Modelling Software

Project Management Complexity

- An Assessment Model

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Abstract

During the last years, more and more business use projectised organisation as an organisation structure to tackle complex problems needed for the implementation of their strategic objectives. A significant number of these projects were/are challenged or even failed to meet their initial requirements in terms of cost, time and quality. This phenomenon is more intense in software projects due their special characteristics sourcing from the dynamic and continuous changing environment they operate and the nature of the software itself. Most of these failures were attributed to complexity that exists in various forms and levels at all projects. Many studies attempted to identify the sources of project complexity and define an appropriate complexity typology for capturing it. However, most of these studies are theoretical and only a limited number is proposing models capable to evaluate or measure project complexity. This research, acknowledges the endogenous character of complexity in projects but instead of trying to identify complexity dimensions of this complexity in projects, focuses on the complexity in the interfaces between project processes, project management processes and project managers, which consists of the critical point for successful project execution. The proposed framework can be used in order to highlight the most significant complexity areas either organisation specific or project specific, providing in that way the necessary awareness for better, efficient and effective project management. The approach followed in framework design, identifies the variation of perception of complexity between different organisations. Allow organisations to evaluate complexity of projects and provide them with an important information that will assist project selection process. Identifies the significance of peoples' knowledge and experience and generally the maturity/capabilities of an organisation in management in order to handle complexity, as this was revealed through the findings of this research. Furthermore, considers complexity as variable that can be measured and propose a model for it. To implement this framework, an extended literature review was initially performed, for identifying the complexity factors sourcing from project management aspects. Subsequently, statistical methods for processing and refining the identified factors were used, resulting to the final set of measures used in the framework. Finally, the proposed model was validated through the appliance of case study methodology.

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1. Introduction

1.1. Introduction to the subject

Projects are used by organisations as a means to enhance their competiveness, increase their presence in the market, provide new services and fulfil the expectations of their clients and stakeholders (Shenhar, 2004). However, some projects, due to their temporary and unique nature, have a number of characteristics that can endanger their success. A number of studies attempted to define project success and concluded that project success is dependent on two factors: the accomplishment of a successful project product, and the successful execution of a project management process. (Sudhakar, 2012; Prabhakar, 2008; Baccarinni, 1999). A successful product is one which fulfils all its initially defined features and functions while a successful project management process is the execution of a project within a determined scope, budget, schedule and quality. Thus, the study of project failure sources should enable both factors.

As far as software projects, as IT technology evolves and becomes part of every aspect of our everyday life, the demand for better software is a necessity. This leads to bigger and more complex software systems in terms of development, maintenance, functionality (Janczarek and Sosnowski, 2015) and in terms of innovation and size (Alves et al., 2016). Software projects are considered as the most complex ones and their outcome in various cases, is limited, since they fail to fulfil or to complete the initial requirements set. Several studies corroborate that belief (Standish Group, 2015; 2009; 1995; Charette, 2005). The Standish Group have published, every year since 1995, the CHAOS Report which initially included a snapshot of the state of the software development projects in United States, but nowadays it examines more than 50.000 projects, of various sizes, all over the world. Their results reveal the great challenges the software development industry has dealt with through time. According to the CHAOS report (Standish Group, 1995) the United States are spending more than $250 billion each year on IT application development of approximately 175,000 projects. A great number of these projects will fail to fulfil their initial targets. For example, 31.3% of them will be cancelled before their completion, while 52.7% of projects will cost 189% of their original estimates. On the hand, only 16.2% of software projects are considered successful, meaning that they are completed on-time and on-budget. In terms of functionality the situation is worse as projects completed by the largest American companies have only 42% of their initially planned features and functions. The main problem with this situation is that it remained almost the same during the last year. The following Table 1 represents projects outcome during the last few years.

Table 1 Projects outcome - Chaos report 2015 (InfoQ 2015)

	2011	2012	2013	2014	2015
Successful	29%	27%	31%	28%	29%
Challenged	49%	56%	50%	55%	52%
Failed	22%	17%	19%	17%	19%

Charette, in his study named “Why software fails” (Charette, 2005), identifies a number of factors that affect the success of software projects. In a more detailed approach the CHAOS report identified the most common factors that can lead to project success, challenge and failure. These factors are presented in Table 2 below.

Table 2 identified factors causing project failure, challenge and success

Chaos report study			Why software fails study
Project impaired factors	**Project challenges factors**	**Project Success factors**	**Most common failure factors**
Incomplete Requirements	Lack of User Input	User Involvement	Unrealistic or unarticulated project goals
Lack of User Involvement	Incomplete Requirements / Specifications	Executive Management Support	Inaccurate estimates of needed resources
Lack of Resources	Changing Requirements / Specifications	Clear Statement of Requirements	Badly defined system requirements
Unrealistic Expectations	Lack of Executive Support	Proper Planning	Poor reporting of the project's status
Lack of Executive Support	Technology Incompetence	Realistic Expectations	Unmanaged risks
Changing Requirements / Specifications	Lack of Resources	Smaller Project Milestones	Poor communication among customers, developers, and users
Lack of Planning	Unrealistic Expectations	Competent Staff	Use of immature technology

Chaos report study			Why software fails study
Project impaired factors	**Project challenges factors**	**Project Success factors**	**Most common failure factors**
Didn't Need It Any Longer	Unclear Objectives	Ownership	Inability to handle the project's complexity
Lack of IT Management	Unrealistic Time Frames	Clear Vision & Objectives	Sloppy development practices
Technology Illiteracy	New Technology	Hard-Working, Focused Staff	Poor project management
Other	Other	Other	Other

The CHAOS report indicated that among the main factors affecting project failure, challenge or success, are factors which are related to project management issues. A most careful analysis of the results, also indicate that many of these issues arise at the early stages of project design, for example during the project scope definition and the requirements elicitation stage, which is also supported by other researchers too (Laporti et al, 2009; Molina and Toval, 2009). This implies that the basis for a successful project is set at the initial steps of project design and goes through successful and efficient project management. However, despite the progress of project management practices a project will still fail, with most of these failures to be attributed to the complexity of projects. Project complexity leads to project failure because either complexity is very high (Williams, 2005; 2002), or project complexity has been underestimated (Neleman, 2006).

Complexity can exist in both aspects of project success, as it was defined earlier. A significant number of studies has been undertaken in recent years in order to understand, define and determine the concept of project complexity (Qazi et al., 2016; Chapman, 2016; Bakhshi et al., 2016; Nguyen et al., 2015; Lu et al., 2014; Vidal et al., 2011; Bosch-Rekveldt et al., 2011; Dombkins and Dombkins, 2008; Geraldi and Adlbrecht, 2007; Hass, 2007; Maylor et al., 2008; Vidal and Marle, 2008; Williams, 2002). They proposed various approaches in defining project complexity and determining areas that are sources of complexity. Some of these studies are theoretical while others attempt to identify characteristics of complexity that are measurable and in that way to define complexity models that allow the assessment of project complexity in order to increase the chances of project success. However, the number of different approaches reveals the general lack of consensus on what project complexity is, and create a confusion about the approach which should be followed in order to be managed effectively.

Summarising the above, firstly, a number of different typologies for defining project complexity has been proposed, resulting in confusion about project complexity sources, with limited contribution to practical assessment of project complexity. Secondly, software development projects are highly complex projects that are prone to failure or challenge and finally, among the main factors affecting project success, challenge or failure, are identified factors that are related or can be handled through effective project management. According to this view, project complexity should be investigated through the prism of project management and the focus for complexity source identification should be placed on project management areas.

The above conclusions form the basis for this research. The research problem, aims and objectives are discussed in the following sections.

1.2. Research problem

As the previous section highlights, project complexity is difficult to understand and measure, despite the variety of approaches which have been proposed over time. Software development projects have a significant ratio of failure and/or challenge that in combination, can reach the amount of 70% of total software projects undertaken (Standish Group, 2015). To deal with this situation, it is believed that a better understanding of complexity in projects and an effective measurement of it, are factors that will assist in successful project management (Graci, et al., 2010). As that, in order to assist project managers to understand and measure project complexity this research investigates complexity of software development projects within the aspects of project management taking into consideration the special characteristics of software development process.

1.3. Research aims and Objectives

The aim of this investigation is to define the concept of complexity in software projects from the perspective of project management process and to develop a model that will allow the assessment of software project complexity at the early stages of the project.

The objectives of the research are:

i. To conduct a literature review on PM complexity in order to understand the concept of complexity, especially in relation to software projects.

ii. To present current studies and typologies of project complexity, determine their deficiencies and commonalities and finally to propose a typology of complexity that differentiate this approach.

iii. To investigate sources of complexity in the context of project management and technical aspects of software project development process.

iv. To determine a set of measures or measuring the complexity of software projects

v. To define an empirical model based on the complexity measures tuned to address software project management aspects.

vi. To utilise the developed model to calculate the complexity of selected software projects.

vii. To validate the developed model by applying it to several software projects and evaluate the results.

To design and implement a software tool that will be used for the assessment of project complexity.

1.4. Research questions

The main question of this research is ***"Which complexity framework can efficiently and effectively describe and measure complexity of software development projects?"***

As the answer to this question is not straightforward, it should be decomposed into a set of sub-questions, the answer of which will lead to the answer of the main question. Initially, the definitions and various typologies of complexity provided in the literature should be examined. As next step, the existence of models aiming in measuring complexity and their characteristics should be examined. Subsequently, the sources and factors of complexity should be investigated under the prism of this research approach. Finally, the existence of quantitative, if possible, measures and the possibility of formatting a complexity assessment model should be investigated. The following questions which should be answered during these processes are the following:

i. What is the notion of complexity in projects?
ii. How are complexity typologies defined in the literature?
iii. Which are the models proposed in the literature for assessing complexity?
iv. How can complexity interfere within project management aspects?
v. Which is the optimum set of factors required to determine complexity in software projects?
vi. How can complexity in software projects be measured?

Sub-questions (i), (ii), (iii) and (iv) will be answered through an extensive and critical literature review. Sub –questions (v) and (vi) will be answered through the performance of surveys among project managers or other domain experts that have a substantial experience in managing software development projects. If required, appropriate statistical methods will be applied to optimise survey results and verify their validity. Furthermore, sub-questions (i), (ii) and (iii) will be discussed in Chapter 2, sub-question (iv) will be discussed in Chapter 3 and sub-questions (v) and (vi) will be discussed in Chapters 4, 5 and 6.

1.5. Research Design

The research strategy is presented in detail in Chapter 4. In this section, its basic steps are briefly outlined.

The first step in this research is to conduct a critical literature review on project complexity to determine the aspects of complexity in project management process and in software project development. The next step is to identify through literature the complexity factors that affect software project development from the perspective of project management and technical software development aspects. It is expected that the sources of complexity will be many (Fitsilis et al, 2010) and that it will be necessary to reduce the number of them to a number that allows software project complexity to be measured in a consistent and reliable way.

A survey is performed, by an electronically distributed questionnaire to a group of project management domain experts. The collected data is analysed with the use of statistical methods, in order to end up with a limited number of complexity sources called measures.

The next step is to determine the relative contribution of each measure to the total project complexity and in order to achieve this, expert judgment techniques are used. In this context, a second survey is performed in the form of an in-person distributed questionnaire to a small group of experts. The gathered data is analysed with the use of a multi-criteria decision-making method, resulting in weights assignment to the identified measures.

