified the emergence of financial reactionism. The authors rather analyse the intangible resources and assets (Blunschi, 2016); or the case of assets and resources of victims of the second world war.

The Structure

Melvin Conway's famous citation: "...organizations which design systems ... are constrained to produce designs which are copies of the communication structures of these organizations", in other words, communication glues the various parts of the over-all design, where the *Project* and the iRMS produce a set of artefacts/interfaces based on CSFs that map to the organization's structure and its information technology system (James, Grinter, & Grinter, 1999). This cluster's background combines resource management, enterprise architecture, mathematical models, heuristics, business transformation and business engineering fields. iRMS building using an HMM's instance is the most strategic goal for business companies. Fast transformations and efficient resources management environments have to be supported by a dedicated iRMS. A loose and dedicated iRMS can help in having a holistic control to non-predictive resource management/operations that depend on various factors like finance (honest and not SBM-like), business, resources, etc (Trad & Kalpić, 2019g; DW, 2019). An iRMS should be adapted to handle complex resource management requirements that can generate RMS problems, randomness, unpredictability... Loose iRMS requests can be measured and weighted; while primitive financial risk is not easily measurable. This explains the difficulty of estimating the financial risks of a consequential and rare iRMS problem that could be fatal to the whole *Project*. The *TKM&F* must evaluate the iRMS risks using the decision module and logged events. This chapter proposes an efficient approach to prediction and proactive risk management; which are the basic structures of an iRMS (Taleb, 2012).

Weightings concept enables the HMM's instance to find and select the optimal solution for a given iRMS problem. In many cases, fast changing transformation requests may generate an important set of solutions that can be ambiguous and make the DMS/AI actions uncertain and too complex to implement.

An iRMS can give a business environment the most important competitive business advantages that may insure its future and it is not a secret that intelligent resource artefacts are the basis for such a system. Major research and advisory firms like Gartner and Forester, confirm that resource knowledge services will leverage business information systems' components tangible and intangible resources from various enterprise departments.

Tangible and Intangible Resources

Tangible Resources

Tangible resources, but not approaching the magical SBM that makes everything disappear, are mainly physical and *honestly* measurable enterprise resources that are used in research, development and operations. Resources can be machines, property, buildings, and equipment, etc. (Trad & Kalpić, 2019g; DW, 2019). These resources may include (Murphy, 2019):

- Land and buildings.
- Transport units.
- Equipment and machines.
- Furniture and inventory.
- Securities like stocks, bonds, and cash.
- …

There Are Two Types of Tangible Resources:

- Current or actual resources (or assets) may include items such as debts, cash, inventory, and marketable securities. These items are mainly used within a year and needed in cash for emergencies (Murphy, 2019).
- Fixed resources or assets, known as noncurrent resources, are those that an enterprise uses in operations for more than one year. They figure in the balance sheet as property, and include resources like transport units, buildings, etc. The money that the enterprise generates using tangible resources figures in the income statement as revenue. Fixed resources insure the business continuity (Murphy, 2019).

Intangible Resources

Intangible resources are nonphysical resources needed in all *Projects* subsystems, for a long-term and mainly intellectual/grey cells resources, and it is difficult to evaluate them because of the uncertain outcome of *Projects*. Intangible resources are intellectual property that may include (Murphy, 2019):

- *Project* skills and intellectual capacities that are determinant for *Projects*.
- Enterprise architecture and transformation blueprints.
- DMS/AI solutions/recommandations databases.
- Patents and trademarks.
- Franchises and goodwill.
- Copyrights.
- Enterprise brand.

Other Types of Intangible Resources

Intangible resources may also include, *Project* paradigms, Internet domain names, performance events, licenses, contracts, enterprise software, blueprints, manuscripts, and enterprise secrets. Intangible resources can add to the enterprise's value and can in some cases be more valuable than its tangible resources (Murphy, 2019).

Industries with a High Number of Intangible Resources-Mainly Technology

Most modern transformed industries have business enterprises with a far more important proportion of intangible resources, like technology (or AI) companies, especially the ones specialized in software, copyrights/patents, critical specialists, and research/development are the key intangible resources. The French Airbus or the (originally) Croatian pharmaceutical industry Pliva (today TEVA) are typical European intangible resources examples. Therefore, the role of resources is of crucial importance for transformed (or to be) companies.

The Role of Resources Processing

An iRMS focuses on all aspects, like ethics, business transformation, resources management, business engineering, organizational design and enterprise architecture, where all these fields share choreography layer that is in turn based on microartefacts and "1:1" mapping relationships. A neural network perfectly corresponds to a heuristic tree that is a resource information processing paradigm, inspired by the biological neural systems, such as the human brain. The key element of this paradigm is the novel structure of the iRMS that is based on the HMM's instance. As already mentioned, the HMM is composed of many interconnected modules needed to solve specific *Project* and iRMS problems, as shown in Figure 13. iRMS units are connected to each other like nodes in a tree and there is a real number associated with each connection, which are called weightings used in iRMS (Soft Expert, 2018).

Figure 13. The asset (or resources) management system (Soft Expert, 2018)

Enterprise Resource Management

iRMS integrations are complex because the massive use of tools and technology to radically improve the robustness, performance and achieve hyper-fast business benefits through resource management scripting, makes it complex. Accountant or SBM oriented iRMS automation, through the promotion of off-shoring and rapid ruthless growth has a grave negative effect on *Projects* and business environments, because they promote fast and dirty decisions; that in general creates social problems (Trad & Kalpić, 2019g; DW, 2019), like recently the France's Gilet Jaunes ones. iRMSs are of extreme strategic importance for companies (Trad & Kalpić, 2019g; DW, 2019). If an iRMS is successful, the business company and the economical ecosystem will excel, but when it fails, the business company might face important problems and multiplication of such phenomenon would hurt the overall growth. Today, businesses that have been transformed need iRMSs to automate the management of their resources through system design and integration (Trad & Kalpić, 2013a).

Resource System Design and Integration

An important prerequisite for a successful *Project* integrating an iRMS is the development of a central iRMS architecture, design and integration paradigm in the transformed business enterprise by the means and use of existing business and technical standards. A *Project* and its iRMS, are to be assisted with existing standards like TOGAF, Archimate, Business Process Management, Object Oriented Methodologies, Unified Modelling Language, etc… (Beauvoir & Sarrodie, 2018). These standards include artefacts to be used to integrate iRMS modules' interfaces in the existing processes, like resources accounting, Configuration Management, Development and Operations (DevOps), Architecture Development Method

(ADM), etc... (Desfray, 2011). The main goal of an architecture change management process, is to support the enterprise's architecture to meet its business results; and that includes the management of architecture changes in a synchronous manner to enable tracking and assessment of the underlying iRMS modules (North, 2010). Today, business enterprises are encountering massive pressure to manage their enterprise resources (and assets) proactively and holistically in order to insure their business sustainability, reduce costs, and to integrate the continuously transformed legal, regulatory and economic environments; and above all to insure gain. For an RMS transformation process, there is a need for a just in time decision making, resources planning and optimization activities (Dechow & Mouritsen, 2005); and to achieve that the designed transformation process can manage the inventory of the enterprise's resources. The enterprise architects' role is to coordinate the iRMS integration in the very complex *Project*. A concise iRMS integration pattern that uses CSAs, which represent iRMS subparts like: 1) assets management; 2) Information Technology Resource Management (ITRM); 3) Hardware Resource Management (HRM); 4) Software Resource Management (SRM)… is presented in his chapter. In turn, the CSA contains selected CSFs that relate to unique standardized tags like the Software ID (SWID) that are used in the iRMS; to create a dynamic evaluation of the iRMS' *holistic value* (Uppal & Rahman, 2013).

The Holistic Resource Management System's Design Concept, Critical Success Factors and Link to the Next Section

Based on the CSF review process, the important business case's CSFs that are used and evaluated by the internal engine are presented in an associated chapter entitled: *Business Transformation and Enterprise Architecture-The Resources Management Proof of Concept (RMPoC)* (Trad & Kalpić, 2019f). The next section is related to the PoC.

THE PROTYPE'S INTEGRATION

The iRMS uses the *TKM&F's* functional language development environment to implement its modules. The DMS/AI uses CSFs sets, actions and applicable solutions for iRMS and *Projects* in general. The iRMS' main constraint is that in the RMSPoC, the CSAs having an average result below 7.5 will be ignored. This fact may qualify all the seven CSAs/Tables, which will be presented in the RMSPoC that concludes the first *TKM&F's* phase, and if the initial research and qualification are successful, then the RMSPoC can be conducted. The used ACS is a concrete case where the demo application uses the *TKM&F* for the RMSPoC implementation (Trad & Kalpić, 2018c).

SOLUTION AND RECOMMENDATIONS

The managerial recommendations are needed for finding the solutions to enable the management of iRMS. The resultant technical and managerial recommendations are:

- The iRMS feasibility is to be checked in the RMSPoC.
- The ADM's integration in an iRMS enables its automation and automation of its interfaces.
- Set up a central iRMS to be used in *Projects*.

- Define the interface to the rKMS and DMS. The iRMS needs to implement a DMS.
- Model the iRMS' and microartefacts' interaction.

iRMS managerial recommendations, and the *TKM&F* round up the approach needed for the complex resources management-related research activities.

FUTURE RESEARCH DIRECTIONS

This research and development project and related topics, appear to be undiscovered and in fact very complex, because many are based on intangible values, not the ones from the SBM (or simply a looting model); such models should be ignored, like fictive bookkeeping or banking secrecy that blocks real evaluation. The probable reason for such a de facto estimated situation is the classical approach that is based on too much excel practices and the scoping of the research question, hence the simplification of the research method to the level of marketing-like quantitative descriptive statistics taught in many business schools; which undermines the possibility of solving more complex problems and development of sophisticated decision systems that is essential for systems like the iRMS. The future research and development process will continue to tune the *TKM&F* and will work more specifically on the proof of concept (the RMSPoC).

CONCLUSION

This iRMS is based on the *TKM&F* unique mixed research model; where CSFs and CSAs are offered to help iRMS and *Managers* and resource (and assets) architects to minimize the chances of failure when implementing an iRMS (or *Project)*. This chapter is part of a series of research works related to *Projects*, using DMS/AI and rKMS, based on an HMM structure. In this chapter, the focus is on the iRMS that defines a central pool of CSAs/CSFs to be used throughout the *Projects* and its subsystems like the iRMS. The most important managerial recommendation that was generated by the previous research phases was that the *Manager* must be a strong leader and must have in depth knowledge of RMSRDPs and iRMS. The *TKM&F* can support an iRMS (and *Projects* in general) by using the iRMS to check the feasibility and to deliver a set of managerial recommendations. Concerning financing and preserving resources and assets; it is strongly recommended to avoid any type of looting approaches and models; knowing that suspicious finance and banking are synonyms for illegal manipulations (Trad & Kalpić, 2019g; DW, 2019).

ACKNOWLEDGMENT

In a work as large as this research project, technical, typographical, grammatical, or other kinds of errors are bound to be present. Ultimately, all mistakes are the authors' responsibility. Nevertheless, the authors encourage feedback from readers identifying errors in addition to comments on the iRMS and the *TKM&F* in general. It was our great pleasure to prepare this chapter and its experiment. Now our greater hopes are for readers to receive some small measure of that pleasure and support for his project.

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KEY TERMS AND DEFINITIONS

ADM: Architecture development method.
AHMM4BT: Applied mathematical model for business transformation.
CSA: Critical success area.
CSF: Critical success factor.
DMS: Decision-making system.
EA: Enterprise architecture.
EAP: Enterprise architecture projects.
HCSFMS: Holistic critical success factor management system.
HKMS: Holistic knowledge-management system.
ICT: Information and communication technologies.
iRMS: Intelligent resources management system.
KM: Knowledge management.
KMS: Knowledge-management system.
MM: Mathematical model.
RDP: Research and development projects.
RMS: Resources management system.
RQ: Research question.
SOA: Service-oriented architecture.
TKM&F: Trad Kalpić methodology and framework.
TOGAF: The Open Group's architecture framework.
XML: eXtensible mark-up language.

Chapter 12
An Applied Mathematical Model for Business Transformation and Enterprise Architecture:
The Holistic Project Resources Management Pattern (HPRMP)

ABSTRACT

This chapter presents transformation projects based on the holistic project resource management pattern (HPRMP) to optimize the ERM in a transformed enterprise that is the result of research and development on 1) business and resources case studies, 2) enterprise resources management and processes management, 3) business transformations, 4) applied mathematics models, 5) software and resources modelling, 6) business engineering, 7) financial analysis, 8) decision-making systems, 9) artificial intelligence (AI), 10) business process management, and 11) EA. The HPRMP is based on an authentic and proprietary research method that is supported by an underlining mainly qualitative holistic reasoning model module, which is an AI/empirical process that uses a natural language environment that can be easily adopted by the project teams.

The HPRMP is based on an authentic and proprietary research method that is supported by an underlining mainly qualitative holistic reasoning model module; which is an AI/empirical process that uses a natural language environment that can be easily adopted by the project teams (Trad & Kalpić, 2019b; Myers, Pane & Ko, 2004; Kim & Kim, 1999; Della Croce & T'kindt, 2002; Trad & Kalpić, 2017a, 2017b, 2017c, 2017d; Gunasekare, 2015). The HPRMP is implemented in a proof of concept for the feasibility of the chapter using the HMM approach. The HPRMP supports Business Transformation Projects and Enterprise Architecture Projects (EAP) (or simply *Projects*). This chapter is supported mainly by an adapted fictious case from the insurance domain (Jonkers, Band, & Quartel, 2012a). The uniqueness of the authors' proposed HMM, promotes a holistic cohesive architecture and implementation model that supports complex HPRMP integrations (Farhoomand, 2004). The integrated ERM and Decision Making System (DMS) are used in a day- to-day business and technology problems solving. In this chapter, the

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proposed solution (or model) is supported by a real-life case of business transformation methodology in the domain of HPRMP that in turn is based on the alignment of various standards and avant-garde methodologies. The "i" prefix, which will be used later in this text, does not stand just for the common intelligent agile environments but for a distributed and holistic intelligent resource system's approach that identifies this works background; and "a" will stand for resources. This research project's keywords are: 1) HPRMP and ERM; 2) Enterprise Architecture; 3) Business Transformation Project; 4) Business Transformation Manager; 5) Applied Mathematical Model, 6) Neural Networks; 7) Holisms; 8) Risk Management; 9) Decision Making Systems; 10) Artificial Intelligence; 11) Knowledge Management Systems; and 12) Innovation. Using recently (February 7th 2019) the Google Scholar search portal, in which the authors combined the previously mentioned keywords and key topics, the results have shown uniqueness and the current leading role of the authors' methodology, research and contribution in this field (Trad & Kalpić, 2019b). From this point of view, the authors consider their endeavour on the mentioned topics as successful and useful; so the main topics, like the ERM (Moon, 2007), will be introduced.

The HMM for *Projects* uses an advanced natural language development and simulation environment that can be adopted by any type of *Project,* and for that goal the authors propose to use the HPRMP, which can be instantiated in multiple instances by an ERM based system, as shown in Figure 1 (Myers, Pane & Ko, 2004; Neumann, 2002).

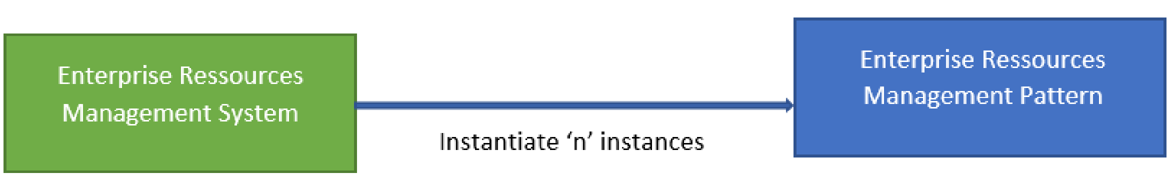
The HPRMP is, or can be, supported by a central HMM based DMS as a part of the framework, for any type of *Project*. The Proof of Concept (PoC) is based on a concrete business case, where the central point is a transformation process of the existing legacy ERM into a modern and intelligent ERM (iERM). Such *Projects* are managed by the Business Transformation Managers or an Enterprise Architecture Manager (simply a *Manager*); who are supported with a methodology and a framework that can estimate the risks of implementation of such *Projects*.

Regarding the resources management system, the related research cluster is made up of four research chapters:

- The Resources Management Implementation Concept is treated in the current chapter and is a separate chapter.
- The Holistic Project Resources Management Pattern (HPRMP), is introduced in this chapter.
- The Resources Management Proof of Concept (RMPoC) is presented in a separate chapter.
- The Resources Management Research Development Project (RMRDP) is also in a separate chapter.

The *Manager* is responsible for the implementation of complex *Projects* that include an iERM; the HPRMP supports him or her (for simplicity, in further text – him) in a just-in-time manner, where he should have a solid background in DMS based iERM (Trad & Kalpić, 2016b).

Figure 1. The relation between the resource pattern and resource management system



BACKGROUND

An important factor in complex *Projects* are the roles of the *Manager*, EA and the iERM's integration, which should be supported by the optimal transformation framework that ought to support a Global Resource Management Strategy (GRMS) model that is described in an associated chapter entitled: *Business Transformation and Enterprise Architecture-The Resources Management Implementation Concept (RMIC)*, which makes an introduction to this research cluster (Trad & Kalpić, 2019d). The GRMS model should be also capable of supporting the *Project's* executives, legal control and integration in a complex block-chained globalized business world. To achieve these goals, ERM based systems, technology components, cultural, financial and logistics integration strategy factors should be classified in Critical Success Areas' (CSA) categories, which contain CSFs that can be used to evaluate possible pitfalls and risks, to audit, assert, govern, automate, trace, monitor and control the iERM. The *Project* and its iERM subproject's CSFs can be configured to manage the complexities in asynchronous event flows from local and external environments. A transformed ERM system must have support of built-in automated controls, capable of recognizing major changes and requirements. *Projects* involve the complete digitalization of iERM processes, where automation enables new iERM models to optimize their evaluation processes. This research is considered as a pioneering and unique one and actually or even unfortunately, there is no similar frameworks, what confirms its lead; proposing a HPRMP that can be used for *Projects* in design and maintenance phases, which come after the finalization of the implementation phase. This research phase's background is related to risk evaluation of *Projects* using CSF based iERM, which are managed by the Trad Kalpić Methodology and Framework (*TKM&F*), as shown in Figure 2 (Trad & Kalpić, 2018f). The CSFs are selected from various iERM areas like resource categories, valuation, processes, technology, human skills …. and other. As all this chapter's and book's figures, contain many abbreviations, it is recommended to use this book's abbreviations chapter.

In this chapter, the authors present a set of HPRMP integration and technical recommendations that can be applied to various fields of business engineering, like ERM based systems, Knowledge Management (KM), business transformations and other engineering fields. Integrating a HPRMP and GRMS should be a fundamental and even strategic goal for *Projects* (Trad & Kalpić, 2018a, 2018b; Cearley, Walker & Burke, 2016).

The proposed HPRMP usage and instantiation is based on: 1) a holistic approach, by interfacing various *Project* fields; 2) it uses HMM based AI, DMS and risk management engine(s); 3) manages resources; 4) applies factors and categories and resources tracking; and 4) it uses the *TKM&F's* capabilities and its pool of patterns. The AI based DMS, iERM and HPRMP are based on the authors' Research and Development Project (RDP) method that in turn is based on intelligent neural networks (Trad & Kalpić, 2018a), where the HPRMP is agnostic to any specific application, technical or business domain, as shown in Figure 3, and is based on the Architecture Development Method (ADM) (The Open Group, 2011a), but it can use any existing architecture framework.

Any EA framework is central to implement *Projects,* where the *Manager* or an enterprise architect can use the HPRMP for iERM's integration (Trad & Kalpić, 2017b, 2017c; Thomas, 2015; Tidd, 2006). In *Projects*, the *Manager*'s role is important, and his actions are supported by the HPRMP to build a distributed iERM system that is a part of a Holistic (e)Business/(e)Commerce Management System (HeBCMS) (Trad & Kalpić, 2019c; Lanubile, Ebert, Prikladnicki, Vizcaíno, & Vizcaino, 2010).

Figure 2. The research framework's concept (Trad & Kalpić, 2016a)

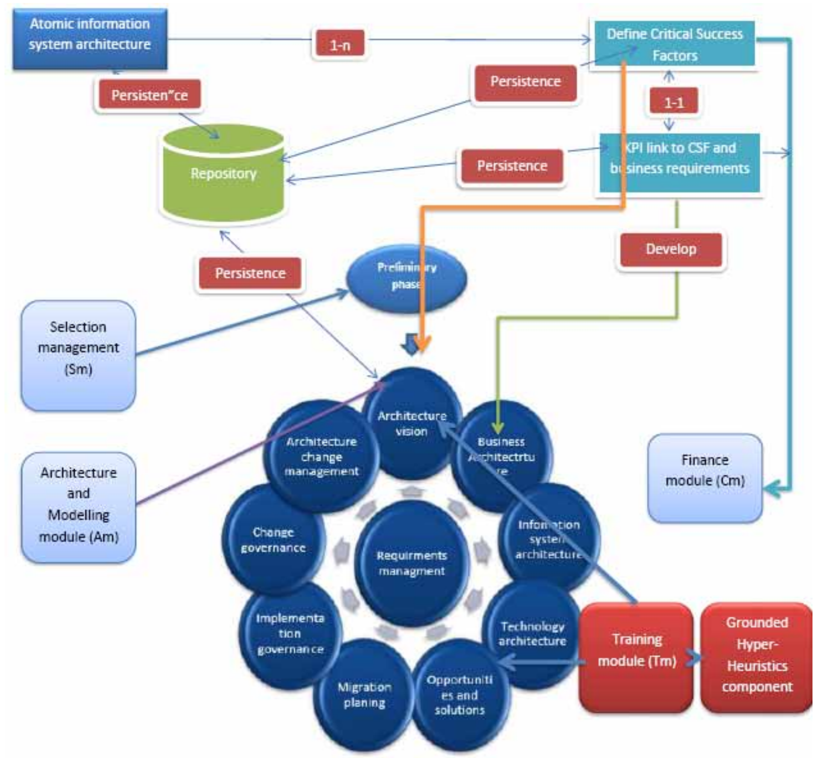


Figure 3. The research framework's architecture method's phases (The Open Group, 2011a)

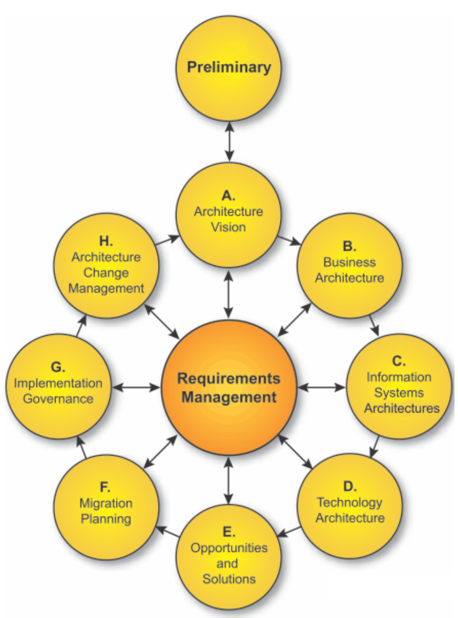
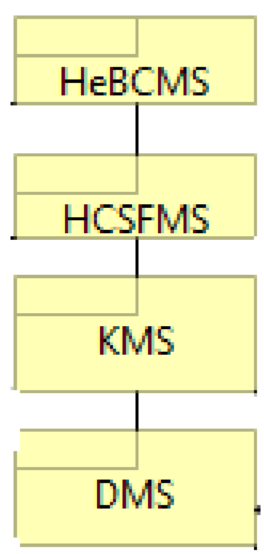


Figure 4. Intelligent management system internal interaction



A holistic systems approach is the optimal choice to model such a HPRMP for an HeBCMS, as shown in Figure 4, where the DMS interacts with internal components and external world via the *TKM&F* to manage CSFs (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a). As shown in Figure 5 the CSFs are important for the phase 1 that qualifies the needed CSF set and decides whether there is a need for a PoC.

Projects and iERM based systems are very difficult to implement, because of their holistic and complex nature, where a substantial part of complexity is met in their technical implementation and integration phases (Gudnason & Scherer, 2012). As shown in Figure 6 (ueses Global and Unique Identifier (GUID) and *Projects*, the *TKM&F* can be applied to all types of *Projects*, including the iERM's system integration.

iERM refers to any ERM that uses an HMM-similar structures or approaches and assists business transactions' executions and uses microartefact-based technologies. The development and evolution of iERM is fundamental for *Projects*. The technical implementation phase is the major cause of high failure rates in iERMs and *Projects* in general; mainly because of lacking holistic aspect that is supported by the HPRMP, what is this chapter's focus (Thomas, 2015; Cearley, Walker, & Burke, 2016; Trad & Kalpić, 2016b).

FOCUS OF THE CHAPTER

HPRMP recommendations can be applied by *Project* teams (Desmond, 2013) to integrate and transform enterprise resources. The RDP is based on a mixed methodology and it is unique (Easterbrook, Singer, Storey & Damian, 2008); where this chapter tries to prove the HPRMP and iERM feasibility through an experiment and Research Question for this research process.

Figure 5. Interaction with factors with all the framework's components

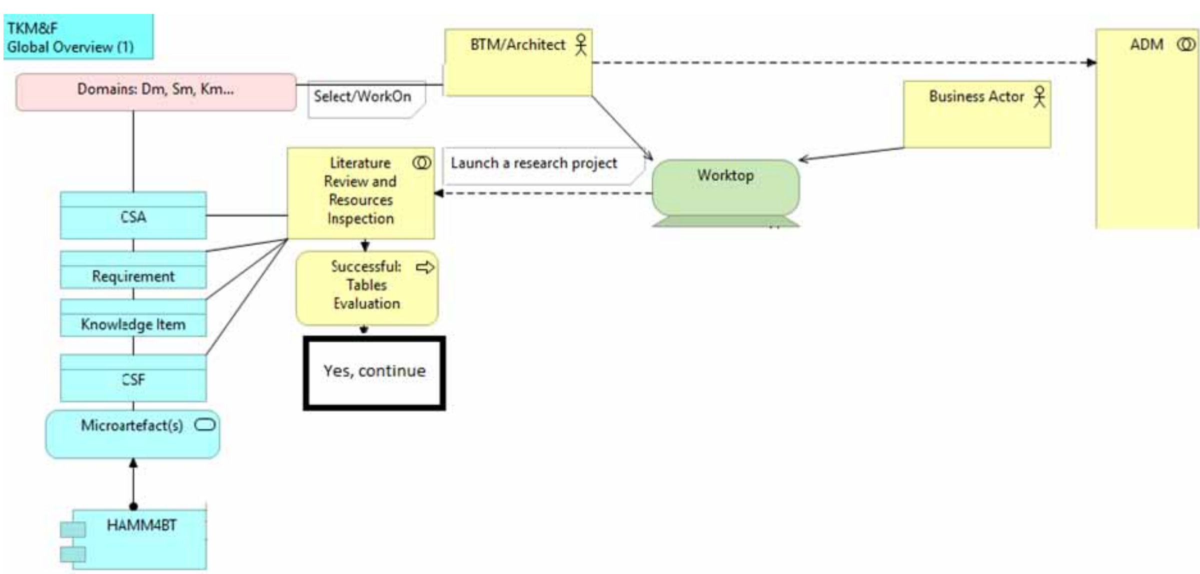
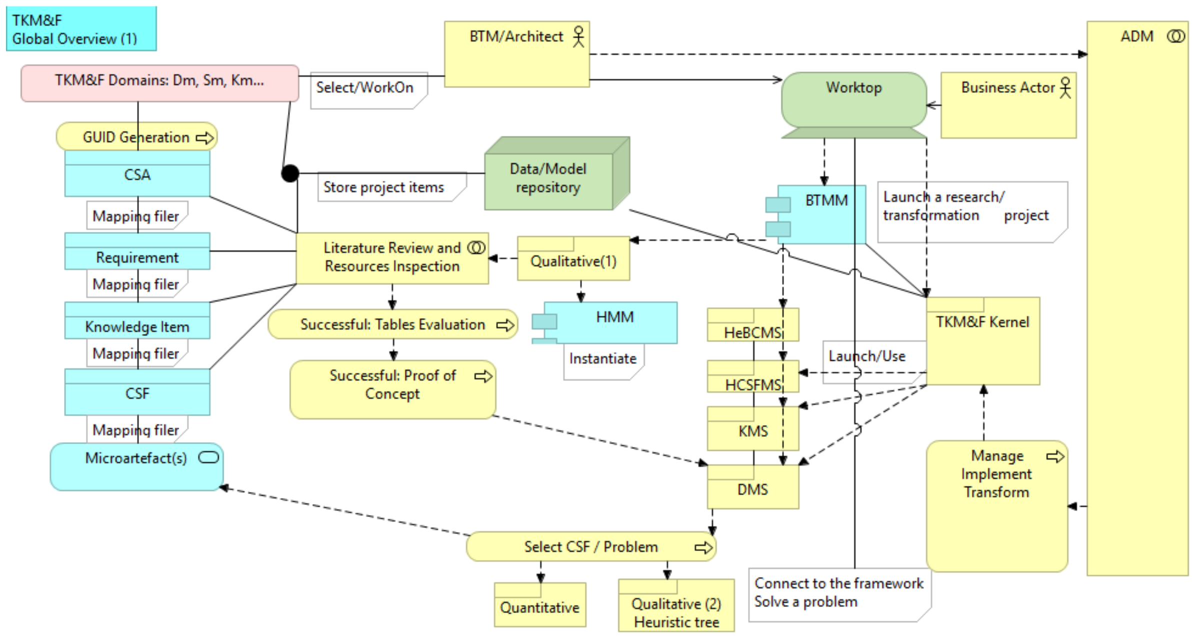


Figure 6. The Trad-Kalpić Methodology and Framework's flow and interaction



THE RESEARCH PROCESS

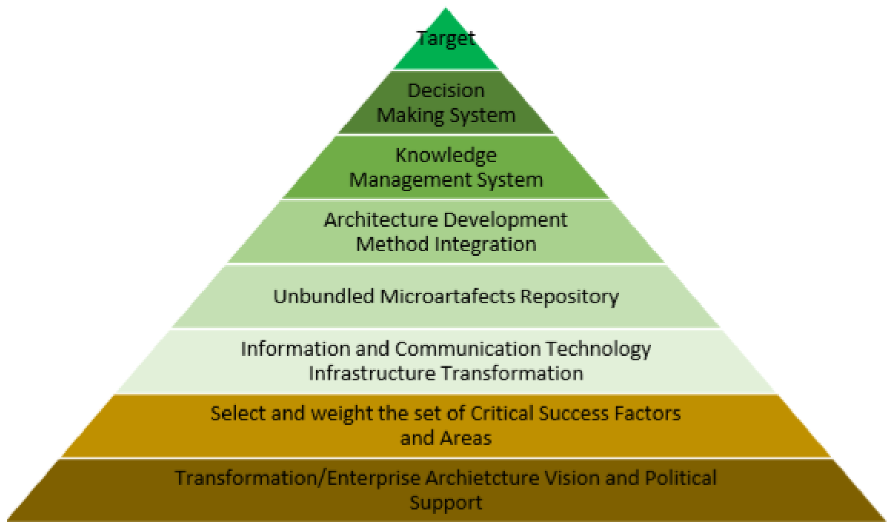
Projects failure rates are high and were constantly increasing (Bruce, 1994) that is due to the complexity encountered in the implementation phase (CapGemini, 2009); to enhance the success rate, the authors propose the *TKM&F* based research that is unique and can be considered as a pioneering approach. *TKM&F* recommends linking the HMM to all levels of the iERM that is in the target level, as shown in Figure 7 (Trad & Kalpić, 2018b; Agievich, 2014; Tidd & Bessant, 2018); where the CSF-based HPRMP instance would use the DMS and unbundling levels that are parts of the applied research framework, the *TKM&F* that is described in an associated chapter entitled: *Research Development Project* (Trad & Kalpić, 2019d).

THE BUSINESS CASE

Managing the Business Case

HPRMP uses an Applied Case Study (ACS), developed by the Open Group as a reference study, it presents the possibilities to implement *Project's* components and is related to an insurance company named ArchiSurance (Trad & Kalpić, 2018f); in this chapter it is used to check the HPRMP using CSFs.

Figure 7. Levels of project's interaction (Trad & Kalpić, 2017b, 2017c)



Integrating Critical Success Factors

A CSF is measurable and mapped to a weighting that is roughly estimated in the first iteration and then tuned through Architecture Development Method (ADM) iterations, to support the iERM; where holistic business and enterprise architecture CSFs are essential (Felfel, Ayadi, & Masmoudi, 2017). The main issue here is how to define the skills and processes that are needed to integrate the iERM and on how to interrelate the different business and EA domains (KPMG, 2014).

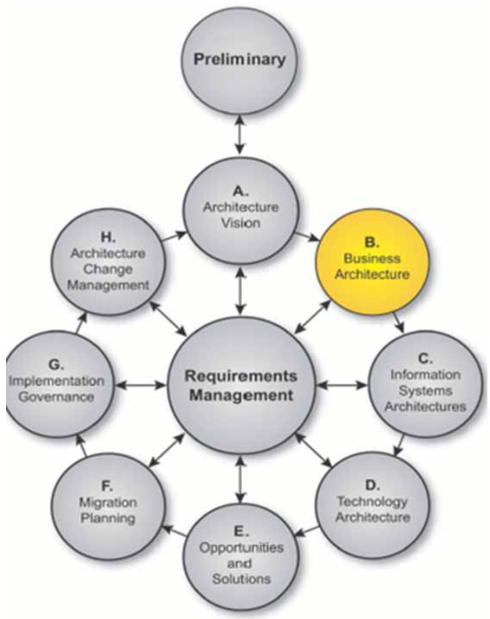
The Architecture Development Method and Projects

This RDP focuses on the design of *Projects'* iERM integration and presents the influence of HPRMP to select the *Manager*. In the actual age of resources optimization, distributed intelligence, complexity, knowledge, economy and technology, it permits HPRMP to offer a pattern that includes a hyper-heuristics tree that supports a wide class of problem types, and it is a major benefit (Markides, 2011), where the DMS supports the iERM (Trad, Kalpić & Fertalj, 2002; Trad & Kalpić, 2014d). The *TKM&F's* parts must synchronize with the Architecture Development Method (ADM) that are shown in Figure 8.

The Business Case Study's Critical Success Factors

Based on the CSF review process, the important business case's CSFs that are used and evaluated by the internal engine and are presented in an associated chapter entitled: *Business Transformation and Enterprise Architecture-The Resources Management Proof of Concept (RMPoC)* (Trad & Kalpić, 2019f). The next CSA to be analysed is the holistic Mathematical Model's integration.

Figure 8. Business architecture phases (The Open Group, 2011b)



The Research Section's Link to the Applied Mathematical Model

This section's (and practically all this RDP's) recommendation is that the HMM is crucial for this HPRMP related research's credibility.

THE APPLIED MATHEMATICAL MODEL'S USAGE

A generic *Project* model and its kernel ADM are the base of this RDP and they are the basics of its *TKM&F*. The authors propose a mathematical model to represent the *TKM&F* global architecture and solve the ERM integration problems. The literature review has shown that existing research resources on ERM related topics, as a mathematical model, are practically inexistent. This pioneering research work is cross-functional and links all the HPRMP microartefacts to *Projects* and enterprise architecture method (Agievich, 2014).

The *Project's* initialization phase generates the needed CSAs/CSFs and hence creates the HPRMP patterns to be analysed. The HMM makes a part and is the skeleton of the *TKM&F* that uses microartefacts' scenarios to support HPRMP instance requests (Agievich, 2014).

The Mathematical Model's Integration Critical Success Factors

Based on the CSF review process, the important business case's CSFs that are used and evaluated by the internal engine and are presented in an associated chapter entitled: *Business Transformation and Enterprise Architecture-The Resources Management Proof of Concept (RMPoC)* (Trad & Kalpić, 2019f). The next CSA to be analysed is the holistic management of the ICS.

The Research Section's Link to the Information and Communication System (ICS)

This section's recommendation is that the infrastructure and ICS unbundling processes are crucial for the HPRMP.

THE INTEGRATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES

Internet of Things-Gluing the Environment

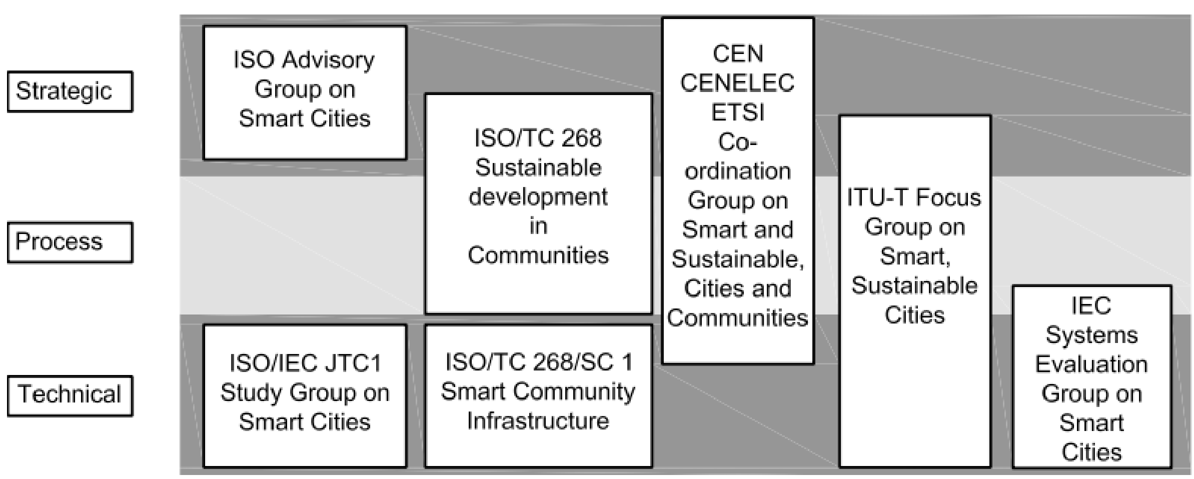
The HPRMP is enabled using distributed communication that is based on a standard by the Institute of Electrical and Electronic Engineers (IEEE) for building an Internet of Things (IoT)-based iERM, as shown in Figure 9. Traditional ERMs can be transformed to become an iERM, by applying common architecture elements supporting complex domains (BSI, 2015).

IoT and mobile infrastructure have expanded to interconnect endpoints and iERM, to create a virtual and holistic environment. In these virtually interconnected iERM, standard applications, endpoints and mobile apps collaborate in real-time, using standard technology procedures.

Standard Information Technology Procedures

The evolution of intelligent systems and the actual design, development, qualification and operations for iERMs are still basic. Tools for implementing iERMs are still confronted with serious issues. These problems show that archaic tools are inappropriate for large enterprise intelligent systems and the authors recommend the use of information technology concepts, such as:

Figure 9. An example of Internet supported services for intelligent systems (BSI, 2015)



- Patterns concept, which expresses a structural concept for iERMs where it offers templates: 1) to provide resources management, knowledge and intelligence templates to instantiate microartefact scenarios; 2) to describe their responsibilities, relationships and content; 3) to help defining complex relationships; 4) to define a default CSA and CSF sets model; and 5) to simplify the CSF table evaluations.
- Resources, microartefacts and CSFs, the *TKM&F's* repository maps, selected CSFs to various types of *Project's* resources, like architecture models, microartefacts and requirements; that use existing ERM standards.

An Atomic Building Block's Architecture

A fundamental architecture element in transforming a traditional business environment and its business information system, including its iERM subsystem, into an innovative automated and lean business platform, is the role of the information system's building vision, which should be crafted in an applicable framework. This framework should include easy to integrate patterns. The proposed just-in-time framework can change the information system's architecture and its implementation outcomes. The atomic information system architecture's role and applied the patterns are of crucial importance for the implementation phase of the complex business transformation projects; where these patterns can be adapted in a just-in-time manner, using atomic building blocks. There is also a need to govern or control the atomic information system architecture's patterns for business transformation projects; unfortunately an adaptable atomic information system architecture pattern for such projects is inexistent. An atomic information system architecture pattern can be also used in the enterprise's production activities which come after the finalization of the implementation phase of business transformation project, to control and govern the resultant business system. The atomic information system architecture's pattern main component is the atomic building block that manages the implementation of autonomous business service transactions. In this article the author presents a set of atomic information system architecture recommendations in the form of reusable patterns to promote an optimal information system's architecture (Trad & Kalpić, 2015d).