Finally, the model is formed and it is validated by applying it to a pilot set of selected projects and their complexity is calculated. The results are evaluated by comparing the level of complexity calculated by the model, with the empirical level of complexity perceived by project managers. The comparison results are then evaluated for model

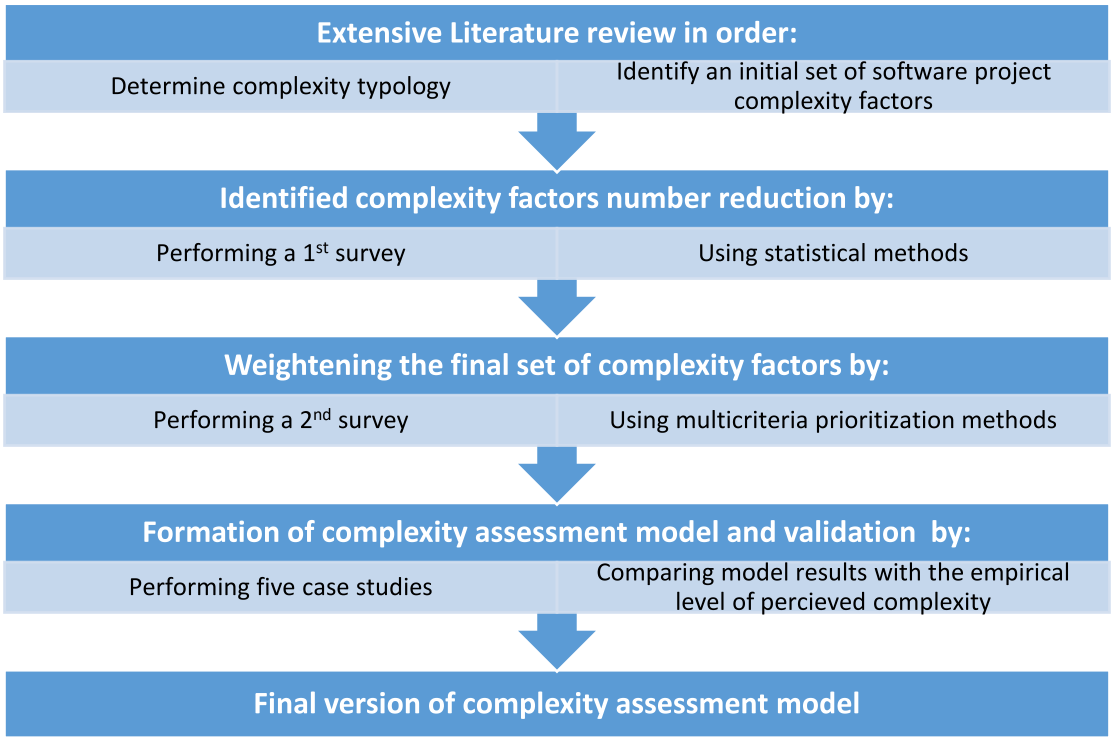

Figure 1 Research design

endorsement or adjustment and re-iteration, if needed, according to the findings. The design of the research is outlined at Figure 1.

1.6. Thesis structure

The thesis is organised in seven chapters as described below

Chapter 1 – Introduction: This chapter presents the research overview, aims, objectives and questions. It also outlines the basic steps of research methodology and thesis structure.

Chapter 2 – Literature review (part I): This chapter presents the literature review within the concept of complexity. The notion and characteristics of complexity are discussed and the various complexity typologies which have been proposed the previous years, are briefly presented. Furthermore, it presents the sources of projects' complexity and the existing approaches to assess it.

Chapter 3 – Literature review (part II): This chapter presents an overview of project management frameworks and the selection of the appropriate project management framework for this research is discussed. Next, the literature review in the selected project management framework areas is presented as well as the identification of complexity sources in these areas. The literature review conducted in order to identify the technically related software development complexity factors is also presented.

Chapter 4 – Research Approach, Design and Methodology: This chapter presents in detail the research philosophy, approach and design. The research methodology followed is also presented and the justification and applications of the selected methods are discussed.

Chapter 5 – Research results: This chapter presents the results obtained from the application of the methodology described in Chapter 4. More specifically, the results of the first and the second survey are presented and the subsequent statistical analysis performed in order to end up with the final set of software projects complexity factors.

Chapter 6 – Project management complexity framework: This chapter presents the complexity model definition philosophy and algorithm. Model validation and subsequent case studies are presented and discussed. The basic aspects of a software tool that implement the complexity model are described, too. Finally, an overview of research findings is presented

Chapter 7 – Conclusions, Implications and Recommendations: This chapter presents and discusses the outcomes of this research through the prism of case study results. Implications for business and academia are also discussed and implications for future research are presented.

1.7. Summary

In this chapter, our motivation for this work and the problem statement was presented. Next the research aims, objectives and research design and structure were given.

In the next chapter, the literature review covering the following points: the concept of project complexity, the various proposed project complexity typologies in general and in software projects in particular, the approaches to complexity evaluation and measurement and a discussion of them are presented.

2. Literature review (Part I) - Notion of complexity and current typologies

2.1. Project complexity

2.1.1. Introduction

This section initially presents the notion of project complexity. Next several complexity typologies, stemming from various studies of project complexity during the last years, are discussed. Emphasis is given to their perspective of project complexity examination, as well as their commonalities and differences.

2.1.2. Notion of complexity

Complexity is part of our environment and appears in different domains. Complex systems exist in many scientific fields and different definitions of complexity have been given for each domain. This implies that the term complexity is defined differently in computational theory, in information theory, in business, in software engineering etc. and at times different definitions of complexity exist within the same domain (Morel and Ramanujam, 1999).

Very often people have difficulties in distinguishing between the term complex and complicated, considering them as synonyms. (Geraldi et al., 2011). A project, even large in scale, that is self-contained, well-defined, with clear and structured steps to solution can be complicated but not complex. For example, the wiring of a skyscraper can be complicated but not complex since it follows a clear methodology, specific design and structured steps during its implementation. On the other hand, the definition of the term complex should at least contain interaction, structural and dynamic elements (Whitty and Maylor, 2009). A project, at every size that is highly dependent on its environment (e.g. political, economic, legal etc.) with stakeholders having conflicting interests or stakeholders that demanding continuous changes in requirements, strategies and decisions can be considered complex (Chapman, 2016). For example, a project concerning the construction of a business centre can be a complex project, since it has several parameters that cannot be completely understood and predicted, such as project environment interactions, differences between internal and external project stakeholders etc.

The distinction between the terms “complex”, “complexity” and “complicated” is important to be completely understood in order to move on to the study of project complexity and its sources. In projects, the sources of complexity vary and are more than one, including ambiguity in requirements, lack of scope clarity, communication barriers etc., resulting in different levels and types of complexity for each project (Remington et al., 2009). According to the Association for Project Management (APM) (https://www.apm.org.uk) the complexity in a project stems from the interactions between organisations forming project organisation, the interaction of various units within the same organization, the requirement for coordination between various project elements and the use of wide range project management tools, methods and techniques (APM, 2008).

Parwani (2002, p.1) stated that “Complexity refers to the study of complex systems, of which there is no uniformly accepted definition because, well, they are complex”. Schlidwein and Ison, (2004) state that there are two major approaches to complexity. The first one is called descriptive complexity and describes complexity as a property of a system. The second approach is called perceived complexity and it is described as the subjective complexity that someone experiences through the interaction with the system. Hagan et al., (2011) and Baccarinni, (1996) state that considering complexity as a subjective issue that can change according to the observer, implies difficulty in understanding and dealing with a problem or situation and for that reason it is not a reliable basis for further research analysis.

On the other hand, a number of researchers argue that the perception of complexity is dependent on the cognitive level (knowledge, experience, background, personality) of the people involved (Jakhar and Rajnish, 2014; Remington et al., 2009; Fioretti and Visser, 2004). According to them it is possible for some people to identify complexity in a system, for some other to identify complexity but have different understanding of it and for some other to be unaware of its existence. Another characteristic of complexity that should be considered is that an observer’s perception of complexity can change over time. This change may be due to experience and/or knowledge that is gained over time, making a project that was initially perceived as complex, to look less complex if performed repeatedly or followed by more ambitious projects (Chapman, 2016).

2.1.3. Complexity typologies

Baccarini, (1996) states that complexity is a project characteristic that determines the managerial actions which should be made in order to have a successful project completion. The appropriate management of complexity on projects is a critical issue to their success. Davidson, (2002, p.24) states that “Project Management has operated in a management environment of chaos and complexity for decades”. However, the relationship between complexity and project management practice is still blur (Kiridena and Sense, 2016; Geraldi et al., 2011). Furthermore, although a significant number of researchers are studying complexity in projects (Bakhshi et al., 2015), there is still no consensus on defining project complexity resulting in a variety of approaches and definitions of it (Nguyen et al., 2015; Ireland, 2013; Sedaghat-Seresht, 2012; Vidal and Marle, 2008; Standish Group, 2009;1995).

One of the first definitions of complexity exists in Oxford Advanced Learner’s Dictionary (Hornby and Wehmeier, 1995), which defines complexity as an entity that consists of many interrelated parts and elements such as tasks components and interdependencies.

Turner and Cochrane (1993) state that complex projects can be judged against two criteria: how well defined their *goals* are, and how well defined their *development methods* are.

Baccarini, (1996) was one of the first researchers that dealt systematically with the concept of complexity. He considered complexity as something “consisting of many varied and interrelated parts” and operationalized them in terms of “differentiation”, the number of varied elements (e.g. tasks, components) and “interdependency”, meaning the degree of interrelatedness between these elements. He describes four types of complexity a) *organizational complexity by differentiation, b) organisational complexity by interdependency, c) technological complexity by differentiation and d) technological complexity by interdependency*.

Williams, (1999) extending the work of Baccarini, Turner and Cochrane added the dimensions of *uncertainty in projects* and the *multi-objectivity* and *multiplicity of stakeholders*. The definition of project complexity according to Williams should contain the structural complexity sourcing from the number and interdependence of elements and the uncertainty sourcing from uncertainty in goals and methods as seen in Figure 2.

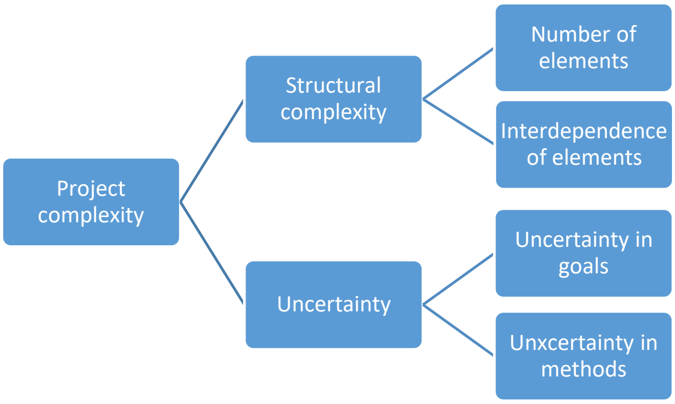

Figure 2 Dimensions of complexity (Williams, 1999)

Tatikonda and Rosenthal, (2000) identified three complexity parameters in projects, a) the degree of interdependence between and among the product and process technologies to be developed, b) the newness of a project's objectives regarding the development organization and c) the difficulty of project objectives. Considering these parameters through the prism of task uncertainty, they identified three complexity dimensions: *the interdependence of task units, the novelty of task objectives and the level of task performance required*.

Ribbers and Schoo, (2002) in their research for complex software implementation programs, examined complexity through the prism of implementation complexity and identified three complexity dimensions: *variety, variability and integration*. Variety is defined as the different states a system can take. Variability of a system is defined as the dynamics of its elements and the interrelations between them. Finally, integration is referred to as the planned changes during the implementation program including IT systems and business processes.

A different approach to project management complexity was taken by Jaafari (2003) who studied how project management is affected by the complexity stemming from society, identifying four characteristics of "complex society" as follows: *"Open systems"* referred to instability and continuous changes in an environment of interconnections and interrelationships; *"Chaos"* referred to the uncertainty that prevents long term planning and control; *"Self-organization"* referred to a tendency for self-organization based on an actor's competences and abilities; and *"Interdependence"* referred to various interdependencies that make it difficult to predict future behaviour on the basis of past experience.

Xia and Lee, (2005) focused on complexity in Information System Development Projects (ISDP) and described two types of complexity: a) organizational complexity and b) technological complexity under two dimensions, the structural dimension and the dynamic dimension (see Figure 3). As a result, they end up with defining four complexity components:

- *Structural Organizational* complexity referred to relationships between project elements in the organizational environment such as project resources, project staffing, personnel skills etc.
- *Structural IT* complexity referred to the relationships between the IT elements such as data nature, technology being used, software environment etc.
- *Dynamic Organizational* complexity referred to the changes in the IDSP organizational environment such as changes in business process, organization structure etc.
- *Dynamic IT* complexity referred to changes in the IDSP's IT environment such as IT infrastructure, development tools etc.

They also proposed an ISDP complexity model in order to measure complexity in IS development projects.

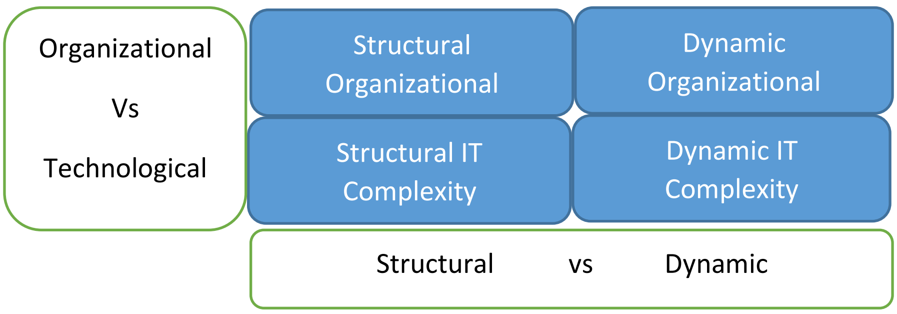

Figure 3 Taxonomy of IDSP complexity (Xia and Lee, 2004)

Cicmil and Marshall, (2005) approached complexity by evaluating ambiguity, equivocality and paradox of control in projects under the dimensions of time, space and power of the organizational processes in project settings. They identified three components of project complexity: a) *Flux change – radical unpredictability, b) Complex processes of social interaction and c) Persisting ambiguity and equivocality of performance criteria, contradictory and conflicting understanding of project success*.

Geraldi and Adlbrecht, (2007) and Geraldi (2008) based on two widely proposed in literature dimensions of complexity, the structural complexity and uncertainty defined three types of complexity:

- *Complexity of faith* (CoFaith) referred to the complexity of creating something new, solving new problems or dealing with high uncertainty.
- *Complexity of Fact* (CoFact) referred to the complexity in dealing with a large amount of interdependent information under time pressure and necessity for immediate decisions.
- *Complexity of Interaction* (CoInt) referred to the complexity in interfaces between locations (people, organizations) such as politics, ambiguity etc. and affects both previous subgroups.

Maylor et al., (2008) focused on perceived managerial complexity and examined it under structural and dynamic elements. They identified five aspects of complexity and defined a complexity model that is based on *Mission, Organisation, Delivery, Stakeholders* and *Team* (MODeST) dimensions as displayed in Figure 4.

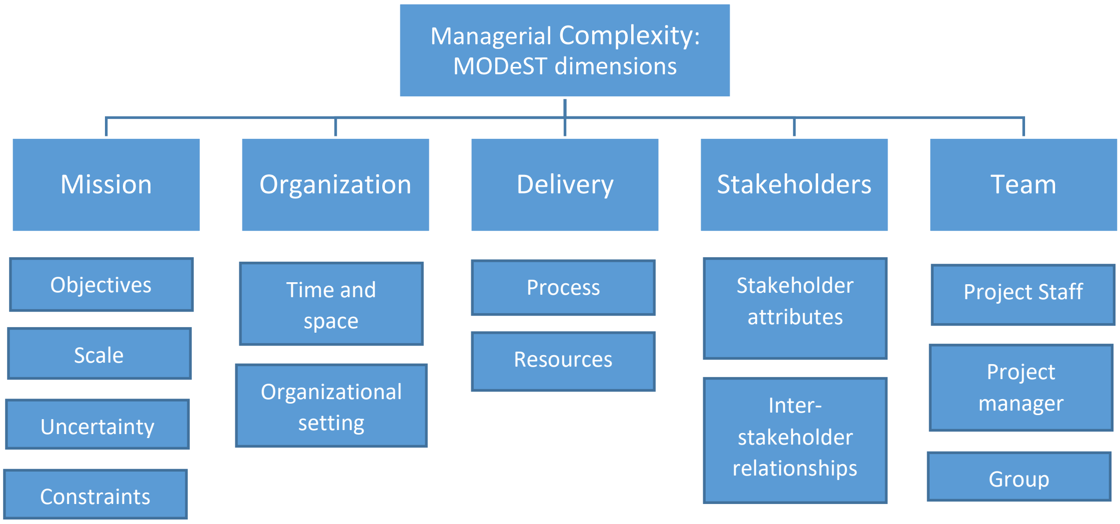

Figure 4 MODeST dimensions of complexity (Maylor et al. ,2008)

Remington et al., (2009) studied the perceived complexity in projects from the perspective of either severity that referred to factors which exacerbate the complexity or dimensions that referred to factors which characterise the nature of complexity or both. They identified seven key themes and instances that contribute to perceived complexity namely *goals, stakeholder's interfaces and dependencies, technology, management processes, work practices and time*.

Hertogh and Westervelde, (2010) investigated the relation between management and complexity. They identified two types of complexity, the detailed complexity and the dynamic complexity. They also identified a number of complexity factors that evaluate the two complexity types from six dimensions, namely *technical, social, financial, legal, organisational and temporal.*

Vidal et al., (2011) studied project complexity under the organizational and technological dimensions and identified four aspects for studying project complexity: *project size, project variety, project interdependence and project context* with their corresponding complexity factors. They also proposed a framework and a model for accessing project complexity based on Analytic Hierarchy Process (AHP) and on a set of complexity measures that can be seen in Figure 5.

Family	Organisational Complexity (Org)	Technological Complexity (Tech)
Project system size	Number of stakeholders	
Project system variety	Variety of information systems to be combined	
	Geographic location of the stakeholders (and their mutual disaffection)	
	Variety of the interests of the stakeholders	
Project system interdependencies	Dependencies with the environment	Specifications interdependence
	Availability of people, material and of any resources due to sharing	
	Interdependence between sites, departments and companies	
	Interconnectivity and feedback loop in the task and project networks	
	Team cooperation and communication	
	Dependencies between schedules	
	Interdependence of information systems	
	Interdependence of objectives	
	Level of interrelation between phases	
	Processes interdependence	
Project system context-dependence	Cultural configuration and variety	Environment complexity (networked environment)
	Environment complexity (networked envrionment)	

Figure 5 Project complexity framework (Vidal et al., 2011)

Bosch-Rekveldt et al., (2011), based on technical, organizational and environmental elements of complexity, proposed a framework aiming to complexity of large engineering projects, in which they identify three categories of project complexity *Technical, Organizational and Environment* complexity (TOE) and fourteen subcategories as can be seen in Figure 6.

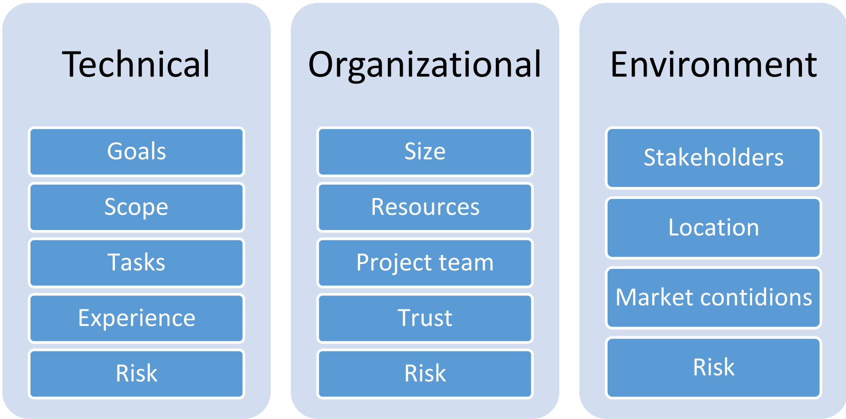

Figure 6 TOE complexity framework (Bosch-Rekveldt et al., 2011)

Hagan et al., (2011) examined project complexity from a socio-technical system perspective, based on six complexity dimensions which are p*rocess, people, goals, product, decision making and resource availability, allocation and scheduling* and identified thirty six complexity factors.

Sedaghat-Seresht et al., (2012) identified seven dimensions of complexity: *environmental, organizational, objective, stakeholder, task, technology,* and *information systems complexity*. They also utilized the "DEMATEL" method to identify the relationships between project complexity dimensions as displayed in Figure 7.

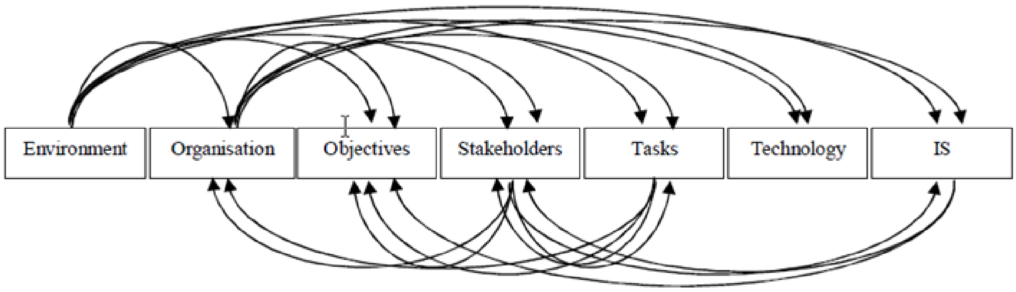

Figure 7 . Impact - relations map for project complexity dimensions (Sedaghat-Seresht et al., 2012)

Lu et al., (2014) study project complexity from *a task and organization* (TO) perspective. They identified twenty technical and organisational complexity measures and used the Project Sim software and the Computational Project Organization and Process (CPOP) model to propose a measurement model of project complexity based on hidden workload.

Dunovic et al., (2014) based on the work of Williams and Hertogh and Westervelde, proposed a complexity framework that incorporates three sources of project complexity (*structural complexity, uncertainty and constraints*) and defined how they intertwine each other as can be seen in Figure 8.

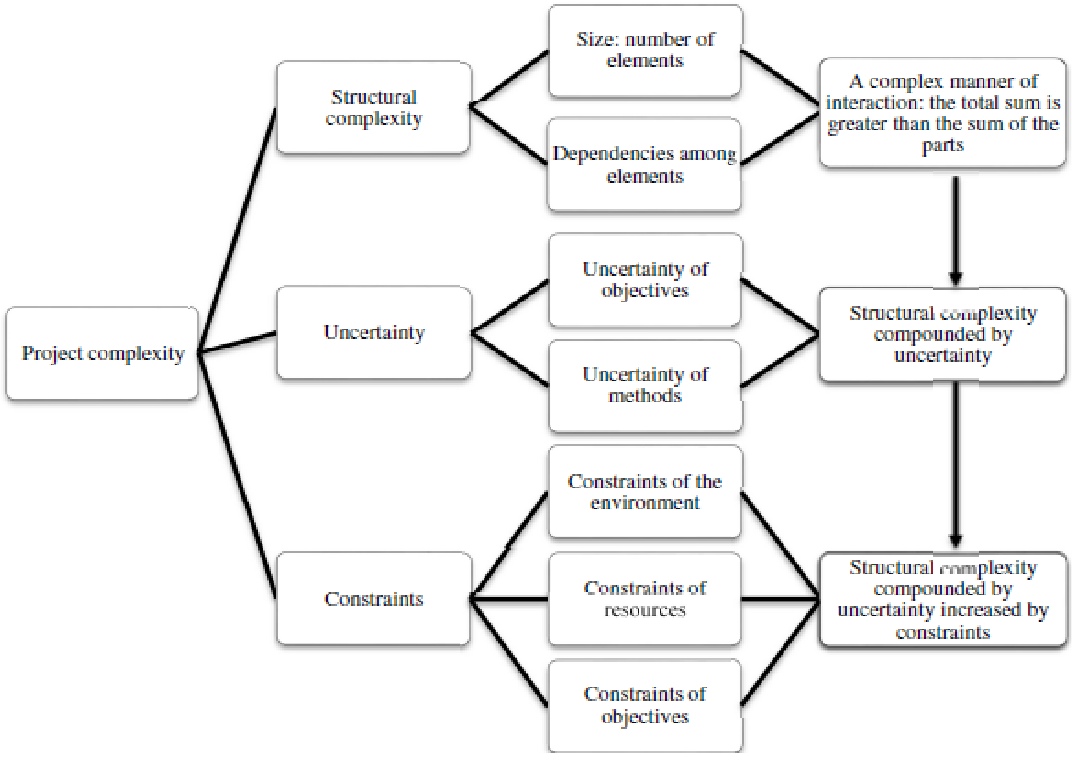

Figure 8 Complexity framework proposed by Dunovic et al., (2014)

Tie and Bolluijt (2014) approach on project complexity is based on Contextual and Inherent characteristics of it. They also proposed a complexity measurement meta-framework based on 11 Contextual Factors and 10 Inherent Characteristics, which was identified as the key insights from existing frameworks, concepts and research.

He et al. (2015) while studying the complexity of construction megaprojects in China, identified 28 complexity measurements attributed to six categories named *technological, organizational, goal, environmental, cultural and information* complexities and proposed a model based on fuzzy ANP to measure it.

Nguyen et al., (2015) in their research in project complexity related to transportation projects, identified the "cube" of complexity consisting of six complexity components named as *socio-political, environmental, organizational, infrastructural, technological and scope complexity* with their corresponding parameters as displayed in Figure 9. They also proposed a complexity measurement model based on fuzzy AHP methodology.