An Atomic Building Block's Implementation and Integration

Today's flexible global economy forces business companies to struggle for long-term survival; where such business companies must be competitive and loosely interconnected in a wide networked business market, using IoT. It is not a secret that a solid business environment that wants to insure its sustainable business future, must adapt itself to frequent *Projects* and their iERM subsystem, has to adapt to just-in-time change situations, by the use of building blocks-based solutions. Building blocks are proposed to support the business transformation project. Such a building block strategy for frequent business transformation changes is translated in a set of recommendations that support the company's iERM-based systems in order to optimize the companies' various business and information technology resources. Unfortunately, most of business transformation projects fail, because of the very difficult business transformation project's "decoupled and technical" implementation or re-engineering phase. The authors recommend a re-engineering phase that is based on atomic building blocks architecture; where the business transformation manager must have the right skills to model and prototype the most important Atomic Building Blocks (ABB), in order to insure the success of business transformation projects. It is recommended to apply the adequate ABB architecture and the needed modelling concepts. Such concepts are based on a one-to-one mapping pattern that is in turn based on enterprise architecture standards. Business transformation projects should apply an ABBs-driven implementation phase to help the implementation capability of the iERM based system; such an approach needs a specific set of integration, modelling and prototyping skills. Adaptable and loosely coupled ABB architecture patterns, like the ABBs can be used to improve the quality and success rate of the implementation and integration of the defined iERM requirements. That is achieved by simplifying and unifying of the applied HPRMP for the: analysis, design, development and maintenance processes of the final iERM-based system. The optimal HPRMP is based on the one-to-one mapping, in which each business requirement and its transaction microartefact is totally independent. Standardized and simplified enterprise business architecture based on HPRMP, enables the business transformation process to become iterative, where its design is based on a holistic approach, using interconnection between all its implementation phases. The ABBs resources traverse through the ADM, where each phase refines the ABB's implementation's capability; such an approach uses a unified view on the complete iERM-based system that consists of: 1) the targeted and unified collection of ABBs used to implement the iERM using the HPRMP; 2) the ABBs-based data and applications' loose HPRMP components; and 3) the underlying ABBs-based scalable technology infrastructure. The coordination of these main HPRMP architecture parts is assured by the coordinated use of: 1) an enterprise business architecture pattern; 2) standardised methodology; and 3) portable tools, like the Open Group's Architecture Framework's ADM, for example. *Managers*, enterprise architects, business architects, business analysts and information technology managers can use this concept to gain knowledge on how an iERM-based system's project can be managed; using ABBs, and solution blocks, for a successful transformation. Such a *Project* has to make a choice of the optimal tooling and modelling environment, based on a pseudo Model- View-Controller pattern. The complexity of the *Project's* implementation phase often causes the *Project's* failure and these failure rates are very high and the authors estimate that the *Manager* should apply an ABBs pseudo bottom-up approach. iERM are business engineering projects, and are cross-functional disciplines that refer to the architecture, design, development and implementation of: 1) iERM requirements solutions; 2) enterprise business architecture; 3) the underlying business process model; 4) the corresponding business processes use in the HPRMP; 5) the organizational structure of the business environment (that is known today as organizational engineering); 6) the (business) information systems; and 7) the underlying information technology. As already mentioned, the research topic is about managing resources in *Projects*, using standardized methodologies; where all these methodologies have many abbreviations and terms that makes the reading of such topics difficult, but unfortunately that is the nature of such fields (Trad & Kalpić, 2015c).

Atomic Building Blocks Structure

The *TKM&F's* ABBs are based on the Open Group's Architecture Framework's generic characteristics of building blocks that have the following generic characteristics:

- A building block is a package of requirements, functionalities and artefacts designed to meet the business needs of the iERM-based transformation project.
- A building block has a standardized usage of HPRMP interfaces to access all the *Project's* resources and functionalities.

- A building block is interoperable with other HPRMP building blocks types.
- A building block defines the functionalities that will be implemented and captures the business, as well as the technical requirements of the iERM.
- A building block is technology-aware and is standardized.
- A building block is used as a template to build solution building blocks.

The ABB has the following implementation characteristics:

- It unifies implementation and usage, and easily adapts to evolution of technology and standards.
- ABB can be an aggregation of other building blocks, hence a subassembly of other building blocks.
- An ABB is a reusable and easily replaceable template.
- An ABB can have many implementations.
- An ABB has a unique identifier.
- An ABB respects the "1:1" mapping concept.
- An ABB enables business interoperability and integration.

Atomic Building Blocks Distribution

An ABB is a microartefact package (or a jar file for java, for example) of functionalities and resources, designed to meet a precise HPRMP transaction or another atomic business transaction. The way in which HPRMP microartefacts, functionalities and development resources are combined into an ABB might vary between individual architecture solutions. The *Manager* has to coordinate, design and prototype the iERM's ABBs using the ADM's various phases; where these ABBs will improve the legacy ERM system transformation, integration and interoperability (Trad & Kalpić, 2015c).

Solution Building Blocks

The ABBs based Atomic Solution Blocks (Trad & Kalpić, 2015c):

- Define exactly which HPRMP services and components will implement the resources/business functionality.
- Define the implementation of each Atomic Solution Block, using the "1:1" concept.
- Fulfil atomic HPRMP transaction requirements.
- Are traceable and are interoperable; they can be used just-in-time.
- Are compiled in execution, to enable dynamic systems building.

Atomic Reference Models

The ABBs are based on the Open Group's Architecture Framework's foundation architecture, which is based on the foundation architecture of generic services. This foundation architecture is part of the Technical Reference Model, which provides a model for generic platform of services. The Technical

Reference Model is interoperable, and can be used to build any system architecture microartefacts, like the ABBs to emphasize two major common architectural objectives to create atomic reference models for supporting HPRMP instantiation (Trad & Kalpić, 2015c):

- HPRMP microartefacts portability, by using the Application Platform Interface, which identifies the set of ABBs in the form of services that are to be made available for applications via the iERM-based platform.
- Interoperability, via the Communications Infrastructure Interface, for identifying the set of Communications Infrastructure services that are to be leveraged in a standard way by the iERM-based platform.

The Information and Communication Technology's Critical Success Factors

Based on the CSF review process, the important business case's CSFs that are used and evaluated by the internal motor and are presented in an associated chapter entitled: *Business Transformation and Enterprise Architecture-The Resources Management Proof of Concept (RMPoC)* (Trad & Kalpić, 2019f). The next CSA to be analysed is the holistic management of the ADM.

The Research Section's Link to the Architecture Development Method

This section's deduction is that the ICS and other fields are dependent on an EA paradigm and therefore the ADM is crucial for the integration of the HPRMP.

THE INTEGRATION WITH THE ARCHITECTURE DEVELOPMENT METHOD

The HPRMP's integration with TOGAF's and ADM, enables the management and automation of iERM development, where the ADM is a generic method and recommends a set of phases and iterations to develop iERMs.

Reference Architecture and its Phases

The intent of HPRMP's architecture is to support iERMs development and make it vendor-agnostic with a standard blueprint. Technological and implementation agnostic concept promotes: 1) avoiding locked-in concepts; 2) integrate various resource management and business processes platforms; 3) audit, certification and compliancy; 4) modularity and inter-operability; and 5) market structure agnostic concept. The ADM manages the iERM's development based on HPRMPs' instantiation.

The Unit of Work and Enterprise Architecture

In this chapter's section the authors present ADM's phases that are relevant to the HPRMP's integration (The Open Group, 2011a):

- The preliminary phase prepares the business enterprise resources schemes, for a successful HPRMP integration and defines its main goals.
- The architecture vision and business architecture phases define the HPRMP's constraints and final objectives; validates the business capabilities and creates the Statement of Architecture Work (SAW).
- The information system architecture phase develops the HPRMP's ICT architecture for integration.
- The technologies architecture phase develops the HPRMP's technology architecture and its baselines.
- The requirements management and tests phases, testing and validation are applied to all the implemented microartefacts and mapped to the iERM's requirements.

Resource Management System's Architecture Blueprint

The iERM uses existing standards, like, EA frameworks, business process modelling, microartefacts interoperability implementation… The mentioned iERM-used standards are managed by the *TKM&F*, which delivers added value and robustness to *Projects*. The proposed *TKM&F*'s EA capabilities help in establishing architecture principal guideline that defines the *Project's* initial phase and vision; which is based on a "just-enough" architecture using the ADM (The Open Group, 2011a).

The Architecture Development Method (ADM) Critical Success Factors

Based on the CSF review process, the important business case's CSFs that are used and evaluated by the internal motor and are presented in an associated chapter entitled: *Business Transformation and Enterprise Architecture-The Resources Management Proof of Concept (RMPoC)* (Trad & Kalpić, 2019f). The next CSA to be analysed is the holistic management of the ADM. The next CSA to be analysed is the resources KMS.

The Research Section's Link to the Resource Knowledge Management System

This section's deduction is that the HPRMP can be integrated with certain difficulty in *Projects* and a holistic ADM and the HPRMP is applicable for KMs and DMSs; or any other intelligence-based systems, like the resources management oriented KMS.

THE HOLISTIC ASSET KNOWLEDGE MANAGEMENT SYSTEM

For a resource KMS (rKMS) the goal is to manage information on resource items using a holistic management concept that offers also the possibility to access distributed heterogeneous knowledge; where the knowledge items are associated with the CSFs (Rockart, 1979). In the 21st century rKMS is of ultimate strategic importance for the resource management of knowledge in an iERM. In an iERM, many traditional knowledge management accesses exist and are a barrier for an rKMS and for *Projects* in general (Malhotra, 2005).

The Resource Knowledge Management Basics

The HPRMP and its rKMS interface concept are based on a set of multiple coordinated resource knowledge management interfaces that correspond to various just-in-time knowledge access microartefacts (Cearley, Walker & Burke, 2016). Distributed resource information coordination manages knowledge items, data, extracts. They are correlated in space and time to detect heuristic patterns to deliver various types of synthesised information that can be considered as a primitive problem solving (Gardner, 1999). These access microartefacts and their underlying mechanics are the stub of the rKMS and the *TKM&F*. (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a). A successfully integrated HPRMP can give a company the most important competitive business advantages that may insure its future and it is not a secret that intelligent resource microartefacts are the basis of any successful *Project* (Trad, 2018a; 2018b, 2018c). Major research and advisory firms like Gartner, confirm that resource knowledge services will leverage business ICTs' components from various enterprise departments. Gartner confirms also that services are the dominating business enablers for Fortune 500 companies that need dynamic business resource and intelligence support (Clark, Fletcher, Hanson, Irani, Waterhouse, & Thelin, 2013).

The Knowledge Management Success Factors

Based on the CSF review process, the important business case's CSFs that are used and evaluated by the internal motor are presented in an associated chapter entitled: *Business Transformation and Enterprise Architecture-The Resources Management Proof of Concept (RMPoC)* (Trad & Kalpić, 2019f). The next CSA to be analysed is the holistic management of the ADM. The next CSA to be analysed is the resources DMS.

The Modules Chained Link to the Intelligence Support or Decision System

The rKMS' integration result proves that it is fairly possible to implement an HPRMP to interface the DMS.

THE INTEGRATION WITH THE DECISION-MAKING SYSTEM

Complex Resource Decision Making Systems

This RDP is about cross-functional complex iERM that refers to the transformation of classical domains like resources management system, decision making, resource management, mathematical systems, systems analysis and global systems engineering; which are supported by the HMM formalism. Complex decision systems' holistic management is an approach for an iERM using a central decision process (Daellenbach & McNickle, 2005).

The Decision-Making Process

In the HMM-based DMS, where any *Project* team member can configure the types of microartefacts and CSFs to be used, these microartefacts are orchestrated by the HMM's choreography engine. The HMM based DMS' actions map to the various ICT system's mechanisms to deliver the needed actions.

The HMM instance is in all the *Project*'s processes; such a set of actions is modelled and presented in this chapter's experiment or a proof of concept (The Open Group, 2011a; Trad & Kalpić, 2017a, 2017b, 2017c).

The Decision-Making System's Critical Success Factors

Based on the CSF review process, the important business case's CSFs that are used and evaluated by the internal engine and are presented in an associated chapter entitled: *Business Transformation and Enterprise Architecture-The Resources Management Proof of Concept (RMPoC)* (Trad & Kalpić, 2019f). The next CSA to be analysed is the holistic management of the ADM. The next CSA to be analysed is the resources KMS. In the next section HPRMP will be presented in the section below (and it is at the same time this chapter's title).

The Research Section's Link to the Proof of Concept

The DMS' integration result proves that it is possible to implement an HPRMP to interface the DMS.

THE HOLISTIC PROJECT RESOURCES MANAGEMENT PATTERN

The Basics

The HPRMP produces a set of artefacts based on CSFs that map to the organization's structure and its resources schemes. This work's background combines resource management, enterprise architecture, mathematical models, heuristics, business transformation and business engineering fields. iERM building using an HMM is one of the most strategic goals for business companies to be transformed. Fast transformations and efficient iERMs have to be supported by a flexible HPRMP. A flexible HPRMP can help in having a holistic and broad guide to non-predictive resource management operations that depend on various factors like skills, finance, business, resources accessibility, etc. A iERM should be adapted to handle complex ERM requirements that can handle complex problems, randomness, unpredictability... Flexible iERM problems can be measured and weighted; while financial risk is not easily measurable. This explains the difficulty of estimating the financial risks of a consequential and rare HPRMP problem that could be fatal to the iERM. The *TKM&F* must evaluate the iERM risks using the decision module and logged events. This chapter proposes an efficient approach to prediction, proactive risk management; that are the basic structures of an HPRMP. Weightings concept enables the HMM to find and select the optimal solution for a given iERM problem. In many cases, fast changing transformation requests may generate an important set of solutions that can be ambiguous and make the iERM actions uncertain and too complex to implement.

Competitive Advantage

An iERM can give a company the most important competitive business advantages that may insure its future and it is not a secret that iERM microartefacts are the basis for such a system. Major research and advisory firms like Gartner, confirm that iERM microartefacts will leverage business information systems' components tangible and intangible resources from various enterprise departments.

The Role of Resources Management and Processing

An iERM focuses on all aspects, like business transformation, resources management, business engineering, organizational design and enterprise architecture, where all these fields share some kind of choreography layer that is in turn based on microartefacts and "1:1" mapping relationships. A neural network perfectly corresponds to a heuristic tree that is a resource information processing paradigm, inspired by the biological neural systems, such as the human brain. The key element of this paradigm is the novel structure of the iERM that is based on the HMM. As already mentioned, the HMM is composed of a large number of interconnected modules needed to solve specific *Project* and iERM problems, like asset management, as shown in Figure 10. iERM units are connected to each other like nodes in a tree and there is a real number associated with each connection, which are called weightings used in iERM's asset management subsystem (Soft Expert, 2018).

The integration and control proceed through iERM-based systems, where integration is an unending process and it is frequent. iERM Integration is not only about basic visibility and control where the integration is more profound, and control is performed through financial and non-financial processes which distinguish an accounting approach from a logistics one. A primary recommendation is that control cannot be conducted apart from technology and in its context; because such an integration involves many technologies and many types of control methodologies. iERM-based system integrations should make 'blind spots' and 'trading zones' impossible. Control of an iERM is not a simplistic accounting function but a complex holistic approach of global management that implies the needs of an HPRMP to implement an iERM (Dechow, & Mouritsen, 2005).

Figure 10. Asset (or resource) management system (Soft Expert, 2018).

Enterprise Resource Management

iERM integrations are complex and massive use of tools and technology to radically improve availability, performance and achieve hyper-fast business benefits through iERM automation, making it fail prone. Accountant oriented iERM approach promotes off-shoring and rapid ruthless growth that has a grave negative effect on iERM and *Projects* in general; that affects the end business environments, because they promote fast and dirty decisions. iERMs are of extreme strategic importance for companies and if an iERM is successful, the business company and the related economical ecosystem will excel, but when it fails, the business company might face important problems and multiplication of such phenomenon would hurt the overall growth. Today, businesses that have been transformed, need iERMs to automate the management of their resources through design (Trad & Kalpić, 2013a).

Global Resource Management Strategy

The GERM, defines the main objective which is the use of a methodological framework for dealing with complex iERM problems and for evaluating their transformation. The competitive pressure unleashed by the process of globalization is forcing the implementation of iERM based systems' projects with frequent change initiatives. iERM-based systems are the most dominant part in actual rapidly increasing *Project's* investments. Astonishingly, the literature review has revealed a deteriorating trend of evaluation of *Projects* investments. Taking into account the enormous *Project* risks of failure and the associated costs of iERM-based systems using HPRMP, it is essential to evaluate these iERMs correctly and precisely. Existing methodologies, which use only the cost CSF that is correlated with the possible benefits, has proved totally inadequate for actual *Projects* and their iERM subsystem. It is suggested instead to decrease the importance of the cost reduction CSF and increase the focus on effectiveness CSF. Effectiveness CSF is a multi-dimensional criterion and is not measurable with simplistic quantification practices. iERM-based systems and *Projects* in general, need multi-dimensional evaluation criteria and a holistic and iterative methodology that extends into the ADM's implementation phase as their status influences the next iterations; that is supported by the *TKM&F*. The *TKM&F* is a solution, that offers a heuristic based framework that incorporates empiric learning and decision making processes based on a natural language and the evaluation process adopting the decision tree, is proposed; a case and a PoC are related to illustrate its applicability of the proposal (Teltumbde, 2000).

The Holistic Resource Management System's Design Concept Critical Success Factors

Based on the CSF review process, the important business case's CSFs that are used and evaluated by the internal motor are presented in an associated chapter entitled: *Business Transformation and Enterprise Architecture-The Resources Management Proof of Concept (RMPoC)* (Trad & Kalpić, 2019f). The next CSA to be analysed and implemented is the proof of concept.

The Research Section's Link to the Proof of Concept

The following phase is the PoC for HPRMP's implementation.

THE PROTYPE'S INTEGRATION

The HPRMP proposes the use of a functional language development environment, to implement the PoC. The HPRMP uses CSFs sets, actions and applicable solutions for *Projects* and its iERM subsystem. The HPRMP's main constraint is that CSAs having an average result below 7.5 will be ignored. This fact can qualify the RDP's seven CSAs, what concludes the phase 1. The results of Phase 1 that may show, whether the HPMAP and iERM were independent components and whether it is possible to integrate them in *Projects*. The ACS is used and is a concrete case where the demo application uses the *TKM&F* for the PoC implementation (Trad & Kalpić, 2018c; Trad & Kalpić, 2019f).

The Setup and iERM Factors of the Architecture Method

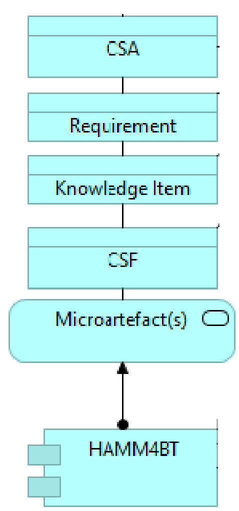
The HPRMP's implementation phases' setup looks as follows:

- phase A or the Architecture Vision phase, establishes an iERM implementation roadmap.
- Phase B or the Business Architecture phase shows how the iERM targets roadmap realizes the key requirements.

The Proof of Concept

The related PoC chapter is implemented using the *TKM&F*, which was also developed exclusively by the authors, who own the total copyrights. The PoC presents the HPRMP mechanics, which interface the DMS that uses the internal initial *Project*'s set of CSFs that serves as an example for this chapter; it is presented and evaluated in various tables. The services-based microartefacts have bindings/mappings to specific *Project*'s resources like CSFs, as shown in Figure 11.

Figure 11. The TKM&F services based microartefacts concept.



SOLUTION AND RECOMMENDATIONS

The managerial recommendations for the HPRMP's integration present solutions to enable the holistic management of iERM. This depends on the score. which may show whether the HPRMP implementation is feasible and whether it is a risky transformation process and whether the *TKM&F* could be used for *Project's* iERM integration. The PoC's resultant technical and managerial recommendations may confirm the following:

- Whether the HPRMP can be established and is it feasible.
- Whether the ADM's integration with the HPRMP enables the automation of its interfaces.
- Whether the *Project's* iERM must be separated in multiple transformation sub-projects.
- Whether the unbundling of the iERM' services to deliver the needed HPRMP's services classification.
- Whether the *Manager* must be an iERM specialist.
- How to setup the weighting and rating rules.
- How to setup the mapping concept.
- How to setup a central HPRMP to be used in *Projects*.
- How to select the HPRMP's CSFs, KPIs and CSAs.
- Should a *Manager* necessarily be an agile project manager.
- How to use of iERM process models.
- Whether the *Manager* should have cross-functional skills and a strong leadership.
- How to define the interface to the rKMS and DMS. The *Project* needs to implement a DMS.
- How to model the HPRMP's and microartefacts' interaction.

HPRMP proposition, and the *TKM&F*, round up the approach needed for the complex iERM integration.

FUTURE RESEARCH DIRECTIONS

This research topic appears to be undiscovered and very complex, because many intangible values were ignored, like schooling. The probable reason for such a de facto situation is the classical approach that is based on too much scoping of the research question and simplifying the research method to the level of marketing-like quantitative descriptive statistics, taught in many business schools; which undermines the possibility for solving more complex problems and development of sophisticated decision systems. The future research and development process will continue to tune the *TKM&F* and will work more specifically on the iERM PoC.

CONCLUSION

The proposed HPRMP is a part of the *TKM&F* that is based on a unique mixed research model; where the pool of CSFs and CSAs are supports to *Managers* and are a resource responsible to minimize the chances of failure when implementing a *Project*. This chapter is part of a series of research works related to HMM, *Projects*, DMS and rKMS. In this chapter, the focus is on the HPRMP that defines a central pool of factors to be used throughout the iERM and all the *Project's* components. The most important managerial recommendation that was generated by the previous research phases was that the *Manager* must be a strong leader. The iERM's PoC is based on the CSAs/CSFs links to a specific iERM and *Project's* resources and the *TKM&F's* reasoning model to evaluate the selected CSFs. The PoC's may deduce feasibility results that can imply whether the attempt of an HPRMP-based transformation is possible. The resultant managerial recommendations are offered to help *Manager*s decrease the high failure rates. The already published research and development publications have produced the following outcomes:

1. The research has proved the existence of a multi-dimensional knowledge gap existing between the complexity and the feasibility of iERM development.
2. The iERM needs to interface the rKMS and DMS.

The *TKM&F* supports the *Project* by using the HPRMP pattern and delivers a set of managerial recommendations for *Projects*.

ACKNOWLEDGMENT

In a work as large as this research project, technical, typographical, grammatical, or other kinds of errors are bound to be present. Ultimately, all mistakes are the authors' responsibility. Nevertheless, the authors encourage feedback from readers identifying errors in addition to comments on the HPRMP and the *TKM&F* in general. It was our great pleasure to prepare this chapter and its experiment. Now our greater hopes are for readers to receive some small measure of that pleasure and support for their projects.

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KEY TERMS AND DEFINITIONS

ADM: Architecture development method.
CSA: Critical success area.
CSF: Critical success factor.
DMS: Decision-making system.
EA: Enterprise architecture.
EAP: Enterprise architecture projects.
ERM: Enterprise resources management.
HMM: Holistic mathematical model.
iERM: Intelligent enterprise resources management.
KM: Knowledge management.
KMS: Knowledge-management system.
Projects: Business transformation projects.
RDP: Research and development projects.
TKM&F: Trad Kalpić methodology and framework.
TOGAF: The Open Group's architecture framework.

Chapter 13
An Applied Mathematical Model for Business Transformation and Enterprise Architecture:
The Resources Management System–Research Development Project (RMSRDP)

ABSTRACT

This chapter presents the resources management system's research and development project (RMSRDP) that explains in detail the application of the research concept where the enterprise research management (ERM)-based transformation projects are carried on to optimize enterprise resources in transformed end enterprises, the result of an innovative research and development on 1) business resources-oriented case studies, 2) ERM, 3) business transformations, 4) applied mathematical models, 5) software modelling, 6) business engineering, 7) financial analysis, 8) decision-making systems and CSFs, 9) artificial intelligence (AI), and 10) enterprise architecture. The RMSRDP is based on an authentic and proprietary research method and framework that are supported by an underlining mainly qualitative holistic reasoning model module.

The RMSRDP is based on an authentic and proprietary research method and framework that are supported by an underlining mainly qualitative holistic reasoning model module; which is an AI/empirical process that uses and interprets natural language environment scripts that can be easily adapted by the project teams (Trad & Kalpić, 2019b; Myers, Pane & Ko, 2004; Kim & Kim, 1999; Della Croce & T'kindt, 2002; Trad & Kalpić, 2017a, 2017b, 2017c, 2017d; Gunasekare, 2015). The RMSRDP is implemented in a proof of concept, which is a part of this research cluster, and uses the HMM to prove the feasibility of the research approach. The RMSRDP supports Business Transformation Projects, ERM construction and Enterprise Architecture Projects (EAP) (or simply *Projects*). This chapter is supported mainly by an adapted fictious case from the insurance domain (Jonkers, Band & Quartel, 2012a). The uniqueness of the authors' proposed HMM promotes a holistic cohesive research, architecture and implementation model that supports complex RMSRDP for transformations (Farhoomand, 2004). The integrated Re-

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source Management System (RMS) and the Decision Making System (DMS) are used in a day to day business, resources and technology-related problems solving. In this chapter, the proposed solution (or model) is supported by a real-life case of business/resources transformation methodology in the domain of insurance that in turn is based on the alignment of various standards and avant-garde methodologies. The "i" prefix, which will be used later in this text, does not stand just for the common intelligent agile environments but for a distributed and holistic intelligent resource system's approach that identifies this works background; and "r" will stand for resources. This research project's main keywords are: 1) RMSRDP and RMS; 2) Enterprise Architecture; 3) Business Transformation Project; 4) Business Transformation Manager; 5) Applied Mathematical Model, 6) Neural Networks; 7) Holisms; 8) Risk Management; 9) Decision Making Systems; 10) Artificial Intelligence; 11) Knowledge Management Systems; and 12) Innovation. Using recently the scholar engine in Google's search portal, in which the authors combined the previously mentioned keywords and key topics; the results have shown clearly the uniqueness and the leading role of the authors' methodology, research and works (Trad & Kalpić, 2019b); in fact, they were placed in front of some major consortiums. From this point of view and facts, the authors consider their works on the mentioned topics as successful and useful, even essential; so the main RMSRDP topics will be introduced. HMM for *Projects* uses a natural language development and simulation environment that can be adopted by any *Project,* and for that goal the authors propose to use the RMS pattern that can be instantiated in multiple instances by an RMS, as shown in Figure 1 (Myers, Pane & Ko, 2004; Neumann, 2002).

The RMSRDP is (or can be) supported by a central DMS/HMM and any type of Enterprise Architecture Projects (EAP), as shown Figure 2.

Figure 1. The relation between the resource pattern and resource management system

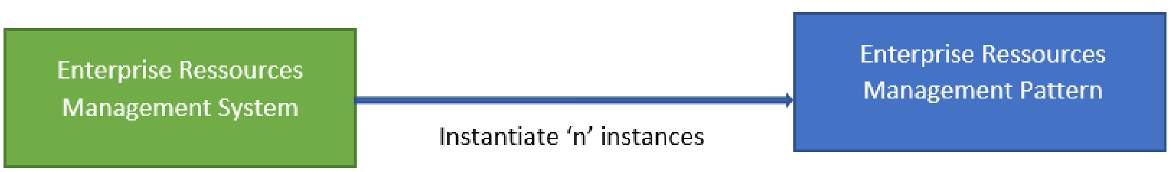
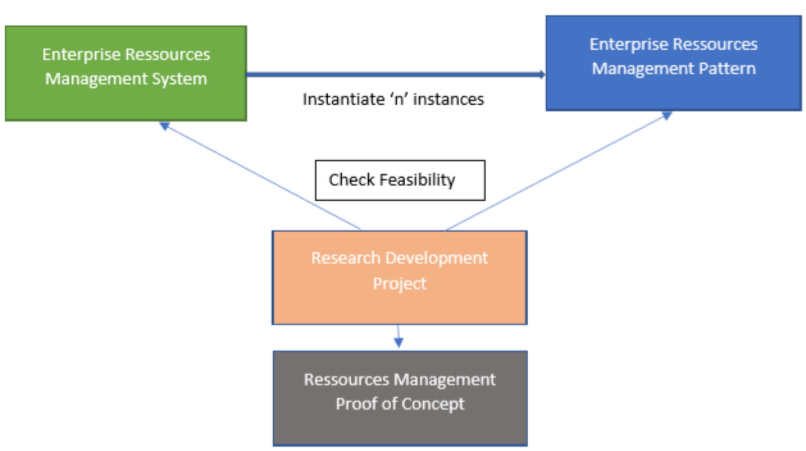


Figure 2. The relation between the research project and resource management system



The Proof of Concept (PoC) is based on a concrete business case; where the central point is the transformation process of the existing legacy RMS into a modern and intelligent RMS (iRMS). Such *Projects* are managed by the Business Transformation Managers or an Enterprise Architecture Manager (simply *Manager*); who are supported by a research methodology and a framework that can estimate the risks of implementation of such *Projects*. The RMS related research cluster is made up of four research chapters:

- The Resources Management System Implementation Concept, which is this cluster's introductory chapter (RMSIC).
- The Resources Management Research Development Project (RMRDP), which is the current chapter.
- The Holistic Project Resources Management Pattern (HPRMP), which is a separate chapter.
- The Resources Management System Proof of Concept (RMSPoC), which is a separate chapter.

For the readability and comprehension of this research project some important sections are (re) inserted and modified, otherwise this chapter would have been a sheet full of inter-related refences and the respected reader would have been obligated to look for them and the reading process would become intractable; we had many of such tough feedbacks in the past. Anyway, most important professional texts, like for example Microsoft books, are practically recopied, so these austere methods are seemingly not applied to such giants of massive copying. The *Manager* is responsible for the implementation of complex *Projects* using iRMS; the RMSRDP supports him or her (for simplicity, in further text – him) in a just-in-time manner, to check the feasibility, where he should have a solid background in DMS-based iRMS (Trad & Kalpić, 2016b).

BACKGROUND

An important factor in complex *Projects* are the roles of the *Manager*, EA and iRMS integrations, which should be supported by the optimal research and development framework that ought to support a Global Resource Management Strategy (GRMS) model. The GRMS model should be also capable of supporting the *Project's* executives, legal control and integration in complex block-chained globalized RMS environments. To achieve these goals, resources management, technology components, cultural, financial and logistics integration strategy factors should be classified in Critical Success Areas (CSA) categories that contain CSFs that can be used to evaluate possible pitfalls and risks, to audit, assert, govern, automate, trace, monitor and control the iRMS. The *Project* and its RMSRDP subproject, use a set of CSFs that can be configured to manage and measure complexities in a distributed environment in local and globalized international environments. A transformed iRMS must have support of built-in automated RMSRDP controls capable of evaluating major changes and requirements. RMSRDPs involve the complete digitalization of research processes, where automation enables new intelligent evaluation models for feasibility. The RMSRDP is considered as a pioneering and unique one and actually or even unfortunately, there is no similar research frameworks, what confirms its current lead. The authors are proposing a RMSRDP that can be used for *Projects* in estimating the feasibility of design and maintenance phases, which come after the finalization of the implementation phase. The RMSRDP phase's background is related to risk evaluation of *Projects* using CSF-based iRMS that are managed by the

Trad Kalpić Methodology and Framework (*TKM&F*), as shown in Figure 3 (Trad & Kalpić, 2018f). CSFs are selected from various iRMS areas like resource categories, valuation, processes, technology, human skills …. and other. Dm stands for Decision making...

In this chapter, the authors present a set of RMSRDP managerial, financial and technical recommendations that can be applied to various fields, like iRMS, Neurosciences, Knowledge Management (KM), HMM, EA, information technology management, business transformation and other engineering fields. Integrating a RMSRDP and GRMS should be a fundamental and even strategic goal for *Projects* and many other fields (Trad & Kalpić, 2018a; Trad & Kalpić, 2018b; Cearley, Walker & Burke, 2016).

The proposed RMSRDP usage and implementation is based on: 1) a holistic research approach, by interfacing various *Project* fields; 2) it uses AI, DMA and risk management engine(s); 3) manages resources; 4) applies factors and categories for research activities; and 4) it uses the *TKM&F's* capabilities and its pool of patterns. The DMS, iRMS and RMSRDP are based on the authors' Research and Development Project's (RDP) mixed methods that in turn are based on intelligent neural networks (Trad & Kalpić, 2018a) where the RMSRDP is agnostic to any specific application, technical or business domain, as shown in Figure 4, and is based on the Architecture Development Method (ADM) (The Open Group, 2011a), but it can use any existing architecture framework.

Any EA framework is central to implement RMSRDP and other *Project's* modules, where the *Manager* or an enterprise architect can use the RMSRDP for evaluating the feasibility of *Projects* and iRMS' integration (Trad & Kalpić, 2017b, 2017c; Thomas, 2015; Tidd, 2006). In *Projects*, the *Manager*'s role

Figure 3. The research framework's concept (Trad & Kalpić, 2016a)

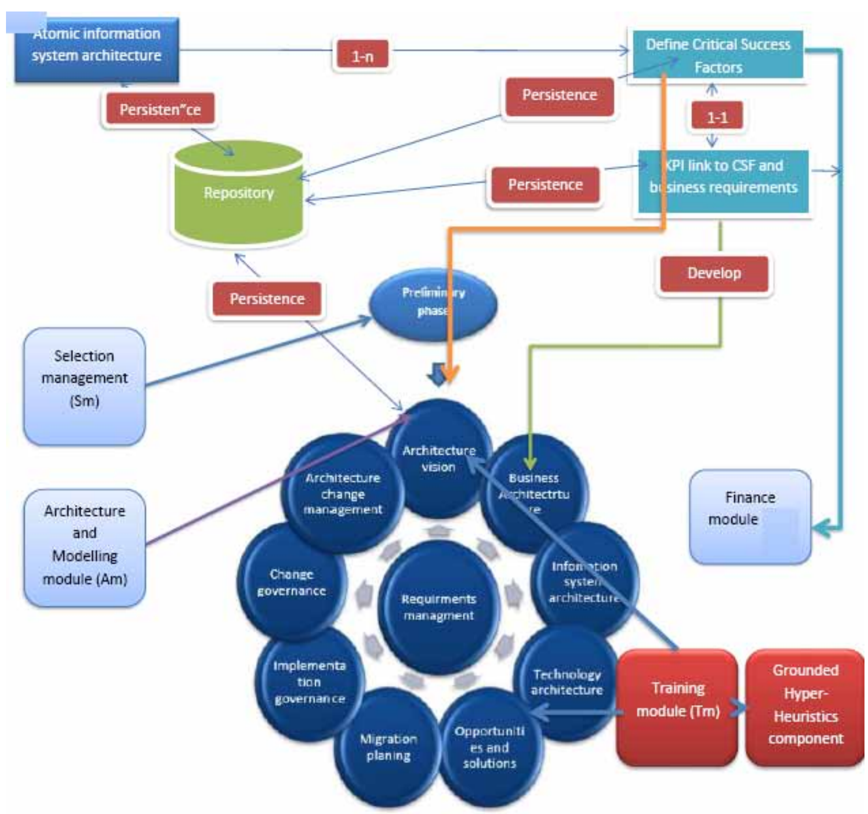


Figure 4. The research framework's architecture method's interface (The Open Group, 2011a)

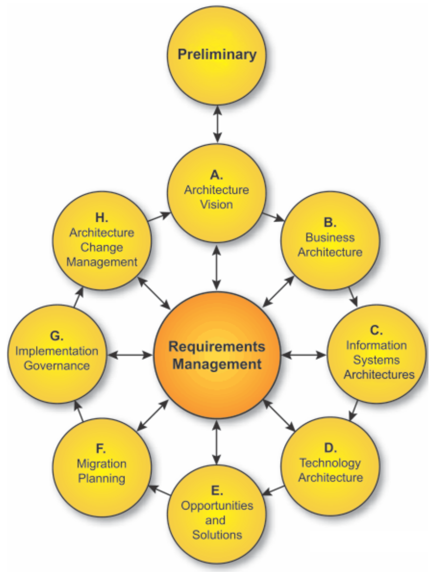
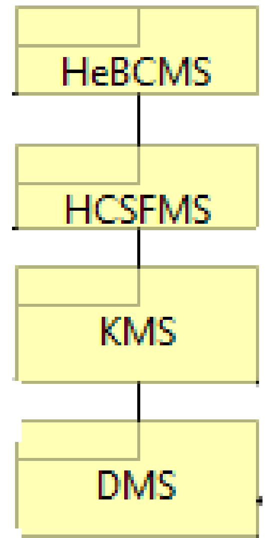


Figure 5. Intelligent management system that supports a distributed web enterprise system



is important, and his actions are supported by the RMSRDP to build a distributed web enterprise system, or a Holistic (e)Business/(e)Commerce Management System (HeBCMS) (Trad & Kalpić, 2019c; Lanubile, Ebert, Prikladnicki, Vizcaíno & Vizcaino, 2010).

A holistic systems approach is the optimal choice to model such a RMSRDP for an iRMS and its frontend the HeBCMS, as shown in Figure 5, where the DMS interacts with the external world via the *TKM&F* to manage CSFs (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a). As shown in Figure 6 the CSFs are important for the phase 1 that qualifies the needed CSF set and decides whether there is a need for a RMS PoC.

Projects and its main components, like the iRMS, are very difficult (where most have certain failure) to implement, because of their holistic and complex nature, where the big part of complexity is met in their technical implementation and integration phases. The RMSRDP (or RDP) helps in testing feasibility (Gudnason & Scherer, 2012). As shown in Figure 7, the *TKM&F* can be applied to all types of *Projects* including the iRMS' integration.

iRMS refers to any RMS that uses a Research Development Project (RDP) that in turn is based on an HMM-similar structure or approach and assists business transactions and uses microartefact-based technologies (please do refer to the cluster's chapter on HPRMP for more information) (Trad & Kalpić, 2019e). Zzzz The development and evolution of RMSRDP is fundamental for *Projects* and iRMSs. The technical implementation phase is the major cause of high failure rates in iRMSs and *Projects* in general; mainly because of the lack of a holistic aspect that is supported by the RMSRDP's feasibility, what is this work's focus (Thomas, 2015; Cearley, Walker & Burke, 2016; Trad & Kalpić, 2016b).

Figure 6. Interaction of what with which factors

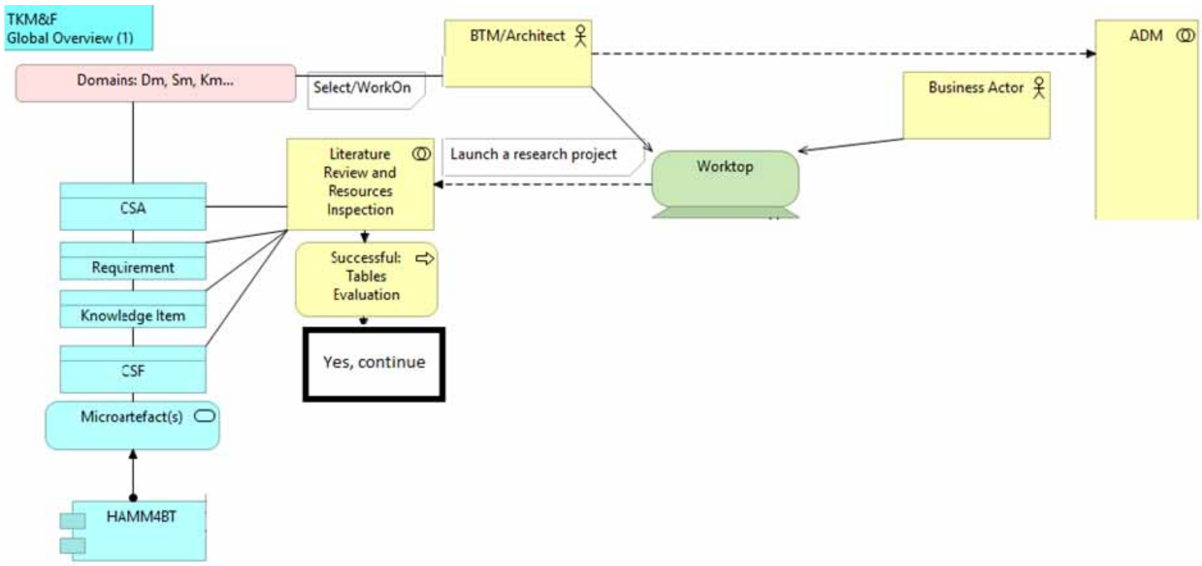
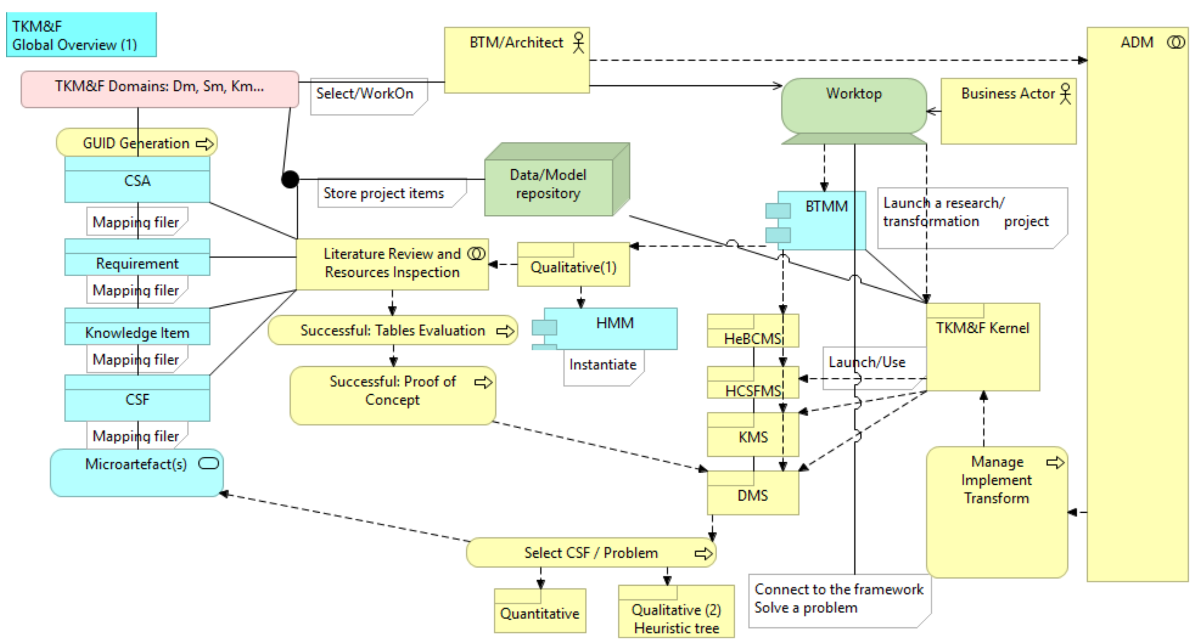


Figure 7. The Trad-Kalpić Methodology and Framework's flow and interaction



FOCUS OF THE ARTICLE

RMSRDP feasibility recommendations can be applied by *Managers* and stakeholders (Desmond, 2013) that use *TKM&F* to manage iRMSs. This version of the RDP is based on a mixed methodology and it is unique (Easterbrook, Singer, Storey & Damian, 2008); where this chapter tries to prove the RMSRDP and iRMS feasibility through an experiment and Research Question (RQ) for this research process.