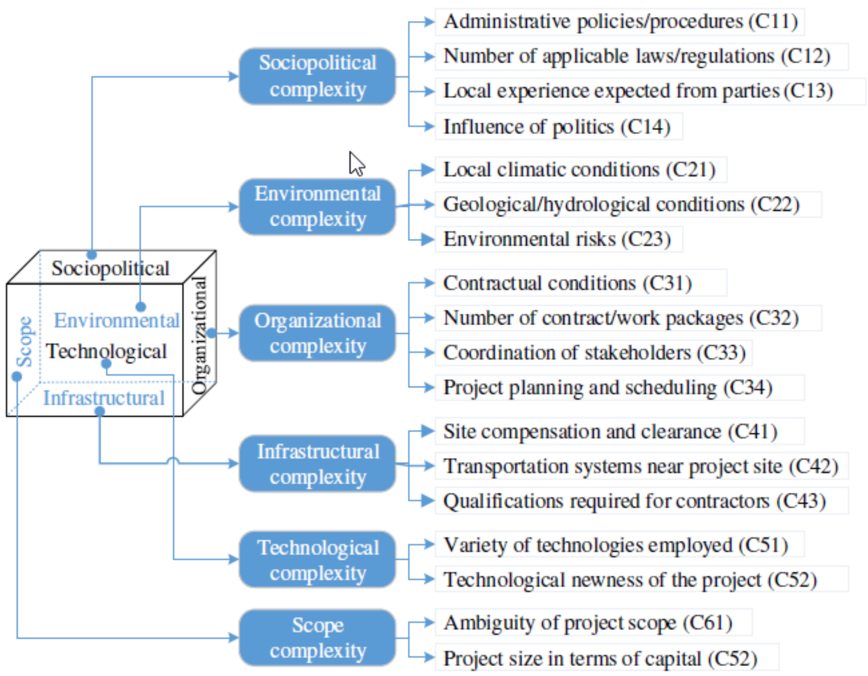

Figure 9 The "cube" of complexity (Nguyen at al., 2015)

Chapman, (2016) considering the dynamic notion of complexity in projects and that project complexity stems from uncertainty, identified six dimensions of complexity named *finance, context, management, site, task and delivery* with their relevant characteristics and sources.

Qazi et al., (2016) in their research to define a risk management model that utilises the complexity of a project, identified twelve project complexity elements divided in three categories: *Technical, Organisational and Environment*.

Schuh et al. (2017) in their study of complexity in new product development projects consider projects as systems and under that prism they proposed a resource cost based method in order to identify the key complexity drivers of a project. Furthermore, they proposed a list of 87 complexity drivers divided in four categories namely *Environment, Product, Organisation and Technology & Resources*

2.1.4. Discussion

Complexity has received wide attention from practitioners and academics alike. We have made significant progress in understanding the different aspects of complexity in projects, programmes, and portfolios. Yet there is still significant work to be done in bridging complexity concepts and managerial reality.

The first conclusion which can be drawn from the above is that a significant number of complexity frameworks have been proposed during the last years, trying to capture the complexity in projects and despite the progress have been done there are still a significant work to be done (Oehmen et al., 2015). The majority of these studies are empirical, as they are based on the opinions of experts or key point project team members and stakeholders in order to identify factors which affect project complexity. The sources of information used in these researches, were projects from construction (Qazi et al., 2016; Hagan et al., 2011; Cicmil and Marshal, 2005; Turner and Cochrane, 1993) infrastructure (Chapman 2016; Nguyen et al., 2015; Dunovi at al., 2014), large infrastructure (Vidal et al., 2011; Hertogh and Westervelde, 2009) engineering (Bosch-Rekveldt et al., 2011; Geraldi and Adlbrecht, 2007), new product development (Schuh et al., 2017) and information systems (Xia and Lee; 2005; Ribbers and Schoo, 2002) domains. There were also researches that tried to identify project complexity components that exist in every type of projects (Lu et al., 2014; Sedaghat-Seresht et al., 2012; Remington et al., 2009; Tatikonda and Rosenthal, 2000; Williams, 1999; Baccarini, 1996). Although there is no consensus on the definition of complexity among the various researchers and most of them define complexity from the perspective of their own domain or field, there is a general consensus about the project aspects that affect complexity. Uncertainty is probably the most common factor which is identified as a main source of complexity, either implicitly or explicitly, in the proposed frameworks. Uncertainty is considered to be the factor that reflects the ambiguity associated with many project aspects such as data, lack of clarity, lack of structure and unpredictable behaviour among project stakeholders (Ward and Chapman, 2003). Williams, (1999) discusses uncertainty in goals related to the requirements elicitation, resource limitation and task complexity. Also, the uncertainty stemming from means used to carry out the project, is acknowledged as an important dimension of project complexity (Lu et al., 2014; Xia and Lee, 2005). Williams (1999) states that uncertainty adds to project structural complexity. Xia and Lee, (2005) and Baccarini (1996) identify two dimensions of structural complexity, one related to organizational issues and the other related to the technology being used. Organizational and technological factors are next to uncertainty the most commonly identified complexity factors among the researchers. The organizational factor is related to project staffing, coordination of stakeholders, contract management project planning and scheduling, organization departments, hierarchy structure etc. and has received great attention by researchers during the previous years (Nguyen et al., 2015; Lu et al., 2014; Vidal et al., 2011; Bosch-Rekveldt, 2011; Xia and Lee, 2005; Baccarini, 1996). Vidal et al., (2011) suggest that organizational complexity is the most significant source of project complexity. The technological factor refers to relationships between technology elements, the variety of technology platforms, technology novelty, newness of project technology, technology changes and has also attracted attention from other researchers (Nguyen et al., 2015; Lu et al., 2014; Vidal et al., 2011; Bosch-Rekveldt, 2011; Xia and Lee, 2005, Remington, 2009; Baccarinni, 1996). Two aspects of project technology, which are the newness of technology being used in projects and the technology immaturity, are identified by PMI (2013) among the most important factors of the complexity of projects and their management.

It is worth noticing that despite the number of proposed complexity frameworks the majority of them are limited to a conceptual approach and do not provide a practical framework for assessing or measuring complexity on projects. Taking a step further Xia and Lee, (2005), Geraldi and Adlbrecht, (2007), Bosch-Rekveldt, (2011) and Lu et al., (2014), (Tie and Bolluijt, 2014) proposed complexity frameworks that can be used to assess the complexity of the project but they do not provide a specific methodology on how to measure it. Attempts to measure complexity were made by Vidal et al., (2011), He et al., (2015), Nguyen et al., (2015) and Schuh et al., (2017). They proposed not only a conceptual complexity framework, but also models for measuring the level of project complexity. The first three approaches are based on AHP, fuzzy AHP and fuzzy ANP methodology respectively. The fourth approach is based on Monte Carlo simulations, statistical analysis and a complexity calculation method proposed by Schuh et al., (1989).

Summarizing, the above mentioned studies tried to identify theoretical concepts and practical approaches of project complexity, in order to define and understand it. The studies of Geraldi and Adlbrecht, (2007), Xia and Lee (2005), Vidal et al. (2011), Bosch-Rekveldt et al. (2011), Lu et al., (2014), He et al., (2015), Nguyen et al., (2015), Schuh et al., (2017) not only tried to identify project complexity dimensions and aspects, but also moved one step further and proposed frameworks and models in order to assess project complexity and provide project managers with a footprint of project complexity, giving them a better chance to handle complexity and improve project management, thus enhancing the chance of project success. A comparison between the main characteristics of the proposed typologies are displayed in Table 3.

Table 3 Comparison of characteristics of complexity typologies

Researchers	Research domain	Conceptual definition of project complexity	Can be used for evaluating project complexity	Introduces a model that can be used for assessing project complexity
Turner and Cochrane (1993)	Construction	X		
Baccarini (1996)	General	X		
Williams (1999)	General	X		
Tatikonda and Rosenthal (2000)	Product development	X		
Ribbers and Schoo (2002)	Software product development	X		
Jaafari (2003)	Project management	X		
Xia and Lee (2005)	Information systems development process	X	X	
Cicmil and Marshall (2005)	Construction	X		
Geraldi and Adlbrecht (2007)	Plant engineering	X	X	
Maylor et al., (2008)	Management complexity	X		
Remington et al., (2009)	General	X		
Hertogh and Westervelde, (2009)	Infrastructure projects	X		
Vidal et al., 2011	Large	X	X	X

	infrastructure			
Bosch-Rekveldt et al., (2011)	Engineering projects	X		
Hagan et al., (2011)	Construction	X		
Sedaghat-Seresht et al., (2012)	General	X		
Lu et al., (2014)	General	X	X	
Dunovic et al., (2014)	Infrastructure projects	X		
Tie and Bolluijt, (2014)	Large projects	X	X	
He at al., (2015)	Large construction projects	X	X	X
Nguyen et al., (2015)	Transportation projects	X	X	X
Chapman, (2016)	Rail megaprojects	X		
Qazi et al., (2016)	Construction	X		
Schuh et al. (2017)	New product development	X	X	X

2.2. Complexity in software projects

2.2.1. Software Project Complexity

As computer hardware and software evolved, software developers began to deal with an increasing complexity of software systems. Complexity relates to both the software product and the software development process. A number of different definitions of software complexity were proposed by researchers according to the domain where they originated from.

Zuse, (1990) defined software complexity from a programmer's psychological perspective, as the difficulty to analyse, maintain, test, design and modify software. Along the same lines, Kushwaha and Mishra, (2006) defined software complexity as the degree of difficulty to understand and verify a system or component. Keshavarz et al., 2011) stated that although there were different approaches to defining software complexity, the majority of them were in compliance with Zuse's approach.

Software engineers defined software complexity by measuring software code characteristics such as code size, number of code errors, development cost and time, number of control paths and counting of occurrences of operators and operands in code. A number of methods that are based on previous characteristics were developed, such as counting Lines of Code (LOC)(Park, 1992), Functions Point Analysis (FPA)(Albrecht, 1979; Gamus and Herron, 2000), Counting Use Case Points (UCP)(Karner, 1993; Banerjee, 2001), COCOMO II (Boehm et al, 2000), MacCabe cyclomatic complexity (McCabe, 1976), Halstead complexity measure (Halstead, 1977). These methods were used and studied for many years (Nuñez-Varela et al., 2017).

However, according to Ghazarian, (2015) the existence of more classes, control flows or modules in code does not necessarily mean that is more complex than another one with less of these characteristics and therefore a more rigorous approach is needed. In addition, Khan et al., (2016a) in their research compared several complexity measurement models based on code characteristics and identified that different models produce different results as they capture different aspects of software code. Sharma and Kushwaha, (2010) stated that software complexity measures based on code are not the best approach to assessing software complexity as the code of the software is usually produced at the later stages of software development. They proposed a complexity framework based on requirements engineering document that utilize software aspects such as functional and non-functional requirements, technical expertise, design constraints, number of interfaces, number and type of inputs and outputs and number of users and locations that will be deployed by a software system.

Fitsilis et al., (2010) stated that size alone is not sufficient for measuring software project complexity, "since a large but well – structured software project with a relaxed cost and time constraints can be much less complex in comparison with a relatively small-in-size project, which has a highly integrated product design and limited budget and/or time-to-market objectives".

Trying to respond to this situation and in order to provide high quality software, a set of empirical software development methods were introduced in order to handle the complexity of process oriented software development known as Agile Manifesto (Beck et al, 2001). Some of the known agile software development methodologies are: Agile Unified Process (AUP) (Ambler, 2002), Extreme Programming (XP) (Beck, 2004) and SCRUM (Takeuchi and Nonaka, 1986; Beedle and Schwader, 2002).

These approaches emphasise measuring the software product or the software development process mainly and only partially and/or fragmentally take into consideration project management as a separate entity, despite according to Kiridena and Sense (2016) the project management community have made a great efforts in updating their methods, tools, knowledge and approaches in order to deal with project complexity. Project management has a major contribution to project success and its complexity can significantly affect the project result (Cooke-Davies et al., 2007). Ribbers and Schoo, (2002) in their proposed framework for assessing software programs implementation complexity, identified the management aspects which affect complexity such as team structure, communication, cost and time management. Lee and Xia (2002) stated that the complexity of the information systems development projects sources from both technological and business processes. Tie and Bolluijt (2014) state that project management and project complexity management are very close related. Kermanshachi et al. (2016) acknowledging the relationship between project complexity and project management identified 37 complexity indicators and the corresponding management strategies. These should be incorporated to the project execution plan, in order to keep it within budget and schedule constraints. Other researchers are studying software project complexity from various perspectives such as project maturity (Bolat et al., 2017), adoption of an effective project management model (Aydin and Dilan, 2017), creation of an effective project management plan (Rahman et al., 2016), identification of critical project success factors (Stevenson and Starkweather, 2017) or by the adoption of agile development methods (Truong and Jitbaipoon, 2016). This indicates that the study of complexity of IT projects and of SDP is a multifaceted phenomenon.

Regarding the top ten factors that lead to project success or project failure as described in various studies such as the "CHAOS report" (Standish Group 2015, 2009, 2005) and "Why software fails" (Charette, 2005), it is obvious that most of them identified many project management aspects as the causes of failure. Issues related to proper planning, requirements management, scope management, risk management, procurement management, communication management, human resource management, executive management support, user involvement and technology related issues are referred to as success or failure factors within these researches.

From a project management viewpoint and considering the factors that influence it, complexity in software projects is quite similar with projects in other domains, regarding the tools, processes, restrictions etc. (Fitsilis and Stamelos, 2007). Hughes et al., (1999) and Kiountouzis, (1999) stated that software projects differ since they are complicated, supple and technology dependent. Furthermore, Xia and Lee, (2005)(p.2) stated that information systems projects "are inherently complex because they deal not only with technological issues but also with organisational factors largely beyond the project team's control".

Considering the previous approaches, it is apparent that project management and project complexity interlock and the management of the one should involve the aspects of the other, too. Therefore, the assessment of software projects complexity should take into account all project management aspects. This research, follows the Project Management Body of Knowledge (PMBOK) framework (PMI, 2013) which implies that it relies on the assumption that project management is a typical process and as such, empirical approaches such as those mentioned before (e.g. XP, SCRUM etc.) are not applicable in this case.

2.3. Approaches for assessing project complexity

2.3.1. Assessment of Complexity

Complexity can lead to challenges or even the failure of a project because either the complexity is very high (Williams, 2002, 2005), or project complexity has been underestimated (Neleman, 2006). Considering the above, it is obvious that many failure factors would have been reduced, if not eliminated if there was a better understanding of the level of project complexity.

Therefore, in order to reduce the possibility of project challenge or failure, caused by complexity, we have to control it. The first step to do this is to know the level of expected complexity by assessing it. Whitty and Maylor, (2009) propose the use of complexity as a metric, to measure complexity in a system. Complexity should be considered as a variable that we should measure and faced with the question "How complex is this project?" reply "Its complexity is….." (Whitty and Maylor 2009) as can be seen in Figure 10.

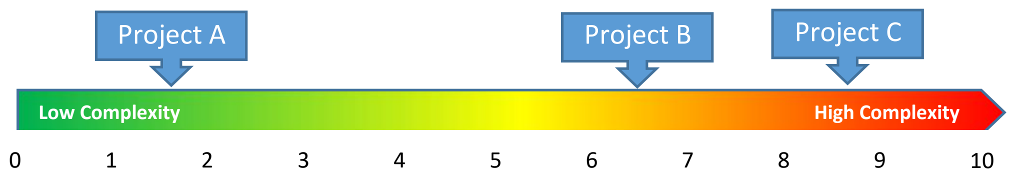

Figure 10 Projects evaluation according their complexity

Therefore, the definition of a model, which allows the practical assessment of project complexity is considered as an essential element of a complexity framework. Furthermore, the supplement of complexity framework with a software tools that automates the whole process will be useful. This research argues that the definition of a complexity framework with the above characteristics will assist managers to understand the concept of project complexity from the perspective of project management, will allow them to make meaningful assessments about the project complexity and take effective actions, in order to reduce or even overcome the complexity impact to project progress and hence to enhance the probability of project success.

2.3.2. Previously proposed complexity assessment approaches

The studies that follow the above approach are those proposed by Vidal et al., (2011). He at al. (2015), Nguyen et al., (2015) and Schuh et al (2017).

Vidal et al., (2011) in their study identified two dimensions of project complexity, the organizational and the technological dimension and four aspects of it that are in compliance with the system thinking approach, named project size, project variety, project interdependence and project context. Based on this approach, an initial complexity framework consisting of 68 complexity factors was identified through literature. Continuing on, a Delphi survey was performed in order to refine the complexity framework, by evaluating complexity factors on their contribution into project complexity. The means of standard deviation was used as a criterion to refine framework resulting in a framework consisting of 18 complexity criteria. The AHP methodology was used to assign weights to criteria and to calculate the overall project complexity, on a scale from 0 to 1 with higher values indicating higher complexity, based on a set of projects that were set as alternatives within the AHP methodology.

He et al. (2015) in their study of complexity in construction mega projects in China, proposed a framework consisting of six complexity categories/factors named technological, organizational, goal, environmental, cultural and information complexity. They also identified 28 complexity measurements/subfactors attributed to these categories. The proposed model uses two round Delphi surveys in order to define the relative contribution of each one of the 28 complexity measures to project complexity. Next, all measures with normalised values below 0.3 are suppressed. Finally, for determining factors and sub-factors weights a fuzzy ANP methodology is applied.

Nguyen et al. (2015) in their study of complexity in transportation construction projects, identified six complexity components named as socio-political, environmental, organizational, infrastructural, and technological and scope complexity with their corresponding complexity factors. An initial list of 50 complexity factors was identified through literature and then, these factors were evaluated by a group of experts resulted in a final list of 36 complexity factors. As a next step, a survey and subsequent factor analysis was conducted in order to reduce the number of complexity factors involved, resulting in a final list of 18 factors. A second survey was conducted to define the weights of complexity components and factors using fuzzy AHP methodology. The overall project complexity was calculated by the summing the products of the weight of each factor with the complexity value assigned to each factor by professionals. The scale used for factor evaluation was between 1 and 10 with higher values indicating higher complexity.

Schuh et al. (2017) identified a resource-oriented process cost calculation method to systematically link the impact of complexity to resource demand after considering of the project uncertainties. The project complexity evaluation model was implemented in Microsoft Excel and MATLAB. The method examines every project activity for existence of complexity drivers that can cause additional resource demands as well as their likelihood of occurring. Then using Monte Carlo simulations, the overall possible impact scenarios of the identified complexity drivers are evaluated. In continuous a comparison of the frequency distributions of the total resource demands with the capacities of the organizations enables managers to identify possibly critical complexity drivers. To calculate the overall project complexity and the possible requirements for extra resources beyond those initially planned, the results of the data collection and evaluation of the activities are aggregated at the project level.

2.3.3. Discussion

From the number of project complexity typologies that have been proposed during the last two decades, only a few of them provide complexity frameworks that can help project managers and stakeholders to assess project complexity and only few of them attempt to propose models for measuring project complexity. According to this research view, despite the significant contribution that these methods had in the field, they have limitations that restrict their practical applications. The limitations identified, concern both the conceptual framework and the assessment model.

The current conceptual frameworks determine the dimensions of complexity having the notion of complexity as starting point. Following on from that, each framework identifies a number of complexity dimensions according to its perspective of complexity and to the domain it evaluates. The logical structure of this approach can be seen at Figure 11. However, this approach is not very helpful to project managers since they have a different view and approach to the project. Complexity undoubtedly exists in every aspect of projects in various forms and levels and having many facets, but according to this research view, project managers should only be interested in it, if it interferes with the different aspects of their work.

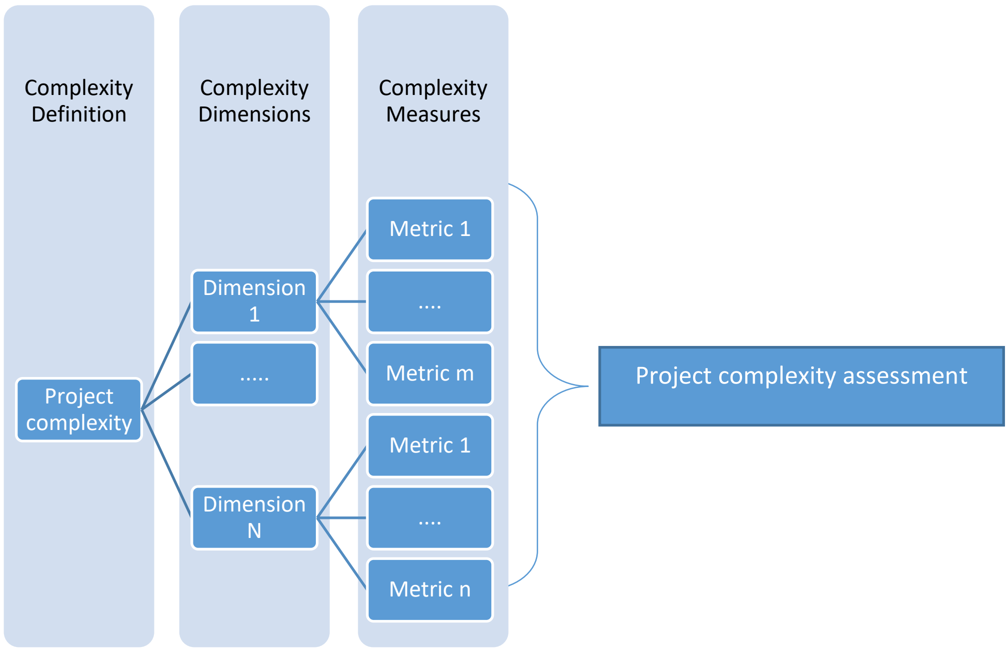

Figure 11 Traditional project complexity approach

They need to manage projects in order to be successful and because of that, they are interesting in the appearances of complexity within the areas that interfere with their management approach to the project and prevent them from being successful. Complexity pertains to all project processes including project management processes. A project manager probably does not care if the complexity he deals with is technological, organisational, environmental etc. but in which way and through which means it appears and interferes with project management activities. This approach entails that the study of complexity should be studied within project management processes and the dimensions of project complexity should be identified through this prism.

Considering the assessment approaches, can be identified the following limitations in the proposed models. Specifically, the results of the model proposed by Vidal et al. (2011), are highly depended on the set of projects that are set as alternatives in the applied AHP model. Complexity, as mentioned in a previous section, is dynamic, is evolved over time and one's perception of it can be changed over time also, due to experience or knowledge gained. This implies that the projects used as alternatives should be updated over time and be different for different organisations. However, the selection of the appropriate projects is not a trivial process and a bad selection may can lead to erroneous results of the model. These limitations have also been identified by Vidal et al., (2011).

On the other hand, the complexity assessment model proposed by Nguyen et al., (2015) is strictly related to a specific type of projects, as it referred to transportation construction projects, therefore limiting its use. However, in its abstract notion it is compatible with this research complexity assessment approach as it is described in Chapter 4 and presented in a number of articles (Fitsilis and Damasiotis, 2015; Damasiotis et al., 2014; Damasiotis and Fitsilis, 2013).

The complexity assessment model proposed by He at al., (2015) requires two rounds of Delphi surveys for initial complexity measures identification and in continuous uses fuzzy ANP to perform complexity calculations. Both processes are not straightforward to implement by project managers. The first requires the availability and commitment of responders to participate in recursive surveys in order a consensus about the most significant complexity measures to be obtained and the second requires the knowledge of mathematical models and calculations that most project managers are not familiar with.

The complexity assessment method proposed by Schuh et al., (2017) is strictly based on complexity impact to project resources quantification and their cost, which is a significant limitation of this method. Furthermore, it does not take into consideration possible interdependencies between identified complexity drivers. It is quite complex, time consuming and with significant overhead as it requires the examination of every project activity for possible complexity drivers affecting the resources required. Next, through a sequence of Monte Carlo simulations and statistical analysis for each complexity driver, calculate the overall project complexity as a result of possible additional resources required and their cost in relation to initial project resource plan.

In summary, even though some studies have proposed methods and techniques to assess project complexity, the need for a more practical complexity framework, which will consist of a typology of complexity compatible with the project management process, a set of indicative complexity factors and a simple understandable complexity assessment model, which is supplemented by an aid software tool, is evident.

2.4. Summary

In this chapter, we have critically presented the concept of project complexity along with different existing approaches. Next, our focus was put upon software projects and the existing complexity assessment approaches were presented. At the same time we have set the background for this research.

In the next chapter, initially the rational for selecting the most appropriate project management framework is presented. Next, the literature review for identifying the complexity factors for each complexity area that is defined in this research is presented.

3. Literature review (Part II) – Complexity factors identification

3.1. Introduction

This chapter critically presents complexity factors identified through a literature review. Initially the dominant project management frameworks are briefly presented and the reasons which have led to the selection of PMBOK as the appropriate project management framework for this research are discussed.

3.2. Project management frameworks overview

The emergence of project management goes back to the 1950's following the development of two mathematical models, the Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM) (Meredith and Mantel, 2008). In subsequent years, the development of large projects created the need for advanced methodologies and techniques for managing large projects. Currently, the application of project management techniques is considered as "sine qua non" in achieving projects goals. In the next paragraphs a short introduction on the three globally acknowledged project management frameworks, namely IPMA Competence Baseline (IPMA, 2015), PRINCE2 (OGC,2009) and Project Management Body of Knowledge (PMI, 2013), is given.

IPMA Competence Baseline (ICB) proposed by IPMA (http://www.ipma.world), describes in detail the competences that are required for project management. These competencies are classified in three main categories, technical competencies, behavioural competences and contextual competencies. ICB is not process based and is focused on required project management skills, and subsequently on tasks and activities.

PRINCE2 was introduced by OGC in 1996 and is widely used in the UK. It was fundamentally revised in 2009 in order to adapt to changes in the project and business environment, address weaknesses and adjust with other OGC methods. PRINCE2 is a process driven project management framework which is very prescriptive and provides the necessary techniques and templates for project managers to apply.