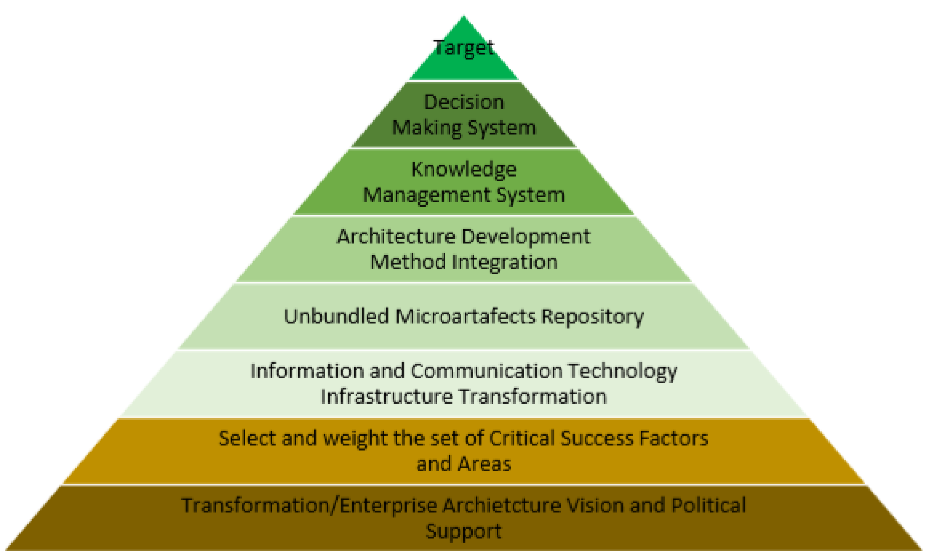
THE RESEARCH PROCESS

Projects failure rates are high and were constantly increasing (Bruce, 1994) that is due to the complexity encountered in the implementation phase; these failures can be avoided by applying an RMSRDP feasibility analysis (CapGemini, 2009); to enhance the success rate, the authors propose the *TKM&F* with internal RDP that are unique and can be considered as a pioneering approach. *TKM&F* and its RDP (where the RMSRDP is an instance of the standard RDP), recommends linking the HMM to all levels of the iRMS that is in the target level, as shown in Figure 8 (Trad & Kalpić, 2018b; Agievich, 2014; Tidd & Bessant, 2018); where the CSF-based RMSRDP, an RDP instance, would use the DMS and unbundling levels that are parts of the applied methodology and framework, the *TKM&F* that can be considered a meta-model.

Research Meta-Model and Templates

The proposed RMSRDP is based on a methodology and framework that were developed by the authors. This chapter follows the proposed methodology's precise meta-model; like many other research frameworks. Therefore, we conclude that each topic treated by the applied research framework is authentic and as mentioned, *unique*.

Figure 8. Levels of project's interaction (Trad & Kalpić, 2017b, 2017c)



The Applied Research Framework

The RMSRDP can be applied to various types of transformations like, the iRMSs (Trad 2018c; Trad 2018d) and is a part of the Selection management, Architecture-modelling, Control-monitoring, Decision-making, Training management, *Projects* management, Finance management, Geopolitical management, Knowledge management, Implementation management and Research management Framework (SmAmCmDmTmPmFmGmKmImRmF, for simplification reasons, in further text the already familiar term *TKM&F* will be used). This chapter's RQ is: "Can a holistic research project check the feasibility of resource management system's implementation?" (Trad, 2011a; Trad & Kalpić, 2011a).

The *TKM&F* is owned in its totality including copyright, by the authors; where this chapter is an IGI Global copyright and these two objects are distinct and different. This chapter's RQ was formulated after a literature review process that uses CSFs.

Critical Success Areas, Factors and KPIs

The RMSRDP uses the concept of Critical Success Area (CSA), which is a set of Critical Success Factors (CSF) and each CSF is a set of Key Performance Indicators (KPI), where each KPI corresponds to a single *Project* requirement and/or iRMS feature. For a given iRMS problem, an enterprise architect can identify the initial set of CSFs for the RMSRDP to check the feasibility. Hence the CSFs are important for the mapping between the resource constructs and organisational items (Peterson, 2011). Therefore, CSFs reflect performance areas that must meet strategic *Project* goals and defined constraints. Measurements are used to evaluate *Project* requirements or features in each of the CSA sets, where CSFs can be internal or external to the environment; like for example: 1) resource item or gap analysis is an internal CSF; and 2) decisions making in real time and in minimal time is also an internal one. Once the initial set of CSFs has been identified, then the *Project* can use the RMSRDP to propose estimated values as solutions. The proposed RMSRDP delivers a set of resource items' values, recommendations and solutions for an aligned iRMS that is part of the *TKM&F*, which applies the evaluations of CSA and its set of CSFs (Trad & Kalpić, 2018a, 2017b, 2017c).

The *Project* and iRMS team has to identify the initial set of CSFs to be used for the evaluation/measurement system. Hence CSFs are the most important mapping/relation between resources management, strategic planning, enterprise architecture vision and decision-making system's evaluation/measurement systems; and an example of possible operational CSAs, CSFs and KPIs, iRMS can be used for:

- Applied Case Study's (ACS) Critical Success Areas (ACS' CSA):
- Here is an example for enumeration of CSFs: 1) Modelling; 2) KPIs; 3) References; 4) ArchitectureDevMethod; 5) Technologies; 6) Governance; 7) Transformation_TKM&F; and 8) Leading_Governance.
- KPIs can also be illustrated as an enumeration: I) VeryComplex; II) PossibleClassification; III) Exists; IV) IntegrationPossible; V) AdvancedStage; VI) Advanced; and VII) Possible.
- Holistic Mathematical Model's Critical Success Areas (HMM's CSA):
- It is a set of CSFs that in turn is an enumeration: 1) Problem solving; 2) Business efficiency; and 3) Success.
- KPIs as an enumeration: I) Costs; II) Time management and scheduling; and III) Resources management, etc.

- Information and Communication Technology's Critical Success Areas (ICT's CSA):
- CSFs as an enumeration: 1) Efficiency; 2) Costs; 3) Production; and 4) Availability.
- KPIs as an enumeration: I) Performance; II) executed transactions; and III) scalability etc.
- Architecture CSA:
- CSFs as an enumeration: 1) Vision; 2) Deliverables; 3) Governance; and 4) Gap analysis;
- KPIs as an enumeration: I) Finished requirements; and II) Budget management; etc.
- Knowledge Management System's CSA (KMS' CSA):
- CSFs as an enumeration: 1) Audits; 2) Budget; 3) Feasibility; and 4) Sanity.
- KPIs as an enumeration: I) Performance; II) financial transactions; and III) currency unit etc.
- Decision Making System's CSA (DMS's CSA):
- CSFs as an enumeration: 1) Audits; 2) Budget; 3) Feasibility; and 4) Sanity.
- KPIs as an enumeration: I) Performance; II) financial transactions; and III) currency unit etc.
- Intelligent Resources Management System's CSA (iRMS' CSA): CSFs, which is as an enumeration: 1) Information Technology; 2) Financial; 3) Static; and 4) Deposits.
- KPIs as an enumeration: I) Value; II) Amortization; and III) Maintenance etc.

The exact list of CSAs, CSFs and KPIs will be introduced in this research cluster's RMSPoC chapter.

Evaluation of Critical Success Factors in the Context of Critical Success Areas

The RMSRDP promotes the transformation process through the use of CSAs that contains sets of CSFs, where a CSF is a set of KPIs, where each KPI corresponds to a single *Project's* (iRMS in this chapter) requirement and/or any *Project* item/resource that can be a technical or business requirement or a skill characteristics that has a column in each evaluation table (Putri & Yusof, 2009; Peterson, 2011; Trad & Kalpić, 2018f). For each CSA an Excel Workbook (WB) is created, in which all its CSFs are stored. As shown in Figure 9, the WB has scripts in the background that are automated to calculate the weightings and ratings. This RMSRDP concept, proposes a standardized and automated manner to evaluate literature reviews that is an evolution in regard to the very subjective method, which may or may not make sense. If the automated literature review's evaluation is successful, only then the experiment is completed. What is unique to the *TKM&F* and RMSRDP, is that it can automate complex RDPs.

As shown in Figure 10, one *Project* CSA, corresponds to one WB, which contains all the information needed for the targeted category, including the RQ and its hypothesis. In the WB and as shown in Figure 10, the sheets HPAMP_1, HPAMP_2… are seen and they represent the CSA's set of CSFs that map to an enumeration set which contains meaningful names representing values from 0, 1, etc... These enumeration values are mapped to humanly understandable symbolic names.

As shown in Figure 11, an RMSRDP starts with the first phase called the factors' feasibility phase, or Phase 1 (in light yellow colour), to check the basic CSFs. This phase checks if the *Project* makes (or could make) sense.

These checks are based on the WB evaluation processes, as shown in Figure 12, in which the script opens a file triggering the evaluation processes. Based on the RMSRDP literature review and related evaluation processes known as the Qualitative(1), the most important extracted CSFs are used and evaluated using the following rules (Trad & Kalpić, 2018f):

- Stored WB references should be credible and are estimated by the authors and there follows a classification, supported by the CSF management system.
- *Projects* like mergers are the result of organisational changes in companies, to act as a single enterprise with consolidated WB CSFs, resources and business interests.
- Applied modelling language should be limited in order to make the *Projects* manageable and not too complex.
- The Architecture Development Method (ADM) is considered to be mature if it has been in use for more than ten years and if it has been reported as successful to enforce the interest in using the ADM.
- The ADM is appropriate for any project's local conditions and manages the *TKM&F's* iterations and CSFs with WB tuning scripts.
- If the aggregations of all the *Project's* CSA/CSF WB tables/sheets are positive and exceed the defined minimum, the *Projects* continues to its RMSPoC or can be used for problem solving.
- This evaluation concept will be applied to seven different CSAs that are presented in tables.
- Each CSF is reviewed as an independent element.

The evaluation process of the sets of CSAs, CSFs and KPIs will be introduced in this research cluster's RMSPoC chapter. The evaluation process follows a review of various sources in order set by the conditions and constraints needed for such a process.

Figure 9. The factors and areas development workbook sheets

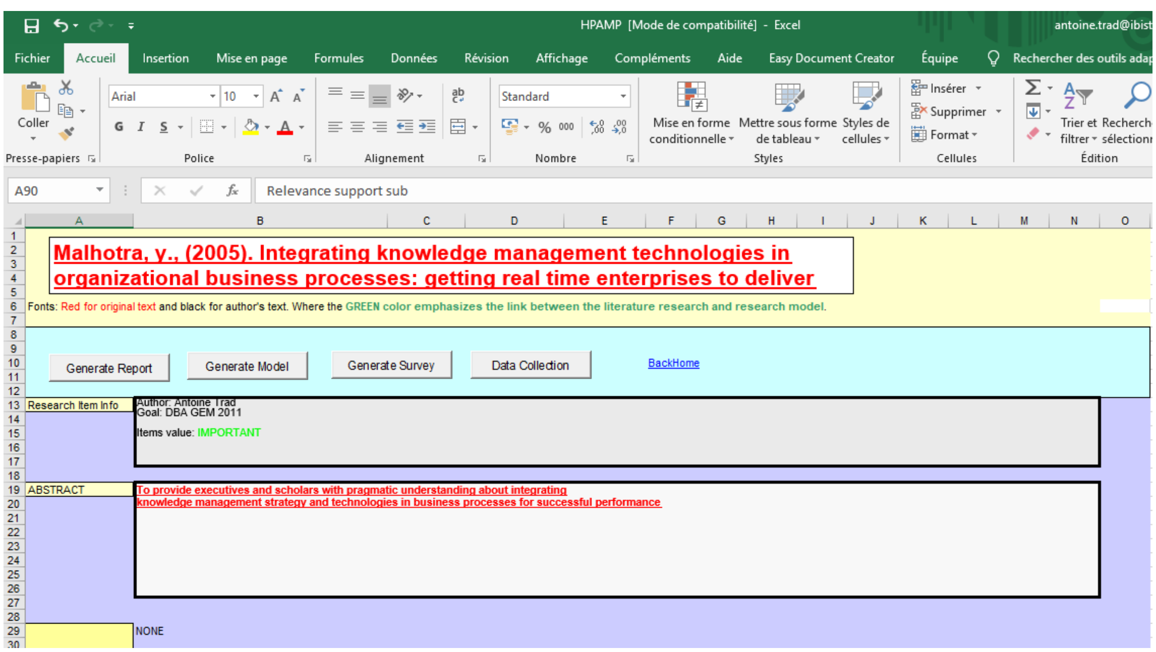


Figure 10. The critical success factors in the workbook sheets., like HPAMP_2_V1

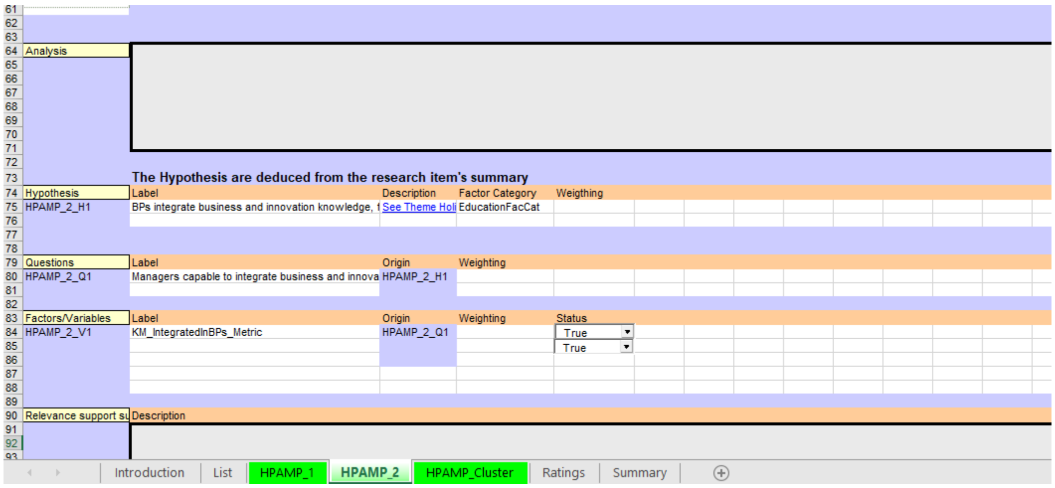


Figure 11. The factors interaction in the TKM&F

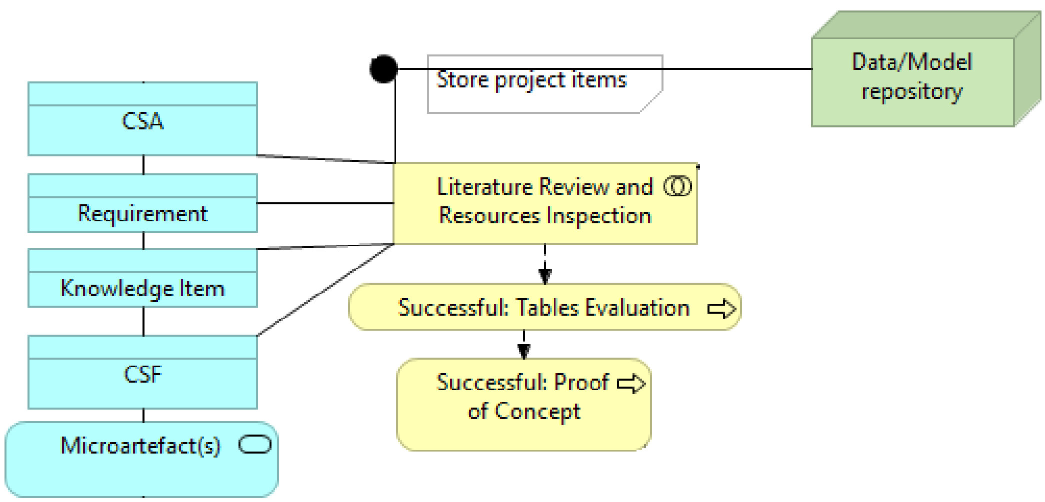
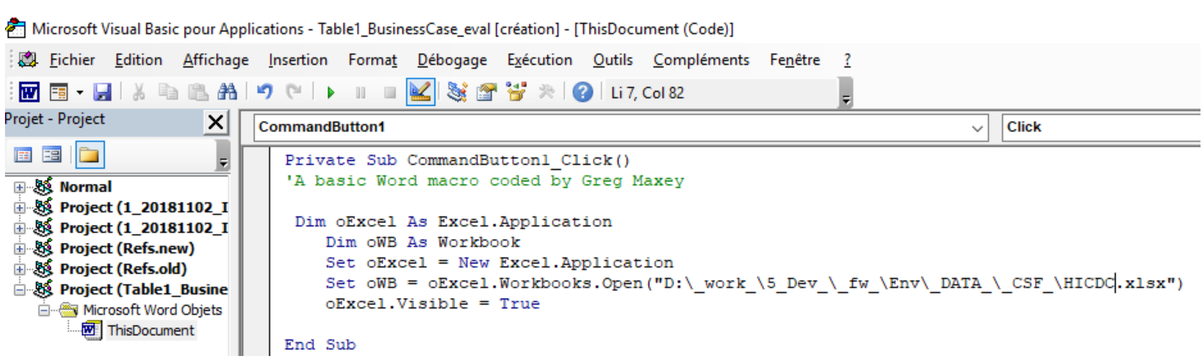


Figure 12. The factors interaction in the TKM&F.



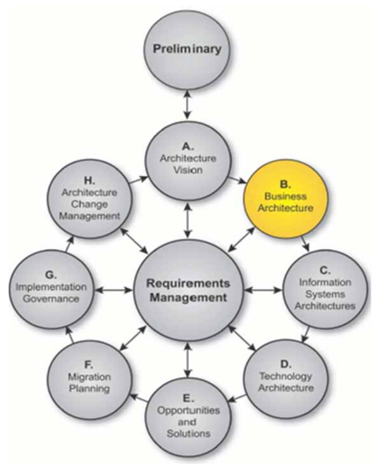
Review's Critical Success Factors as an Independent Element

As already mentioned, the RMSRDP (or *Project's* feasibility check) starts with the first phase called the feasibility phase that is in turn based on the RMSRDP's literature (and/or other resources) review and related evaluation activities, the most important/relevant ones, are extracted CSFs, to be used and evaluated using the following automated heuristic rules:

- Rule_1: references should be credible and are estimated by the authors; the notions of official ranking are less important and ignored, due to ego-concentration of marketing lobbying of closed circles of influence; we often have the same institutions and individuals delivering credible referencing. By references, it is meant the origins found in various types of literature and other CSF-related resources, while the credibility of these references is estimated by KPIs that are related to requirements (or another *Project*): 1) the authors', or other academics'/consultants' academic and professional experience adds to 20% of the whole estimation value; 2) credible statistical checkers, like Centre National de Recherche Scientifique (CNRS) Gartner, Forester and others, make 20% of the whole estimation value; 3) various company's and specialists surveying is 20% of the whole estimation value; 4) CSF related articles/code/application sources' prototyping is 20% of the whole estimation value; and 5) simulation in the RMSPoC and frequency makes the final 20% of the whole estimation value.
- Rule_2: *Projects* like mergers are the result of organisational changes in companies to act as a single enterprise with consolidated resources management and business interests; and their success is measured by the CSFs evaluation process, hence the references to literature or to other resources that was presented in the previous point.
- Rule_3: applied modelling language processing (or scripts), should be limited in order to make the *Project* manageable and not too complex. Whether the CSF is usable and credible, that can be estimated from the literature review process or from one's own working experience or reliable references like Gartner.
- Rule_4: the ADM, as shown in Figure 13, is considered to be mature if it has been in use for more than ten years and it has been reported as successful. The interest in using TOGAF is very high and its ADM kernel is about 90% in most avantgarde *Projects* (Kotusev, 2018). Unfortunately, that does not mean that most *Projects* are successful and in fact their success rate is very low, serious publications present less than 10% success rate.
- Rule_5: the ADM is appropriate for any project's local conditions and manages the *TKM&F's* iterations.
- Rule_6: if the aggregations of all the *Project's* CSA/CSF tables are positive and exceed the defined minimum, the *Project* continues to its RMSPoC or can be used for problem solving.

The main reason that methodologies are not used in a holistic manner to achieve organizational alignment, is that in most business environments, there is no centralized DMS and KMS (Syynimaa, 2015). This work is based on literature review activities and is a major gap in the presented fields (or keywords).

Figure 13. The architecture method



The Research's Literature Review and the Gap

The knowledge gap was confirmed, mainly because of the status of existing literature on the presented keywords and *Projects'* failure rates; and on various methodologies treating *Projects*. The research acknowledges that there is practically, no insight into a holistic approach to RMSRDP and on designing iRMS (Trad & Kalpić, 2013b; Trad & Kalpić, 2013c). This RMSRDP inspects a holistic approach for this cluster's RQ, which is mainly based on the *TKM&F*, what makes it a unique research process.

The Research's Uniqueness

The uniqueness of this research is in promoting a holistic unbundling process, the alignment of standards and strategies to support complex systems like the intelligent Resource Management System (iRMS) (Farhoomand, 2004). The uniqueness of this research project is based on its holistic approach that combines: 1) *Project's* iRMS and RMSRDP; 2) AI based HMM structure; 3) software development, auditing, modelling and architecture; 4) business research and engineering; 5) financial analysis; 6) *Manager*'s role and profile; 6) holistic EA; 7) it offers a unique, more precisely, a leading methodology and framework, the *TKM&F*; and 8) a set of related credible works.

Related Research Works

This research chapter, like all the other research works that are related to this research cluster, that follow and all have the same common construct:

- An introductory part that explains the overall subject.
- A cluster of associated parts or chapters.
- The RDP part that explains the research concept.
- The Applied Case Study (ACS) and PoC (Trad & Kalpić, 2018c) parts that specify the specific business topic to be researched.

- The Information and Communication Technology (ICT), ADM, KMS, DMS and CSF parts that present these sections in the work's specific RQ context.
- Each table contains selected and weighted CSFs/KPIs.

They consist as well of a specialized part that looks as follows:

- Resource Management System (RMS) in automated business environments (Trad, & Kalpić, 2018g).
- The alignment of RMS and EA methodologies (Trad, & Kalpić, 2018h).
- The PoC, for EA and iRMS (Trad, & Kalpić, 2018i).
- The basics, of EA and iRMS (Trad, & Kalpić, 2018j).
- The RMS' HMM basics (Trad, & Kalpić, 2018k).
- The RMS' HMM PoC (or RMSPoC) (Trad, & Kalpić, 2018l).
- A specialized part, like in this case the RMSRDP's section, which presents the literature review and synthesis of the main topic.
- The PoC, conclusion and recommendations that summarize and conclude the research work that can be considered as an empirical engineering research model.

Empirical Engineering Research Model

This research book's chapter is based on an empirical engineering research approach (Johnson & Onwuegbuzie, 2004; Easterbrook, Singer, Storey & Damian, 2008). It uses an authentic mixed method (where mixed research is a simplistic synonym) that can be considered as a natural complement to conventional qualitative and quantitative research methodologies, to deliver empirical pragmatism concepts as a possible holistic approach for mixed methods research. Empirical validity checks whether the research work is acceptable as a contribution to existing scientific knowledge, this book's chapter's researchers want to convince the valuable readers that this book's chapter's recommendations and the related RMSPoC are valid. A controlled experiment or a RMSPoC is a design/software prototype of a testable hypothesis where one or more CSFs (or independent variables) are processed to evaluate their influence on the model's dependent variables. Controlled experiments or proof of concepts permit to evaluate with precision the CSFs and if they are related, whether the cause–effect relationship exists between these CSFs.

An iRMS integration causes a major paradigm-shift and is complex to implement; therefore, *Managers* and architects should understand transformation paradigm's shift that can have disruptive impacts on *Projects* that need an agnostic RMSRDP. In the proposed RMSRDP for iRMS, feasibility integration concept supports classical resources' implementation constructs as well as complex ones in order to support business sustainability (Trad & Kalpić, 2017a, 2017b). The RMSRDP is business-driven and is founded on a research framework that is presented using a business case (The Open Group, 2011a).

THE BUSINESS CASE

The RMSRDP, uses an Applied Case Study (ACS), developed by the Open Group as a reference study, it presents the possibilities to implement *Project's* components (like the iRMS) and is related to an insurance company named ArchiSurance (Trad & Kalpić, 2018f); in this chapter it is used to support the RMSRDP in its use in the RMSPoC.

The Research Section's Link to the Applied Mathematical Model

Following the *TKM&F* sequence, the ACS section is followed by the applied HMM as crucial for the RDP's credibility.

THE APPLIED HOLISTIC MATHEMATICAL MODEL'S USAGE

The Applied Mathematical Model's Structure

The HMM for RMSRDP has a composite structure that can be viewed as follows:

- The static view has a similar static structure like the relational model's structure and the unified modelling language, which include sets of CSAs/CSFs that map to tables/classes (simply entities) and the integrated ability to auto-create them and to apply actions on these entities; in the case of HMM for an iRMS, entities are microartefacts and not tables (Lockwood, 2018).
- The behavioural view comprises actions designed using a set of mathematical nomenclature; the implementation of the HMM is in the internal scripting language; used also to tune CSFs (Lazar, Motogna, & Parv, 2010).
- As the skeleton, the *TKM&F* uses microartefacts' scenarios to support just-in-time RMSRDP requests that integrate qualitative and quantitative modules.

Qualitative Research Model

The *TKM&F's* qualitative research module enables a holistic systematic approach to research a problem, RQ, factor or phenomenon in given *Project* environment situation (Gast, 2010). The RMSRDP is capable to recommend actions and deliver solutions; or knowledge items (Lincoln & Guba, 1985). A problem, RQ, requirement, factor or phenomenon are examined in iterations relating breadth and depth, using heuristics/beam search, which is specialized for unknown problems or the ones that are in a preliminary phase or in their first iterations (Babbie, 1989). The solutions or recommendations on feasibility, are offered in the form of reports of professional or academic experiences (Capaldi & Procter, 2005). The qualitative research module processed solutions or recommendations are generated by experiments/ RMSPoCs, specialists' interviews, direct professional observations, processing and analysis of *Project* artefacts, credible documents from for example Gartner or Forester and reference records, visual materials or personal mixed experiences (Denzin & Lincoln, 1994). The solutions or recommendations are delivered with the aim of formulating hypotheses outcomes that can call quantitative methods.

Quantitative Research Model

The *TKM&F's* RMSRDP quantitative research module enables a specific quantitative analysis and a precise focus on proving or disproving RQ, problem or hypotheses in a cause-effect manner by applying a detailed and precise processing of pre-defined variables; CSFs in the RMSRDP (Shuttleworth, 2008). The *TKM&F's* RMSRDP quantitative research module input data streams(s) consists of sets of numbers that are collected from sets generated by using designed/structured and approved/validated data object-collection modules and statistically processes. The quantitative research module results are used as generalized for a given qualitative node and can be applied to other qualitative tree node that gives the ability to analyse the cause and effect; as well as offering solutions or recommendations, even make proactive estimations (Leung, 2015). The *TKM&F's* RMSRDP qualitative research module input data streams(s) can be fed from experiments/RMSPoCs, surveys, interviews with precise questions (Kelley & Clark, 2003). That makes a mixed model.

A Quantitative-Qualitative Research Mixed Model

The RMSRDP mixes the two mentioned methods to solve: 1) any type of problem, which means that it is generic; 2) any RQ or hypothesis in any field; 3) give explanation to a specific event; etc… By mapping a problem linked to a CSF or phenomenon that is attempted to be solved in iterations and tuning, relating breadth and depth, using heuristics/beam search with the possibility of calling quantitative methods; it can be also applied to unknown problems or the ones that appear in a preliminary phase or the first iterations. Then, the RMSRDP qualitative research module input data stream(s) consist(s) of sets of numbers that are collected from sets generated by using designed/structured and approved/validated data object-collection modules and statistically processed using HMM's basic elements.

The Basic Element and Structure

The RMSRDP CSFs define the initial algorithm nodes (at the *Project's* initial phase) that are identified as vital for successful targets (solutions) to be reached and maintained. The CSFs and tree nodes are the HMM's basic elements that are needed for the *Project's* iRMS to estimate and optimize its resource management processes and avoid failure; using the exposed two phases (Morrison, 2016).

The *Project* and its underlying RMSRDP have a major precondition and that is, that the traditional business environment has to undergo a total and successful unbundling process of the whole environment's technology system to deliver a repository of classified services and scenarios, as described with a mathematical nomenclature, as shown in Figure 14.

The RMSRDP offers an HMM, which in its instance uses an intern Mathematical Language to describe, transform and implement the behaviour of any business (or non- business) system and its iRMS (Goikoetxea, 2004). The HMM is presented to the reader in a simplified form in Figure 15, to be easily understood on the cost of a holistic exact formulation of the architecture's vision.

As shown in Figure 15, the sum symbol $\sum$ indicates summation of all the relevant elements called set members. The proposed model should be understood in a broader sense, more like related sets and unions. The proposed HMM enables the possibility to define *Project* as a model; using CSFs weightings and ratings.

The HMM nomenclature is presented to the reader in Figure 14 in a simplified form, to be easily understood, on the cost of a holistic formulation of the model. As shown in Figure 15:

Figure 14. The applied mathematical model's nomenclature (Trad, & Kalpić, 2017a)

Model's nomenclature

mcEnterprise	A micro enterprise component
mcRequirement	A micro requirement
mcArtefact	A microartefact
action (or action)	An atomic service (or neuron) execution scheme
mcIntelligenceArtefact	A set that contains: dynamic basic intelligence + governance + persistence+ traceability + data_xsd + resources
mcArtefactDecisionMaking	A microartefact_decision making entity
mcArtefactScenario	A microartefact scenario

Figure 15. The holistic mathematical model (Trad, & Kalpić, 2017a)

HMM

rncRequirement	= KP I	(1)
CSF	= Σ KPI	(2)
CSA	= Σ CSF	(3)
Requirement	= U̲ rncRequirement	(4)
(e)neuron	= action+ rncInteligenceArtefact	(5)
mcArtefact	= U̲ (e)neurons	(6)
rncEnterprise	= U̲ mcArtefact	(7)
(e)Ellterprise	= U̲ rncEnterprise	(8)
mcArtefactScenario	= U̲ mcArtefactDecisionMaking	(9)
IntelligenceComponent	= U̲ mcArtefactScenario	(10)
OrganisationalIntelligence	= U̲ InteligenceComponent	(11)
HMM	= ADM+ OrganisationalIntelligence	(12)

- The abbreviation (and prefix) "mc" stands for micro.
- The symbol $\sum$ indicates summation of weightings/ratings, denoting the relative importance of the set members selected as relevant.
- The symbol U̲ indicates sets union.

- The proposed HMM enables the possibility to define *Project* as a model; using CSFs weightings and ratings.
- The selected corresponding weightings to CSF ϵ { 1 … 10 }; are integer values in ascending importance.
- The selected corresponding ratings to CSF ϵ { 0.00% … 100.00% } are floating point percentage values.
- For a selected CSF there is a predefined enumeration of KPIs or ratings. For example: KPI ϵ { ImpossibleToIntegrate, VeryComplex, Complex, PossibleIntegration, Feasible } are the possible discrete constant values.

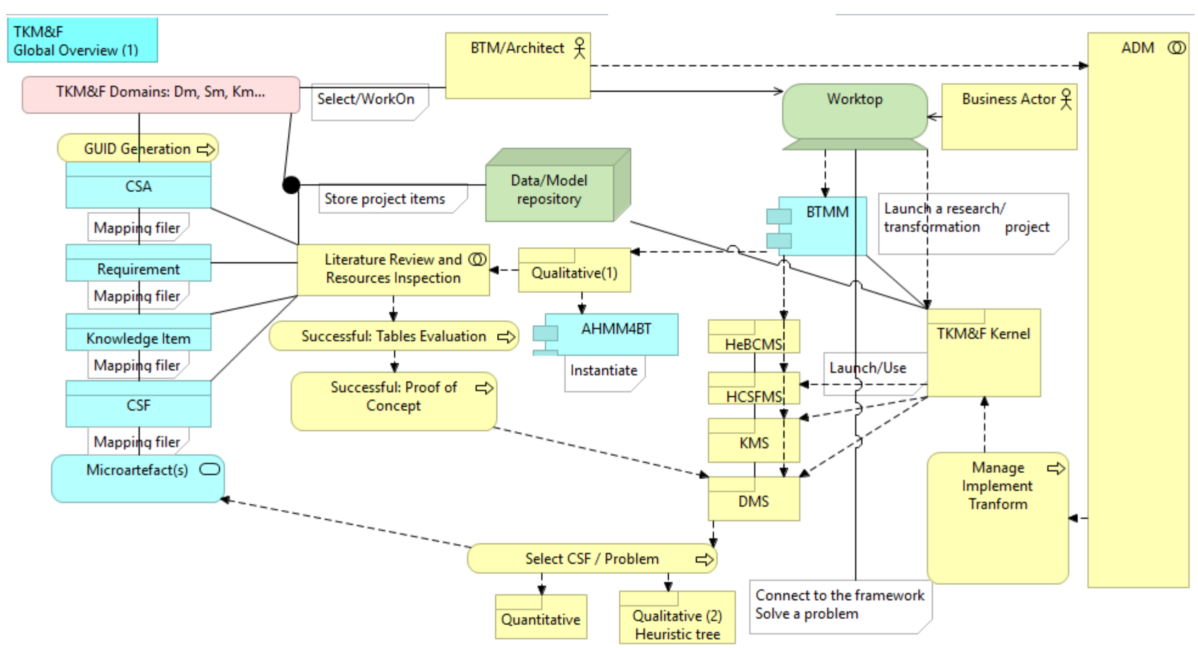
A weighting is defined for a RMSRDP CSF and a rating for a KPI; where the KPI for a given CSF is a value taken out of a predefined enumeration. The first evaluation is generally very rough and through frequent ADM iterations it is tuned (the results are numeric values), because a *Project* may take more than 20 years to be completed.

Concerning the constructs (or formulas) containing the symbol U, they are generated when the valuation button is pushed, like for example, for the CSF, CSF_ResourceCase_Modelling:

- REQ_ResourceCase_Modelling is linked and created for the associated requirement.
- mcArtefact_ResourceCase_Modelling is linked and created for the associated microartefact.
- …

$$\text{HMM} = \text{Weigthing}_1 * \text{Qualitative}(1) + \text{Weigthing}_2 * \text{Quantitative}(2)\ . \quad (1)$$

Figure 16. The framework's components and its mathematical model



As shown in Figure 16, Qualitative(1) is the heuristics tree algorithm where Weigthing_1 and Weigthing_2 are tuned by the *Project* team. The presented nomenclature defines the HMM of the static part of the HMM. Where Quantitative(2), is any appropriate quantitative method that is delivered by the user.

Phase two that follows the literature review qualification (or phase 1), Qualitative(2) is the heuristics tree algorithm, where Weigthing_1 and Weigthing_2 are tuned by the *Project* team and the presented nomenclature defines the static part of the transformation's HMM.

The Applied Business Transformation Mathematical Model

The HMM, which is a set of Mathematical Models (MM), can be modelled after the following formula for Business Transformation Mathematical Model (*Manager*) that abstracts the *Project*:

$$\text{HMM} = \sum \text{MM for an enterprise architecture's instance.} \tag{2}$$

(*Manager*):

$$\textit{Manager} = \sum \text{HMM instances.} \tag{3}$$

Where an instance is created for each iteration; the objective function of the *Manager*'s formula can be optimized by using constraints and with extra variables that need to be tuned using the HMM. The variable for maximization or minimization can be, for example, the *Project's* success, costs or another CSF. For the RMSRDP's PoC, the success will be the main and only constraint and success is quantified as a binary 0 or 1, where the objective function definition will be:

$$\text{Minimize risk } \textit{Manager}. \tag{4}$$

By minimize, the authors refer to the optimization of phase 1; and if it is successful, then phase 2 is launched to inspect and solve surging problems.

The *Manager* is the combination of a *Project* methodologies and a holistic mathematical model that integrates the enterprise organisational concept, information and communication technologies (Lazar, Motogna & Parv, 2010).

As shown in Figure 14, the HMM is a part and is the skeleton of the *TKM&F* that uses microartefacts' scenarios to support RMSRDP requests (Kim & Lennon, 2017).

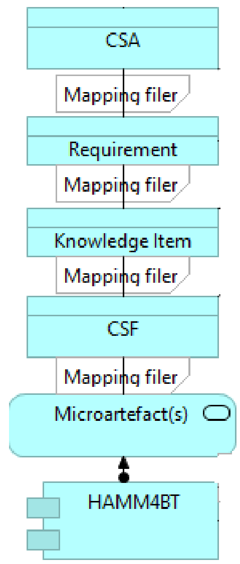
The RMSRDP components interface the DMS and KMS, as shown in Figure 17, to evaluate, manage and map CSFs for selection activities; if the aggregations of all the *Project's* CSA/CSF tables exceed the defined minimum, the *Projects* continues to its second part, the RMSRDP PoC.

The Applied Transformation Mathematical Model

The HMM is a part and the skeleton of the *TKM&F* and its RMSRDP, which use microartefacts to support just-in-time requests. The RMSRDP components and interfaces, are based on a light version of the ADM.

The HMM can be modelled after the following formula for the Transformation Mathematical Model (HMM):

Figure 17. The framework's components mapping



$$\text{iHMM} = \text{Weigthing}_1 * \text{HMM\_Qualitative} + \text{Weigthing}_2 * \text{HMM\_Quantitative}. \quad (1)$$

$$\text{HMM} = \sum \text{iHMM for an enterprise architecture's instance.} \quad (2)$$

(TMM) that abstracts the *Project*:
(TMM):

$$\text{TMM} = \sum \text{HMM instances.} \quad (3)$$

The objective function of the TMM's formula can be optimized by using constraints and with extra variables that need to be tuned using the HMM. The goal function, for maximization or minimization can be, for example, the goal that the *Project* meets success, costs limits or some other objective (Dantzig, 1949; Sankaralingam, Ferris, Nowatzki, Estan, Wood & Vaish, 2013). For this cluster's RMSPoC, the success will be the main and only objective and success is quantified as a binary 0 (failure) or 1 (success), where the objective/goal function definition will be:

To minimize the risk by applying the TMM (4).