Project Management Body of Knowledge (PMBOK) is globally accepted as the main standard for project management both from companies and from organizations such as IEEE and ANSI (Pant and Baroudi 2008; Morris et al.,2006; Thomas and Mengel, 2008). PMBOK, in its latest version, identifies 10 knowledge areas in project management which are: Project Integration Management, Project Scope Management, Project Time Management, Project Cost Management, Project Quality Management, Project Human Resource Management, Project Communication Management, Project Risk Management, Project Procurement Management and Project Stakeholders Management (PMI, 2013).

PMBOK and PRINCE2 focus on “hard” skills such as processes, procedures and techniques, while the ICB is focused on “soft” skills which are related to human behaviour such as leadership, motivations etc. Winter et al., (2006) states that project management thinking is focused on “hard” aspects, which emphasises more planning and control rather than “soft” skills represented in other project management frameworks. The importance of “soft” skills such as leadership, social conduct and interaction between project stakeholder and active participation and accountability has been studied before by many authors (Turner and Muller, 2005; Cicmil and Marshall, 2005; Thamhain, 2004). In this research, PMBOK is chosen as the base project management framework. This is because, while it provides project managers with a pool of procedures and techniques in applying project management, it does not provide any templates for using them, but gives managers the freedom to take initiatives, utilise their experience and thus it can be argued that PMBOK enables the development of “soft skills” also.

PMBOK is selected as the reference project management framework for this research for three main reasons:

i. PMBOK defines ten project management areas and five management process phases that extensively cover all aspects of project management,
ii. it is process based and as that is compatible with our approach as defined in the previous section

iii. due to its popularity and extensive use worldwide

3.3. Identifying complexity factors according to PMBOK's categorisation

3.3.1. Introduction

As a first step in this research, an extensive literature review was conducted and properties of projects and of the project management process were identified in order to determine the appropriate complexity factors according to the described approach. The methodology approach followed for this literature review is presented in Chapter 4.

3.3.2. Time project management area

Time is a critical parameter in project design and progress and a determinant factor in successful or unsuccessful project completeness. (Wright, 1997; Atkinson, 1999; Nordqvist et al., 2004). Project management, among the other important operations, involves project planning and scheduling operations trying to ensure the completion of projects within specific time frames (Babu and Suresh, 1996). The project time management process should answer questions such as what are the activities that are needed to be performed and when, what are the resources required and when they should be allocated, what are the dependencies between activities, resources etc. However, this is quite a complex process to determine, due to the number of activities, the type of activities, the interdependencies between them and a great number of other interior or exterior project environmental factors. The importance of time in project management was acknowledged early on many organizations and the Project Management Institute included Time Management in projects as one of the main areas of project management in PMBOK guide.

According to PMBOK (PMI, 2013) the first thing that should be considered when starting to implement the project time management plan is to establish the policies and procedures that should be followed. Applying different methods and policies in time management planning may result in different hierarchies in project time management requirements, resulting in different actions that should be implemented and to possibly different results. For example, if the planning method will be based on the well-known "critical path method" then it is very possible according to Goldratt, (1997) for the bottleneck resources to be ignored, resulting in time planning delays and project decreased performance. According to Ramo (2002) in project organizations, it is of great importance doing the right things rather than doing things right in terms of timing. This approach is also known as "Successive Principle" and is also used in other areas of project management (Lichtenberg 2000). The control of time is considered the most important variable in business nowadays. The goal of project time management is to define timely and well understood operations in projects as these are critical factors in order to improve project performance and gain competitive advantages (Hameri and Heikkila, 2002). The notion of time in projects includes more dimensions than just the duration and scheduling. It also includes the dimensions of activities sequence and synchronization and project intensiveness (Maanine-Olsson and Mullern, 2009). As Chin et al., (2015) and Lundin and Soderholme (1995) state, the projects should be considered as a set of activities that evolve over time from project start to project finish. Considering the above, it is obvious that the number of project activities is an important complexity factor in project time management as it is strongly related to the duration, scheduling, synchronization and sequence issues of project time as has been proposed by other researchers as a project complexity factor (Vidal et al., 2011; Fitsilis et al., 2010).

Each project can be considered as a set of interconnected activities that correlate, interact and share a pool of common resources which generally is not suffice for all activities to work concurrently. So the aim is to prioritize the activities in a way that will assist and enhance the efforts to achieve project goals. In that context, factors sourcing from activities correlation, synchronization, duration and resource requirements, such as the number of critical activities (e.g. activities that belong to critical path), the number of activities executed in parallel, number of activities with overlapping resource requirements, number of activities that require high variety of resource types, number of dependencies between activities and variance in project activities duration can be considered as complexity factors that affect the project time management process.

Time resources in a project are not infinite. In fact, projects are usually faced with strict time resources and deadlines/milestones, which have a great impact on the way they were planned and executed. Deadlines/milestones have a significant contribution in how work is regulated and time and work is partitioned into smaller parts (Nordvist et al., 2004). This is usually a means to enhance the motivation of the project team working on the project and increase its productivity as the deadline approaches ((Maruping et al., 2015; McGrath and O'Connor, 1996; Seers and Woodruff, 1997; Ancona, 1990), otherwise team members may lose their focus and commitment to project activities due to other external interferences (Berg and Karlsen, 2016; Gevers et al., 2001). However, there is a limit into that pressure that should not be exceeded, as otherwise the results will not be those expected (Maruping et al., 2015). The stress that can overwhelm team members can lead them to passivity, avoidance reduced performance and have a negative effect on their health (Rissler, 1994; van Eerde, 2000). In addition, milestones should be clearly defined and communicated to team members as by that way the negative effects of time pressure can be reduced (Nordqvist, 2004). It is the responsibility of those performing the project time management to take these into consideration and to ensure that contradicting factors, such as the availability of time and the number of milestones be handled in such a way that will result in conditions that will enhance project progress and success. So the density of project (rate of tempo: relaxed or stressful), the number of project intermediate deliverables/milestones and the project duration are important complexity factors in project time management process.

Uncertainty, sourcing from project environment, interconnections between project activities and resources and the number of different methods used to deal with, is embedded in project time management and have a great influence in the effectiveness of project time management process (Hameri and Heikkila, 2002). A time manager should take into consideration properties of activities (such as number, type, criticality, duration, etc.), properties of resources (such as number, type, availability, criticality, scarcity, etc.) and project environmental factors (interior and exterior). For that reason, the experience of those performing the time management process within project can be considered as an important complexity factor in project time management success, as usually highly experienced time managers decrease the possibility of selecting and applying "wrong" methods that could raise the time management project complexity resulting in decreased performance and finally to challenge the entire project success.

However, team experience is not adequate by itself to perform time management successfully. From the above it is clear that time management is a quite complex and complicated process and therefore the availability of a set of tools to assist project managers in planning and monitoring the various aspects of project scheduling is necessary. For example, consider the existence of a schedule control mechanism/tool that is able to monitor the current project status and allow early changes in project schedule to accommodate differences between project implementation and scheduling status. For that reason, the availability or not of such tools is considered as an important complexity factor in time management.

Table 4 presents the complexity factors identified within project time management processes.

Table 4 Identified complexity factors in the Time management area

	Time management area complexity factors
1.	Number of project activities.
2.	Number of critical activities.
3.	Number of project activities executed in parallel.
4.	Number of activities with overlapping resource requirements.
5.	Large number of dependences between activities.
6.	Number of activities that require high variety of resource types.
7.	Long project duration.
8.	Number of long duration activities.
9.	Variance in project activities duration.
10.	Number of intermediate deliverables should be delivered.
11.	High project deliverable density.
12.	Low availability of project resources.
13.	Number of activities require highly specialized resource types.
14.	Insufficient time management experience within project management team.
15.	Lack/shortage of tools for planning and monitoring project schedule.

3.3.3. Cost project management area

Effective cost management is an important parameter for a successful project outcome. A fundamental process of cost management is cost estimation, as according to these estimations, substantial information should be gathered and used for decision making, scheduling and resource allocation (Carr, 1989). If cost estimation underestimates actual cost needs, then the project may be delayed or may fail to meet objectives. In contrast, if cost estimations overestimate actual costs, then probably there will be funds that will be denied to other projects or a project may not be approved at all as too expensive. Research such as CHAOS report (The Standish group 2015, 2009, 2005) indicates that almost one third of software projects experience cost overruns of more than fifty percent of the initial budget caused by wrong cost estimates. This is something that sets the project in serious danger or may lead to compromises in quality of project deliverables. So, the question is why cost estimations fail so often? Many reasons can be identified but usually this is due to lack of necessary information, lack/unavailability of cost estimation tools, due to actions of senior management (e.g. arbitrary budget cut-offs), inexperienced cost management team, design errors etc. However, consensus prevails that cost estimation models do not always work (Chou, 2009; Yeo, 1990).

Project cost management is mainly concerned with the cost of resources needed to complete the project activities and the stakeholder requirements for managing costs. Beyond that it should also be taken into consideration what effects the decisions taken at this stage may have later on the recurring cost of using, maintaining and supporting the product or service deliverable of the project (PMI, 2013). However, this is quite complex process to determine, due to the number of activities, the type of activities, the interdependencies between them and the great number of other interior or external project environmental factors.

As already mentioned, project cost management is mainly concerned with the cost of resources needed to complete the project activities and the stakeholder requirements for managing costs. Cost estimation process is quite a complex process and various approaches can be used to implement it (Torp and Klakegg, 2016). These can be classified as probabilistic, determinist, bottom-up, top-down, analogous, qualitative and quantitative (Chou, 2011; Doloi, 2011; Niazi et al., 2006). Regardless of which approach will be selected for cost estimation, all rely on utilization of existing cost data from previous projects and to cost estimation experience of team performing cost management (Chou, 2009; Aibinu and Pasco, 2008; Henry et al., 2007; Akintoye and Fitzgerald, 2000). However, historical cost data, especially if detailed data are required, are not always available. On the other hand, using historical cost data from previous projects, even if these are similar to current projects, is not always considered a good choice in the cost estimation process, especially in projects that operate in a rapidly changing environment. (Chou, 2011;2009)

The deterministic approach relies on utilization of existing past cost project data and to cost estimation experience of the team performing cost management. The probabilistic approach is based on simulation processes that requires project data as input. However, these data are not necessarily all available at initial project stages and hence team experience is the factor that determines the accuracy of estimation. The top down cost estimation is simple, low cost, requires historical cost data that are usually easy to find but has low transparency, low versatility and high level of assumptions. The bottom up cost estimation approach offers the best accuracy, high credibility, is transparent, granular and versatile. However, it requires detailed data that often are unavailable and requires the most time to be implemented. The analogy cost estimation approach is a deviation of bottom-up approach that makes extensive use of data obtained from similar past projects, which is analysed for metric differences with the current project with the help of appropriate software tools. Lack of or bad quality of historical project data or tools leads to inaccurate cost estimations. The quantitative approach also makes use of historical cost data from previous similar projects and expert knowledge but beyond that, it analyses project processes and units using analytical methods to produce accurate costs (Chou, 2011). The quantitative approach relies on historical cost data from similar projects and to expertise of those performing cost estimation. The critical point of this approach is the degree of similarity to past projects used.

When considering the cost estimation approaches similarities can easily be identified between them and that there are mainly two basic methodologies. One that is more analytical and detailed and produces more accurate estimates, but requires time and detailed historical cost data that are not always available and a second that is quick, easy to perform but the accuracy and robustness of produced cost estimations is very often under question. It is obvious that factors such as the existence of historical cost data, the level of expertise and experience of team performing cost management, the availability of time to perform cost estimation and the availability of specialized methods and tools for estimating, monitoring and reporting cost progress are among the basic factors that influence the cost management complexity process and the availability or lack of them can significantly affect the complexity of the whole cost management process.

In addition, the cost estimation teams often have to deal with senior management, that considering that project cost is too high proceeds to arbitrary cost reductions without making analogous reductions and in project scope (Doloi, 2011). Flyvbjerg et al. (2002) in their research indicate that projects very often fail not only due to technical reasons but due to external project dependencies such as political environment or stakeholders' psychological reasons. Market conditions is also a factor that affects complexity in cost estimations process as difficulties in market affect the economic situation of business and society. Under that prism, the long project duration can affect cost management complexity as it is more vulnerable to meet changes in political, economic, market and technological environment that could change the economic status and feasibility status of the project (Xia and Lee, 2005).

Another aspect of cost management process is how project cash flows evolve. Smooth and accurate cash flows are critical to project progress as these determine the amount of capitals that should be reserved at any time, allows determination of project financial requirements and performing earn value analysis (Maravas and Pantouvakis, 2012). Thus, irregularities in project cash flows add a layer of complexity in cost management process. Another factor that is strongly related to project payments is the variety of project financiers and how it affects cost management complexity (Vidal and Marle, 2008). For example, it may be better to have a large number of financiers in order to distribute the cost at any stage of the project and expand the economic base of the project. On the other hand, this may result in more bureaucracy, increased communications requirements necessity to deal with psychological barriers between financiers and hence increased cost management complexity. Therefore, the number of project financiers can be considered as a complexity factor of cost management process.