The risk is defined in the HMM's goal function; and the TMM is the combination of a *Project* methodologies and the application of the HMM instance that integrates and communicates with the enterprise organisational concept, information and communication technologies, by the means of ADM (Lazar, Motogna & Parv, 2010).

Framework's Applied Mathematical Model Integration

A generic *Project* model and its kernel ADM are the base of this RMSRDP and they are the basics of its *TKM&F*. The authors propose an HMM to represent the *TKM&F* global architecture and structure to solve *Project* problems. The literature review process, or the *TKM&F's* phase 1, has shown that relevant research literature references/resources on topics, like *Projects* in general, and RDPs in particular, that are based on a mathematical model, are practically inexistent, or very limited. This pioneering RDP is cross-functional and links all the *Project*'s fields and their pools of microartefacts to standard packages and enterprise architecture method. The *Project's* initialization phase generates the needed CSAs/CSFs and hence creates the RMSRDP patterns to be analysed. The HMM is a part and is the skeleton of the *TKM&F* that uses microartefacts' scenarios to support RMSRDP instance requests (Agievich, 2014).

The Critical Success Factors of Mathematical Model's Integration and the Link to the Next Section

In the PoC (or in this cluster RMSPoC), the review process will present the most important CSFs. Following the *TKM&F* sequence, the ACS section followed by the holistic management of the Information and Communication System (ICS) is important for the RMSRDP's credibility.

THE INFORMATION AND COMMUNICATION TECHNOLOGIES' INTEGRATION

The iRMS as all today's systems are based on distributed communication, using standards from the Institute of Electrical and Electronic Engineers (IEEE) for an architectural framework, based on Internet of Things (IoT) that enables basic Internet services. The standard is in its early stages and offers a reference model defining relationships among various IoT domains, like RMS, transportation, healthcare and many others… (BSI, 2015).

The Mathematical Model's Integration Critical Success Factors and the Link to the Next Section

In the PoC (or in this cluster RMSPoC), the review process will present the most important CSFs. Following the *TKM&F* sequence, the ACS section, is followed by the ADM is important for the RMSRDP's credibility.

THE INTEGRATION WITH THE ARCHITECTURE DEVELOPMENT METHOD

The RMSRDP' integration with TOGAF and ADM, enables the management and automation of research activities. The intent RMSRDP's reference architecture is to support research activities with an implementation and vendor agnostic concept with enhanced interoperable and standards blueprint and defines the main building blocks:

- The unit of work for the ADM.
- An iRMS architecture blueprint.

The Architecture Development Method (ADM) Critical Success Factors and the Link to the next Section

In the PoC (or in this cluster RMSPoC), the review process will present the most important CSFs. Following the *TKM&F* sequence, the ACS section, is followed by the holistic management of the KMS is important for the RMSRDP's credibility.

THE HOLISTIC RESOURCES KNOWLEDGE MANAGEMENT SYSTEM

For an resource KMS (rKMS), the goal is basis to manage resources' information items using a holistic management concept that offers also the possibility to access distributed heterogeneous knowledge; where the knowledge items are associated with the CSFs (Rockart, 1979). In an iRMS many traditional knowledge management accesses exist and are a barrier for an rKMS and *Projects* in general (Malhotra, 2005).

The Knowledge Management System (KMS) Critical Success Factors and the Link to the Next Section

In the PoC (or in this cluster RMSPoC), the review process will present the most important CSFs. Following the *TKM&F* sequence, the ACS section, is followed by the holistic management of the DMS is important for the RMSRDP's credibility.

THE INTEGRATION WITH THE DECISION MAKING SYSTEM

This RMSRDP is about cross-functional complex *Project*s' related research that refers to the transformation of classical domains like decision making, resource management, mathematical systems, systems analysis and global systems engineering; which are supported by the HMM formalism. Complex decision systems' holistic management is an approach for an iRMS using a central decision process (Daellenbach & McNickle, 2005).

The aim of such systems is: 1) to help administration of complex iRMS; 2) improving communication, technology, performance and infrastructure; and 3) improving security. These actions would improve economic situation. This implies that the analysis and management of risk is one of the important prerequisites to ensure the success of an iRMS implementation. The *TKM&F* integrates iRMS risk management and performs the analysis using a DMS (Hussain, Dillon, Chang, & Hussain, 2010).

The Decision Making System (DMS) Critical Success Factors and the Link to the next Section

In the PoC (or in this cluster RMSPoC), the review process will present the most important CSFs. Following the *TKM&F's* processing sequence, the DMS section, is followed by the holistic management of the iRMS as important for the RMSRDP's credibility.

INTEGRATION OF THE HOLISTIC RESOURCES MANAGEMENT SYSTEM

The *Project* and the RMSRDP produce a set of microartefacts based on CSFs that map to the organization's structure and its information technology system. This work's background combines research methodologies, resource management, enterprise architecture, mathematical models, heuristics, business transformation and business engineering fields. iRMS building using an HMM is the most strategic goal for business companies. Fast transformations and efficient business environments have to be supported by a RMSRDP. A loose iRMS can help in having a holistic and broad guide to non-predictive resource operations that depend on various factors like finance, business, resources management, etc. A *Project* should be adapted to handle complex iRMS requirements that can generate complex problems, randomness, unpredictability... iRMS problems can be measured and weighted; while financial risk is not easily measurable. This explains the difficulty of estimating the financial risks of a consequential and rare iRMS problem that could be fatal to the *Project*. The *TKM&F* must evaluate the iRMS risks using the decision module and logged events. This chapter proposes an efficient approach to prediction, proactive risk management; that are the basic structures of an RMSRDP (Taleb, 2012).

Weightings concept enables the HMM to find and select the optimal solution for a given iRMS problem. In many cases, fast changing transformation requests may generate an important set of solutions that can be ambiguous and make the iRMS actions uncertain and too complex to implement. An iRMS can give a company the most important competitive business advantages that may insure its future and it is not a secret that iRMS microartefacts are the basis for such a system.

The Resources Management System's Critical Success Factors And The Link To The Next Section

In the PoC (or in this cluster RMSPoC), the review process will present the most important CSFs. Following the *TKM&F* sequence, the ACS section is followed by the holistic management of the RMSPoC as important for the RMSRDP's credibility.

THE PROTYPE'S INTEGRATION

The RMSRDP uses the *TKM&F's* functional language development environment to implement the RMSPoC. The RMSRDP uses CSFs sets, actions and applicable solutions for iRMS and *Projects* in general. The RMSRDP's main constraint is that CSAs having an average result below 7.5 will be ignored. This fact may qualify all the seven CSAs/Tables, which will be presented in the RMSPoC that concludes the first phase, and if the initial research and qualification is successful, then the RMSPoC can be conducted. The used ACS is a concrete case where the demo application uses the *TKM&F* for the RMSPoC implementation (Trad & Kalpić, 2018c).

SOLUTION AND RECOMMENDATIONS

The managerial recommendations are needed for finding the solutions to enable the holistic management of RMSRDP. The resultant technical and managerial recommendations are:

- A RMSRDP (or something similar) must be established and used to check feasibility.
- The ADM's integration in a RMSRDP enables the automation of its interfaces.
- The *Manager* must be an RDP specialist.
- Setup a central RMSRDP to be used in *Projects*.
- Select the RMSRDP's CSFs, KPIs and CSAs.
- Define the interface to the rKMS and DMS. The RMSRDP needs to implement a DMS.
- Model the RMSRDP's and microartefacts' interaction.

RMSRDP managerial recommendations, and the *TKM&F*, round up the approach needed for the complex *Project* research activities.

FUTURE RESEARCH DIRECTIONS

This research and development topics appears to be undiscovered and very complex, because many intangible values are ignored, like knowledge for evaluation. The probable reason for such a de facto situation is the classical approach that is based on siloed methodologies; which undermines the possibility of solving more complex problems and development of sophisticated decision systems. The future research and development process will continue to tune the *TKM&F* and will work more specifically on the proof of concept.

CONCLUSION

This RMSRDP is based on the *TKM&F* unique mixed research model; where CSFs and CSAs are offered to help iRMS and *Project's* managers and resource architects to minimize the chances of failure when implementing an iRMS (or *Project)*. This chapter is part of a series of research works related to HMM, *Projects*, DMS and rKMS. In this chapter, the focus is on the RMSRDP that defines a central pool of factors to be used throughout the *Projects*. The most important managerial recommendation that was generated by the previous research phases was that the *Manager* must be a strong leader and must in depth knowledge of RDPs. The *TKM&F* supports the iRMS (and *Project*) by using the RMSRDP to check the feasibility and to deliver a set of managerial recommendations.

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In a work as large as this research project, technical, typographical, grammatical, or other kinds of errors are bound to be present. Ultimately, all mistakes are the authors' responsibility. Nevertheless, the authors encourage feedback from readers identifying errors in addition to comments on the HPRMP and the *TKM&F* in general. It was our great pleasure to prepare this chapter and its experiment. Now our greater hopes are for readers to receive some small measure of that pleasure and support for his project.

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KEY TERMS AND DEFINITIONS

ADM: Architecture development method.
CSA: Critical success area.

CSF: Critical success factor.
DMS: Decision-making system.
EA: Enterprise architecture.
EAP: Enterprise architecture projects.
HMM: Holistic mathematical model.
ICT: Information and communication technologies.
KM: Knowledge management.
KMS: Knowledge-management system.
MM: Mathematical model.
Projects: Transformation projects.
RDP: Research and development projects.
RMS: Resources management system.
RQ: Research question.
TKM&F: Trad Kalpić methodology and framework.
TOGAF: The Open Group's architecture framework.

Chapter 14

An Applied Mathematical Model for Business Transformation and Enterprise Architecture:

The Enterprise Architecture's Integration Pattern for a Proof of Concept (EAP4PoC)

ABSTRACT

This chapter is supported mainly by an adapted fictitious case from the insurance domain. The uniqueness and market lead of the authors' proposed HMM promotes a holistic cohesive enterprise architecture, design, and implementation model that supports complex projects integrations using a targeted PoC, in this case the EAP4PoC. The adaptable management system (aMS), which is described in a separate chapter, and decision-making system (DMS) are used in day-to-day business, architecture, and technology problem-solving activities. In this chapter, the proposed solutions are supported by a real-life case of a project methodology in the domain of enterprise architecture that in turn is based on the alignment of various business, architecture, and technology standards.

INTRODUCTION

The proposed concept is mainly based on research, design and development on: 1) business and technical architecture case studies; 2) enterprise architecture and optimization; 3) continuous business and technical transformations; 4) applied mathematics/models represented in the HMM; 5) software architecture and modelling; 6) business architecture and implementation engineering; 7) financial/audit intelligent analysis (and not looting initiatives); 8) decision making systems and AI; 9) standardized architecture methodologies; and 10) integrated enterprise architecture as a central concept. The EAP4PoC is based on an authentic and proprietary research method that is supported by an underlining mainly qualitative holistic reasoning module that is explained in this series' research and development project management (Trad & Kalpić, 2019b). The EAP4PoC is an AI/empirical process that uses a natural language environment, which can be easily adapted by the architecture teams (Trad & Kalpić, 2019b; Myers, Pane & Ko,

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2004; Kim & Kim, 1999; Della Croce & T'kindt, 2002; Trad & Kalpić, 2017a, 2017b, 2017c, 2017d; Gunasekare, 2015). The EAP4PoC is implemented to check the feasibility of the proposed concept, using the HMM and CSFs approaches. The EAP4PoC supports Business Transformation Projects (BTP) and Enterprise Architecture Projects (EAP) (or simply *Projects*). This chapter is supported mainly by an adapted fictious case from the insurance domain (Jonkers, Band & Quartel, 2012a). The uniqueness and market lead of the authors' proposed HMM, promotes a holistic cohesive enterprise architecture, design and implementation model that supports complex *Projects* integrations using a targeted PoC; in this case the EAP4PoC (Farhoomand, 2004). The adaptable Management System (aMS), which is described in a separate chapter (Trad & Kalpić, 2019f), and Decision Making System (DMS) are used in a day to day business, architecture and technology problem solving activities. In this chapter, the proposed solutions are supported by a real-life case of a *Project* methodology in the domain of enterprise architecture that in turn is based on the alignment of various business, architecture and technology standards and avant-garde methodologies. The "i" prefix, which will be used later in this text, does not stand just for the common intelligent agile environments but for a distributed and holistic intelligent architecture concept's approach that identifies this work's background; and "a" will stand for artefacts. This research project's main and overall keywords are: 1) EAP4PoC and aKMS concepts; 2) existing standard enterprise architecture frameworks; 3) business transformation projects; 4) business transformation manager's profile; 5) applied mathematical model; 6) neural networks; 7) holisms and global concept; 8) risk management; 9) decision making systems; 10) artificial intelligence; 11) knowledge management systems; and 12) transformation and innovation, iterative approaches. Using the scholar engine, in Google's online search portal, in which the authors combined the previously mentioned keywords and key topics; the results have shown very clearly the uniqueness and the absolute lead of the authors' framework, methodology, research and works (Trad & Kalpić, 2019b). From this point of view and facts, the authors consider their works on the mentioned topics as innovative, credible and useful; so the main topics will be introduced. HMM for *Projects* offers an internal natural language development (for scripting and prototyping) environment that can be adopted by any *Project* to manage the relationships between the EAP4PoC, patterns, microartefacts and aMS, as shown in Figure 2.

, and for that goal the authors propose to use the EAP4PoC that can be instantiated (in n instances) by an architecture pattern to create a blueprint, as shown in Figure 2 (Myers, Pane & Ko, 2004; Neumann, 2002).

The EAP4PoC is (or should be) supported by a central DMS (which is based on an HMM) and any type of enterprise architecture methodology; it can be of any type in addition to the one proposed by the authors

(Loginovskiy, Dranko, & Hollay, 2018). The EAP4PoC is based on a concrete business case; where the central point is the transformation process of the existing legacy resources system into a modern aMS (Abdullah, Widiaty, & Abdullah, 2018). Such *Projects* are managed by the Business Transformation

Figure 1. The relation between the patterns, microartefacts and end system

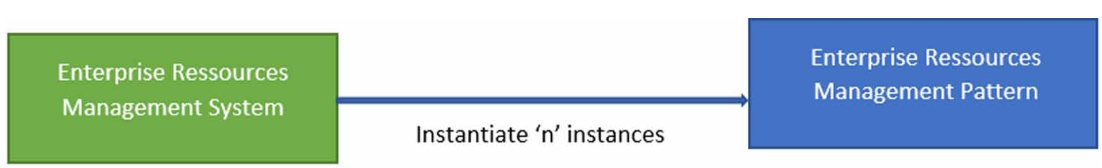
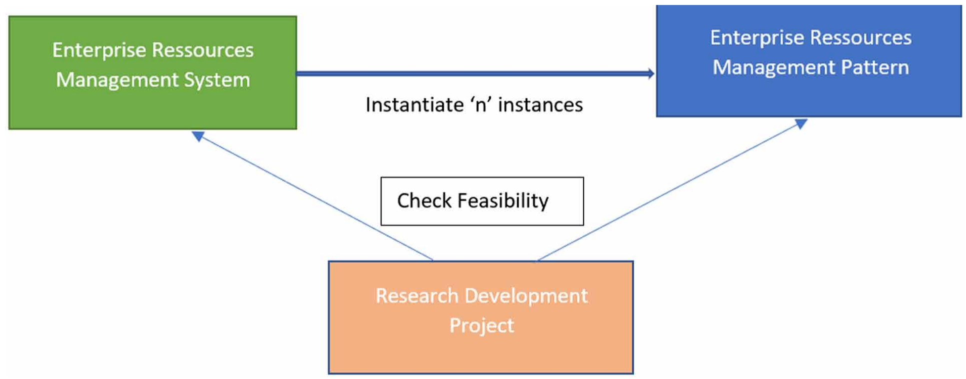


Figure 2. The relation between the pattern and architecture blueprint



Managers or an Enterprise Architecture Manager (simply a *Manager*); who, in this case, are supported with a methodology and a framework that can estimate the risks of implementation of such *Projects'* and its aMS. The aMS related research is made up of four inter-related approaches that are:

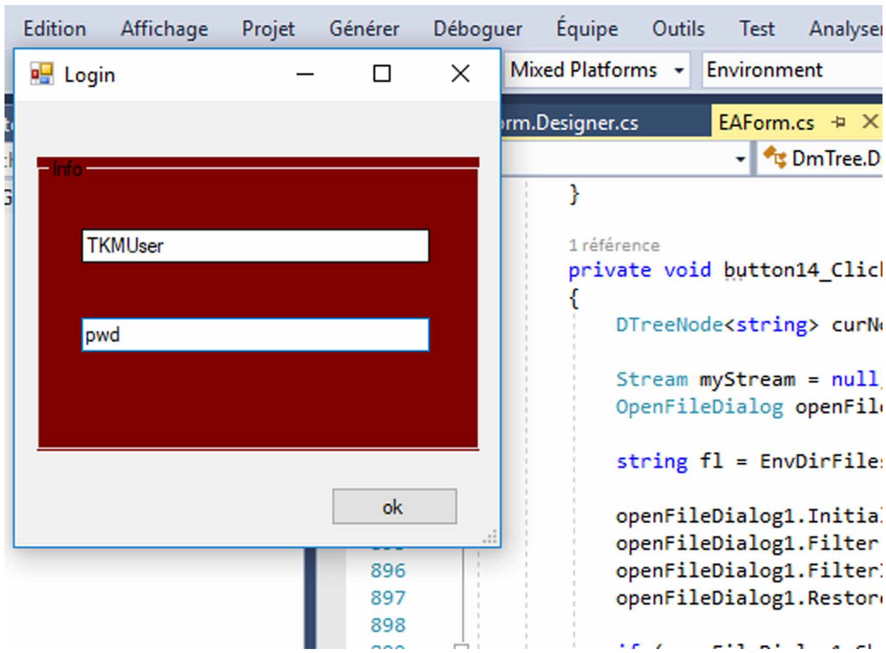
- The research concept (Trad & Kalpić, 2019d) describing the Research and Development Project (RDP) for the aMS and its EAP4PoC as shown in Figure 3.
- The architecture pattern describes a structural pattern that can be instantiated to create the aMS.
- The PoC, explains all the steps that are needed to check the EAP4PoC' feasibility.

The *Manager* is responsible for the implementation of complex *Projects* using architecture pattern, RDP and their EAP4PoC; the EAP4PoC supports him or her (for simplicity, in further text – him) in a just-in-time manner in the area where he should have a solid background in architecture patterns based aMS implementations (Trad & Kalpić, 2016b), which is the topic of the next section.

BACKGROUND

The stub of a complex *Project* and its various subsystems, like the aMS, are the roles of the *Manager*, EA blueprint, standard technologies and aMS integration concept, which should be supported by the optimal transformation framework that ought to support a Global Enterprise Architecture Integration Vision and Strategy (GEAIV&S) that in turn is the kernel of the implementation of the EAP4PoC. The GEAIV&S should be also capable of supporting the *Project's* executives, business engineers, auditors, legal control and integration in a complex interconnected (block-chained) globalized business world that has a jungle like approach. To achieve GEAIV&S goals, global enterprise architecture, technology and infrastructure components, cultural, financial and logistics integration strategy factors should be classified in Critical Success Areas (CSA) categories containing CSFs, used to evaluate possible pitfalls and risks, to audit, assert, govern, automate, trace, monitor and to control the aMS and its interfaces (Putri & Yusof, 2009). These *Projects* start with the unbundling process, initiated by an organizational reengineering process that is initiated by the EAP4PoC supporting framework. The first step is to initiate the system and the creation of three departments corresponding to the Applied Case Study (ACS). Once logged-in and the

Figure 3. The relation between the architecture pattern, artefacts and the research/development project



system is up, the EAP4PoC appears and is started as shown in Figure 4, on the left side in a TrueView, showing the three initial departments; then the *Project* and its aMS subprojects' CSFs can be configured to manage various activities in local and global eco-systems.

A fully or partially transformed aMS, must have support of built-in automated scripts in the form of estimation controls, capable of recognizing major changes' and requirements' risks that are classified in a tree, as shown in Figure 5, where the internal subsystems collaborate.

Projects involve the complete digitization of aMS processes, where automation enables new intelligent architecture patterns to optimize their evaluation processes (Felfel, Ayadi, & Masmoudi, 2017). This research series that includes the RDP, used in the EAP4PoC are considered as a pioneering and a unique combination, and actually or even unfortunately, there are no similar frameworks available. The RDP consists of two phases:

- Phase 1, which checks the literature review, as shown in Figure 6.
- Phase 2, which tries to solve a concrete problem, as shown in Figure 7.

It confirms the authors' impression to have a lonely lead that might last more than the next 10 years, in proposing a feasibility check concept to be used for *Projects* in general, and to assist in their design and maintenance phases, which come after the finalization of the implementation phase. The EAP4PoC supports *Projects'* architecture. The CSF based EAP4PoC is managed by the Trad Kalpić Methodology and Framework (*TKM&F*), and its interface is shown in Figure 8; where the reader has to the *TKM&F* user's guide to understand its structure (Trad, 2018a; Trad, 2018b). Figure 6 shows its main modules and components (Trad & Kalpić, 2018f). The EAP4PoC CSFs are selected from various aMS related areas like architecture development, gap valuation, processes, technology/infrastructure, human skills …. and other..

Figure 4. The framework's main graphical interface

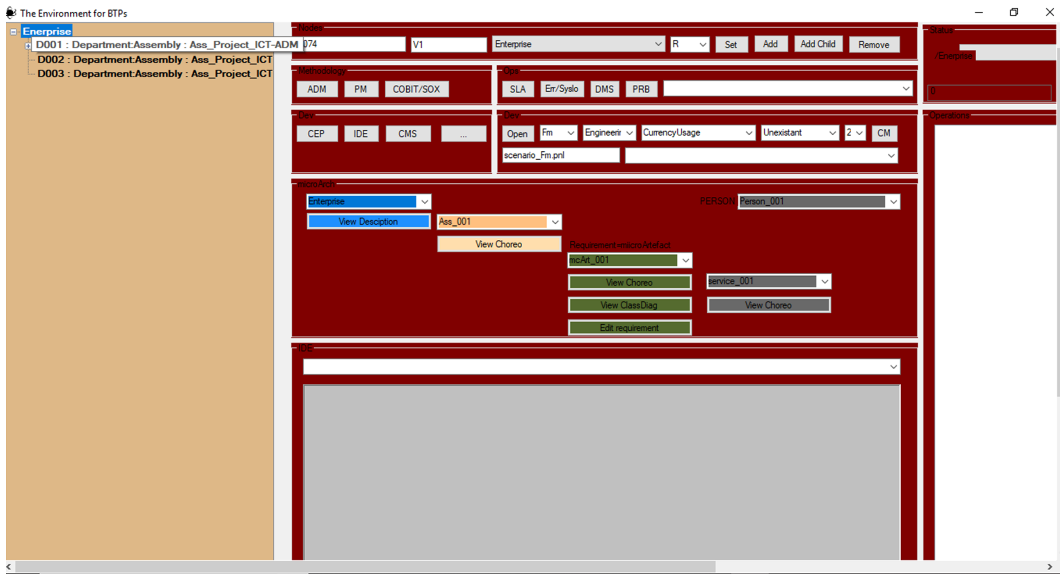
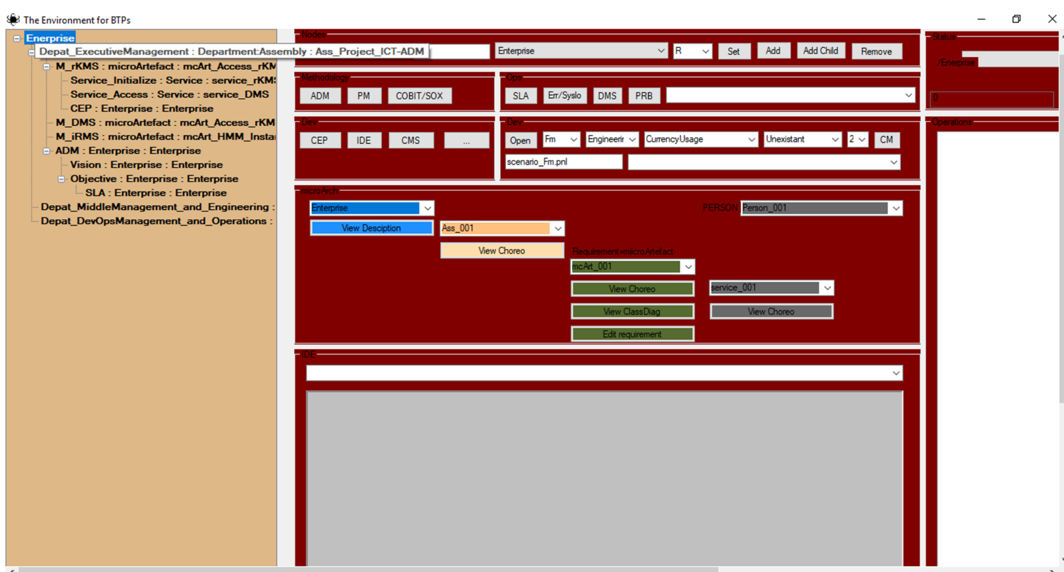
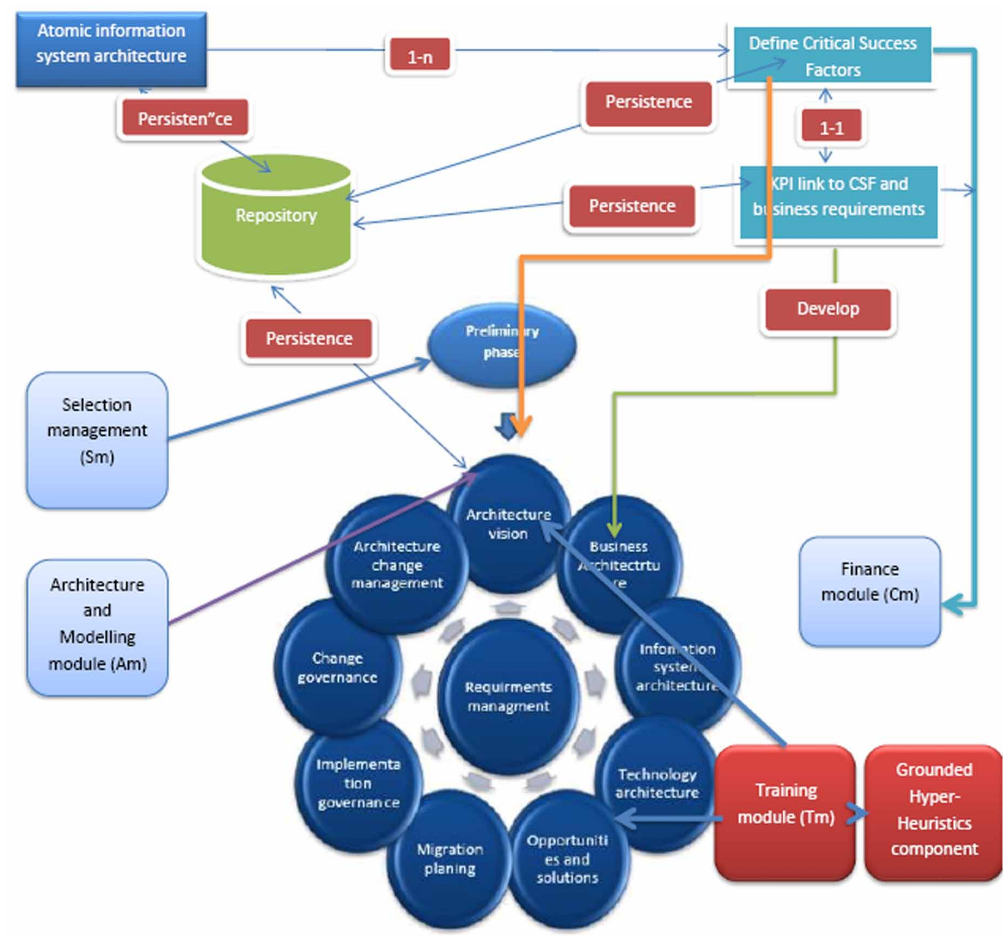


Figure 5. The framework's main subsystems linking



In this chapter, the authors present the EAP4PoC that is the enterprise architecture pattern usage experiment offering the details on how to apply the *TKM&F* and concludes with managerial, financial and technical recommendations, applied to various fields, like the aMS and its subsystems, like Knowledge Management (KM), DMS, EA, ICS, business transformation and other engineering fields. Integrating a EAP4PoC and the GEAIV&S, should be a fundamental and even strategic goal for aMS (Trad & Kalpić, 2018a, 2018b; Cearley, Walker, & Burke, 2016). The EAP4PoC, presents a concrete application/inte-

Figure 6. Phase 1 execution steps



gration of its components that are based on: 1) a holistic architecture approach, by interfacing various *Project* fields to access artefacts; 2) Architecture Development Method (ADM) integration; 3) it uses AI, DMS and risk management engine(s), using its structure is presented in Figure 8; 3) manages phases, using its structure, which is presented in Figure 8; 4) applies factors and categories and implementation tracking; and 5) it uses the *TKM&F's* capabilities and its pool of patterns (Taleb & Cherkaoui, 2012). The DMS, aMS and the introductory EAP4PoC are based on the authors' RDP (Trad & Kalpić, 2019d) method that in turn is based on intelligent neural networks (Trad & Kalpić, 2018a), where the EAP4PoC is agnostic to any specific application, technical or business domain, as shown in Figure 9, and is based on the ADM (The Open Group, 2011a), but it can use any other existing architecture framework, like for example, Zachman's (The Open Group, 2002).

In each of these phases, shown in Figure 9, sets of the CSAs/CSFs are retuned depending on the *Project's* context. For a concrete prototype, the *Manager* must choose an adequate EA framework; and that is the *Project's* central objective to successfully implement the aMS, where the *Manager* use the EAP4PoC to check the aMS' architecture integration feasibility (Trad & Kalpić, 2017b, 2017c; Thomas, 2015; Tidd, 2006). In *Projects*, the *Manager*'s role is crucial, and his architecture/design capabilities

Figure 7. Phase 2 execution steps

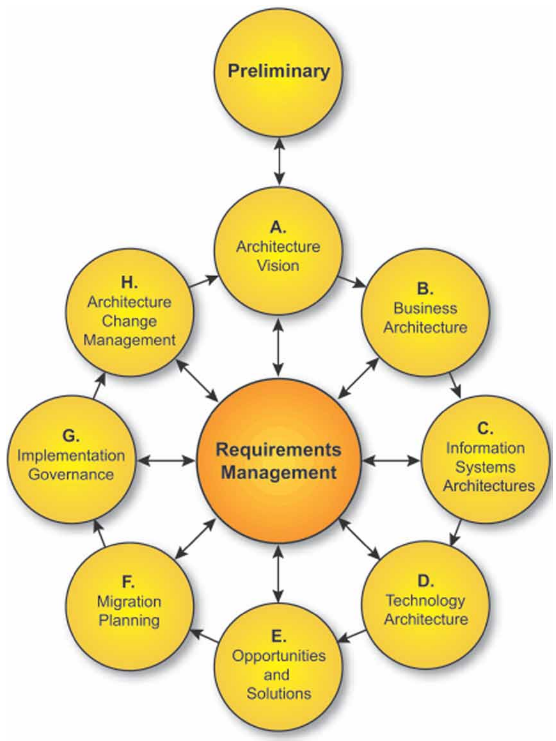


Figure 8. The research framework's concept (Trad & Kalpić, 2016a)

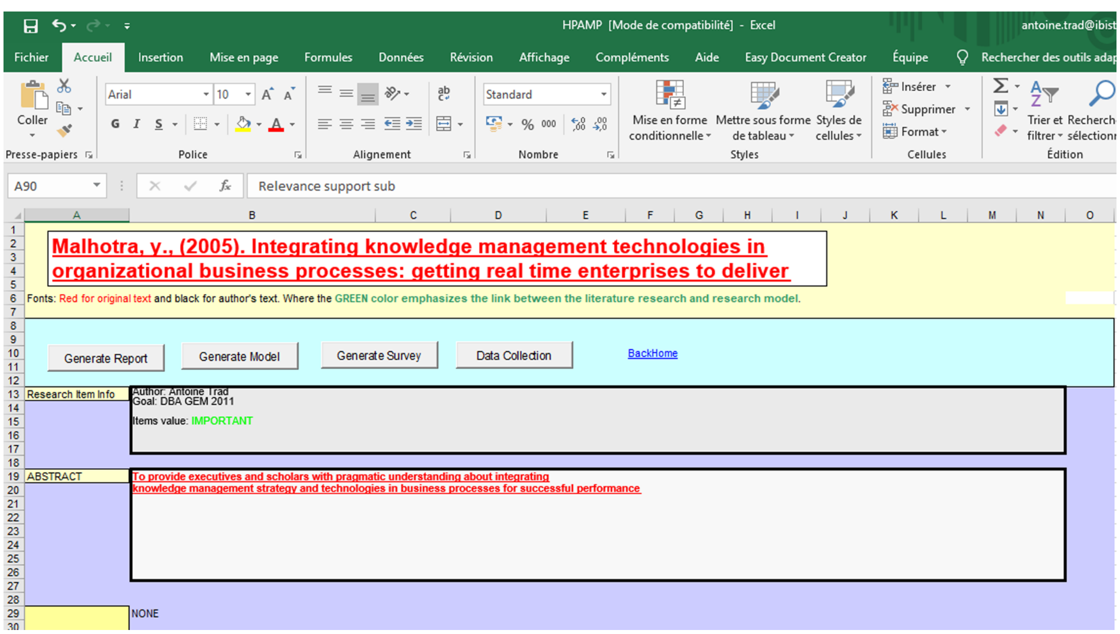
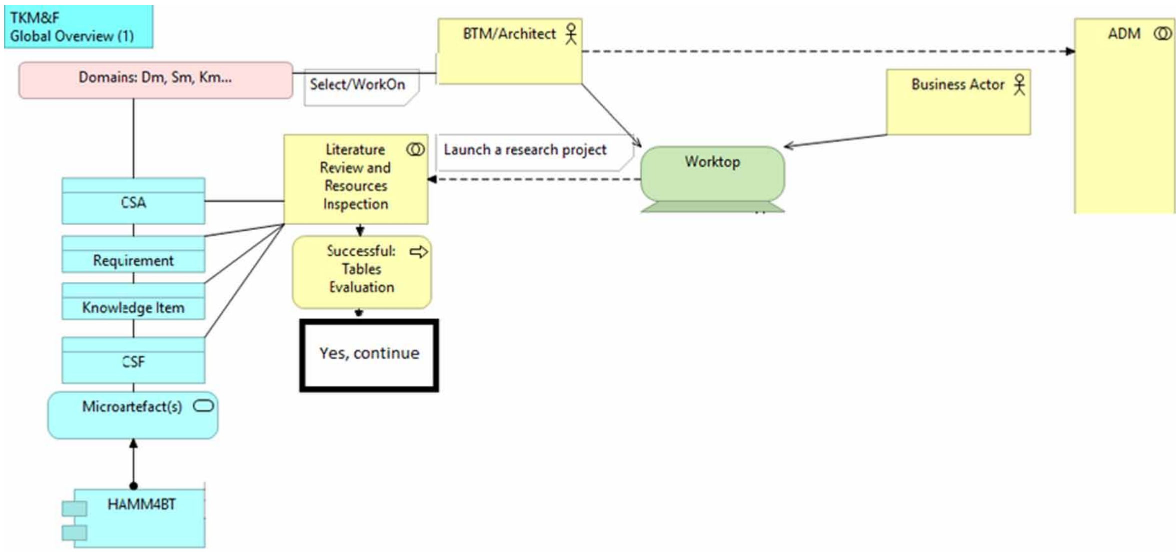


Figure 9. The architecture method's structure (The Open Group, 2011a)



are needed for the EAP4PoC setup to support a distributed enterprise business system (Trad & Kalpić, 2019c; Lanubile, Ebert, Prikladnicki, Vizcaíno, & Vizcaino, 2010); the ACS will be used as the HeB-CMS or the EAP4PoC's frontend.

The EAP4PoC, uses a systemic/holistic approach, where its application interface, as shown in Figure 10, where the DMS/AI interacts with the external world via the *TKM&F* to define and modify CSFs (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a). As shown in Figure 9, where the internals of CSF Management System (CSFMS) is presented; the CSFs are important for the phase 1 that qualifies the needed CSF set and decides whether there is a need for a EAP4PoC; in most *Projects* that decision would be called *go or nogo* procedure.

Figure 10. Intelligent management system that uses an item/factor management system

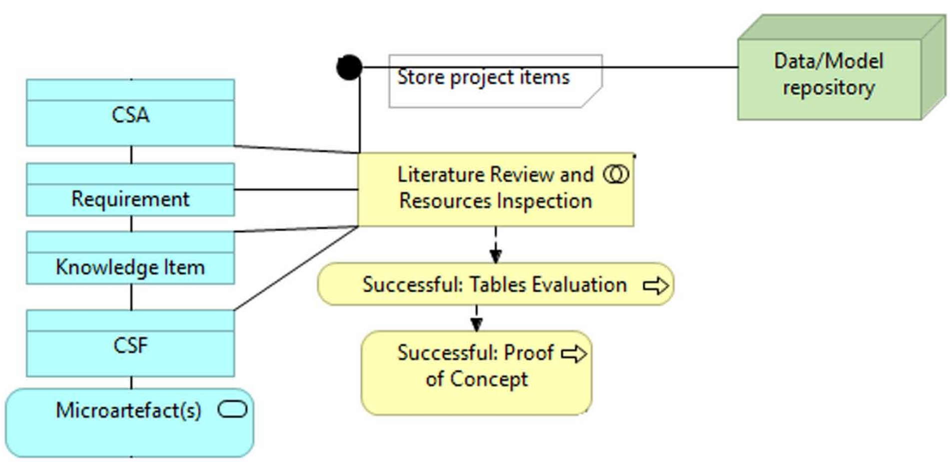


Figure 11. Interaction with critical success factors

Projects and their internal aMS' are difficult to implement, because of their complexity and lack holisticity, archaically distributed and siloed nature, where the biggest part of complexity is encountered in the process of artefacts classification, technical implementation and integration phases and the linking to sets of CSFs (Gudnason & Scherer, 2012). CSFs are managed from the *TKM&F* client Graphical User Interface (GUI) by selecting the active phase from the list box. After selecting the CSF tag and its phase, the CSF is linked to a CSF; which is implemented as an item, in an Excel file; where all its details are defined and as shown in Figure 12.

Concerning the internal *TKM&F* interaction details, as shown in Figure 13, the *TKM&F* can be applied to all types of *Projects* including the aMS integration using CSFs (Joseph, 2014).

The EAP4PoC presents how to check the feasibility of an aMS uses access to microartefact based technologies (Sankaralingam, Ferris, Nowatzki, Estan, Wood, & Vaish, 2013). In 2013, Gartner, Inc., the leading information technology research and advisory company, announced the fact, that failure rates for projects from now until 2016, ranges in the limits of 20 to 28 percent. Gartner, recommends that business environments should prepared to face even more risk to achieve the *Project's* returns and to accept failure and to continue to transform. As business environments have mainly the focus on cost reduction, they should embrace the failure (Gartner, 2013a; Allen, Alleyne, Farmer, McRae, & Turner, 2014). The EAP4PoC, checks mainly the technical implementation phase, which is the major cause of high failure rates in *Projects*; because of the lack of a holistic approach and this fact is this work's focus (Thomas, 2015; Cearley, Walker & Burke, 2016; Trad & Kalpić, 2016b).

FOCUS OF THE ARTICLE

EAP4PoC checks the aMS feasibility and proposes recommendations that can be applied by *Managers* for change management initiatives (Desmond, 2013). The EAP4PoC, uses the RDP that is based on the HMM which is a mixed methodology (Easterbrook, Singer, Storey & Damian, 2008); where this chapter presents an experiment of the aMS architecture integration and ties to relate feasibility check process to an experiment and a Research Question (RQ), by using a research process.

Figure 12. Tuning and linking factors

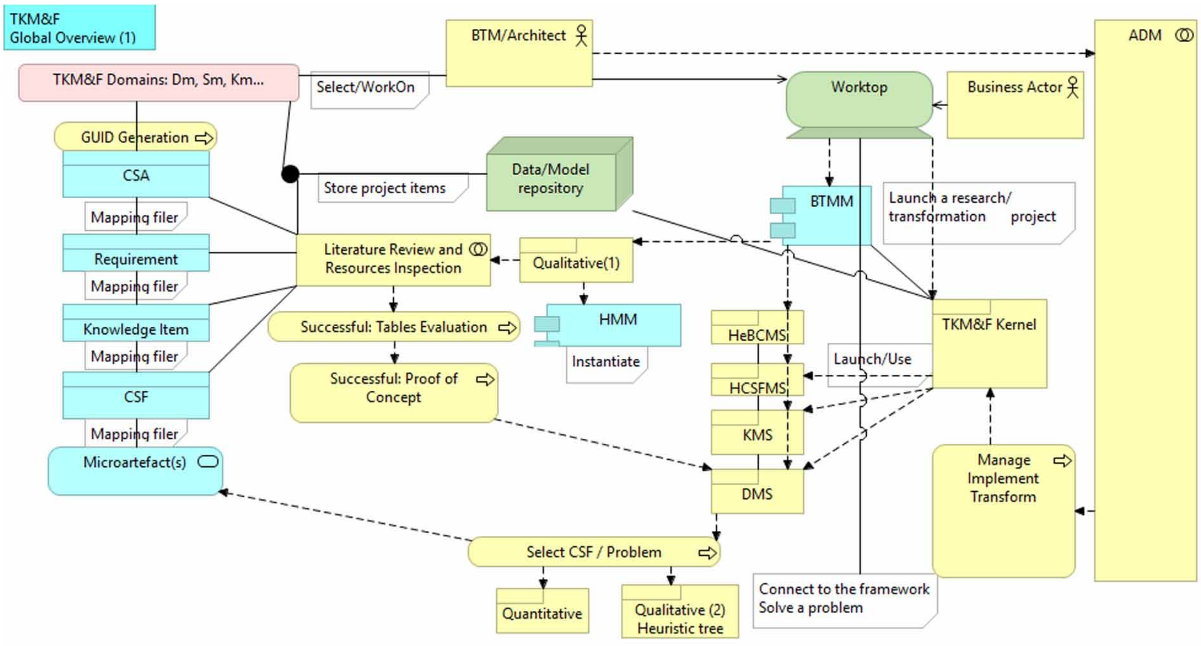
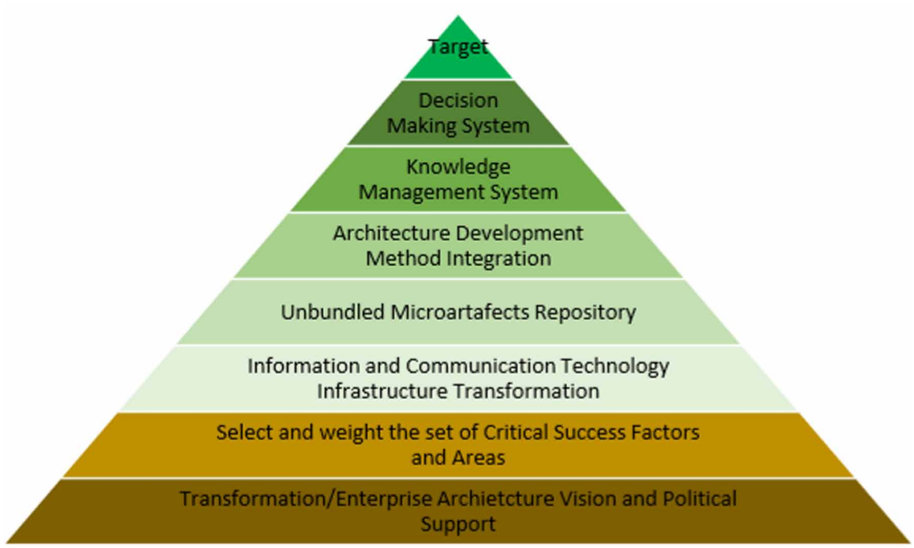


Figure 13. The Trad-Kalpić Methodology and Framework's flow and interaction, including factors



THE RESEARCH PROCESS

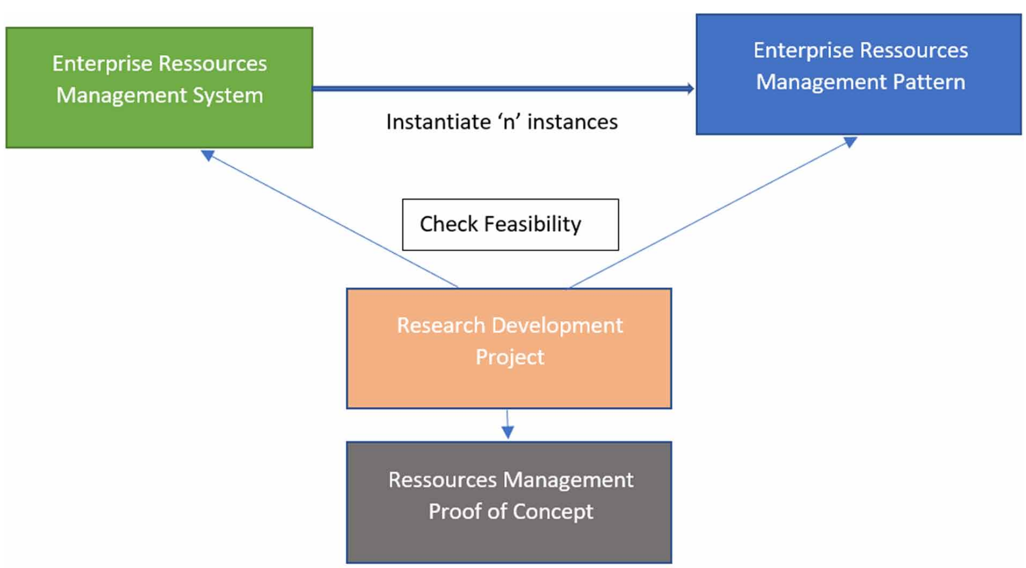
Projects failure rates are high and were constantly increasing (Bruce, 1994) what is due to the complexity encountered in the implementation phase (Capgemini, 2009); to enhance the success rate, the authors propose the *TKM&F* and a concrete PoC, in the case the EAP4PoC is to check the feasibility; where the proposed concept can be considered as a pioneering approach (Gartner, 2013a). *TKM&F* recommends linking the HMM to all levels of the aMS that is in the target level, as shown in Figure 14, where starts at its bottom of the pyramid, in the architecture vision phase (Trad & Kalpić, 2018b; Agievich, 2014; Tidd & Bessant, 2018). This chapter's RQ is: "Can a holistic architecture concept be applied to an intelligent business system's implementation?"

The CSF-based RDP would use the DMS/AI subsystem and unbundling levels that are parts of the *TKM&F* (Trad, 2018a; Trad, 2018b, Trad & Kalpić, 2019d). The RDP phase 1 (represented in tables), checks the following CSAs:

- Business case, synthesized in Table 1.
- HMM, synthesized in Table 2.
- ICS, synthesized in Table 3.
- ADM, synthesized in Table 4.
- KMS, synthesized in Table 5.
- DMS, synthesized in Table 6.
- The applied domain; which is in this research article the aMS, synthesized in Table 7.

Table 8, aggregates tables 1 to 7. As shown in Figure 3, the RDP, coloured in brick-orange interfaces the series various parts; include the EAP4PoC that uses an ACS (Jonkers, Band & Quartel, 2012a).

Figure 14. Levels of project's interaction (Trad & Kalpić, 2017b; Trad, & Kalpić, 2017c)



THE BUSINESS CASE

Information and Communication Infrastructure

The EAP4PoC uses an ACS (Jonkers, Band & Quartel, 2012a), developed by the Open Group as a reference study for its Open Group Architecture Framework (TOGAF) environment, it offers the capability to implement *Project* components and is related to an insurance company named ArchiSurance (Trad & Kalpić, 2018f); the authors recommend the readers to read the original ACS because it is used to check the aMS feasibility. The aMS, like actual avant-garde systems, uses Information and Communications Systems (ICS). Concerning the EAP4PoC, the needed goals to be achieved:

- Offer an ICS and infrastructure feasible solutions.
- Design aMS architecture solutions, based on the architecture pattern.
- Select a jump start objective from the ACS; and use as template architecture blueprint.
- Build resource microartefacts to support the architecture blueprint.
- Prepare *TKM&F's* phase one and if successful, select a problem from the ACS to prove phase two.

Managing the Business Case

An architecture pattern instances are used by the ACS, which is developed by the Open Group as a reference study for its own TOGAF and its ADM, it presents the possibilities to implement the aMS, and is related to an insurance company named ArchiSurance (Trad & Kalpić, 2018f); which is used in the EAP4PoC.

Integrating Critical Success Factors

A CSF its KPI enumerations are measurable and mapped to a weighting that is roughly estimated in the first iteration and then tuned through Architecture Development Method (ADM) iterations, to support the aMS; where holistic business and enterprise architecture CSFs are essential (Felfel, Ayadi, & Masmoudi, 2017); this process of evaluation is described in this series RDP (Trad & Kalpić, 2019d). The main issue here is how to define the EAP4PoC goals to integrate aMS and how to interrelate the different business, ICS and EA components; where the ADM is its skeleton (KPMG, 2014).

The Architecture Development Method and Projects

This RDP focuses on the architecture and design of *Projects'* integration and presents the influence of an architecture pattern to support the aMS (Trad & Kalpić, 2019e). Currently, distributed intelligence, complexity, knowledge, economy and technology, need an architecture pattern supported by a hyper-heuristics tree that supports a wide class of problem types that are processes in the RDP's Phase 2 (Markides, 2011), where the Decision Making System (DMS) supports the aMS (Trad, Kalpić & Fertalj, 2002; Trad & Kalpić, 2014d). The *TKM&F's* parts must synchronize with the ADM, where the aMS (or IRMS in the) and its internal components are interfaced in all the ADM phases.

The Business Case Study for Architecture Critical Success Factors and the Link to the Next Applied Mathematical Model Section

Based on the CSF review and evaluation processes, the evaluation is done with the relation and influence of Architecture to this section. The important business case's CSFs that are used and processed by the internal heuristic engine and are presented in to an associated chapter entitled: Business Transformation and Enterprise Architecture-The Resources Management Research and Development Process (RMSRDP) (Trad & Kalpić, 2019e); it is strongly recommended to refer to this chapter. Based on the CSF review process, the important business case's CSFs are used and evaluated as explained below.

As presented in the EAP4PoC is based on CSA, CSF and KPIs evaluation (Trad & Kalpić, 2019e) which for the possible operational RDP the sets of CSAs, CSFs and KPIs, aMS can be used in the architecture ACS' CSAs/CSFs:

Here is an example for enumeration of CSFs: 1) Modelling; 2) Critical Success Factors; 3) References; 4) ArchitectureDevMethod; 5) Technologies; 6) Governance; 7) Transformation_TKM&F; and 8) Leading_Governance.

KPIs are valid in all the chapter's CSFs and can also be illustrated as an enumeration: 1) Complex or ComplexToImplement; 2) PossibleClassification; 3) Exists or Existing; 4) IntegrationPossible; 5) AdvancedStage or AdvancedState; 6) Advanced; 7) IntegrationPossible; 8) ModeratelyComplex; 9) Feasible or Implementable; 10) Stable or Supported; 11) Standard or StandardIntegration; 12) IntgeratesAsKernel; 13) ManagementEnabled; 14) FullyIntegrated; 15) IsApplicable; and 16) Possible or Transformable.

In this RDP, the deductions are done by using the analysis of each CSA of a total of 7, where a *TKM&F's* script is created, in which all its CSFs are stored and appear in Table's 1 column. As shown in Figure 15, the *TKM&F's* scripts in the background that are automated to calculate the weightings and ratings; known as the KPIs and a value from the enumerated sets; and they are tuned and stored in column 2. This RDP concept proposes a standardized and automated manner to evaluate literature

Table 1. The applied case study's critical success factors that have an average of 9.25

Critical Success Factors	KPIs	Weightings
CSF_RessourcesCase_Modelling	ModeratelyComplex	From 1 to 10. **08 Selected**
CSF_RessourcesCase_Factors	PossibleClassification	From 1 to 10. **10 Selected**
CSF_RessourcesCase_References	Exists	From 1 to 10. **08 Selected**
CSF_RessourcesCase_ArchitectureDevMethod	IntegrationPossible	From 1 to 10. **08 Selected**
CSF_RessourcesCase_Technologies	AdvancedStage	From 1 to 10. **09 Selected**
CSF_RessourcesCase_Governance	Advanced	From 1 to 10. **09 Selected**
CSF_RessourcesCase_Transformation_TKM&F	IntegrationPossible	From 1 to 10. **10 Selected**
CSF_RessourcesCase_Leading_Governance	Possible	From 1 to 10. **09 Selected**

valuation

reviews that is an evolution in regard to the very subjective method, which may or may not make sense, as shown in Figure 15. If the automated literature review's evaluation is successful, only then the experiment can be completed.

What is unique about the *TKM&F* and its RDP, is that it can automate complex RDPs in phase 1, and estimate the values for each selected KPI, as described in the in the associated RMSRDP chapter; on how to use CSA, CSF, KPI processing in the complex research projects (Trad & Kalpić, 2019e).

As shown in Table 1, the results justify (an average of 9.25) the usage of the ACS and how it can be used with the final PoC or phase 2; where the described process is applied to the next six CSAs and their tables. This process enables to go to the next CSA to be analysed that is the Holistic Mathematical Model's (HMM) integration. This section's deduction is that the HMM is crucial for the EAP4PoC's credibility, where it is the basis for its structure.

THE APPLIED MATHEMATICAL MODEL'S FEASIBILITY

As already mentioned, it is recommended to refer to RMSRDP chapter, to understand this chapter (Trad & Kalpić, 2019d). An architecture pattern and its links to the ADM are the base of this chapter and they are the basics of the *TKM&F.* The authors propose the HMM as the skeleton of the *TKM&F* to solve feasibility checking and *Project* problems . The literature review has shown that existing research resources on *Project* topics, as a mathematical model, are practically inexistent or more precisely irrelevant (Trad & Kalpić, 2019e). This pioneering RDP is cross-functional and links all the *Project*'s microartefacts to

Figure 15. The critical success factors and areas (like HPAMP_1) stored in workbook sheets

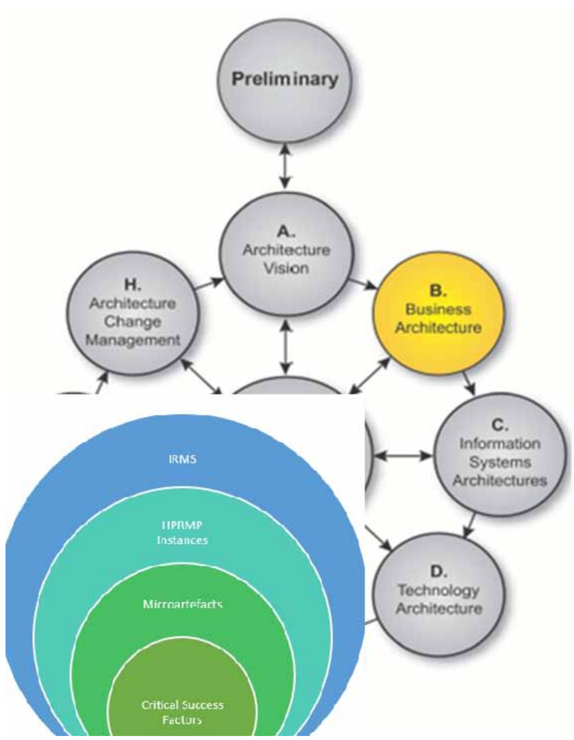
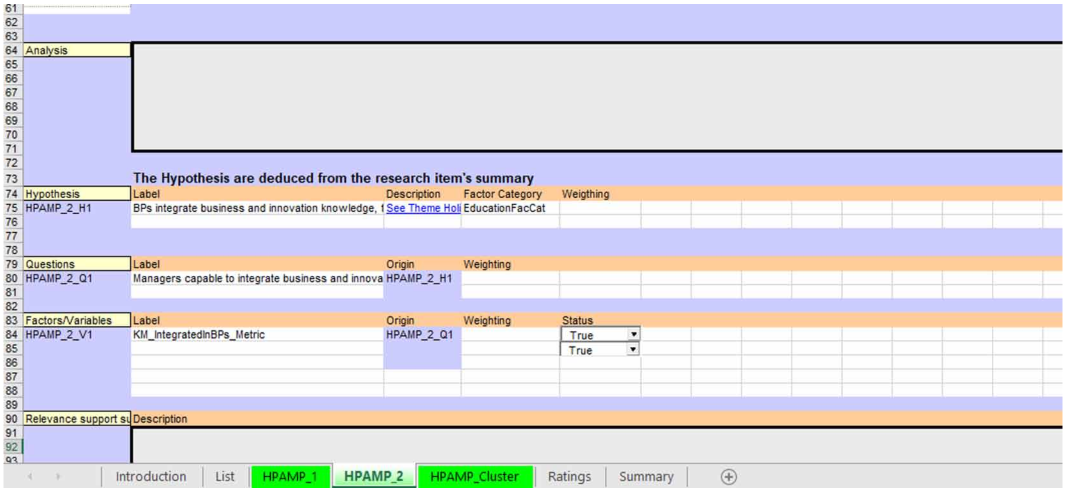


Figure 16. The phase 1 interactions with factors and areas evaluation



the enterprise architecture method. The *Project's* initialization and vision phase, generates the needed CSAs/CSFs and hence creates/proposes the architecture pattern types to be used. The HMM is a part of the *TKM&F* that uses microartefacts' scenarios to support architecture pattern instantiation requests (Agievich, 2014).

The Holistic Mathematical Model's Critical Success Factors and Link to the Next Applied Mathematical Model Section

Based on the selected and evaluated CSFs, using the same concept from the previous CSA and table (Trad & Kalpić, 2019e), the results are presented in Table 2, below.

As presented in the RMSRDP section (and chapter) the CSA, CSF and KPIs evaluation (Trad & Kalpić, 2019e) which for the possible operational CSAs, CSFs and KPIs, aMS can be used in ACS' CSAs. Here is an example for enumeration of CSFs: 1) TKM&F_Integration; 2) InitialPhase; 3) EAP-4PoC_Phase; 4) Qualitative&Quantitative; 5) Final_BTMM; 6) ADM_Integration; and 7) architecture pattern_InterfacingModelling. The CSFs are stored and appear in Table's column 1. As already shown in Figure 15, the *TKM&F's* scripts results or KPIs are stored in column 2; this operation is identical for all 7 tables of Phase 1. As shown in Table 2, the processed results (with an average of 8.72) justify the usage of an HMM instance and that it can be used with the final PoC or the RDP's Phase 2; and this fact enables the continuation to the next CSA, which is the ICS integration.

THE INTEGRATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES

Technology for Decoupled Architecture

Adaptable and loosely coupled Integration Business Block (IBB) based EAP4PoC l can be used to improve the quality and robustness of the aMS and its integration of the defined business requirements

Table 2. The holistic mathematical model's critical success factors that have an average of 8.72

Critical Success Factors	KPIs	Weightings
CSF_HMM_TKM&F_Integration	Feasible	From 1 to 10. **09 Selected**
CSF_ HMM_InitialPhase	Stable	From 1 to 10. **10 Selected**
CSF_ HMM_PoCPhase	Complex	From 1 to 10. **08 Selected**
CSF_ HMM_Qualitative&Quantitative	Complex	From 1 to 10. **08 Selected**
CSF_ HMM_Final_BTMM	VerifiedModel	From 1 to 10. **09 Selected**
CSF_ HMM_ADM_Integration	Synchronized	From 1 to 10. **10 Selected**
CSF_ HMM_HPRMP_Interfacing	Stable	From 1 to 10. **09 Selected**

valuation

(Trad, 2015c). An optimal IBB integration is based on the one to one mapping in which each business requirement and its transaction artefact is autonomous. Standardized and transformed enterprise business architecture, enables the transformation process to be iterative, where its design is based on a holistic approach and patterns using interconnection between all implementation phases (Abdullah, Widiaty, & Abdullah, 2018). The IBBs resources traverse the ADM phases, where each phase refines the IBB's implementation resources; such an approach uses a unified view on the complete business information system that consists of: 1) the targeted and unified IBB based patterns; 2) the IBB based data and loose components; and 3) the underlying IBB based scalable infrastructure. The coordination of the pattern is insured by the interaction of: 1) an enterprise business architecture pattern; 2) standardised methodologies; and 3) portable tools; like the ADM. *Managers*, business architects and business analysts can use the pattern concept to gain support for business architecture implementations; using IBBs, and Solution Blocks (SB), for a successful transformation (Gartner, 2013b). Such a *Project* has to make a choice of the optimal tooling and modelling environment based on a pseudo Model View Control pattern (MIS, 2014), as shown in Figure 17. *Project's* complexity lies in its implementation phase, mainly causes high failure rates are very high; the IBBs and pseudo bottom-up approach can improve succes rates (Bishop, 2009; Shimamoto, 2013). *TKM&F* is a cross-functional construct that refers to the architecture, artificial intelligence, design, development and implementation of *Project's*: 1) requirements solutions; 2) business architecture; 3) the business process models integration; 4) business services linkage; 5) organizational structure reengineering; 6) ICS' evolution; and 7) infrastructure scalability (Österle, 1995).

It is strongly recommended to understand to refer to various other authors works, As already mentioned the research topic is about managing complexity in business transformation projects using standardized methodologies; where all these methodologies have many abbreviation and terms that makes the reading of such topics difficult, but unfortunately that is the nature of such fields (Türkmen, & Soyer, 2020).

the chapter related to the RMIC to understand this section (Trad & Kalpić, 2019f). Th current section presents this CSA in the sense of a literature review and the resultant CSFs that are needed for the EAP4PoC, from the following sections:

- Internet of Things (IoT) which is the infrastructure glue, uses the service-oriented architecture (and microartefacts) to support the *TKM&F*, which are the *Project's* units of work.
- Standard ICS procedures and technology standards, presented in Table 1.
- Global Unique Identifiers Integration (GUID) for resource items, are used to identify and monitor the aMS.
- Processes, architecture patterns and models supported by the *TKM&F* to enable inter-connected intelligent enterprise architecture (Folinas, 2007); presented in Tables 5 and 6.
- Intelligent microartefacts integration and strategy to relate and assemble the aMS' and *Project's* resources. This concept is used to manage autonomic *TKM&F's* microartefacts' instances in all the implementation phases; and it is based on an iterative model that maps all the *TKM&F's* microartefacts to CSFs (The Open Group, 2011a); presented in Table 3.
- Security, has to define a global vision on security by applying holistic qualification procedures that englobe security concepts from many domains used by electronic finance.
- Intelligent static architecture using architecture pattern, which expresses a structural concept or schema for aMS implementations (Trad & Kalpić, 2019e).

The Information and Communication Technology's Critical Success Factors and Link to the Next Chapter

Based on the literature review process and *TKM&F's* processing, the CSFs are evaluated (Trad & Kalpić, 2019e) and are explained below, in this section.

As explained before (the respectable reader can refer to other articles related to this research project) the CSA, CSF and KPIs evaluation (Trad & Kalpić, 2019e) which for the possible operational CSAs, CSFs and KPIs, aMS can be used in ICS' CSAs. Here is an example for enumeration of CSFs: 1) CSF_ICS_GUID_IntegrationProcessesModels; 2) CSF_ICS_Standards; 3) CSF_ICS_Services; 4) CSF_ICS_

Table 3. The information technology critical success factors that have an average of 8.70

Critical Success Factors	HMM enhances: KPIs	Weightings
CSF_ICS_GUID_IntegrationProcessesModels	Standard	From 1 to 10. **09 Selected**
CSF_ICS_Standards	AdvancedState	From 1 to 10. **10 Selected**
CSF_ICS_Services	Supported	From 1 to 10. **09 Selected**
CSF_ICS_Performance	Exists	From 1 to 10. **08 Selected**
CSF_ICS_IoT	Stable	From 1 to 10. **09 Selected**
CSF_ICS_Finance	ExistingSupport	From 1 to 10. **09 Selected**
CSF_ICS_Security	Complex	From 1 to 10. **07 Selected**
CSF_ICS_Automation	Supported	From 1 to 10. **08 Selected**
CSF_ICS_HPRMP_StandardsIntegration	Supported	From 1 to 10. **09 Selected**
CSF_ICS_Procedures	Supported	From 1 to 10. **10 Selected**

valuation

Performance; 5) CSF_ICS_DistributedCommunication; 6) CSF_ICS_Finance; 7) CSF_ICS_Security; 8) CSF_ICS_Automation; 9) CSF_ICS_Pattern_StandardsIntegration; and 10) CSF_ICS_Procedures.

Following the *TKM&F* rules and processing, the CSFs are stored and appear in Table's 1st column. The *TKM&F's* scripts results or KPIs are stored in column 2. As shown in Table 3, the results (an average of 8.70) justify the usage of the ICS integration in the architecture pattern and how it can be used with the final EAP4PoC or phase 2; and enable to go to the next CSA to be analysed that is the holistic management of the ADM.

THE INTEGRATION WITH THE ARCHITECTURE DEVELOPMENT METHOD

The aMS' integration with ADM, enables the management and automation of aMS items and considers the following:

- Reference architecture and its phases concept and integration.
- The Unit of Work (in the form of microartefacts) and Enterprise Architecture.
- Business system's architecture blueprint.

The proposed *TKM&F*'s EA capabilities help in establishing an architecture principal guideline that defines the *Project's* initial phase and vision; which is based on a just-enough architecture in the ADM for the aMS (The Open Group, 2011a).

The Model First Approach

The pseudo bottom up approach of an IBB strategy used by the *TKM&F* is influenced by the microartefacts that are managed by a model strategy, methodology and productivity environment.

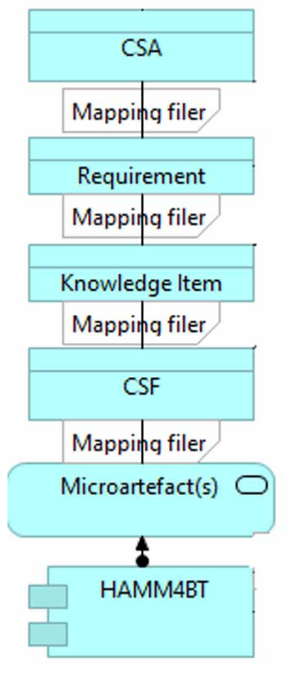
The *TKM&F* proposes an upstream pattern that are altered to accommodate traditional services environments; these services are stored into a specialized atomic service repository using the model-view-control pattern, as shown in Figure 17. The author recommends that *Managers* should apply the Open Group's Architecture Framework as a base for their business transformation strategy.

Integration Building Blocks

IBBs help *Projects* by breaking system components into a set of classified microartefacts. *An IBB is just another business brick in the wall...* The *Manager* builds a prototype to propose a set of IBBs templates to be used during the unbundling process of the actual monolithic environment. The IBBs has the following implementation characteristics:

- It unifies implementation and usage, and easily adapts to evolution of technology and standards.
- An IBBs can be an aggregation of other building blocks, hence a subassembly of other building blocks.
- An IBBs is a reusable template and easily replaceable.
- An IBBs can have many implementations.
- An IBBs has a unique identifier.

Figure 17. The Model-View-Control pattern (Palermo, Bogard, Hexter, Hinze, & Skinner, 2012).



- An IBBs respects the “1:1” mapping concept.
- An IBBs enables business interoperability and integration.

Integration Architecture

Architectures derived from standardized enterprise architectures like TOGAF differ greatly, because they depend on the business requirements quality and *Manager’s* skills and the company’s status. In reality many *Project* architectures will not include many of the reference services, but will include specialized services to support applications that are specific to the *Project*. In implementing an IBBs based architecture pattern, the *TKM&F* can be used to support and assess the requirements. The *TKM&F* focus is on the development and modelling of architectures, which in turn is based on IBB services. This approach is about ensuring that *Projects* are under control by the applied strategy; this approach implements a clear alignment between business requirements, organizational (re)structure, governing and business information technology; resulting in a pattern for the actual *Project*. EA models are developed using microartefacts’ based architectures and their integration’s success can be measured by using CSFs (Ylimäki, 2008).

The Architecture Development Method (ADM) Critical Success Factors and Link to the Next Section

Based on the literature review and associated evaluation processes, the CSFs are evaluated (Trad & Kalpić, 2019e) and are explained below.

Table 4. The Architecture Development Method's critical success factors that have an average of 9.4

Critical Success Factors	HMM enhances: KPIs	Weightings
CSF_ADM_CSF_Initialization&Setup	Feasible	From 1 to 10. **10 Selected**
CSF_ADM_IntegrationProcesses	Supported	From 1 to 10. **09 Selected**
CSF_ADM_Phases	Supported	From 1 to 10. **09 Selected**
CSF_ADM_Requirements	MappingAutomated	From 1 to 10. **09 Selected**
CSF_ADM_HPRMP_Architecture	Supported	From 1 to 10. **08 Selected**

valuation

As presented in the RDP section (and related chapter) the CSA, CSF and KPIs evaluation (Trad & Kalpić, 2019e) which for the possible operational CSAs, CSFs and KPIs, aMS can be used in ADM' CSAs. Here is an example for enumeration of CSFs: 1) CSF_ADM_CSF_Initialization&Setup; 2) CSF_ADM_IntegrationProcesses; 3) CSF_ADM_Phases; 4) CSF_ADM_Requirements; and 5) CSF_ ADM_architecture pattern_Architecture.

The CSFs are stored and appear in Table's, first column. The *TKM&F's* scripts results or KPIs are stored in the second column . As shown in Table 4, the result's (an average of 9.4) justify the usage of the ICS integration concept and how it can be used with the final EAP4PoC or phase 2; and enables to go to the next CSA to be analysed is the KMS interfacing.

THE HOLISTIC ASSET KNOWLEDGE MANAGEMENT SYSTEM

For a architecture KMS (aKMS) the goal is basis to manage resource's information items using a holistic management concept that offers the following:

- The architecture Knowledge Management Basics.
- Architecture Knowledge Microartefacts.
- The Holistic Architecture Knowledge Access Management.
- The Holistic Architecture Knowledge Strategy.

The Knowledge Management Success Factors

Based on the literature review and associated evaluation processes, the CSFs are evaluated (Trad & Kalpić, 2019e) and are explained below.

As presented in the RDP section (and related chapter) the CSA, CSF and KPIs evaluation (Trad & Kalpić, 2019e), which for the possible operational CSAs, CSFs and KPIs, aMS can be used in aKMS' CSAs. Here is an example for enumeration of CSFs: 1) CSF_aKMS_Infrastructure_Integration; 2) CSF_aKMS_Item_Mapping; 3) CSF_aKMS_Patterns; and 4) CSF_aKMS_Pattern_Integration; 5) CSF_aKMS_Pattern_AccessManagement.

Table 5. The knowledge management critical success factors that have an average of 9.0

Critical Success Factors	HMM enhances: KPIs	Weightings
CSF_rKMS_Infrastructure_Integration	Supported	From 1 to 10. **09 Selected**
CSF_rKMS_Item_Mapping	ComplexToImplement	From 1 to 10. **08 Selected**
CSF_rKMS_Patterns	Implementable	From 1 to 10. **09 Selected**
CSF_rKMS_HPRMP_Integration	Implementable	From 1 to 10. **09 Selected**
CSF_rKMS_HPRMP_AccessManagement	StandardIntgeration	From 1 to 10. **10 Selected**

valuation

The CSFs are stored and appear in Table's first column. The *TKM&F's* scripts results or KPIs are stored in the second column. As shown in Table 5, the result's (an average of 9.0) justify the usage of the ICS integration concept and how it can be used with the final EAP4PoC or phase 2; and enables to go to the next CSA to be analysed, which is the resources DMS.

THE INTEGRATION WITH THE DECISION MAKING SYSTEM

The DMS' integration depends on:

- As mentioned CSFs can be applied in the aMS and DMS engine's processing (Trad & Kalpić, 2014b).
- Complex DMS uses the HMM.
- An extremely long and risky *Project*.
- The decision making processes.

The Decision Making System's Critical Success Factors and the Link to the Next Section

Based on the literature review, the CSF are evaluated (Trad & Kalpić, 2019e) and are explained below.

As presented in the RDP section (and related chapter) the CSA, CSF and KPIs evaluation (Trad & Kalpić, 2019e) which for the possible operational CSAs, CSFs and KPIs, aMS can be used in aKMS' CSAs. Here is an example for enumeration of CSFs: 1) CSF_DMS_ComplexSystemsIntegration; 2) CSF_DMS_architecture pattern_Interfacing; 3) CSF_DMS_KMS_Interfacing; 4) CSF_DMS_DMP; and 5) CSF_DMS_HolisticApproach. The CSFs are stored and appear in Table's first column. The *TKM&F's* internal scripts results are stored in the second column. As shown in Table 6, the result's (an average of 8.80) justify the usage of the ICS integration concept and how it can be used with the final EAP4PoC or phase 2; and enables to go to the next CSA to be analysed is the aMS.

Table 6. The decision making critical success factors that have an average of 8.80

Critical Success Factors	HMM enhances: KPIs	Weightings
CSF_DMS_ComplexSystemsIntegration	Possible	From 1 to 10. **09 Selected**
CSF_DMS_HPRMP_Interfacing	Supported	From 1 to 10. **08 Selected**
CSF_DMS_KMS_Interfacing	Possible	From 1 to 10. **09 Selected**
CSF_DMS_DMP	IntgeratesAsKernel	From 1 to 10. **10 Selected**
CSF_DMS_HolisticApproach	Complex	From 1 to 10. **08 Selected**

valuation

THE ENTERPRISE ARCHITECTURE INTEGRATION PATTERN BASED SYSTEM

Monolithic business and information systems and teams are the major cause of failure for *Projects;* this fact has motivated the authors to research various techniques to promote and recommend solutions like the use of IBB based architectures for aMS. Concerning the aMS the following Characteristics:

- A deductive Approach.
- A recursive structure.
- Tangible and intangible artefacts evaluation capability.
- Business processing capability, based on services.
- Enterprise artefacts management.
- Artefacts system design and integration.

The Critical Success Factors and Link to the Next Section

Based on the literature review, the CSF are evaluated (Trad & Kalpić, 2019e) and are explained below.

As presented in the RDP section (and a related chapter is dedicated to this subject) the CSA, CSF and KPIs evaluation (Trad & Kalpić, 2019e) which for the possible operational CSAs, CSFs and KPIs, aMS can be used in aMS' CSAs. Here is an example for enumeration of CSFs: 1) CSF_aMS_SystemsIntegration; 2) CSF_aMS_Architecture_Structure; 3) CSF_aMS_(in)_Tangible; 4) CSF_aMS_DMP_Capacities; 5) CSF_aMS_HolisticApproach; 6) CSF_aMS_TKM&F_Support; 7) CSF_aMS_RoleOfFinance; 8) CSF_aMS_Skills; 9) CSF_aMS_ExistingStatus; 10) CSF_aMS_Automation; and 11) CSF_aMS_Tracking_Auditing.

The CSFs are stored and appear in Table's first column; where the *TKM&F's* processing scripts results are stored in the second column. As shown in Table 7, the results (an average of 8.81) justify the usage of the aMS integration using architecture patterns and it can be used with the final EAP4PoC or phase 2; and enable to go to the next CSA to be analysed is the EAP4PoC.

Table 7. The enterprise architecture integration critical success factors that have an average of 8.81

Critical Success Factors	HMM enhances: KPIs	Weightings
CSF_iRMS_SystemsIntegration	Possible	From 1 to 10. **09 Selected**
CSF_iRMS_Architecture_Structure	Feasible	From 1 to 10. **10 Selected**
CSF_iRMS_(in)_Tangible	ManagementEnabled	From 1 to 10. **09 Selected**
CSF_iRMS_DMP_Capacities	Feasible	From 1 to 10. **09 Selected**
CSF_iRMS_HolisticApproach	Supported	From 1 to 10. **08 Selected**
CSF_iRMS_TKM&F_Support	Complex	From 1 to 10. **08 Selected**
CSF_iRMS_RoleOfFinance	Possible	From 1 to 10. **09 Selected**
CSF_iRMS_Skills	Exisiting	From 1 to 10. **09 Selected**
CSF_iRMS_ExistingStatus	Transformable	From 1 to 10. **08 Selected**
CSF_iRMS_Automation	Supported	From 1 to 10. **09 Selected**
CSF_iRMS_Tracking_Auditing	Feasible	From 1 to 10. **09 Selected**

valuation

THE PROOF OF CONCEPT OR PROTYPE'S INTEGRATION

The PoC's implementation uses IBBs based on the granularity approach used to refine the "1:1" mapping concept.

The Implementation Environment and the Grounded Hyper-Heuristic Decision Tree

This PoC is implemented using the *TKM&F* which was developed exclusively by the authors, who own the total copyrights; it was developed using Microsoft Visual Studio .NET/C#, C/C++, Microsoft Office (Word and Excel), Python and Java Enterprise Edition development environments as support to implement the subsystems. In this EAP4PoC, the grounded hyper-heuristics to process solutions. The DMS is a *rule of thumb* and a guide to implement problem solving using a goal function and constraints (Loginovskiy, Dranko, & Hollay, 2018). The DMS uses a grounded hyper-heuristics process that includes tuning and getting results by trial and error; with a CSAs/CSFs based system. The DMS outputs are verified and filtered to build an efficient tree algorithm and to process solutions in the form of solutions and recommendations. Like all heuristics based systems, the DMS reasoning engine will not be always perfect and adapted to all possible requirements, but it should be enhanced to make it capable of finding optimal results. The DMS applies the positivist action research that is designed on a model identical to the grounded hyper-heuristics model. This EAP4PoC uses the DMS's heuristics model, which is based on a pseudo beam search tree method (Jaszkiewicz & Sowiñski, 1999). The EAP4PoC is based on the HMM's instance and the aMS mechanics' interfaces the DMS, which uses the internal initial sets of CSFs' that are used in phases 1 and 2.

From Phase 1 to Phase 2

Here is the *Project's* enumeration of CSAs: 1) The Applied Case Study Integration; 2) The Usage of the Architecture Development Method; 3) The Information and Communication Technology System; 4) The Mathematical Model's Integration; 5) The Decision Making System; 6) The Knowledge Management System; and 7) The intelligent Resource Management System.

The *TKM&F* and hence the HMM's main constraint, is to implement the aMS using simple *Projects* components, having CSAS average higher than 7.5. In the case, of the current CSA/CSF evaluation, has an average result higher than 8, as shown in Table 8. This fact keeps the CSAs (marked in green) that helps to make this work's conclusion; and drops the ones in red. It means that the aMS integration can be considered and this concept can be used in all types of *Projects*. Once the *TKM&F* is setup, the CSAs/CSFs and the related script files are configured; in this chapter's seven tables are presented and the result of processing of the first phase (or phase 1) is illustrated in Table 8, which shows clearly that the aMS RDP is credible, with an average of 8.89.

Of course, the complexity in integrating the aMS must be done in multiple iterations, where the first one should try to transform the base aMS services repository. As already mentioned, the EAP4PoC's 1st phase, evaluates CSAs that can be calibrated by the *TKM&F's* user(s)). In this research series seven CSAs/Tables qualification is successful using CSFs which are setup from the main client, as shown in Figure 18.

Table 8. The proof of concept's phase 1 outcome, is over 8.89

CSA Category of CSFs/KPIs	Influences transformation management	Average Result
The Applied Case Study Integration	Complex	From 1 to 10. 8.90
The Usage of the Architecture Development Method	FullyIntegrated	From 1 to 10. 9.00
The Information and Communication Technology System	Transformable	From 1 to 10. 8.60
The Mathematical Model's Integration	IsApplicable	From 1 to 10. 8.72
The Decision Making System	Implementable	From 1 to 10. 8.80
The Knowledge Management System	Implementable	From 1 to 10. 9.00
The intelligent Resource Management System	Implementable	From 1 to 10. 8.20

Evaluate First Phase

Figure 18. The CSFs selection from the client

Afterwards, the KPIs are selected and weighted, as shown in Figure 19 (concerning the abbreviations, the reader needs to refer to the abbreviation chapter related to this research project), then these values are stored in the CSAs/CSFs *TKM&F's* scripts; then the EAP4PoC's second phase can be conducted.

As shown in Figure 20, The aMS uses the *TKM&F's* functional language development environment to configure the DMS/AI, it uses the Holistic CSF Management System (HCSFMS) to select problems, actions and applicable solutions for the aMS. The ACS is a concrete case where the demo application is used (Trad & Kalpić, 2018c).

Phase 2

Phase 2, is implemented using the *TKM&F*, which was also developed exclusively by the authors, who own the total copyrights. The EAP4PoC's Phase 2 presents the problem solving mechanics, which interfaces the DMS that uses the mixed heuristic methods based on services-oriented microartefacts, having bindings/mappings to specific *Projects* resources like CSFs, as shown in Figure 21.

Mappings and Microartefacts

The used microartefacts are designed using EA methodologies and related tools; these microartefacts are built on service based architectures and their integration's success can be measured by using CSFs (Aier, Bucher, & Winter, 2011). The *TKM&F* sets up the relationships between the *Projects* CSAs, CSFs, KPIs, requirements and services-based microartefacts, using global unique identifiers, as shown in Figure 22.