The existence of time consuming processes for project payments, intensive financial reporting and generally high bureaucratic processes are factors that can add a layer of complexity in project cost management process. These factors are strongly related by financial stakeholders' policy and are usually present in projects where the number of financiers is high or public domain is involved and a higher accountability is required (Fitsilis and Chalatsis, 2014).

Table 5 presents the complexity factors identified within project cost management processes.

Table 5 Identified complexity factors in the Cost management area

	Cost management area complexity factors
1.	Long project duration.
2.	Low accuracy of analytical cost estimates due to project external dependencies (e.g. time restrictions, economic condition, political environment etc.).
3.	Lack/shortage of specialized cost estimation method and tools. (e.g. use of well-known methods, availability of specialized software etc.).
4.	Project budget cuts attributed to external facts.
5.	Insufficient cost management experience within project management team.
6.	Lack/shortage of historical cost estimation data.
7.	Project is financed by large number of stakeholders.
8.	Irregularities in project cash flows (e.g. frequency of delay, diversities in delay duration etc.).
9.	Lack/shortage of tools and processes for tracing, monitoring and reporting project cost progress.
10.	Time consuming processes for project payments approvals.
11.	Intensive and time consuming project financial reporting.

3.3.4. Quality project management area

Nowadays companies are operating in a highly competitive environment in terms of providing products of high quality, low cost, with innovative features and in short periods. A critical factor to survive in this tough environment is to produce high quality products and to reduce product cost and time to market by reducing the need for reworks. To succeed organizations are needed to implement and reinforce quality management procedures. Quality management is defined as a set of processes and activities in order to achieve a twofold aim. Firstly, to satisfy the customers' requirements and confidence, in the ability of the organisation to deliver the desired product /service consistently, with the specific characteristics and requirements that was set during the product/service design period in order to meet their needs and expectations. Secondly to satisfy the organisation's requirements, both internal and external for efficient use of available resources (human, material, tool, technology and information) in the most optimum way. According to Flynn et al., (1994) there are two discrete types of quality management, the quality management practices (inputs) and the quality performance (output). A number of studies have tried to identify the key quality management dimensions (Sousa and Voss, 2002) with most of them having a common space with PMBOK's approach for three main dimensions in quality management.

A number of models have been developed for measuring product quality features such as performance, reliability, durability and management practices (Saraph et al, 1989; Parasuraman et al, 1988; Flynn at al. 1994). Software projects were among the first that adopted quality management procedures and measures of the need to avoid budget and schedule overruns failing to deliver products according to specifications or delivering products at all (Standish Group,2009). A number of models which aimed on improving the software development process were introduced such as the COCOMO (Boehm, 1981), Capability Maturity Model (CMM)(Paulk et al., 1993), COCOMO II (Boehm,2000), IEEE 12207.0 standard (IEEE, 2008). These models measure either the effectiveness of development process or the software development process. However, the measurement of the quality of project management is not included as it is difficult to determine abstract and effective quality management metrics. For that reason, although Boehm (1981) states that poor management can affect software project cost more than any other factor, he did not include in his model any quality management factors but relies on assumptions that the project will be well managed.

To apply quality management in projects is not trivial as there are factors that introduce complexity in this process which have not attracted too much attention from researchers and have not been evaluated under the prism of quality management.

The first step in quality management is to create the quality plan and specifically to identify quality standards for the project, set up quality requirements, define how quality will be managed and validated. Strict quality requirements may increase the complexity of quality management as intensive quality management processes and a bureaucratic and heavily documented quality management system should be established. This system should cover the areas of specifications, guidance, monitoring and reporting of project quality. Although the level of complexity that will occur especially in large software engineering projects, will be perceived as requiring to ensure both quality in processes and outputs, and to ensure compliance, there is still the risk that sub parts of an overall design will suffer from poor design and documentation or that even basic assumptions become flawed or outdated (Ogland, 2009). Such undesirable factors would likely lead to a significant amount of rework that would affect project process and would increase project quality management complexity further.

There is consensus between scholars (Gutierrez-Gutierrez, et al., 2018; Zu et al., 2008; Beckford, 2002; Saraph et al. 1989; Deming, 1986) on the importance of quality management of factors such as top management commitment to quality, process management and stakeholders and employee commitment and training to quality procedures.

Quality management, although it ultimately can contribute to project cost reduction, has a cost by itself that is not negligible (Modhiya and Desai, 2016; Love and Irani, 2003). The commitment of project top management and leadership to quality management should be unquestionable. That is because during project progress they may be challenged to take difficult decisions such as the adoption of a new management philosophy, setting new policies and attitudes and it may be required to select between retaining either time-cost restrictions or quality restrictions. Javed (2015) and Beckford (2002) state that management commitment is the most critical issue in the pursuit of quality. Evidence of this commitment is the existence of a quality assurance (QA) department within the project organisation. The QA department is an organisational mechanism to improve quality management. It is responsible for the proper utilization of the personnel of QA department, for designing quality mechanisms within the departments, for controlling staff applying quality processes (Saraph et al., 1989) etc. The complete absence of a QA function or department does not mean that the organisation is not performing or enforcing quality management techniques but its existence usually makes things easier and instils a quality culture within organisation.

The term “quality culture” refers to an organisational value system that results in an environment that is encouraging to the establishment and continual improvement of quality. Organisations that develop and maintain a quality culture will differ significantly from those with a traditional culture in the areas of operating philosophy, objectives, management approach, attitude towards customers, problem-solving approach, supplier relationship, performance-improvement approach. Although establishing a quality culture is a challenging process for all organisations, it is even more challenging to maintain it over time. In order to establish and maintain quality culture, organisations need to maintain an awareness of quality as a key cultural issue, make sure that there is strong commitment of leadership to quality, empower employees and encourage self-development and self-initiative, apply employee training in quality procedures and recognize and reward the behaviours that tend to adopt and maintain quality culture (Zu et al., 2008; Irani et al., 2004; Saraph et al., 1989).

From the above is obvious that quality management is a complex process which involves a variety of procedures within an organisation. Thus, the implementation of a quality management system should follow and comply with the requirements set by well-known quality management standards developed by international organisations such as the International Organisation for Standardisation (ISO) (http://www.iso.org) For example, the well-known and widespread international standard ISO 9001 – “Quality management systems – Requirements”, provides a set of requirements for setting up a quality management system. This includes monitoring processes, maintaining complete and accurate records, checking for defective output, taking action to correct defects, and continual internal reviews for effectiveness. It should be noted here that ISO 9001 does not provide detailed guides about how to implement it, in order to be able to be adjusted with both organisation requirements and standard requirements. As a result, it is a generic standard that can be applied to a variety of organisations regardless of the size or domain of their business. On the other hand, there are standards that are more domain specific such as ISO 90003 – “Software engineering -- Guidelines for the application of ISO 9001:2008 to computer software”, for software development organisations. An important point that is indicated by quality management experts is that quality managers should not become isolated from the organisation environment or project special environment and should be able to identify special situations and characteristics and to be adjusted accordingly (Ogland, 2008). There are examples which point out that the designing of a quality management system although following the standard requirements, may be finally inappropriate and lead to situations where quality is poorer than before applying the quality management system (Seddon, 2000).

In order to avoid such unpleasant situations, the existence of historical quality management data can provide valuable information in designing good quality management principles, practices, techniques and avoiding errors. In addition, project organisation can comprise of two or more cooperating organisations which may vary in size, capabilities, experience and quality culture. The lack of consistency needs to be managed in order to implement a total quality management system.

Another important factor for successful quality management is the timely collection, distribution and availability of current quality data, both for employees and managers (Zu et al., 2008). These data are necessary for maintaining quality oriented behaviours, quality improvement, problem solving and evaluation of managers and employees based on quality performance and timely quality measurement in order to keep process in control and avoid production defectives (Zu et al., 2008; Flynn et al, 1994; Saraph et al., 1989).

Information that is delayed or is inaccurate or is not properly filtered can result in quality failures due to ineffective decision making. Key elements in avoiding that situation include firstly the existence of an effective and efficient communication system capable of timely distributing the required information, such as quality goals, policies, responsibilities, quality measurement results to the appropriate people, without adding “noise” or adding unnecessary bureaucracy to quality management process. Secondly the existence of appropriate tools and processes to support every stage and aspect of quality management process such as planning, tracing, monitoring and reporting. In this regard, the existence of an information system to support quality management and generally the use of information technology in managing and communicating quality information is mandatory considering the complexity of sourcing from the amount of data that needs to be managed, where in many cases it originates from organisations with differing approaches to quality management (Love and Irani; 2003).

The existence of external quality audits may add complexity to quality management. The external quality audit usually is interested in measuring the organization quality system against the requirements of a selected quality standards model (e.g. ISO 9000 standard) and not the organizational performance against business excellent model criteria (Karapetrovic and Willborn, 2001). Bureaucracy within an organisation may also be increased as more documents should be prepared, that should be compatible with the requirements set from the selected quality standard, used by the external auditor. Another aspect is that external audits may increase the psychological barriers within project members making them act more formally and reducing by that way the flexibility that is required in order to quickly adapt to changes or deal with problems, resulting in decreased project performance. However, the external audits reassure the objectivity, independence of evaluation and a strong assurance that a quality system exists and operates in the organisation.

Table 6 presents the complexity factors identified within project quality management processes.

Table 6 Identified complexity factors in the Quality management area

	Quality management complexity factors
1.	Quality requirements as stated in project quality plan.
2.	Insufficient communication of quality goals, policies and responsibilities within project organization.
3.	Lack/shortage of historical quality management data.
4.	Low management commitment to project quality (e.g. management preference to retain time - cost restrictions versus quality restrictions).
5.	Lack of quality culture of project stakeholders. (e.g. stakeholders' training, experience, commitment to quality management).
6.	Not use of well-known quality management procedures.
7.	Missing of QA organisation department.
8.	Lack of tools and processes for planning, tracing, monitoring and reporting project quality management result.
9.	Existence of external quality audits.

10.	Existence of thorough quality management procedures within customer/contractor organisation.
11.	Process immaturity.

3.3.5. Communication project management area

One of the biggest challenges in the project management process is the coordination of people, processes and activities in projects. For dealing with this challenge, the role of communication is essential (Carvalho, 2013; McChesney and Gallagher, 2004). According to Pinto and Pinto (1990), project communication can be defined as the vehicle through which project stakeholders share information from different functional areas that is critical to the successful implementation of the project.

Project communication has three major components. The first component is the communication between different project participants, who they are and what are their characteristics. The second component is the type of the communicated message and the third component is the communication media that will be used for communicating (Muller, 2003; Pinto and Pinto, 1990). Further project communication can be characterized as internal or external to the project according to the type of stakeholders involved. Internal is the communication between project team members whereas external is the communication between the project team and the project stakeholders.

According to Kennedy et al. (2011), communication acts as a bridge between the various project stakeholders in order to improve team cooperation (Pinto and Pinto, 1990), coordination (Hauptman, 1990), information processing (Hinsz, 1997), decision making (Poole and Hirokawa, 1996), knowledge sharing (de Vries et al., 2006) and enhance team member activities (Oh et al., 1991). Obikunle (2001), states that communication is at the heart of the project and lack of it will give room for rumours to develop and will cause misunderstandings and misinterpretations.

Turner and Muller (2003) mention that the temporary nature of projects is a factor that increases communication complexity. As such, communication management is not trivial process and for this reason, PMI defines communication management as one the ten management areas in the PMBOK guide (PMI, 2013). PMBOK defines communication management as the collection of processes required to “ensure the timely and appropriate generation, collection, distribution, storage, retrieval and ultimate disposition of project information” in order to reduce the probability of communication failures. It is related to a wide range of processes such as stakeholders’ identification, information distribution, stakeholders’ expectation management and performance reporting.

Concerning software projects, there are studies such as the studies of Standish Group (2005, 2009), or the study “Why Software fails” by Charette (2005), which identify communication failure or poor communication between project stakeholders, among the most important factors that affect project success. Further, the increasing demand for software systems, the rapid changes in software technologies and the increasing complexity of software functionality makes the need for effective coordination between project stakeholders a necessity. The means to achieve that is effective communication that can be achieved through effective communication management. It is generally accepted that complexity in communication management is present in every aspect of the communication process (Carvalho, 2013; McChesney and Gallagher, 2004; Saunders and Stewart, 1990; Bergen, 1986). Thus, in order to achieve an effective communication management, it is important to control this complexity.