The *Project* is started by structuring the organisation and linking it to the global unique identifiers by using the client's interface that is shown in Figure 23.

Figure 19. The weightings and performance values

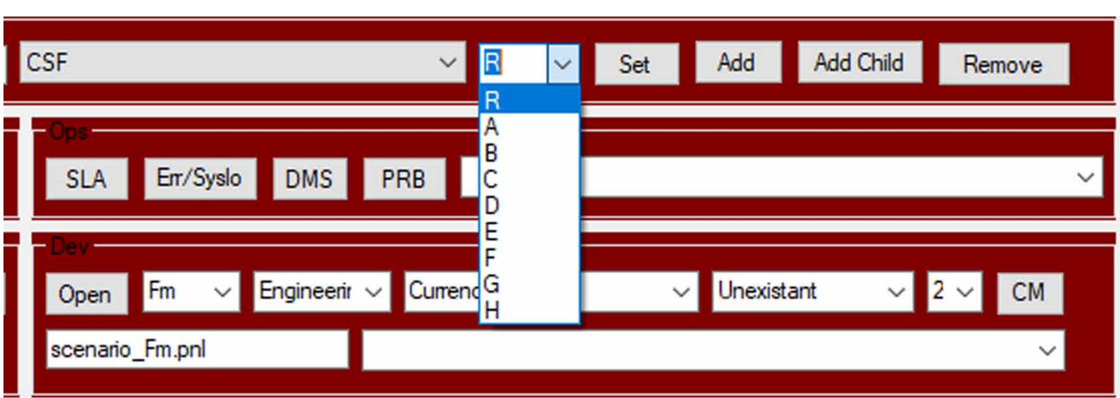
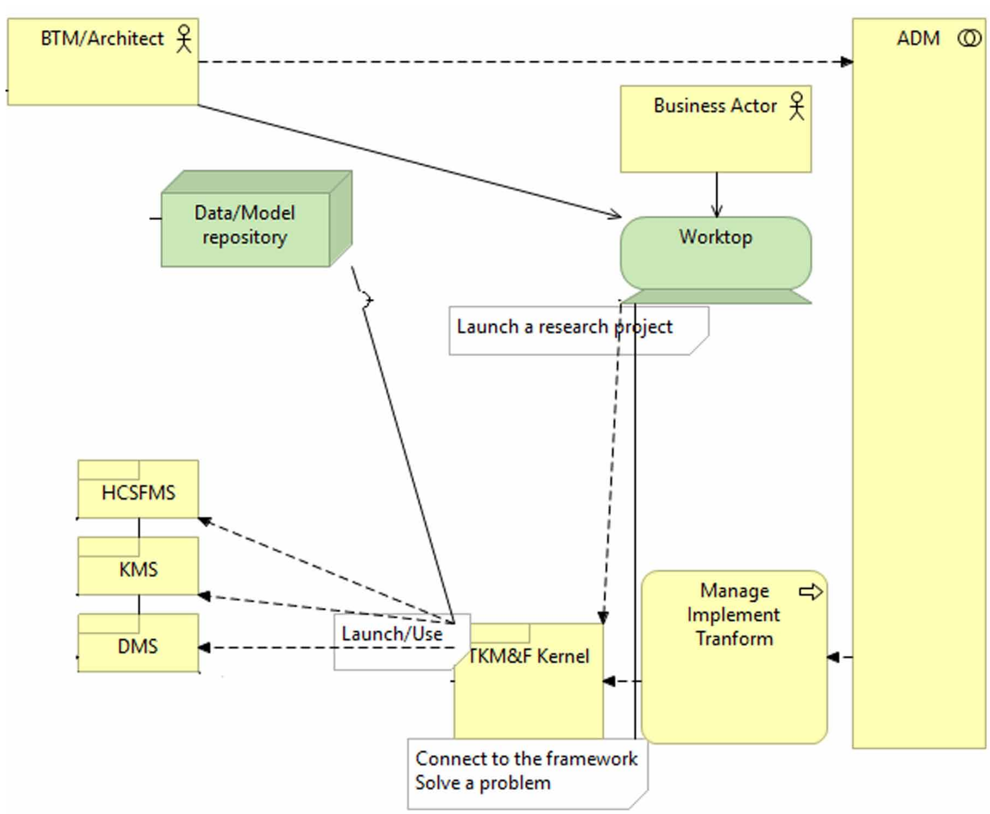


Figure 20. The phase 2 interactions with factors, between all the components to enable problems solving



Once the development setup interface is activated, the scripting language interface can be launched to implement the needed microartefact scripts to process the defined six CSAs. After starting the *TKM&F's* graphical interface, the sets of CSFs are selected. Then follows the CSF attachment to a specific node of the *TKM&F's* graphical tree, as shown in Figure 24 (where Phase_R, is an ADM phase); to link later the microartefacts.

From the *TKM&F* client's interface, the Mathematical Language (ML) development setup and editing interface can be launched to develop the aMS services to be used in microartefacts. These scripts make up the intelligence basis and the HMM's instance set of actions that are processed in the background to support aMS services to be used in microartefacts. The HMM uses aMS services that are called by the DMS actions, which manage the edited mathematical language script and flow. This research's architecture pattern instance, the HMM and its related CSFs were selected as demonstrated previously, for the ACS.

Linking the Applied Case Study - Architecture Unification

The architecture pattern and ACS are used in the EAP4PoC, which is an experiment (Lebreton, 1957; Ronald, 1961; Spencer, 1955). The ACS is an insurance management system that has an archaic information system, a mainframe, claim files service, customer file service. The ACS manages claims activities where the demo application uses the *TKM&F* for the ACS/PoC implementation (Trad & Kalpić, 2018c). The *Project* major achievement is the introduction of microartefacts.

Figure 21. The TKM&F services based microartefacts concept

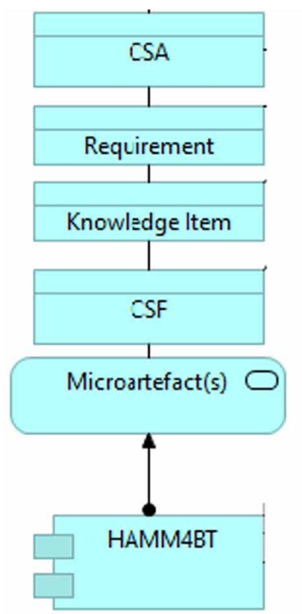


Figure 22. The global unique identifiers interaction

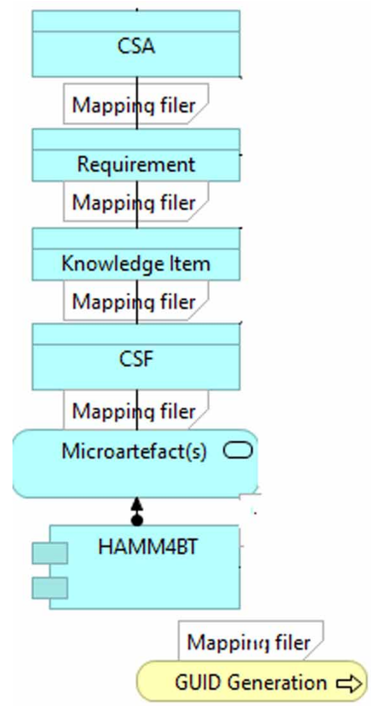


Figure 23. The TKM&F's client interaction

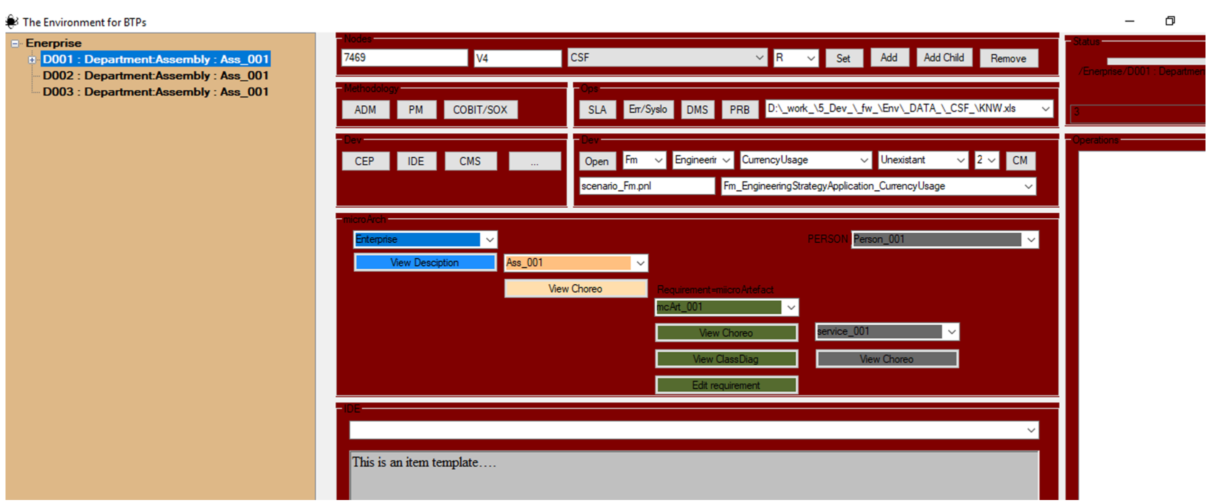
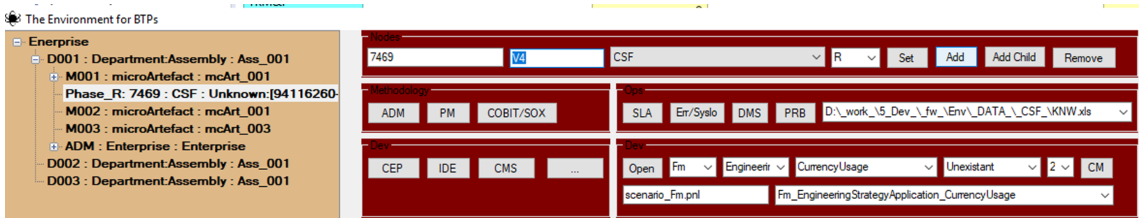


Figure 24. The TKM&F's factor setup interface



This EAP4PoC based on the ArchiSurance ACS; analyses a merger, of an old business system's landscape that has become siloed, that results in abundant data and code, knowledge redundancy, functional overlap and archaic integration, using many formats and technologies. For this EAP4PoC, a holistic approach is tested to structure the aMS data using the central data. The data repository structure has to be transformed and to improve data storage and the common use of applications bias data services consistency, quality and robustness, as shown in Figure 25 that can be considered as the CSA set for Phase 2; which has to be assisted by an architecture method.

The Architecture Method's Phases' Setup and Related Factors

The Phase 2 implementation setup looks as follows:

- Sub-phase A or the Architecture Vision phase's goals, establishes a data architecture; as shown in Figure 26.
- Sub-phase B or the Business Architecture phase shows how the EAP4PoC target architecture realizes the key requirements.
- Sub-phase C or the Gap Analysis phase shows and uses the Application Communication Diagram, which shows the modelled target application landscape.
- Sub-phase D or the Target Technology Architecture and Gap Analysis phase shows the end EAP4PoC infrastructure; where here is limited.
- Sub-phases E and F, Implementation and Migration Planning; the transition architecture, proposing possible intermediate situation and evaluates the EAP4PoC status.

The data services based microartefacts have bindings/mappings to specific aMS resources. The used microartefacts are designed using EA methodologies and related tools. The aMS concept defines relationships between the aMS requirements and data services based microartefacts (and CSAs/CSFs).

Processing a Concrete Node

The hyper-heuristics approach is used, in order to find a combination of heuristics that solve a complex research question. A specific CSF is linked to a problem type and a related set of actions that starts to be processed at a specific node. For this EAP4PoC, the authors have selected the CSF_aMS_SystemsIntegration taken from the Table 7 or aMS CSA and would like to find solutions related to this CSF's related problems. Such problems can be only researched with a mixed-model that is very similar to the

Figure 25. Transformation goals (Jonkers, Band & Quartel, 2012)

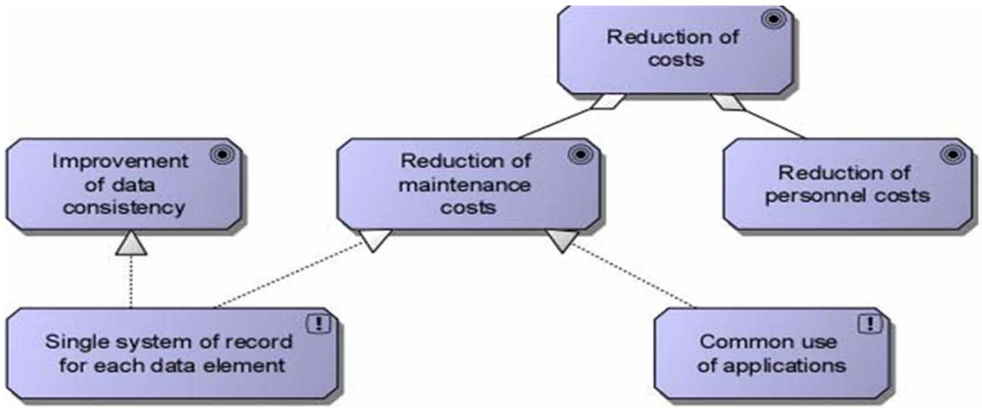
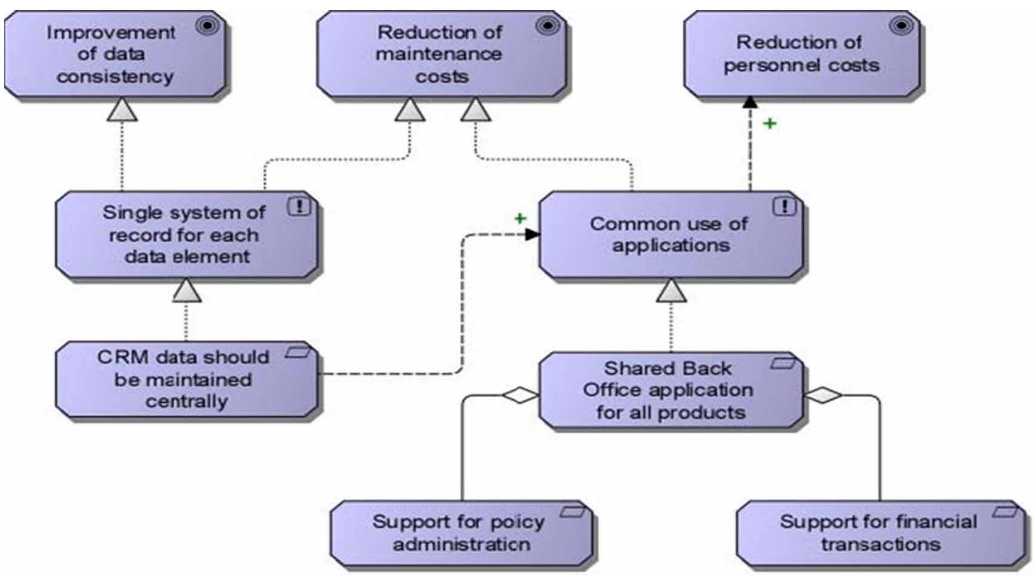


Figure 26. Data goals and principles (Jonkers, Band & Quartel, 2012)



(re)-scheduling of activities model. Solving the given problem involves the determination of actions and related solutions for multiple activities for the ICS integration team. These mixed models are based on quantitative analysis, beam search and grounded hyper-heuristics; that is in fact a dual-objective DMS (McMullen, & Tarasewich, 2005). The authors have decided to apply the DMS to try to solve the CSF_aMS_SystemsIntegration architecture unification problem or the PRB_aMS_SystemsIntegration (Vella, Corne, & Murphy, 2009), which is solved by using the following steps:

- Relating the ACS architecture unification resources to CSF_aMS_SystemsIntegration that is done in Phase 1.
- Link the processing of this node to the pseudo-quantitative modules, then by using qualitative modules, filter and deliver the initial state that is the root node of the DMS decision tree.

- The DMS heuristics engine is configured, weighted and tuned using configuration information.
- The set of possible solutions results from the hyper-heuristics decision model. The DMS starts with the initial CSF_aMS_SystemsIntegration. Then the DMS is launched to find the set of possible solutions in the form of possible improvements.
- Then follows the CSF attachment to a specific node of the *TKM&F's* graphical tree; to link later the microartefacts.
- The DMS tree (or the qualitative/hyper-heuristics decision tree) is a beam search heuristics model that uses the input from the previous phases to propose an optimal solution by using a common data bus.
- Once the development setup interface is activated, the ML interface can be launched to implement the needed microartefact scripts to process the defined six CSAs. After starting the *TKM&F's* graphical interface the script and its sets of CSFs are selected, as shown in Figure 27.
- From the *TKM&F* client's interface, the ML development setup and editing interface can be launched to develop the data services to be used in microartefacts.

Node Solution

These scripts make up the intelligence basis and the HMM's instance set of actions that are processed in the background to support data services to be used in microartefacts. The HMM uses data services that are called by the DMS actions, which deliver the solution and flow, as shown in Figure 28.

This research series, the HMM and its related CSAs/CSFs were selected as demonstrated previously, and are shown in Figure 29.

Figure 27. The mathematical scripting environment

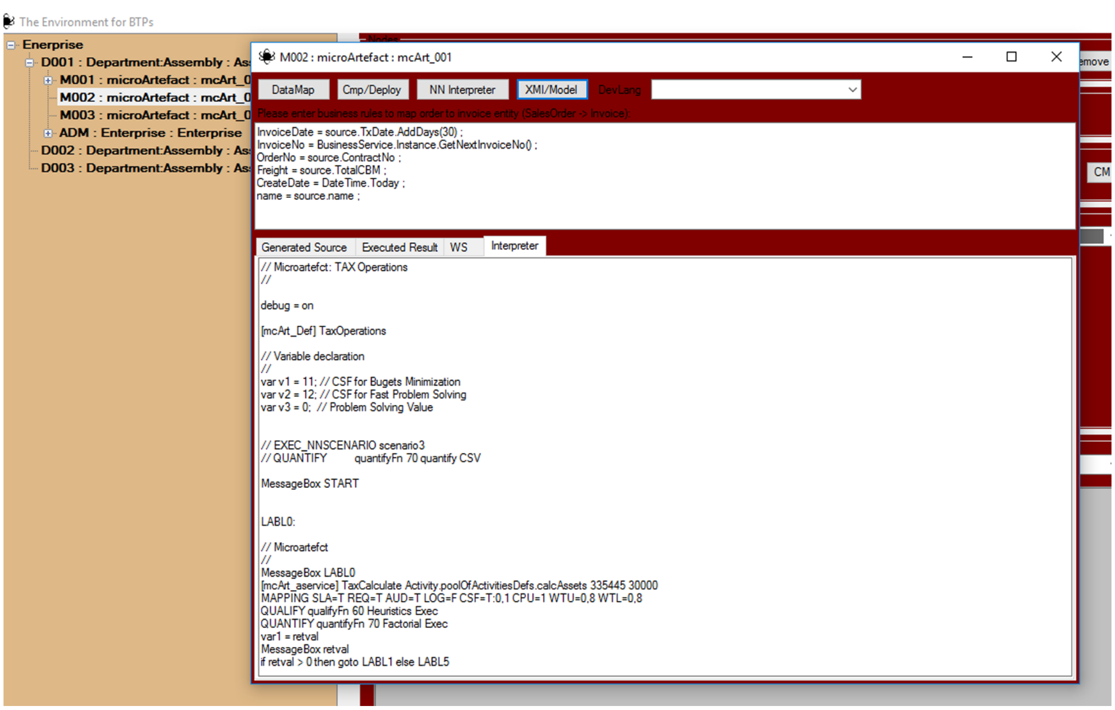


Figure 28. The heuristics tree configuration

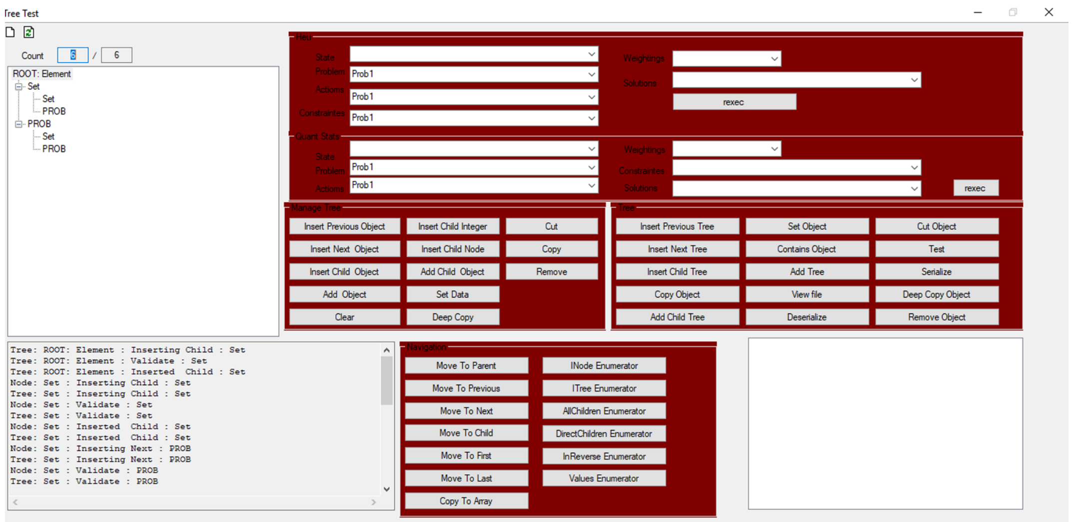
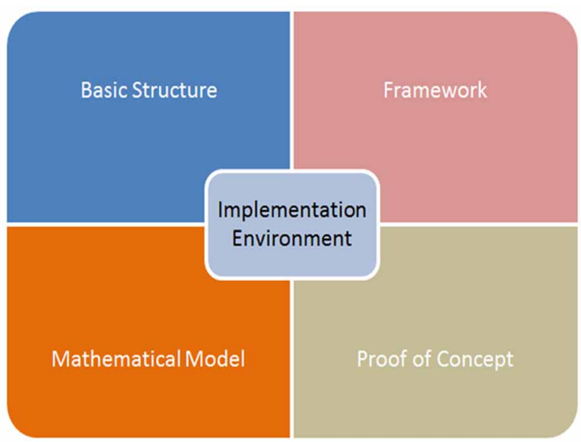


Figure 29. The TKM&F's components' interaction



SOLUTION AND RECOMMENDATIONS

The *Manager* is responsible for the implementation of complex *Projects* using architecture pattern, RDP and their corresponding EAP4PoC, where he should have a solid background in architecture patterns/ DMS based aMS. The managerial recommendations are needed for finding the solutions to enable an aMS. The resultant technical and managerial recommendations are:

- The aMS feasibility was checked by the EAP4PoC.
- The ADM's integration in an aMS enables its automation and automation of its interfaces.
- Setup a central aMS to be used in *Projects*.
- Define the interface to the aKMS and DMS. The aMS needs to implement a DMS.

- Model the aMS' and microartefacts' interaction.

aMS managerial recommendations, and the *TKM&F*, round up the approach needed for the complex research activities related to management of resources.

FUTURE RESEARCH DIRECTIONS

This EAP4PoC and related topics, appear to be undiscovered and in fact are very complex, because many of them are based on intangible values that are complex to formulate. Such formulations should be abstracted using the proposed mathematical model. The goal is also to localize fictive bookkeeping or banking secrecy deviations that block real evaluation and promote plundering.

CONCLUSION

This aMS is based on the *TKM&F* unique mixed research model; where CSFs and CSAs are offered to help aMS and *Managers* and resource (and assets) architects to minimize the chances of transformation related failure; while implementing an aMS (or a *Project)*. This chapter is part of a series of research works related to *Projects*, using DMS/AI and aKMS, based on an HMM structure. In this chapter that is a part of a research series, the focus is on the aMS that defines a central pool of CSAs/CSFs to be used throughout all the *Projects* and including subsystem, the aMS. The Phase 1 proved the feasibility and Phase 2, demonstrated the ability to solve a concrete problem, abstracted by the ACS' architecture unification requirement. The most important managerial recommendation that was generated by the previous research phases was that the *Manager* must be a strong leader and must have in-depth knowledge of transformation projects, enterprise architecture projects, research projects, PoCs and aMS. The *TKM&F* can support an aMS (and *Projects* in general) by using the DMS (and EAP4PoC) to check the feasibility and to deliver a set of managerial recommendations. Concerning financing and preserving resources and assets, it is strongly recommended to implement an aMS to avoid any type of approach or models that would allow looting (Trad & Kalpić, 2019g).

ACKNOWLEDGMENT

In a work as large as this research project, technical, typographical, grammatical, or other kinds of errors are bound to be present. Ultimately, all mistakes are the authors' responsibility. Nevertheless, the authors encourage feedback from readers identifying errors in addition to comments on the aMS and the *TKM&F* in general. It was our great pleasure to prepare this chapter and its experiment. Now our greater hopes are for readers to receive some small measure of that pleasure and support for his project.

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KEY TERMS AND DEFINITIONS

ADM: Architecture development method.
CSA: Critical success area.
CSF: Critical success factor.
DMS: Decision-making system.
HMM: Holistic mathematical model.
ICS: Information and communication system.
KMS: Knowledge-management system.
Manager: Business transformation manager.
Project: Business transformation project.
RDP: Research and development projects.
RQ: Research question.
TKM&F: Trad Kalpić methodology and framework.
TOGAF: The Open Group's architecture framework.

Chapter 15
An Applied Mathematical Model for Business Transformation and Enterprise Architecture:
The Resources Management System Proof of Concept (RMSPoC)

ABSTRACT

The RMSPoC supports business transformation projects (BTP) and enterprise architecture projects (EAP) (or simply projects). This chapter is supported mainly by an adapted fictitious case from the insurance domain. The uniqueness and market lead of the authors' proposed HMM promotes a holistic cohesive enterprise architecture and implementation model that supports complex projects integrations using PoC, in this case the RMSPoC. The intelligent resources management system (RMS), which is described in a separate chapter, and decision-making system (DMS) are used in day-to-day business and technology problem solving. In this chapter, the proposed solutions (or cluster's model) are supported by a real-life case of a project methodology in the domain of resources management that in turn is based on the alignment of various business and technology standards and avant-garde methodologies.

INTRODUCTION

This chapter on resource management systems is the last chapter of a cluster of research chapters on resources management, this one is about the Proof of Concept (PoC). The research cluster as a model that can be used in the context of various types of business, resources management, financial and technical transformation projects, is a conclusion of many years of research, architecture, consulting and development efforts, based on a Holistic Mathematical Model or an Applied Holistic Mathematical Model for Business Transformation (that in the authors' previous articles were labelled as HMM and AHMM4BT, respectively; these terms can be encountered in some of the authors' related research works). The HMM can be instantiated and then used as a basic and static structure of transformation, reengineering and Enterprise Architecture (EA) projects. Resource management, transformation and EA projects, where

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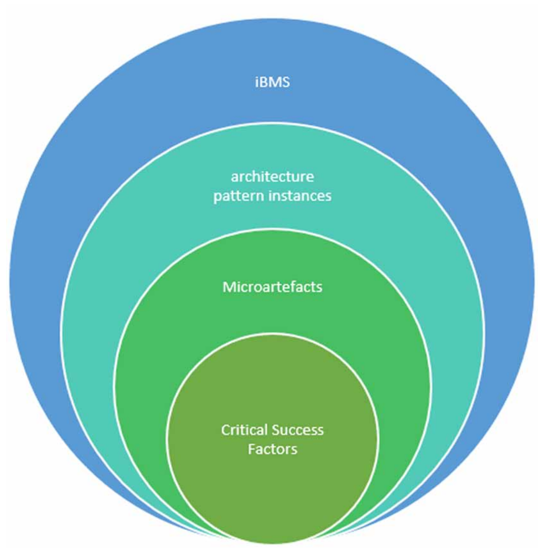
the immense influence of Artificial Intelligence (AI) and information technology is a fact, can be designed and managed using Critical Success Factors (CSF) subsystem (Trad & Kalpić, 2018a, 2018b). In this chapter, the CSFs are selected and tuned to optimize the target organization's resource/wealth creation/management and integration (Putri & Yusof, 2009) in the form of an applied pattern that is also a part, or a chapter in this research cluster (Trad & Kalpić, 2019e). This cluster's chapter that is related to the feasibility prototype, presents the Resources Management System Proof of Concept (RMSPoC) that should (or shouldn't) prove whether transformation projects can optimize resources creation and or management in a transformed enterprise system.

That is normally the result of research, design and development on: 1) business and technical resources case studies; 2) resources management and optimization; 3) continuous business transformations; 4) applied mathematics/models represented in the HMM; 5) software architecture and modelling; 6) business architecture and engineering; 7) financial intelligent analysis (and not bookkeeping for looting); 8) decision making systems and AI; and 9) integrated enterprise architecture. The RMSPoC is based on an authentic and authors' proprietary research method that is supported by an underlining mainly qualitative holistic reasoning module that is explained in this cluster's research and development project management (Trad & Kalpić, 2019b). It is an AI based empirical process that uses a natural language environment, which can be easily adapted by the project teams (Trad & Kalpić, 2019b; Myers, Pane & Ko, 2004; Kim & Kim, 1999; Della Croce & T'kindt, 2002; Trad & Kalpić, 2017a, 2017b, 2017c, 2017d; Gunasekare, 2015). The RMSPoC is implemented to check feasibility of the cluster using the HMM approach. The RMSPoC supports Business Transformation Projects (BTP) and Enterprise Architecture Projects (EAP) (or simply *Projects*). This chapter is supported mainly by an adated fictious case from the insurance domain (Jonkers, Band & Quartel, 2012a). The uniqueness and market lead of the authors' proposed HMM, promotes a holistic credible, cohesive enterprise architecture and implementation model that supports complex *Projects* integrations using PoC; in this case the RMSPoC (Farhoomand, 2004). The intelligent Resources Management System (iRMS), which is described in a separate chapter (Trad & Kalpić, 2019f), and Decision Making System (DMS) are used in a day to day business and technology problem-solving. In this chapter, the proposed solutions (or cluster's model) are supported by a real-life case of a *Project* methodology in the domain of resources management that in turn is based on the alignment of various business and technology standards and avant-garde methodologies. The "i" prefix, which will be used later in this text, does not stand just for the common intelligent agile environments but for a distributed and holistic intelligent resource system's approach that identifies this work's background; and "r" will stand for resources. This research project's main and overall keywords are: 1) RMSPoC and iRMS; 2) Enterprise Architecture; 3) Business Transformation Project; 4) Business Transformation Manager; 5) Applied Mathematical Model; 6) Neural Networks; 7) Holisms; 8) Risk Management; 9) Decision Making Systems; 10) Artificial Intelligence; 11) Knowledge Management Systems; and 12) Transformation and Innovation. Using the scholar engine, in Google's search portal, in which the authors combined the previously mentioned keywords and key topics; the results have shown very clearly the uniqueness and the absolute lead of the authors' methodology, research and works (Trad & Kalpić, 2019b). From this point of view and facts, the authors consider their works on the mentioned topics as successful and useful; so the main topics will be introduced. HMM for *Projects* uses a natural language development (and simulation) environment that can be adopted by any *Project,* and for that goal the authors propose to use the RMSPoC that can be instantiated (in n instances) by an iRMS, as shown in Figure 1 (Myers, Pane, & Ko, 2004; Neumann, 2002).

Figure 1. The relation between the resource pattern and resource management system



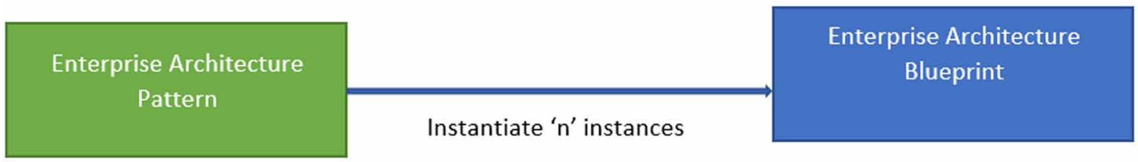
The RMSPoC is (or can be) supported by a central HMM based DMS and any type of Enterprise Architecture Projects (EAP); it can be of any type in addition to the one proposed by the authors. The RMSPoC is based on a concrete business case; where the central point is the transformation process of the existing legacy resources system into a modern iRMS. Such *Projects* are managed by the Business Transformation Managers or an Enterprise Architecture Manager (simply a *Manager*); who, in this case, are supported with a methodology and a framework that can estimate the risks of implementation of such *Projects'* iRMS.

The iRMS-related research cluster is made up of four inter-related research chapters that should be read in the proposed order:

- The Resources Management Implementation Concept (RMIC). It shows all the subjects that are related to this RDP Cluster (RDPC), as shown in Figure 2.
- The Holistic Project Resources Management Pattern (HPRMP)is a chapter describing the structural pattern that can be instantiated to create the iRMS.
- The Resources Management Research Development Project (RMRDP) is a chapter (Trad & Kalpić, 2019d) describing the RDP for the iRMS and its RMSPoC.
- The Resources Management Proof of Concept (RMPoC) is the current chapter. It describes the PoC and explains all the steps that are needed to check the iRMS' feasibility. The RMSPoC is this cluster's introductory chapter

The *Manager* is responsible for the implementation of complex *Projects* using the cluster that is made out if, HPRMP, RMRDP and their RMSPoC; where the RMSPoC supports him or her (for simplicity, in further text – him) in a just-in-time manner in the area where he should have a solid background in DMS based HPRMP based iRMS implementations (Trad & Kalpić, 2016b), which is the topic of the next section.

Figure 2. The relation between the resource pattern, resource management system and the research/ development project



BACKGROUND

The stub of a complex *Project* and its various subsystems, like the iRMS, are the roles of the *Manager*, EA blueprint and iRMS integration concept, which should be supported by the optimal transformation framework that ought to support a Global Resource Management Strategy (GRMS) model that in turn is checked by the RMSPoC. The GRMS model should be also capable of supporting the *Project's* executives, auditors, legal control and integration in a complex block-chained globalized business world; which is capable of recomposing itself. To achieve these goals, resources management, technology components, cultural, financial and logistics integration strategy factors should be classified in Critical Success Areas (CSA) categories containing CSFs, used to evaluate possible pitfalls and risks, to audit, assert, govern, automate, trace, monitor and to control the iRMS and its interfaces (Putri & Yusof, 2009). These *Projects* start with the unbundling process, initiated by an organizational reengineering process that is initiated by the RMSPoC supporting software. In Figure 3, we can see the creation of three departments corresponding to the Applied Case Study (ACS).

Once logged-in, the RMSPoC appears and is started as shown in Figure 4, showing the three initial departments; then the *Project* and its iRMS subprojects' CSFs can be configured to manage various activities in local and global eco-systems.

Figure 3. This research project's initial and log-in graphical interface

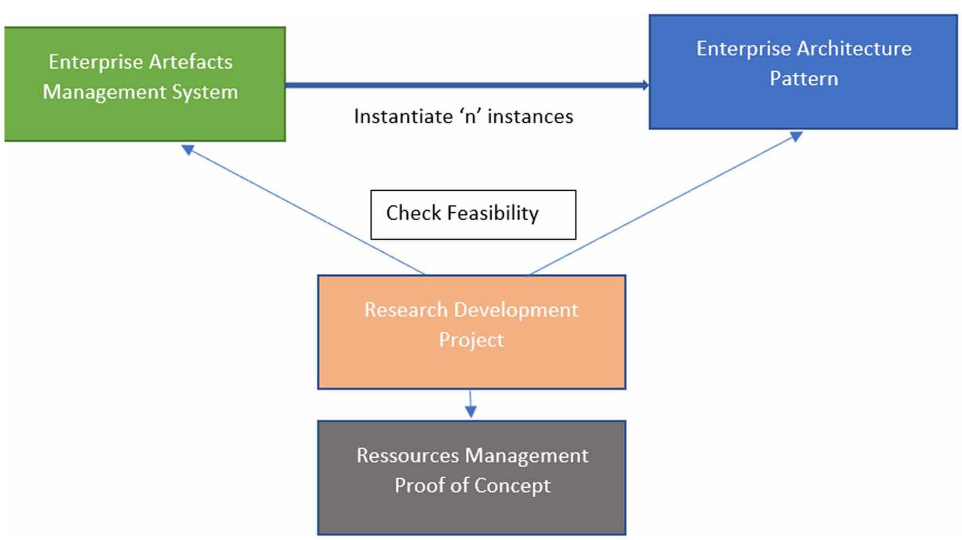
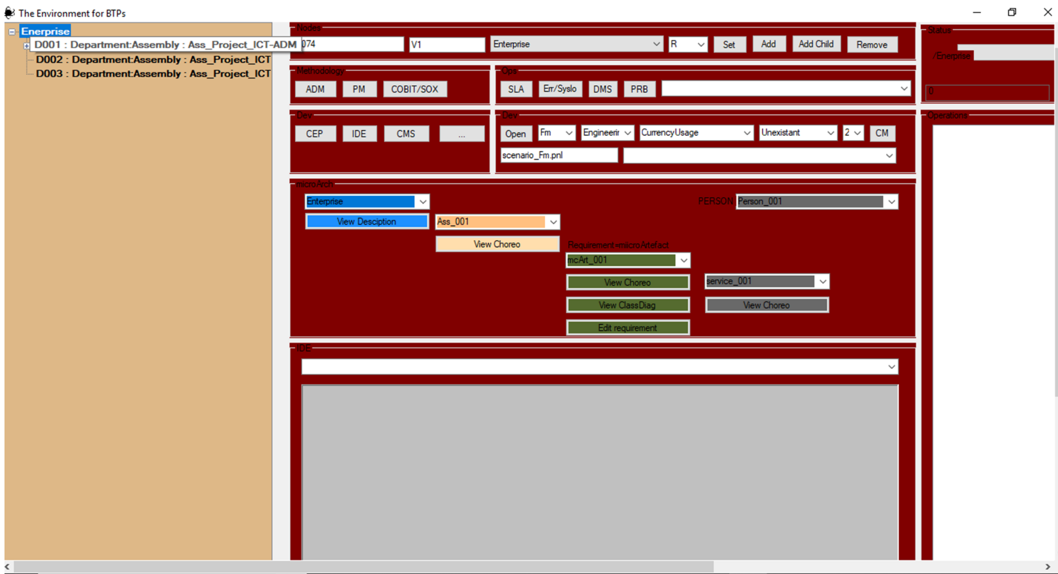


Figure 4. The framework's main graphical interface



A transformed iRMS must have support of built-in automated controls capable of recognizing major changes and requirements, as shown in Figure 5, where the main subsystems are linked to be used. *Projects* involve the complete digitization of iRMS processes, where automation enables new intelligent resources models to optimize their evaluation processes (Felfel, Ayadi, & Masmoudi, 2017). This research cluster that includes the Resources Management System's Research Development Project (RMSRDP) and its RMSPoC are considered as a pioneering and unique assembly in the form of a cluster, and actually or even unfortunately, there are no similar frameworks available. It confirms the authors' impression to have a lonely lead that might last more than the next 20 years, in proposing a feasibility check concept to be used for *Projects* in general, and to assist in their design and maintenance phases, which come after the finalization of the implementation phase.

This RMSPoC's background is related to risk evaluation of *Projects* in general and the iRMS, in this concrete case. The CSF-based RMSPoC is managed by the Trad Kalpić Methodology and Framework (*TKM&F*), and its interface is shown in Figure 5; where the reader has to the *TKM&F* user's guide to understand its structure (Trad, 2018a; Trad, 2018b). Figure 6 shows its main modules and components (Trad & Kalpić, 2018f). The RMSPoC CSFs are selected from various iRMS areas like resource categories, valuation, processes, technology, human skills …. and other..

In this chapter, the authors present in detail the RMSPoC that is the resources management cluster's experiment offering the details on how to apply the *TKM&F* and concludes with managerial, financial and technical recommendations, applied to various fields, like this cluster's iRMS or others, like Knowledge Management (KM), HMM, EA, information technology management, business transformation and other engineering fields. Integrating a RMSPoC and the GRMS, should be a fundamental and even strategic goal for *Projects* (Trad & Kalpić, 2018a, 2018b; Cearley, Walker & Burke, 2016).

The RMSPoC proposed in this chapter, presents the cluster's concrete part and the usage/integration of its main components that are based on: 1) a holistic approach, by interfacing various *Project* fields to access resources, using its interface presented in Figures 2 to 5; 2) it uses AI, DMS and risk manage-

Figure 5. The framework's main subsystems linking

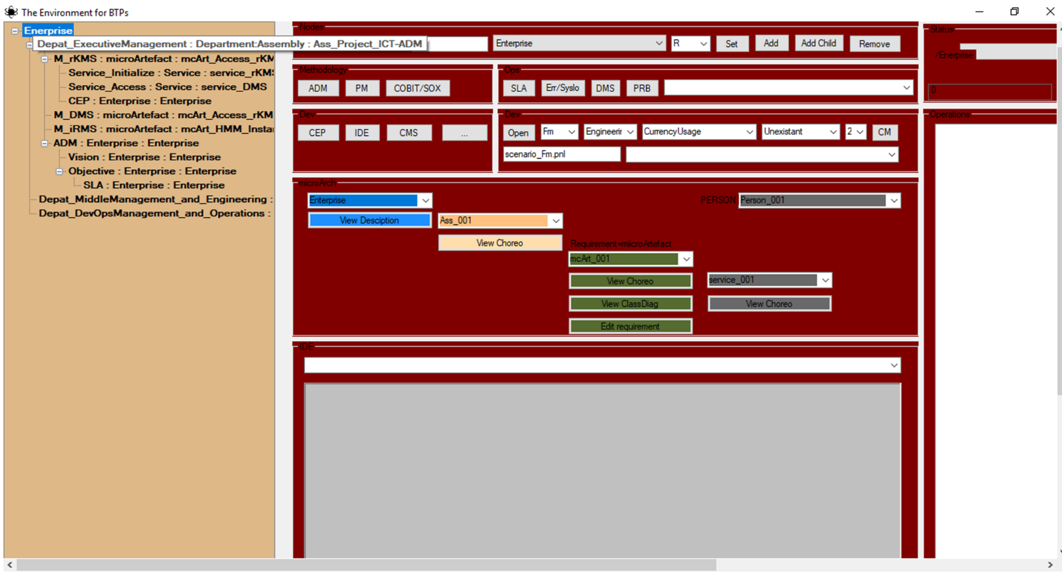
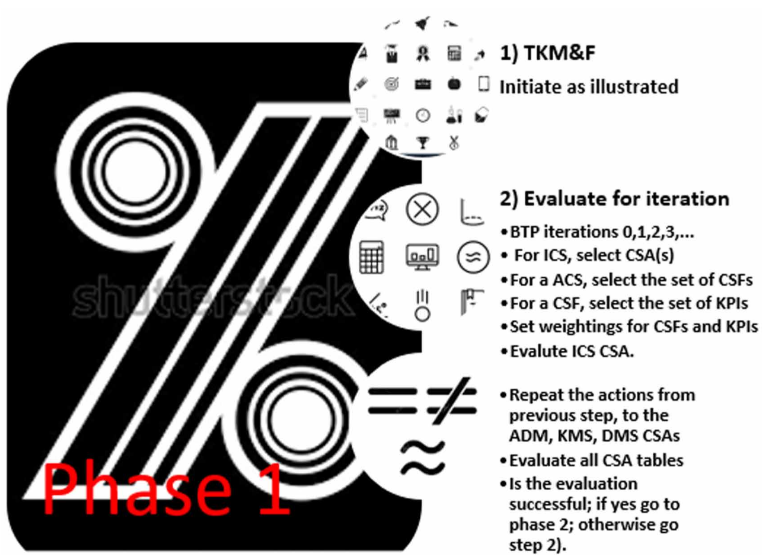
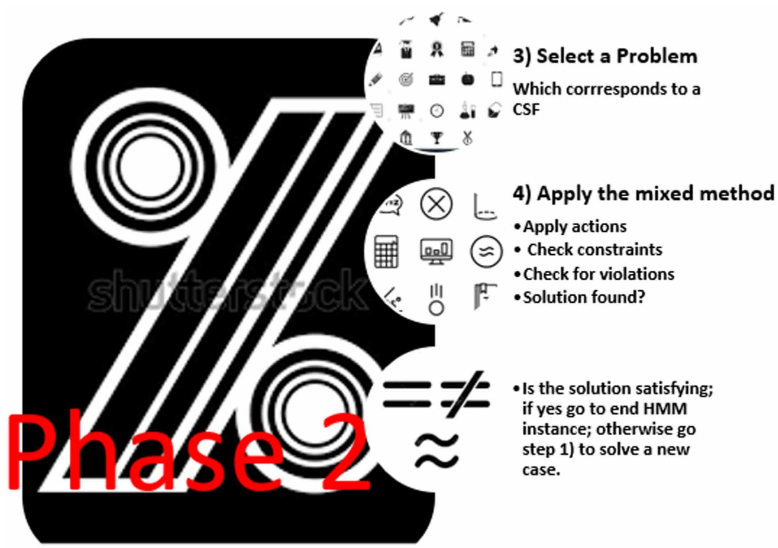


Figure 6. The research framework's concept (Trad & Kalpić, 2016a)



ment engine(s), using its structure is presented in Figure 6; 3) manages resources, using its structure, which is presented in Figure 6; 4) applies factors and categories and resources tracking; and 4) it uses the *TKM&F's* capabilities and its pool of patterns (Taleb & Cherkaoui, 2012). The DMS, iRMS and the introductory RMSPoC are based on the authors' Research and Development Project (RDP) (Trad & Kalpić, 2019d) method that in turn is based on intelligent neural networks (Trad & Kalpić, 2018a), where the RMSPoC is agnostic to any specific application, technical or business domain, as shown in Figure 7, and is based on the Architecture Development Method (ADM) (The Open Group, 2011a), but it can use any other existing architecture framework, like for example, Zachman's (Zachman International, 2019).

Figure 7. The architecture method's structure (The Open Group, 2011a)



In each of these phases some of the CSAs/CSFs are retuned depending on the phases context. For a concrete prototype, the *Manager* must choose an EA framework; and that is the *Project's* central interest to implement *Projects* and the iRMS, where the *Manager* or an enterprise architect use the RMSPoC to check the iRMS' integration feasibility (Trad & Kalpić, 2017b, 2017c; Thomas, 2015; Tidd, 2006). In *Projects*, the *Manager*'s role is important, and his design capabilities are needed for the RMSPoC setup to support a distributed web enterprise system, or a Holistic (e)Business/(e)Commerce Management System (HeBCMS) to be a commercial frontend of the iRMS (Trad & Kalpić, 2019c; Lanubile, Ebert, Prikladnicki, Vizcaíno, & Vizcaino, 2010); the ACS will be used as the HeBCMS or the RMSPoC's frontend.

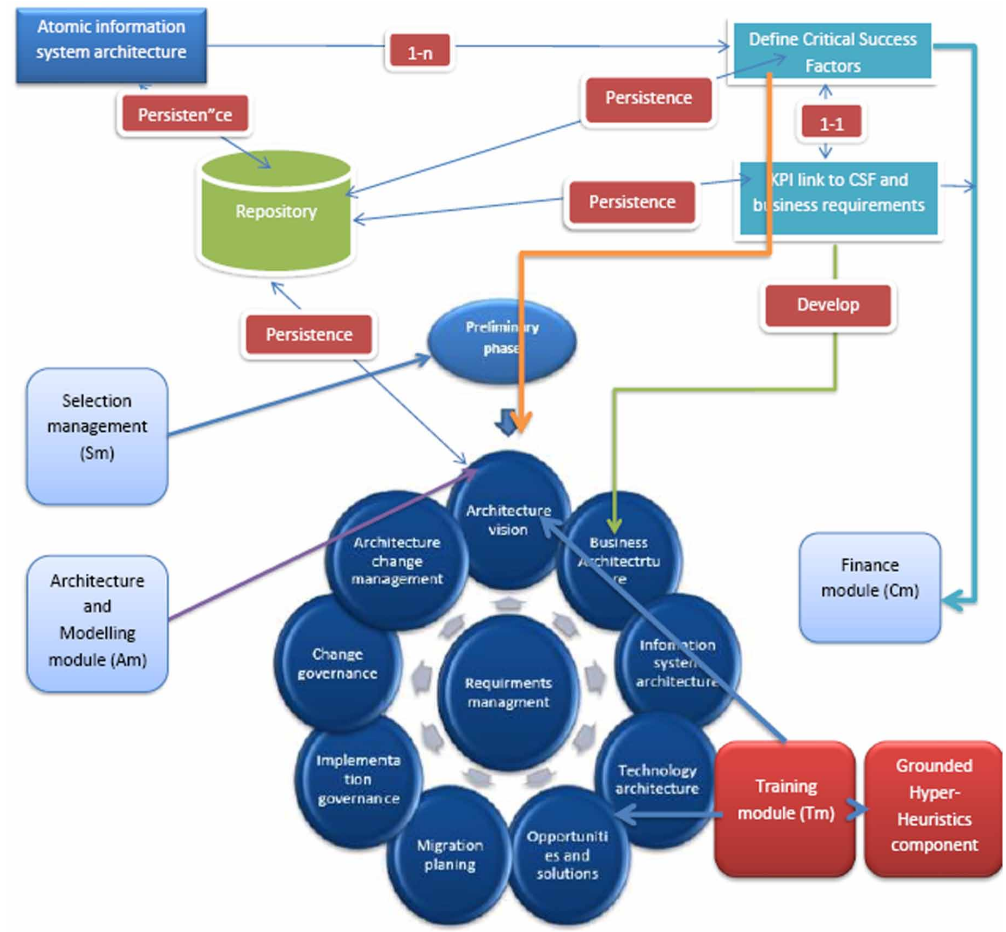
The RMSPoC, uses a systemic/holistic approach, where its application interface is the HeBCMS, as shown in Figure 8, where the DMS/AI interacts with the external world via the *TKM&F* to define and modify CSFs (Daellenbach & McNickle, 2005; Trad & Kalpić, 2016a). As shown in Figure 9, where the internals of CSF Management System (CSFMS) is presented; the CSFs are important for the phase 1 that qualifies the needed CSF set and decides whether there is a need for a RMSPoC; in most *Projects* that decision would be called *go or nogo* procedure.

Projects and their internal iRMSs are difficult to implement, because of their holistic, archaically distributed and complex nature, where the big part of complexity is met in their classification, technical implementation and integration phases and their CSFs (Gudnason & Scherer, 2012). As shown in Figure 10, CSFs are managed from the *TKM&F* client Graphical User Interface (GUI) by selecting the phase from the list box.

After selecting the CSF tag and its phase, the CSF is linked to a CSF item/Excel file where all the details are defined and as shown in Figure 11, in the Dev group-box the various weighting and ratings are setup.

Concerning the internal interaction details, as shown in Figure 12, the *TKM&F* can be applied to all types of *Projects* including the iRMS integration and usage of CSFs (Joseph, 2014).

Figure 8. Intelligent management system that uses an item/factor management system



The RMSPoC presents how to check the feasibility of an iRMS uses access to microartefact-based technologies (Sankaralingam, Ferris, Nowatzki, Estan, Wood, & Vaish, 2013). The RMSPoC, checks mainly the technical implementation phase, which is the major cause of high failure rates in *Projects*; because of the lack of a holistic approach and this fact is this work's focus (Thomas, 2015; Cearley, Walker & Burke, 2016; Trad & Kalpić, 2016b).

FOCUS OF THE ARTICLE

RMSPoC checks this research cluster's feasibility and proposes recommendations that can be applied by *Managers* and stakeholders for iRMS development and change management (Desmond, 2013). This RMSPoC, uses the RMSRDP that is based on the HMM which is a mixed methodology (Easterbrook, Singer, Storey & Damian, 2008); where this chapter presents an experiment of the iRMS integration and ties to roadmap the path to the iRMS feasibility through an experiment and Research Question (RQ) using a research process.

Figure 9. Interaction with critical success factors

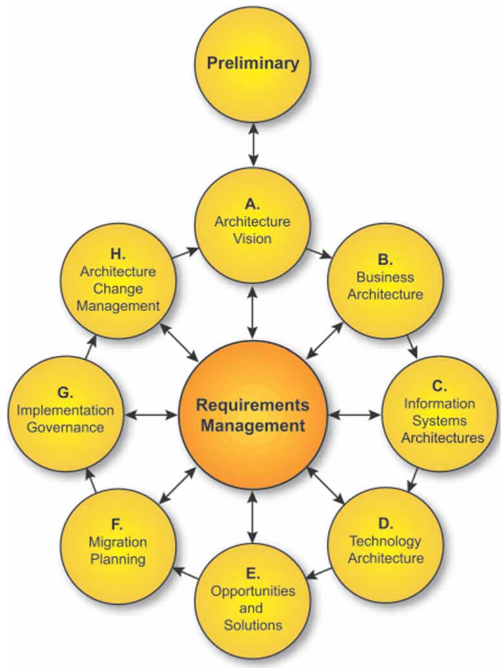


Figure 10. Interaction with factors in the framework

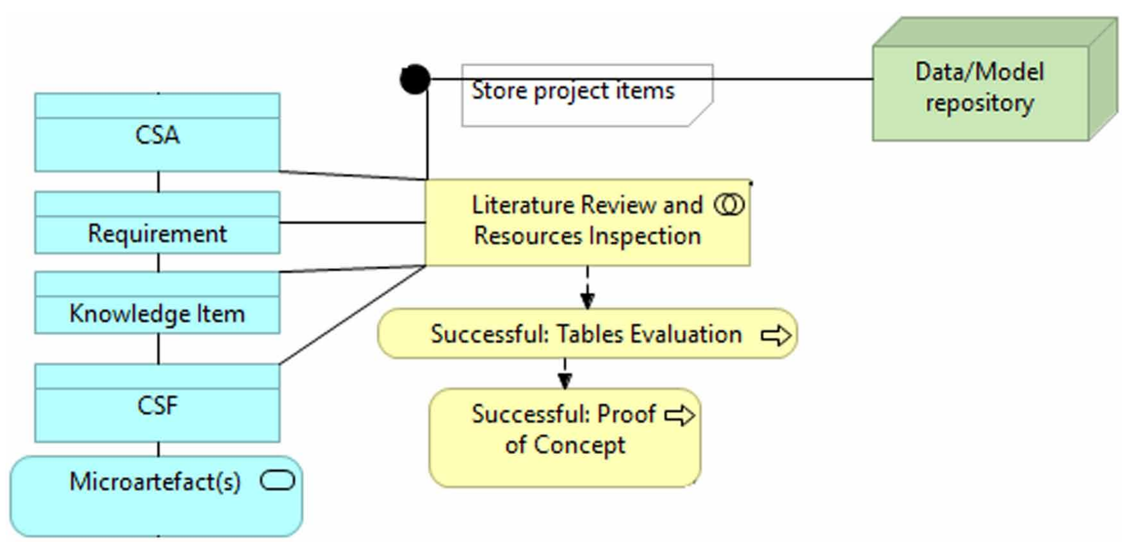


Figure 11. Tuning and linking factors

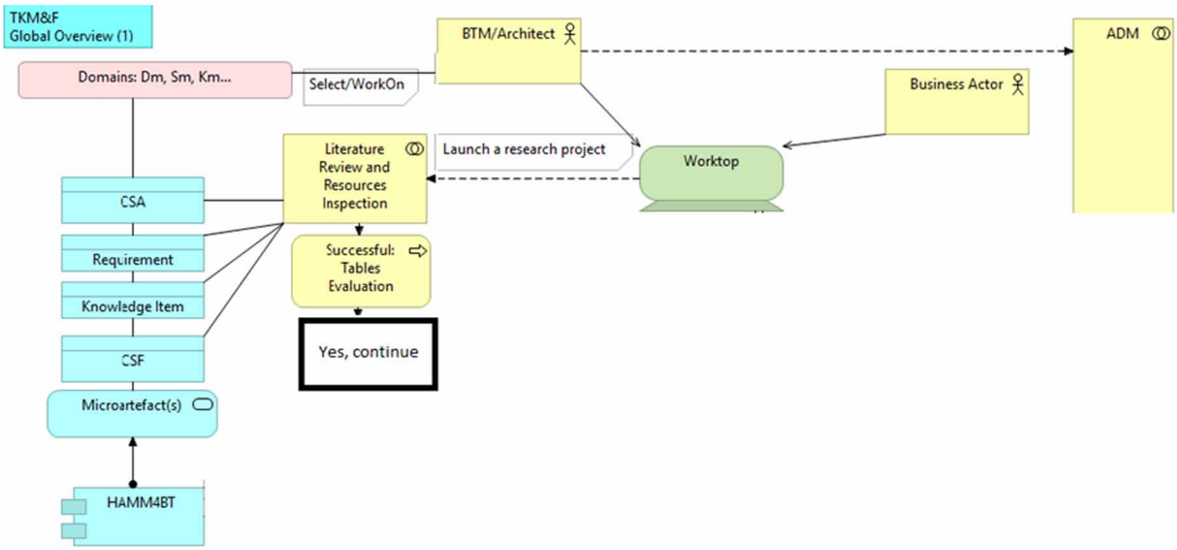
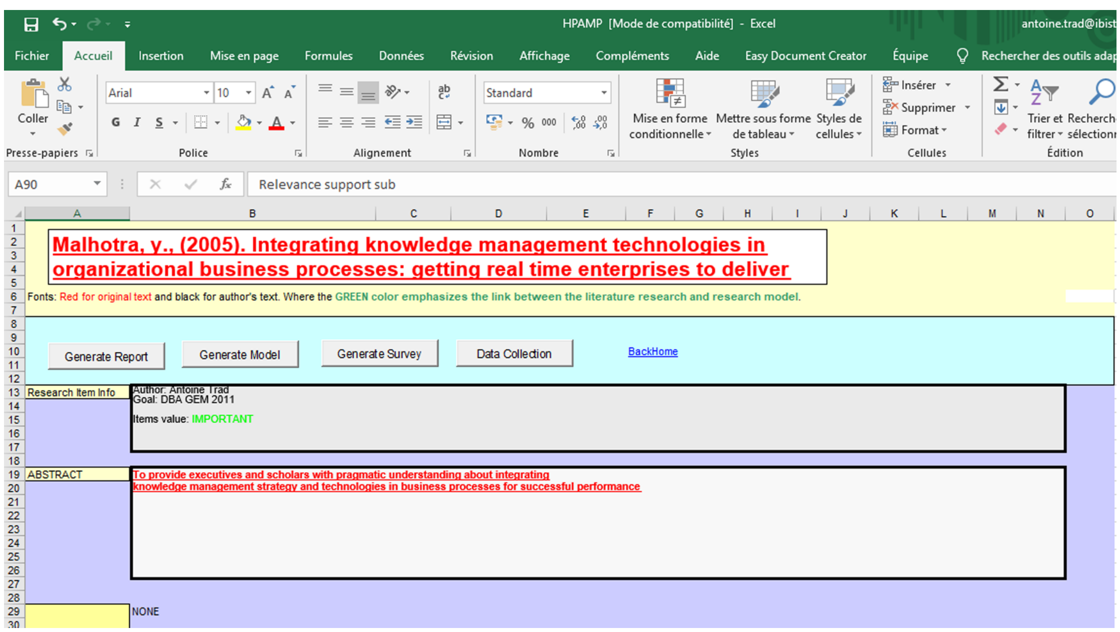


Figure 12. The Trad-Kalpić Methodology and Framework's flow and interaction, including factors



THE RESEARCH PROCESS

Projects failure rates are high and were constantly increasing (Bruce, 1994) what is due to the complexity encountered in the implementation phase (Capgemini, 2009); to enhance the success rate, the authors propose the *TKM&F* and PoCs, in the case the RMSPoC to check the feasibility and it can be considered as a pioneering approach. *TKM&F* recommends linking the HMM to all levels of the iRMS that is in the target level, as shown in Figure 13, where starts at its bottom of the pyramid, in the architecture vision phase (Trad & Kalpić, 2018b; Agievich, 2014; Tidd & Bessant, 2018). This chapter's RQ is: "Can a holistic research project check the feasibility of resource management system's implementation?"

The CSF-based RMSRDP instance would use the DMS/AI subsystem and unbundling levels that are parts of the *TKM&F* (Trad, 2018a; Trad, 2018b, Trad & Kalpić, 2019d). As shown in Figure 14, the RMSRDP (or RDP), coloured in brick-orange interfaces the cluster's various parts; include the RMSPoC that uses an ACS (Jonkers, Band & Quartel, 2012a).

THE BUSINESS CASE

Information and Communication Infrastructure

RMSPoC uses an ACS (Jonkers, Band & Quartel, 2012a), developed by the Open Group as a reference study for its Open Group Architecture Framework (TOGAF) environment, it presents the possibilities to implement *Project's* components and is related to an insurance company named ArchiSurance (Trad &

Figure 13. Levels of project's interaction (Trad & Kalpić, 2017b, 2017c)

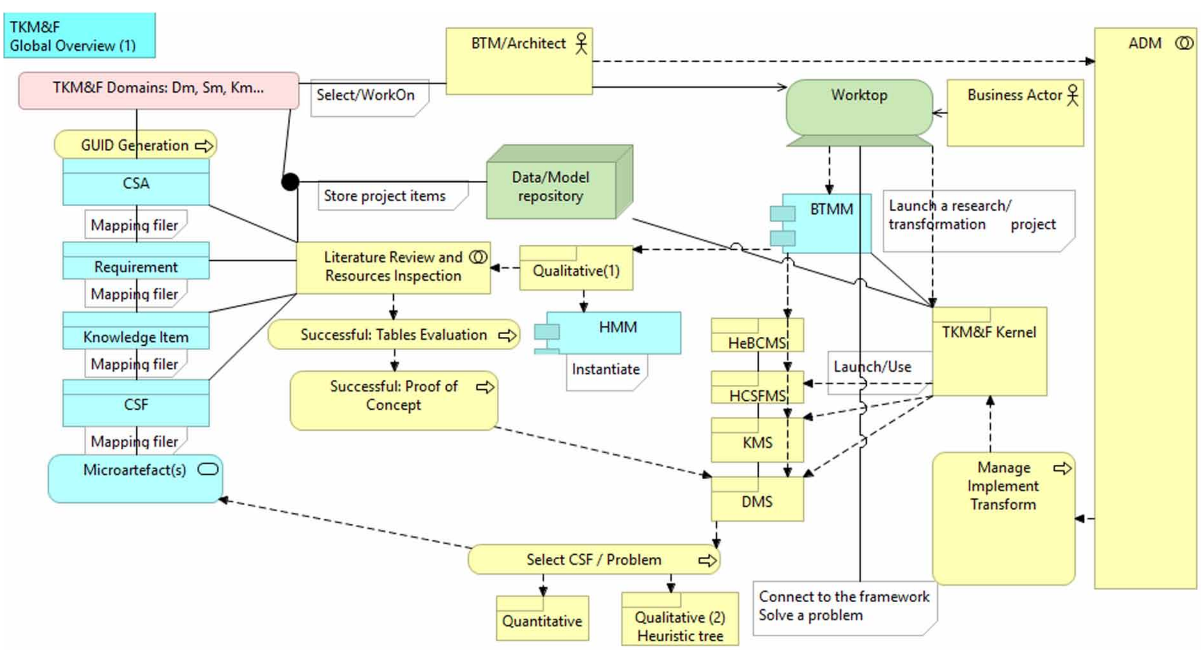
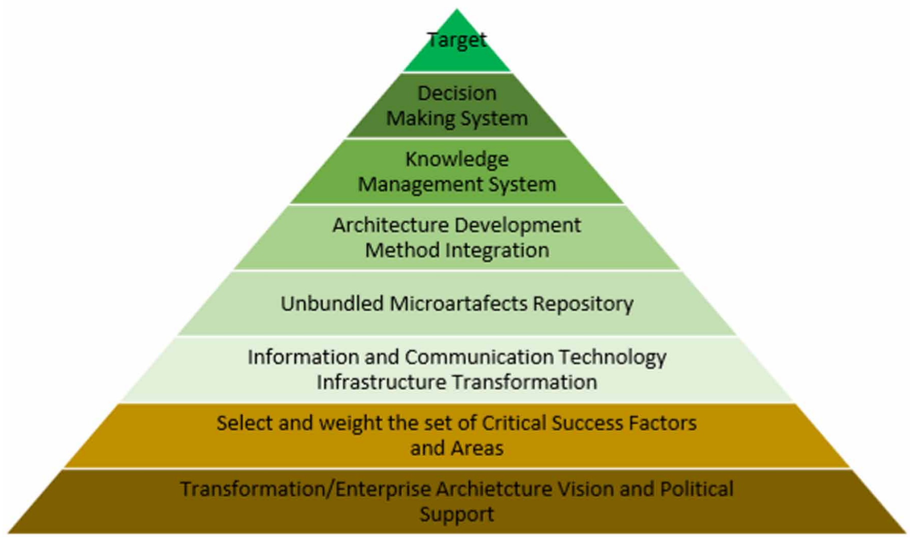


Figure 14. The research cluster parts or chapters and the proof of concept



Kalpić, 2018f); the authors recommend the readers to read the original ACS because it is used to check the iRMS feasibility. The iRMS, like actual avant-garde systems, uses Information and Communications Systems (ICS). Concerning the RMSPoC, the needed goals to be achieved:

- Offer an ICS feasible solutions.
- Design iRMS solutions, based on the HPRMP.
- Select a jump start objective from the ACS; and use as template architecture blueprint.
- Build resource microartefacts.
- Prepare *TKM&F's* phase one and if successful, select a problem from the ACS to prove phase two.

Managing the Business Case

HPRMP instances are used by the ACS, developed by the Open Group as a reference study for its own TOGAF, it presents the possibilities to implement *Project*'*s* components, like the iRMS, and is related to an insurance company named ArchiSurance (Trad & Kalpić, 2018f); which is used in the RMSPoC.

Integrating Critical Success Factors

A CSF its KPI enumerations are measurable and mapped to a weighting that is roughly estimated in the first iteration and then tuned through Architecture Development Method (ADM) iterations, to support the iRMS; where holistic business and enterprise architecture CSFs are essential (Felfel, Ayadi, & Masmoudi, 2017); this process of evaluation is described in this cluster's RMSRDP (Trad & Kalpić, 2019d). The main issue here is how to define the RMSPoC goals to integrate iRMS and how to interrelate the different business, ICS and EA components; where the ADM is its skeleton (KPMG, 2014).

The Architecture Development Method and Projects

This RDP focuses on the design of *Projects'* integration and presents the influence of Holistic Project Asset Management Pattern (HPRMP) to support the iRMS and RMSPoC (Trad & Kalpić, 2019e). In the actual age of distributed intelligence, complexity, knowledge, economy and technology; permits HPRMP to offer a pattern that includes a hyper-heuristics tree that supports a wide class of problem types, and it is a major benefit (Markides, 2011), where the Decision Making System (DMS) supports the iRMS (Trad, Kalpić & Fertalj, 2002; Trad & Kalpić, 2014d). The *TKM&F's* parts must synchronize with the ADM that are shown in Figure 15, where the iRMS (or IRMS) and its internal components are interfaced in all the ADM phases.

The Business Case Study's Critical Success Factors and Link to the Next Applied Mathematical Model Section

Based on the CSF review process, the important business case's CSFs that are used and evaluated by the internal engine and are presented in to an associated chapter entitled: Business Transformation and Enterprise Architecture-The Resources Management Research and Development Process (RMSRDP) (Trad & Kalpić, 2019e). Based on the CSF review process, the important business case's CSFs are used and evaluated as explained below.

As presented in the RMSPoC section CSA, CSF and KPIs evaluation (Trad & Kalpić, 2019e) which for the possible operational CSAs, CSFs and KPIs, iRMS can be used in the ACS' CSAs/CSFs:

Here is an example for enumeration of CSFs: 1) Modelling; 2) Critical Success Factors; 3) References; 4) ArchitectureDevMethod; 5) Technologies; 6) Governance; 7) Transformation_TKM&F; and 8) Leading_Governance.

Figure 15. Business architecture phases (The Open Group, 2011a)

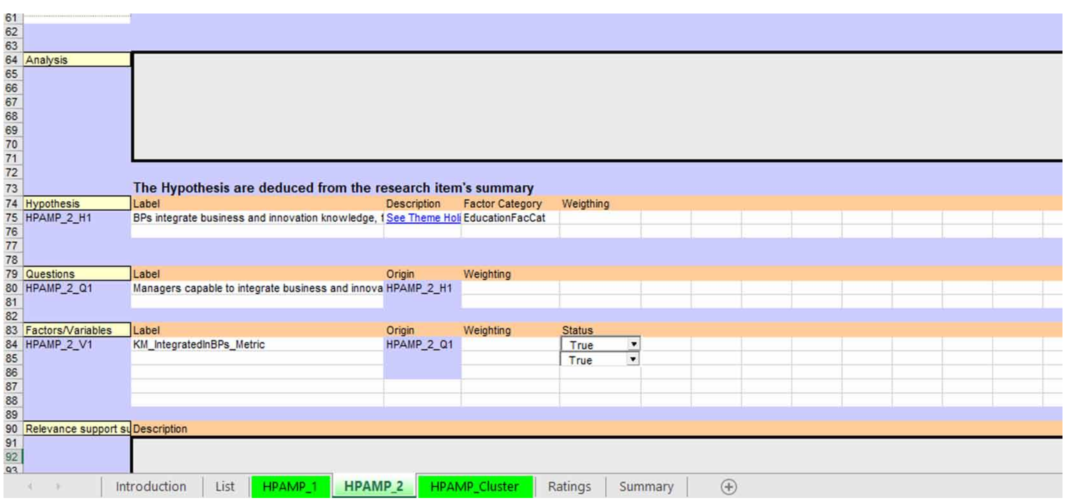


Table 1. The applied case study's critical success factors that have an average of 8.90

Critical Success Factors	KPIs	Weightings
CSF_ArchitectureCase_Modelling	Complex	From 1 to 10. **09 Selected**
CSF_ArchitectureCase_Factors	PossibleClassification	From 1 to 10. **10 Selected**
CSF_ArchitectureCase_References	Exists	From 1 to 10. **09 Selected**
CSF_ArchitectureCase_ArchitectureDevMethod	IntegrationPossible	From 1 to 10. **09 Selected**
CSF_ArchitectureCase_Technologies	AdvancedStage	From 1 to 10. **09 Selected**
CSF_ArchitectureCase_Governance	Advanced	From 1 to 10. **09 Selected**
CSF_ArchitectureCase_Transformation_TKM&F	IntegrationPossible	From 1 to 10. **10 Selected**
CSF_ArchitectureCase_Leading_Governance	Possible	From 1 to 10. **09 Selected**

valuation

KPIs are valid in all the chapter's CSFs and can also be illustrated as an enumeration: 1) Complex or ComplexToImplement; 2) PossibleClassification; 3) Exists or Existing; 4) IntegrationPossible; 5) AdvancedStage or AdvancedState; 6) Advanced; 7) IntegrationPossible; 8) ModeratelyComplex; 9) Feasible or Implementable; 10) Stable or Supported; 11) Standard or StandardIntegration; 12) IntgeratesAsKernel; 13) ManagementEnabled; 14) FullyIntegrated; 15) IsApplicable; and 16) Possible or Transformable.

The deductions are done by using the analysis of each CSA, an Excel Workbook (WB) is created, in which all its CSFs are stored and appear in Table's 1 column. As shown in Figure 16, the WB has scripts in the background that are automated to calculate the weightings and ratings; known as the KPIs and a value from the enumerated sets; and they are tuned and stored in column 2. This RMSRDP concept proposes a standardized and automated manner to evaluate literature reviews that is an evolution in regard to the very subjective method, which may or may not make sense, as shown in Figure 16. If the automated literature review's evaluation is successful, only then the experiment can be completed.

What is unique to the *TKM&F* and RMSRDP, is that it can automate complex RDPs in phase 1, and estimate the values for each selected KPI, as described in the Cluster's RMSRDP's CSA, CSF, KPI processing in the research section (Trad & Kalpić, 2019e).

As shown in Table 1, the results justify (because of the average of 8.90) the usage of the ACS and how it can be used with the final PoC or phase 2; and enables to go to the next CSA to be analysed that is the Holistic Mathematical Model's (HMM) integration. This section's deduction is that the HMM is crucial for the RMSPoC's credibility, where it is the basis for its structure.

THE APPLIED MATHEMATICAL MODEL'S FEASIBILITY

It is recommended to understand the chapter related to the RMSRDP to understand this section (Trad & Kalpić, 2019d). A generic *Project* model and its kernel ADM are the base of this RMSRDP and they are the basics of its *TKM&F*. The authors want to propose a mathematical model to represent the *TKM&F* global architecture and solve its integration problems . The literature review has shown that existing

Figure 16. The factors and areas (like HPAMP_1) of development workbook sheets

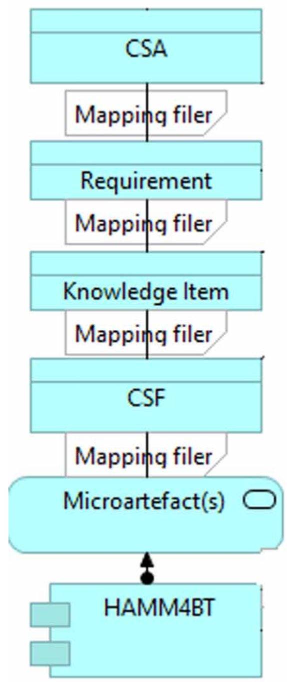
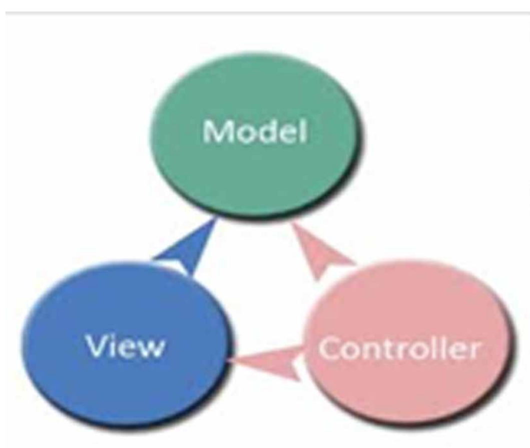


Figure 17. The phase 1 interactions with factors and areas evaluation



research resources on *Project* topics, as a mathematical model, are practically inexistent (Trad & Kalpić, 2019e). This pioneering research work is cross-functional and links all the *Project*'s microartefacts to *Projects* and enterprise architecture method. The *Project's* initialization phase generates the needed CSAs/CSFs and hence creates the HPRMP patterns to be analyzed. The HMM is a part and is the skeleton of the *TKM&F* that uses microartefacts' scenarios to support HPRMP instance requests (Agievich, 2014).

The Holistic Mathematical Model's Critical Success Factors and Link to the Next Applied Mathematical Model Section

Based on previous facts, the CSFs are evaluated (Trad & Kalpić, 2019e) and explained below.

As presented in the RMSRDP section (and chapter) the CSA, CSF and KPIs evaluation (Trad & Kalpić, 2019e) which for the possible operational CSAs, CSFs and KPIs, iRMS can be used in ACS' CSAs:

Here is an example for enumeration of CSFs: 1) TKM&F_Integration; 2) InitialPhase; 3) RM-SPoC_Phase; 4) Qualitative&Quantitative; 5) Final_BTMM; 6) ADM_Integration; and 7) HPRMP_InterfacingModelling.

The CSFs are stored and appear in Table's column 1. As shown in Figure 16, the WB scripts results or KPIs are stored in column 2.

As shown in Table 2, the results (an average of 8.72) justify the usage of the HMM and how it can be used with the final PoC or phase 2; and enable to go to the next CSA to be analysed and that is the ICS integration.

THE INTEGRATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES

It is recommended to understand the chapter related to the RMIC to understand this section (Trad & Kalpić, 2019f). The current section presents this CSA in the sense of a literature review and the resultant CSFs that are needed for the RMSPoC's implementation, from the following sections:

- Internet of Things (IoT) which is the infrastructure glue, uses the service-oriented architecture to support *TKM&F* microartefacts, which are units of work.
- Standard ICS procedures and patterns.
- RMS' standards.
- Global Unique Identifiers Integration (GUID) for resource items, are used to identify and monitor the iRMS.

Table 2. The holistic mathematical model's critical success factors that have an average of 8.72

Critical Success Factors	KPIs	Weightings
CSF_HMM4Architecture_TKM&F_Integration	Feasible	From 1 to 10. **09 Selected**
CSF_HMM4Architecture_InitialPhase	Stable	From 1 to 10. **10 Selected**
CSF_HMM4Architecture_PoCPhase	Complex	From 1 to 10. **08 Selected**
CSF_HMM4Architecture_Qualitative&Quantitative	Complex	From 1 to 10. **08 Selected**
CSF_HMM4Architecture_Final_BTMM	VerifiedModel	From 1 to 10. **09 Selected**
CSF_HMM4Architecture_ADM_Integration	Synchronized	From 1 to 10. **10 Selected**
CSF_HMM4Architecture_HPAMP_Interfacing	Stable	From 1 to 10. **09 Selected**

valuation

- Processes, patterns and models and iRMS are supported by the *TKM&F* to enable inter-connected resource management (Folinas, 2007).
- Intelligent microartefacts integration and strategy to relate and assemble the iRMS' and *Project's* resources. This concept is used to manage autonomic *TKM&F's* microartefacts' instances in all the implementation phases; and it is based on an iterative model that maps all the *TKM&F's* microartefacts to CSFs (The Open Group, 2011a).
- Security, has to define a global vision on security by applying holistic qualification procedures that englobe security concepts from many domains, including financial security concepts (Clark, 2002).
- Electronic Payments and Finance.
- Intelligent static resources modelling, by using the HPRMP, which expresses a structural concept or schema for iRMS implementations (Trad & Kalpić, 2019e).

The Information and Communication Technology's Critical Success Factors and Link to the Next Chapter

Based on WHAT?, the CSFs are evaluated (Trad & Kalpić, 2019e) and are explained below, in this section.

As presented in the RMSRDP section (and chapter) the CSA, CSF and KPIs evaluation (Trad & Kalpić, 2019e) which for the possible operational CSAs, CSFs and KPIs, iRMS can be used in ICS' CSAs:

Here is an example for enumeration of CSFs: 1) CSF_ICS_GUID_IntegrationProcessesModels; 2) CSF_ICS_Standards; 3) CSF_ICS_Services; 4) CSF_ICS_Performance; 5) CSF_ICS_IoT; 6) CSF_ICS_Finance; 7) CSF_ICS_Security; 8) CSF_ICS_Automation; 9) CSF_ICS_HPRMP_StandardsIntegration; and 10) CSF_ICS_Procedures.

Table 3. The Information and Communication Technology critical success factors that have an average of 8.60

Critical Success Factors	HMM enhances: KPIs	Weightings
CSF_ICS_GUID_IntegrationProcessesModels	Standard	From 1 to 10. **09 Selected**
CSF_ICS_Standards	AdvancedState	From 1 to 10. **10 Selected**
CSF_ICS_Services	Supported	From 1 to 10. **09 Selected**
CSF_ICS_Performance	Exists	From 1 to 10. **08 Selected**
CSF_ICS_DistributedCommunication	Stable	From 1 to 10. **09 Selected**
CSF_ICS_Finance	ExistingSupport	From 1 to 10. **09 Selected**
CSF_ICS_Security	Complex	From 1 to 10. **08 Selected**
CSF_ICS_Automation	Supported	From 1 to 10. **08 Selected**
CSF_ICS_Pattern_StandardsIntegration	Supported	From 1 to 10. **09 Selected**
CSF_ICS_Procedures	Supported	From 1 to 10. **10 Selected**

valuation

The CSFs are stored and appear in Table's 1st column. As shown in Figure 16, the WB has scripts results or KPIs are stored in column 2. As shown in Table 3, the results (an average of 8.60) justify the usage of the ICS integration concept and how it can be used with the final RMSPoC or phase 2; and enable to go to the next CSA to be analysed that is the holistic management of the ADM.

THE INTEGRATION WITH THE ARCHITECTURE DEVELOPMENT METHOD

The iRMS' integration with TOGAF and ADM, enables the management and automation of iRMS items and considers the following:

- Reference architecture and its phases concept and integration.
- The Unit of Work and Enterprise Architecture.
- Resource Management System's Architecture Blueprint.

The proposed *TKM&F*'s EA capabilities help in establishing an architecture principal guideline that defines the Project's initial phase and vision; which is based on a "just-enough" architecture in the ADM for the iRMS (The Open Group, 2011a).

The Architecture Development Method (ADM) Critical Success Factors and Link to the Next Section

Based on WHAT?, the CSFs are evaluated (Trad & Kalpić, 2019e) and are explained below.

As presented in the RMSRDP section (and chapter) the CSA, CSF and KPIs evaluation (Trad & Kalpić, 2019e) which for the possible operational CSAs, CSFs and KPIs, iRMS can be used in ADM' CSAs:

Here is an example for enumeration of CSFs: 1) CSF_ADM_CSF_Initialization&Setup; 2) CSF_ADM_IntegrationProcesses; 3) CSF_ADM_Phases; 4) CSF_ADM_Requirements; and 5) CSF_ADM_HPRMP_Architecture.

Table 4. The Architecture Development Method's critical success factors that have an average of 9.0

Critical Success Factors	HMM enhances: KPIs	Weightings
CSF_ADM_CSF_Initialization&Setup	Feasible	From 1 to 10. **10 Selected**
CSF_ADM_IntegrationProcesses	Supported	From 1 to 10. **09 Selected**
CSF_ADM_Phases	Supported	From 1 to 10. **10 Selected**
CSF_ADM_Requirements	MappingAutomated	From 1 to 10. **09 Selected**
CSF_ADM_Pattern_Architecture	Supported	From 1 to 10. **09 Selected**

valuation

The CSFs are stored and appear in Table's 1 column. As shown in Figure 16, the WB has scripts results or KPIs are stored in column 2. As shown in Table 4, the result's (an average of 9.0) justify the usage of the ICS integration concept and how it can be used with the final RMSPoC or phase 2; and enables to go to the next CSA to be analysed is the resources KMS.

THE HOLISTIC ASSET KNOWLEDGE MANAGEMENT SYSTEM

For a resource KMS (rKMS) the goal is basis to manage resource's information items using a holistic management concept that offers the following:

- The Resource Knowledge Management Basics.
- Resource Knowledge Microartefacts.
- The Holistic Resource Knowledge Access Management.
- The Holistic resource Knowledge Management (rKMS).
- The Holistic Resource Knowledge Strategy.

The Knowledge Management Success Factors

Based on WHAT? the CSFs are evaluated (Trad & Kalpić, 2019e) and are explained below.

As presented in the RMSRDP section (and chapter) the CSA, CSF and KPIs evaluation (Trad & Kalpić, 2019e), which for the possible operational CSAs, CSFs and KPIs, iRMS can be used in rKMS' CSAs:

Here is an example for enumeration of CSFs: 1) CSF_rKMS_Infrastructure_Integration; 2) CSF_rKMS_Item_Mapping; 3) CSF_rKMS_Patterns; and 4) CSF_rKMS_HPRMP_Integration; 5) CSF_rKMS_HPRMP_AccessManagement.

The CSFs are stored and appear in Table's 1 column. As shown in Figure 16, the WB has scripts results or KPIs are stored in column 2. As shown in Table 5, the result's (an average of 9.0) justify the usage of the ICS integration concept and how it can be used with the final RMSPoC or phase 2; and enables to go to the next CSA to be analysed, which is the resources DMS.

Table 5. The knowledge management critical success factors that have an average of 9.0

Critical Success Factors	HMM enhances: KPIs	Weightings
CSF_aKMS_Infrastructure_Integration	Supported	From 1 to 10. **09 Selected**
CSF_aKMS_Item_Mapping	ComplexToImpl	From 1 to 10. **08 Selected**
CSF_aKMS_Patterns	Implementable	From 1 to 10. **09 Selected**
CSF_aKMS_Pattern_Integration	Implementable	From 1 to 10. **09 Selected**
CSF_aKMS_Pattern_AccessManagement	StandardIntgeration	From 1 to 10. **10 Selected**

valuation

THE INTEGRATION WITH THE DECISION MAKING SYSTEM

The DMS' integration depends on:

- Critical Success Factors and Objectives that can be applied in the (Trad & Kalpić, 2014b) iRMS and DMS engine's processing.
- Complex resource Decision Making Systems that uses the HMM.
- An Extremely Long and Risky Transformation Process.
- The Decision Making Process.

The Decision Making System's Critical Success Factors and the Link to the Next Section

Based on the CSF are evaluated (Trad & Kalpić, 2019e) and are explained below.

As presented in the RMSRDP section (and chapter) the CSA, CSF and KPIs evaluation (Trad & Kalpić, 2019e) which for the possible operational CSAs, CSFs and KPIs, iRMS can be used in rKMS' CSAs:

Here is an example for enumeration of CSFs: 1) CSF_DMS_ComplexSystemsIntegration; 2) CSF_DMS_HPRMP_Interfacing; 3) CSF_DMS_KMS_Interfacing; 4) CSF_DMS_DMP; and 5) CSF_DMS_HolisticApproach.

The CSFs are stored and appear in Table's 1 column. As shown in Figure 16, the WB has scripts results or KPIs are stored in column 2. As shown in Table 6, the result's (an average of 8.80) justify the usage of the ICS integration concept and how it can be used with the final RMSPoC or phase 2; and enables to go to the next CSA to be analysed is the iRMS.

THE INTELLIGENT RESOURCES MANAGEMENT SYSTEM

Concerning the iRMS the following elements and approaches are important:

- A Cervical Approach.
- The Structure.
- Tangible and Intangible Resources.
- The Role of Resources Processing.
- Enterprise Resource Management.
- Resource System Design and Integration.

The Holistic Resource Management System's Design Concept Critical Success Factors and Link to the Next Section

Based on WHAT? the CSF are evaluated (Trad & Kalpić, 2019e) and are explained below.

As presented in the RMSRDP section (and chapter) the CSA, CSF and KPIs evaluation (Trad & Kalpić, 2019e) which for the possible operational CSAs, CSFs and KPIs, iRMS can be used in iRMS' CSAs:

Table 6. The decision making critical success factors that have an average of 8.80

Critical Success Factors	HMM enhances: KPIs	Weightings
CSF_DMS_ComplexSystemsIntegration	Possible	From 1 to 10. **09 Selected**
CSF_DMS_Pattern_Interfacing	Supported	From 1 to 10. **08 Selected**
CSF_DMS_KMS_Interfacing	Possible	From 1 to 10. **09 Selected**
CSF_DMS_DMP	IntgeratesAsKernel	From 1 to 10. **10 Selected**
CSF_DMS_HolisticApproach	Complex	From 1 to 10. **08 Selected**

valuation

Table 7. The resources management critical success factors that have an average of 8.20

Critical Success Factors	HMM enhances: KPIs	Weightings
CSF_aMS_SystemsIntegration	Possible	From 1 to 10. **09 Selected**
CSF_aMS_EA_Structure	Feasible	From 1 to 10. **09 Selected**
CSF_aMS_(in)_Tangible_Values	ManagementEnabled	From 1 to 10. **09 Selected**
CSF_aMS_DMP_Capacities	Feasible	From 1 to 10. **09 Selected**
CSF_aMS_HolisticApproach	Supported	From 1 to 10. **09 Selected**
CSF_aMS_TKM&F_Support	ComplexButFeasible	From 1 to 10. **08 Selected**
CSF_aMS_RoleOfPatterns	Possible	From 1 to 10. **09 Selected**
CSF_aMS_Skills	Exisiting	From 1 to 10. **09 Selected**
CSF_aMS_ExistingStatus	Transformable	From 1 to 10. **08 Selected**
CSF_aMS_Automation	Supported	From 1 to 10. **09 Selected**
CSF_aMS_Tracking_Auditing	Feasible	From 1 to 10. **09 Selected**

valuation

Here is an example for enumeration of CSFs: 1) CSF_iRMS_SystemsIntegration; 2) CSF_iRMS_Architecture_Structure; 3) CSF_iRMS_(in)_Tangible; 4) CSF_iRMS_DMP_Capacities; 5) CSF_iRMS_HolisticApproach; 6) CSF_iRMS_TKM&F_Support; 7) CSF_iRMS_RoleOfFinance; 8) CSF_iRMS_Skills; 9) CSF_iRMS_ExistingStatus; 10) CSF_iRMS_Automation; and 11) CSF_iRMS_Tracking_Auditing.

The CSFs are stored and appear in Table's 1 column. As shown in Figure 16, the WB has scripts results or KPIs are stored in column 2. As shown in Table 7, the results (an average of 8.20) justify the usage of the iRMS integration concept and how it can be used with the final RMSPoC or phase 2; and enable to go to the next CSA to be analysed is the RMSPoC.

THE PROOF OF CONCEPT OR PROTYPE'S INTEGRATION

The Implementation Environment

The chapters' PoC is implemented using *TKM&F* was developed exclusively by the authors, who own the total copyrights, using the Microsoft Visual Studio .NET/C#, C/C++, Microsoft Office (Word and Excel), Python and Java Enterprise Edition development environments as support to implement the subsystems.

Grounded Hyper-Heuristic Decision Tree

In this RMSPoC, the aim of grounded hyper-heuristics approach is to implement a grounded process that generates solutions in an acceptable response time. The DMS is a *rule of thumb* and a guide to implement problem solving mechanisms and uses a goal function and constraints. The DMS uses a grounded hyper-heuristics process that includes tuning and getting results by trial and error; with a CSAs/CSFs based system. The DMS outputs are verified and filtered to build an efficient tree algorithm and to process solutions in the form of solutions and recommendations. Like all heuristics based systems, the DMS reasoning engine will not be always perfect and adapted to all possible requirements, but it should be enhanced to make it capable of finding optimal results (Oxford Dictionaries, 2013). The DMS applies the positivist action research that is designed on a model identical to the grounded hyper-heuristics model. This RMSPoC uses the DMS's heuristics model, which is based on a pseudo beam search tree method (Jaszkiewicz & Sowiñski, 1999). The RMSPoC is based on the HMM's instance and the iRMS mechanics' interfaces the DMS, which uses the internal initial sets of CSFs' that are used in phases 1 and 2.

From Phase 1 to Phase 2

The *TKM&F* and hence the HMM's main constraint to implement the iRMS, is that CSAs for simple *Projects* components, having an average result below 7.5 will be ignored. In the case of the current CSF evaluation, an average result below 7.0 will be ignored. As shown in Table 8, the overall average is over 8. This fact keeps the CSAs (marked in green) that helps to make this work's conclusion; and drops the ones in red. It means that the iRMS integration can be considered and this concept can be used in all types of *Projects*. Of course, the complexity in integrating the iRMS must be done in multiple transformation sub-projects, where the first one should try to transform the base iRMS services repository.

As already mentioned, the RMSPoC's 1st phase, evaluates CSAs that can be calibrated by the *TKM&F's* user(s)). In this research cluster seven CSAs/Tables qualification is successful using CSFs which are setup from the main client, as shown in Figure 18.

Figure 18. The CSFs selection from the client

Afterwards, the KPIs are selected and weighted, as shown in Figure 19 (concerning the abbreviations, the reader needs to refer to the book's abbreviation chapter), then these values are stored in the CSAs/CSFs WBs; then the RMSPoC's second phase can be conducted.

As shown in Figure 20, The iRMS uses the *TKM&F's* functional language development environment to configure the DMS/AI, it uses the Holistic CSF Management System (HCSFMS) to select problems, actions and applicable solutions for the iRMS. The ACS is a concrete case where the demo application is used (Trad & Kalpić, 2018c).

Once the *TKM&F* is setup, the CSAs/CSFs and the related script files are configured; in this chapter's seven tables are presented and the result of processing of the first phase (or phase 1) is illustrated in Table 8, which shows clearly that the iRMS cluster is credible, with an average of 8.45. iRMS is a dependent system and is bonded to all *Project's* global architecture, hence it justifies the holistic approach.

Here is the cluster's enumeration of CSAs: 1) The Applied Case Study Integration; 2) The Usage of the Architecture Development Method; 3) The Information and Communication Technology System; 4) The Mathematical Model's Integration; 5) The Decision Making System; 6) The Knowledge Management System; and 7) The intelligent Resource Management System.

The CSAs are stored and appear in Table's 1 column. As shown in Figure 16, the WB has scripts results or KPIs are stored in column 2 (this action is repeated in all CSAs). As shown in Table 8, the result's (an average of 8.45) justify the usage of the iRMS integration concept and the move to phase 2.

Phase 2

Phase 2, is implemented using the *TKM&F*, which was also developed exclusively by the authors, who own the total copyrights. The RMSPoC's Phase 2 presents the problem solving mechanics, which interfaces the DMS that uses the mixed heuristic methods based on services-oriented microartefacts, having bindings/mappings to specific *Projects* resources like CSFs, as shown in Figure 21.

Mappings and Microartefacts

The used microartefacts are designed using EA methodologies and related tools. The *TKM&F* sets up the relationships between the *Projects* CSAs, CSFs, KPIs, requirements and services-based microartefacts, using global unique identifiers, as shown in Figure 22.

Figure 19. The weightings and performance values

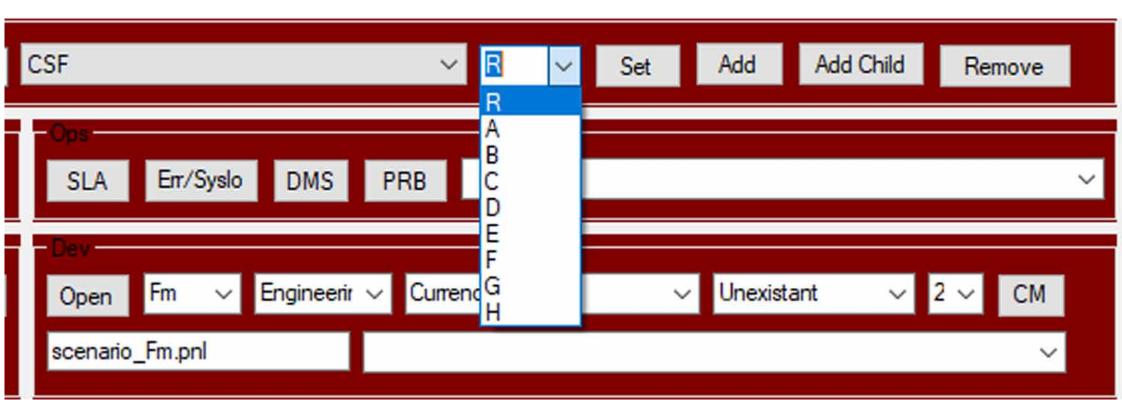


Figure 20. The phase 2 interactions with factors, between all the components to enable problems solving

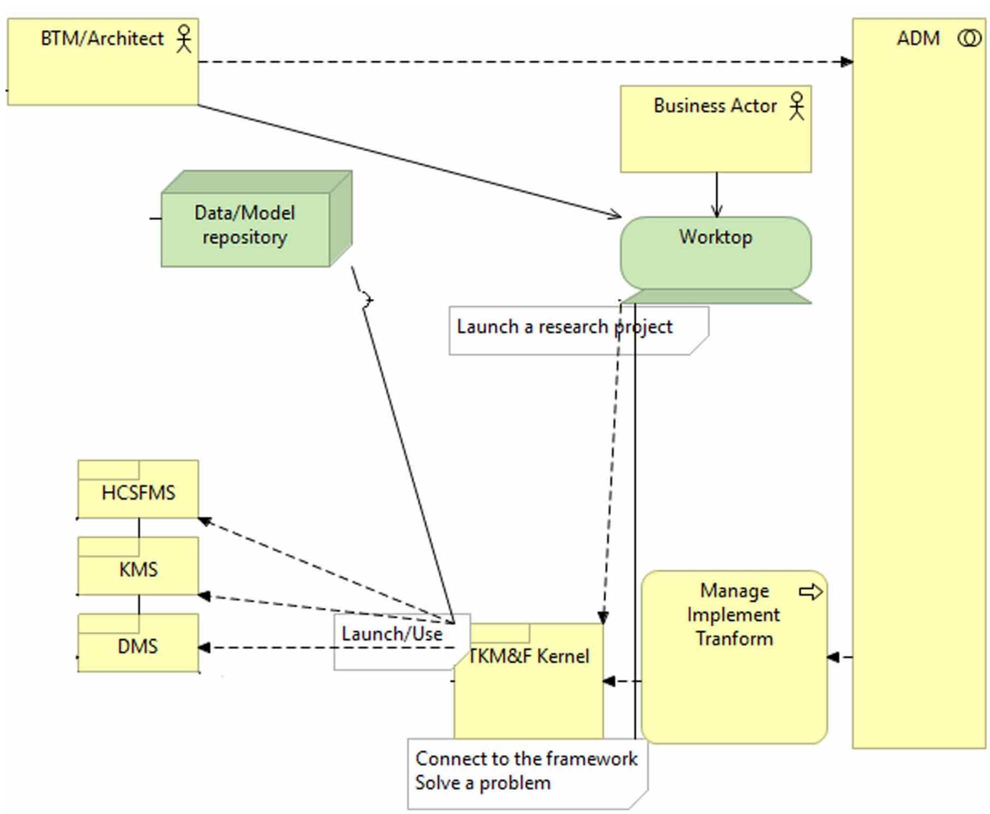


Table 8. The proof of concept's phase 1 outcome, is over 8.45

CSA Category of CSFs/KPIs	Influences transformation management	Average Result
The Applied Case Study Integration	Complex	From 1 to 10. 9.25
The Usage of the Architecture Development Method	FullyIntegrated	From 1 to 10. 9.40
The Information and Communication Technology System	Transformable	From 1 to 10. 8.70
The Mathematical Model's Integration	IsApplicable	From 1 to 10. 8.72
The Decision Making System	Implementable	From 1 to 10. 8.80
The Knowledge Management System	Implementable	From 1 to 10. 9.00
The intelligent Business Management System	Implementable	From 1 to 10. 8.38

Evaluate First Phase

Figure 21. The TKM&F services based microartefacts concept

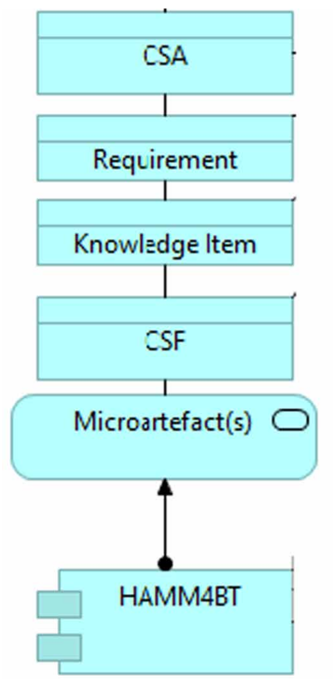
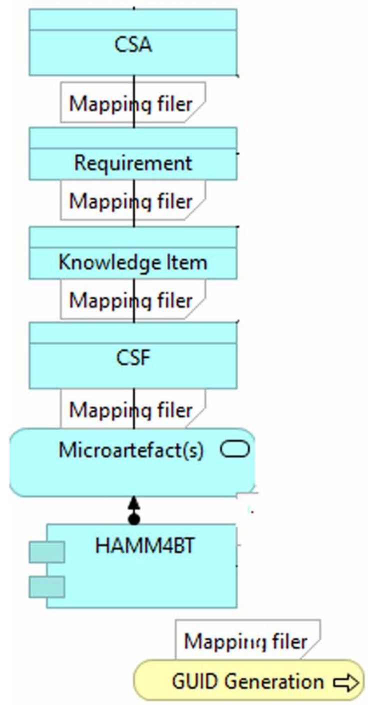


Figure 22. The global unique identifiers interaction



The *Project* is started by structuring the organisation and linking it to the global unique identifiers by using the client's interface that is shown in Figure 23.

Once the development setup interface is activated, the scripting language interface can be launched to implement the needed microartefact scripts to process the defined six CSAs. After starting the *TKM&F's* graphical interface, the sets of CSFs are selected. Then follows the CSF attachment to a specific node of the *TKM&F's* graphical tree, as shown in Figure 24 (where Phase_R, is an ADM phase); to link later the microartefacts.

From the *TKM&F* client's interface, the Mathematical Language (ML) development setup and editing interface can be launched to develop the iRMS services to be used in microartefacts. These scripts make up the intelligence basis and the HMM's instance set of actions that are processed in the background to support iRMS services to be used in microartefacts. The HMM uses iRMS services that are called by the DMS actions, which manage the edited mathematical language script and flow. This research's HPRMP instance, the HMM and its related CSFs were selected as demonstrated previously, for the ACS.

Linking the Applied Case Study - Data Unification

The HPRMP and ACS are used in the RMSPoC, which is an experiment (Lebreton, 1957; Ronald, 1961; Spencer, 1955). The ACS is an insurance management system that has an archaic information system, a mainframe, claim files service, customer file service. The ACS manages claims activities where the demo application uses the *TKM&F* for the ACS/PoC implementation (Trad & Kalpić, 2018c). The *Project* major achievement is the introduction of microartefacts.

Figure 23. The TKM&F's client interaction

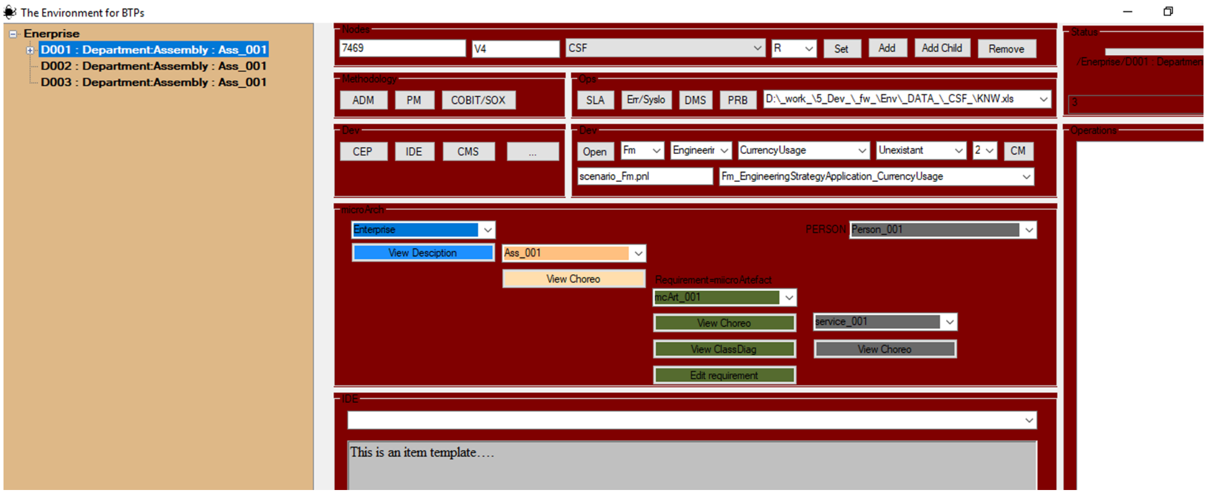
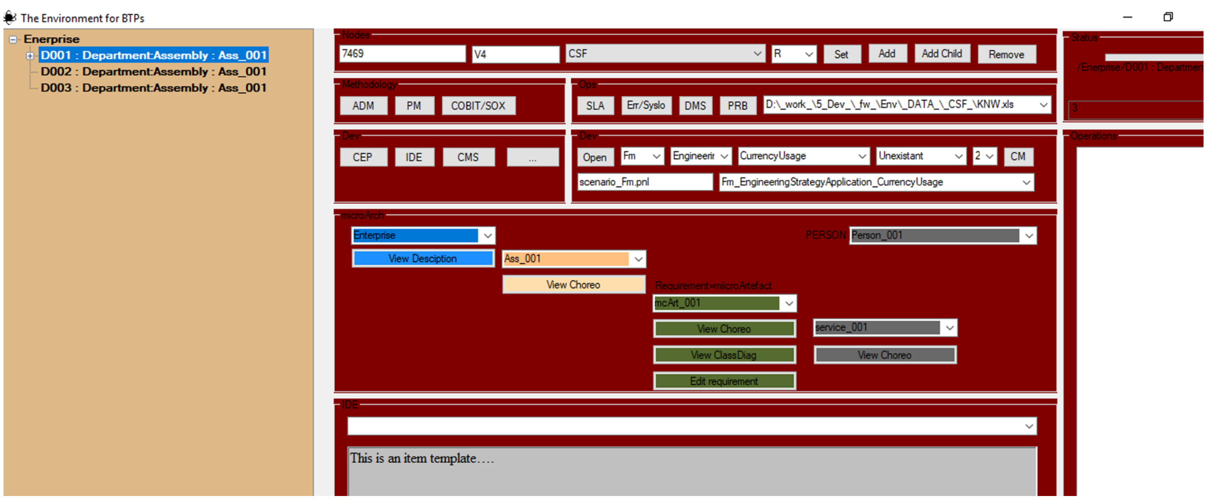


Figure 24. The TKM&F's factor setup interface



This RMSPoC based on the ArchiSurance ACS; analyses a merger, of an old business system's landscape that has become siloed, that results in abundant data and code, knowledge redundancy, functional overlap and archaic integration, using many formats and technologies. For this RMSPoC, a holistic approach is tested to structure the iRMS data using the central data. The data repository structure has to be transformed and to improve data storage and the common use of applications bias data services consistency, quality and robustness, as shown in Figure 25 that can be considered as the CSA set for Phase 2; which has to be assisted by an architecture method.

The Architecture Method's Phases' Setup and Related Factors

The Phase 2 implementation setup looks as follows:

- Sub-phase A or the Architecture Vision phase's goals, establishes a data architecture; as shown in Figure 26.
- Sub-phase B or the Business Architecture phase shows how the RMSPoC target architecture realizes the key requirements.
- Sub-phase C or the Gap Analysis phase shows and uses the Application Communication Diagram, which shows the modelled target application landscape.
- Sub-phase D or the Target Technology Architecture and Gap Analysis phase shows the end RMSPoC infrastructure; where here is limited.
- Sub-phases E and F, Implementation and Migration Planning; the transition architecture, proposing possible intermediate situation and evaluates the RMSPoC status.

Figure 25. Transformation goals (Jonkers, Band & Quartel, 2012)

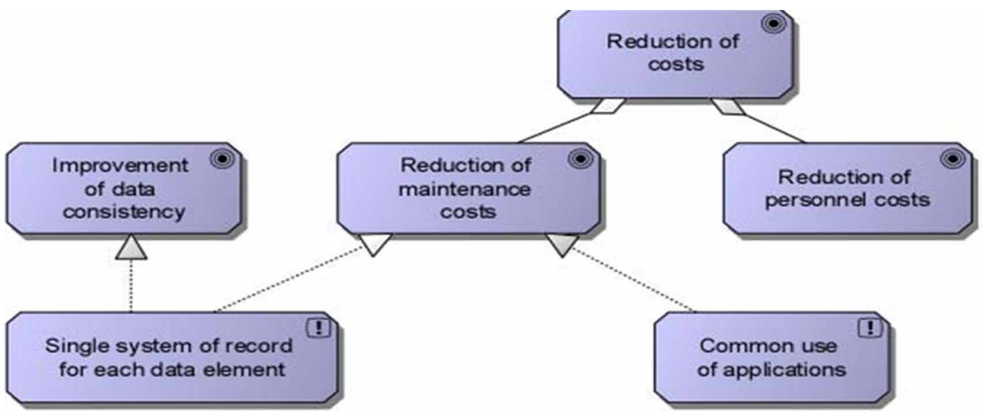
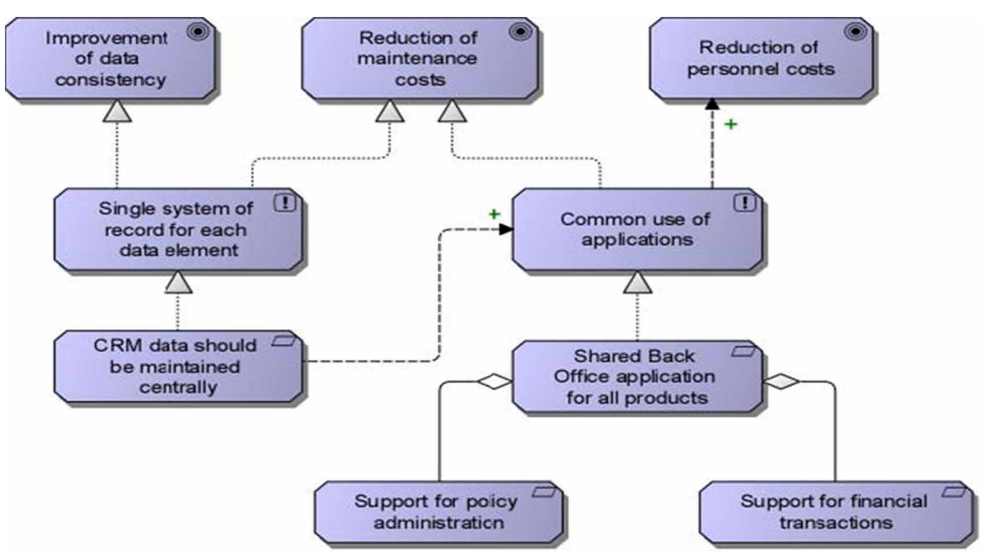


Figure 26. Data goals and principles (Jonkers, Band & Quartel, 2012)



The data services based microartefacts have bindings/mappings to specific iRMS resources. The used microartefacts are designed using EA methodologies and related tools. The iRMS concept defines relationships between the iRMS requirements and data services based microartefacts (and CSAs/CSFs).

Processing a Concrete Node

The hyper-heuristics approach is used, in order to find a combination of heuristics that solve a complex research question. A specific CSF is linked to a problem type and a related set of actions that starts to be processed at a specific node. For this RMSPoC, the authors have selected the CSF_iRMS_SystemsIntegration taken from the Table 7 or iRMS CSA and would like to find solutions related to this CSF's related problems. Such problems can be only researched with a mixed-model that is very similar to the (re)-scheduling of activities model. Solving the given problem involves the determination of actions and related solutions for multiple activities for the ICS integration team. These mixed models are based on quantitative analysis, beam search and grounded hyper-heuristics; that is in fact a dual-objective DMS (McMullen, Tarasewich, 2005). The authors have decided to apply the DMS to try to solve the CSF_iRMS_SystemsIntegration data unification problem or the PRB_iRMS_SystemsIntegration (Vella, Corne, Murphy, 2009), which is solved by using the following steps:

- Relating the ACS data unification resources to CSF_iRMS_SystemsIntegration that is done in Phase 1.
- Link the processing of this node to the pseudo-quantitative modules, then by using qualitative modules, filter and deliver the initial state that is the root node of the DMS decision tree.
- The DMS heuristics engine is configured, weighted and tuned using configuration information.
- The set of possible solutions results from the hyper-heuristics decision model. The DMS starts with the initial CSF_iRMS_SystemsIntegration. Then the DMS is launched to find the set of possible solutions in the form of possible improvements.
- Then follows the CSF attachment to a specific node of the *TKM&F's* graphical tree; to link later the microartefacts.
- The DMS tree (or the qualitative/hyper-heuristics decision tree) is a beam search heuristics model that uses the input from the previous phases to propose an optimal solution by using a common data bus.
- Once the development setup interface is activated, the ML interface can be launched to implement the needed microartefact scripts to process the defined six CSAs. After starting the *TKM&F's* graphical interface the script and its sets of CSFs are selected, as shown in Figure 27.
- From the *TKM&F* client's interface, the ML development setup and editing interface can be launched to develop the data services to be used in microartefacts.

Node Solution

These scripts make up the intelligence basis and the HMM's instance set of actions that are processed in the background to support data services to be used in microartefacts. The HMM uses data services that are called by the DMS actions, which deliver the solution and flow, as shown in Figure 28.

Figure 27. The mathematical scripting environment

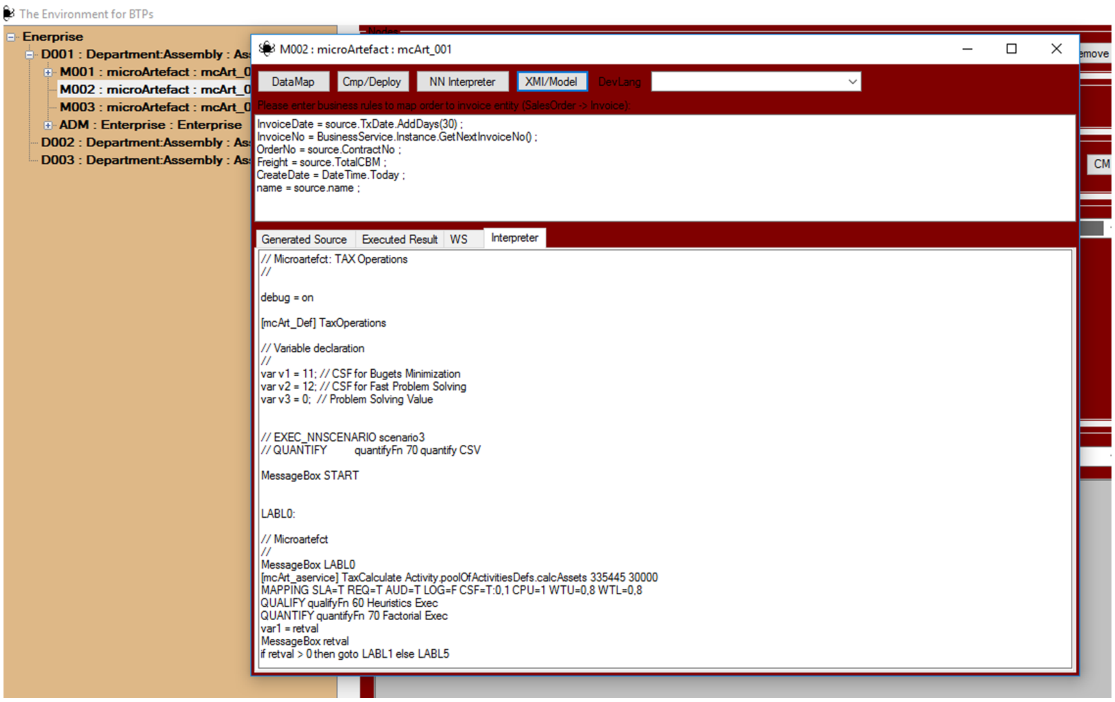


Figure 28. The heuristics tree configuration

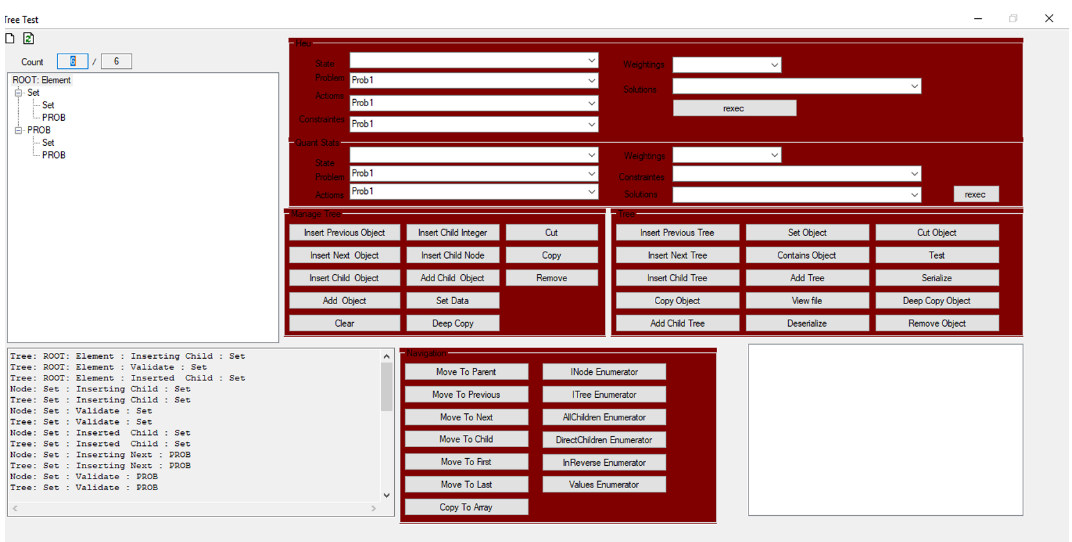
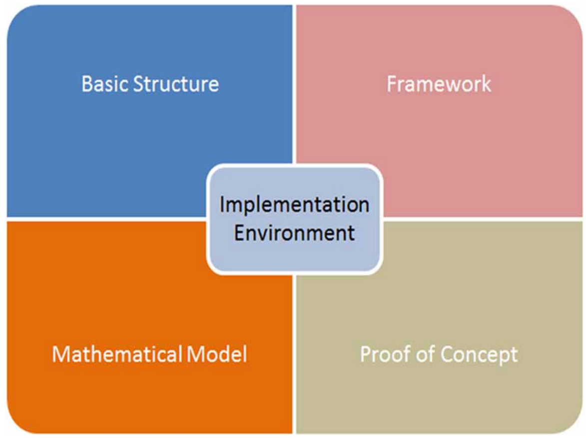


Figure 29. The TKM&F's components' interaction



This research cluster, the HMM and its related CSAs/CSFs were selected as demonstrated previously, and are shown in Figure 29.

SOLUTION AND RECOMMENDATIONS

This research cluster offers four inter-related research chapters that should be read and inspected in the proposed order:

- The Resources Management Implementation Concept, which is this cluster's introductory chapter and gives an overview of the application domain.
- The Holistic Project Resources Management Pattern, which is a separate chapter and it describes the structural pattern that can be instantiated to create the iRMS to be used in this RMSPoC.
- The Resources Management Research Development Project, which is a separate chapter and it describes the RDP that is the core of this chapter and it is recommended to be understood.
- The Resources Management Proof of Concept (or this chapter) describes the PoC for a data unification case. It shows and explains the steps needed to check the iRMS' feasibility through two phases.

The *Manager* is responsible for the implementation of complex *Projects* using HPRMP, RMRDP and their corresponding RMSPoC, where he should have a solid background in HPRMP/DMS based iRMS implementations. He can be assisted by this cluster's recommendations. The managerial recommendations are needed for finding the solutions to enable the management of iRMS. The resultant technical and managerial recommendations are:

- The iRMS feasibility was checked by the RMSPoC.
- The ADM's integration in an iRMS enables its automation and automation of its interfaces.
- Setup a central iRMS to be used in *Projects*.
- Define the interface to the rKMS and DMS. The iRMS needs to implement a DMS.
- Model the iRMS' and microartefacts' interaction.

iRMS managerial recommendations, and the *TKM&F*, round up the approach needed for the complex research activities related to management of resources. .

FUTURE RESEARCH DIRECTIONS

This RMSPoC and related topics, appear to be undiscovered and in fact are very complex, because many of them are based on intangible values that are complex to formulate. Such formulations should be abstracted using the proposed mathematical model. The goal is also to localize fictive bookkeeping or banking secrecy deviations that block real evaluation and promote plundering. The probable reason for such estimation of de facto situation, is the classical approach. based on too much excel practices and scoping of the research question, hence the simplification of the research method to the level of marketing-like quantitative descriptive statistics. as taught in many business schools. This undermines the possibility of solving more complex problems and hinders development of sophisticated decision systems, which are essential for systems like the iRMS. The future research and development process will continue to tune the *TKM&F* and will work more specifically on the reasoning modules.

CONCLUSION

This iRMS is based on the *TKM&F* unique mixed research model; where CSFs and CSAs are offered to help iRMS and *Managers* and resource (and assets) architects to minimize the chances of transformation related failure; while implementing an iRMS (or a *Project)*. This chapter is part of a series of research works related to *Projects*, using DMS/AI and rKMS, based on an HMM structure. In this chapter that is a part of a research cluster, the focus is on the iRMS that defines a central pool of CSAs/CSFs to be used throughout all the *Projects* and including subsystem, the iRMS. The Phase 1 proved this cluster's feasibility and Phase 2, demonstrated the ability to solve a concrete problem, abstracted by the ACS' data unification requirement. The most important managerial recommendation that was generated by the previous research phases was that the *Manager* must be a strong leader and must have in-depth knowledge of transformation projects, enterprise architecture projects, research projects, PoCs and iRMSs. The *TKM&F* can support an iRMS (and *Projects* in general) by using the DMS (and RMSPoC) to check the feasibility and to deliver a set of managerial recommendations. Concerning financing and preserving resources and assets, it is strongly recommended to implement an iRMS to avoid any type of approach or models that would allow looting (Trad & Kalpić, 2019g; DW, 2019).

ACKNOWLEDGMENT

In a work as large as this research project, technical, typographical, grammatical, or other kinds of errors are bound to be present. Ultimately, all mistakes are the authors' responsibility. Nevertheless, the authors encourage feedback from readers identifying errors in addition to comments on the iRMS and the *TKM&F* in general. It was our great pleasure to prepare this chapter and its experiment. Now our greater hopes are for readers to receive some small measure of that pleasure and support for his project.

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KEY TERMS AND DEFINITIONS

ADM: Architecture development method.
AHMM: Applied holistic mathematical model.
AHMM4BT: Applied holistic mathematical model for business transformation.
CSA: Critical success area.
CSF: Critical success factor.
CSFMS: Critical success factor management system.
DMS: Decision-making system.
EA: Enterprise architecture.
EAP: Enterprise architecture projects.
HKMS: Holistic knowledge-management system.
HMM: Holistic mathematical model.
ICS: Information and communication system.
ICT: Information and communication technologies.
iRMS: Intelligent resources management system.
KM: Knowledge management.
KMS: Knowledge-management system.
Manager: Business transformation manager.
ML: Mathematical language.
MM: Mathematical model.
NLP: Natural language programming.
Project: Business transformation project.
RDP: Research and development projects.
RMS: Resources management system.
RQ: Research question.
SOA: Service-oriented architecture.
TKM&F: Trad Kalpić methodology and framework.
TOGAF: The Open Group's architecture framework.

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