Modern projects are operating in a collaborative development environment where two or more organization cooperate in order to develop a specific product or service. A key point for successful cooperation is the establishment of an effective communication between parties allowing the efficient coordination of activities and people. However, communication difficulties are increased as the number of involved parties increases (Backlund and Ronnback, 1999). Although, each organization may have established an efficient internal communication mechanism, this does not imply that an effective communication mechanism can be established easily between them. In addition, the various project parties – stakeholders are coming from different functional areas, with their own unique view about the project and perception of project success (Muller, 2003; Patrashkova and McComb, 2004). The requirement for coordination between them creates the need for an environment of high communication density which adds a layer of complexity in communication management in terms of communication frequency, type of communication (formal-informal), which media will be used and participant’s engagement both in terms of number and specialty. Therefore, the number of different organizations composing the project organization is identified as a communication management complexity factor.

A key point in communication management is the establishment of an effective communication model. Especially, in organizations that attempt to maintain an 24x7 communication model, such as multinational organizations (Daim et al., 2012), this need become more imminent and challenging to project managers. The criticality of effective communication in project performance has been identified by many researchers (Patrashkova and McComb, 2004; Hutchins, 1995; Smith et al., 1994). The relation between communication frequency and project performance has also been investigated. Too little communication can lead to confusion and misunderstandings (Katz and Allen, 1982) whereas too much communication can lead to communication overload (Patroshkova and McComb, 2004). Further, project team members have limits in the amount of information they can process (Fussel et al., 1998; Boisot 1995). Both of these circumstances will lead to the reduction of communication efficiency and project performance which challenges in the project success. Studies have proven that the relation between performance and communication is curvilinear (Kennedy et al., 2011; Patroshkova et al., 2003; Huchins, 1995). This implies that there is an upper limit to the amount of communication in relation to team performance and beyond that, the performance will decreased if communication is increased. The term communication refers both to formal or informal types of communication between project team members. Formal communication includes reports, presentations, meetings and generally all forms of official communication where written documentaries are presented and take place through predefined channels. On the other hand, informal communication does not require written documentaries as it is mainly verbal, allowing team members to discuss work related problems fast and efficiently without the overhead of formal communication and can be spread freely between team members. It is obvious that formal communication is much more demanding and time consuming than informal communication. Formal communication, especially in forms of in person communication such as meetings, presentations etc., is much more demanding and in management terms as it requires the gathering of number of persons at a specific place and time that is not always easy, due for example to geographical distribution of team members. If the frequency of such types of communication is high, then a layer of complexity is added to communication management. In addition, formal communication requires team members to spend a larger portion of their labour time in communication related process in terms of preparing, participating, analysing and evaluating the results, resulting in reduction of labour time available to spent in their original tasks in the project and hence in reduction to project performance. On the other hand, informal types of communication, although not having the overhead of formal communication, can also easily be time consuming for team members if it is taking place of a high frequency. For example, a high number of emails asking for small pieces of information can take up a lot of time and decrease performance. Considering the above, it is proposed that the heavy and frequent project reporting, the frequency of formal in person communications/ meetings/ presentations and the labour time spending in communication processes by team members are factors that can affect the communication management complexity.

In order to achieve an efficient and timely communication, specific communication structures, processes and protocols must be defined (Carvalho, 2008; Saunders and Stewart, 1990). Specific communication lines across team and stakeholders must be established, in order to set a structure of communication between stakeholders. If these lines are not established the control of communication will be lost, as messages will end up being passed from one to the other with no order, specific information may be sent to the wrong person etc. According to Daim et al. (2012), as the number of project stakeholders increases the number of communication lines also increases and complexity is added to communication management. Furthermore, an important prerequisite for establishing effective communication lines is the clear assignment of responsibilities between project members and communication of these within project organization. These two parameters will enhance timely communication, which is a prerequisite for successful project completion, as everybody will know what should be communicated, to whom, and through which communication channel. This becomes even more important in geographically distributed projects and where team members with different cultures exist (Daim et al., 2012). Consequently, it is considered that the lack of clear work assignments and the lack of clear communication lines are factors that can affect the complexity of communication management.

Software development projects operate in an environment of continuous change with respect to the technology. These changes make the continuous sharing of information important between project team members which can be achieved only through communication. Moreover, the practice of creating geographically distributed teams (virtual teams), is used increasingly and especially in high tech projects (Daim et al., 2012; Kozlowski and Ilgen, 2006). These project teams could not even exist if there is no strong communication infrastructure. Geographical distribution of project teams adds complexity in communication management as new difficulties arise in communication process such as time differences, different first languages and differences in culture between project team members (Lee-Kelly and Sankey, 2008). In addition, it is difficult to use certain forms of communication, such as synchronous or in person types of communication, because that, communication is usually relayed on asynchronous types. Obviously, these restrictions add a layer of complexity in communication management. Thus, it is suggested that the geographical distribution of project stakeholders is a factor that affect the complexity of communication management.

Bergen, (1986) refers that according to Lawrence and Lorchs' differentiation theory, people's thinking is coloured due to culture, education, training and responsibility factors and for that reason they gain different impressions for the same data. Geographical distribution of projects as well as with the globalization of labour market (Lu et al., 2005), leads to formation of teams with people from different nationalities and hence with differences in culture, ethic, habits, education, training to mention a few (Dekker et al., 2008; Hardin et al., 2007). These are critical factors in creating attitudinal and psychological barriers between team members (Carvalho, 2008). To overcome this problem, organizations that operate all over the world send employees that are in critical positions, to other countries in order to understand the culture of people there (Daim, 2012). Thus, it is considered that the diversity of project stakeholder's nationalities and the existence of culture differences between project stakeholders are factors that affect the communication management complexity.

Team members, especially in virtual teams, often have difficulties in building trusting relationships with other team members and can be easily feel neglected (Daim, 2012). As such, communication based on email or reports is not adequate as it increases the possibility of misunderstandings and psychological and/or attitudinal barriers arising between team members (Lee-Kelly, 2007). Sigrun (2007) in his research in email communication, note that the use of inappropriate tone and words is very common in that form of communication and can easily lead to misunderstandings. As a result, the need for more interpersonal communication type and media to support communication is intense, as it can reduce barriers sourcing from psychological elements such as defensiveness, lack of credibility or respect between team members, judgmental attitudes etc. When people communicate, they use more than one communication channel to convey a message, such as body language, voice tone, facial expressions and eye contacts. The messages received by these channels can totally change the meaning of words spoken. Because of that, the existence of communication media rich in communication channels is important and can reduce communication complexity. Examples of communication media rich in communication channels are videoconference, face-to-face meetings, or telephone. The richer in communication channels, the more effective is the media in communication (Chudoba and Maznevski, 2000) considering psychological and attitudinal factors (Lee-Kelly, 2008). However, there are disadvantages too, teleconference, for example, cannot satisfy the need for clearance and clarity of requirements. Backlund and Ronnback (1999) indicate that very often in geographically distributed projects the availability of a wide range of media tools is limited and that can affect the effectiveness of communication. Therefore, availability of a wide range of communication media tools, is very important property of communication and can affect the communication management complexity.

An often neglected parameter is the communication beyond the boundaries of the project (Partington, 1997). It refers to communication with the local communities and authorities in order to share information about the project that might concern them. Communities are often wary and sceptical towards projects that will be implemented and it can affect everyday life. This attitude can be easily changed to be negative about a project if rumours about the project prevail over the official information. The goal of communication management is to create a positive common view and share the common vision about the project with the local society. To achieve that, frequent information about the project progress should be established through a variety of media in order for all stakeholders to be informed as even a small group of contradictory people can challenge project success. This need is even bigger in high visibility projects and this is a factor that adds another layer of complexity in communication management.

From the above it can be concluded that there is a wide variety of parameters that the communication management team should take into consideration while preparing the communication plan, such as project environment, communication requirements, communication budget, and communication technologies and tools availability. Further, research has shown that good stakeholders' relationships, clear management strategy and project goals can affect the frequency and the media used in project communication (O'Neil, 2008; Muller, 2003). For example, good relationships between project team members reduce the need for face-to-face communications and increase the usage of traditional written reports as the probability of the appearance of psychological barriers are reduced. Concluding, the communication management team should take into consideration a wide variety of parameters either measurable or not, in order to find the balance between the various forms of communication and the media to be used in order to avoid communication overload or communication starving situations. To achieve this goal, management team experience in communication management is critical. As the literature provides, in many cases, there are contradictory guides about communication parameters for example how much formal, informal or interpersonal communication is required (Lee-Kelly and Sankey 2008; Patrashkoa and McComb, 2004). As a result lack of or insufficient communication management experience can be considered as a complexity factor of the communication management process.

Table 7 presents the complexity factors identified within project communication management processes.

Table 7 Identified complexity factors in the Communication management area

	Communication management complexity factors
1.	Insufficient communication management experience within project management team.
2.	Geographical distribution of project stakeholders.

3.	Labour time spent on communication processes by project team members (consider time for preparing, participating and evaluating a communication process).
4.	Diversity in project stakeholders' nationalities.
5.	Culture differences between project stakeholders.
6.	Shortage in communication media tools (consider availability of media tools for various communication types e.g. face to face, oral, written etc.).
7.	Heavy and frequent project reporting.
8.	Frequency of formal in person communication / meetings / presentations.
9.	Not clear communication lines (refers to lack of definition of organizational hierarchy, lack of formal communication lines, structure and preferred type of communication between project organizational levels and teams).
10.	Not clear job descriptions and work assignment.
11.	Number of organizations composing the project team.
12.	Requirements for communication due to high project visibility (consider local communities, authorities, public etc.).

3.3.6. Human resources project management area

From the first years of management the important role of the Human Resources (HR) in organization performance has been acknowledged (Barney, 1991; Huemann et al. 2007; Buller and McEnvoy, 2012). However, despite this trend there are some empirical studies (Pinto and Prescott, 1988; Belout and Gauvreau, 2004) which contradicts this general perception. The results of their research show that the human factor plays a marginal role in project success. Nevertheless, Belout and Gauvreau (2004) acknowledge that first HR management in the context of project management is yet undeveloped and second that the strategic role of HRM in organization success is increasingly recognised. Nowadays, the significant role of HR management in project success it is generally acknowledged and the Project Management Institute have included HRM among the ten fundamental functions of project management (PMI, 2013). The importance of HR is even bigger in organizations that operate in rapidly changing and complex environment (Hayton, 2003; Huemann et al., 2007). HR are not homogeneous between organizations and, that is among the main factors that makes them differ in how they respond to various challenges and problems even if they are operating in the same area. For that reason a lot of work has been made during the last years in the domain of HR and HR management in order to achieve best utilization and management of HR within an organization (Buller and McEnvoy, 2012; Guest, 2011). A number of methods and metrics have been proposed for selecting personnel, measuring and evaluating staff performance (Becker et al., 2001). Furthermore, the profile and the size of project teams may change during project execution due to assignment of different set of roles and responsibilities to them (Huemann et al. 2007). It is apparent that HR management is a quite complex process and the effective utilization of project HR is critical to project success. Acknowledging that, modern project management frameworks such as PMBOK (PMI, 2013), ICB (IPMA, 2015, 2006) provide specific sections in describing methods, tools, processes and procedures that should be followed in order to identify the required HR competencies and how to utilize them in most effective way. According to PMBOK (PMI, 2013) the project HR management "includes the processes that organize, manage, and lead the project team".

From the above, it can be deduced that HR management is a complex process as it involves a great number of different processes that deal with humans and concepts such as knowledge, skills, abilities, attitudes and people interaction, that are not always easily measured and evaluated especially in our days where projects are becoming more and more globalized and project team members are formed from people with great differences in their backgrounds.

The first factor that can be identified as a complexity factor in HRM is the "Size of project team". The term "Size of project team" is defined as the number of staff that will be employed by the project organization. A number of researchers in their studies about HRM in business and HRM complexity have identified this as a factor that can affect the complexity of HRM (Williams, 2002; Geraldi and Adlbrecht, 2007; Muller and Turner, 2007; Hayton, 2003; Bosch-Rekveldt et al., 2011; Fitsilis et al., 2010; Vidal et al., 2011). According to Hayton, (2003) this factor was self-reported by respondents in his survey about strategic human capital management as critical HRM factor that affect project performance, which is something that enhances the validity of this factor. He also states that firms attempted to find ways to minimize the HRM costs without this affecting the final product or service quality. In the same line, Wi et al. (2009, p.6) state that it is "is not favourable that too many team members are assigned to one project in terms of project management, so it is advantageous to minimize the number of team members" which evince the importance of allocating the "correct" size of project team.

However, despite its importance, the "size" of the project team alone, it is not an absolute factor for measuring HR management complexity. As Daim et al. (2012) state, projects are heavily dependent on a team's collaboration and synchronicity and failure to achieve that can lead to competing lines of authority poor delegation and leadership problems. Consider a project team consisting of 50 people divided in 2 sub-groups and another one consisting of 50 people divided in 10 sub-groups. Which case is prone more to management complexity? Considering also that usually in each sub-group is assigned a different operation to be performed which in turns implies that probably different types of HR skills required, it is important to investigate the contribution of these two factors to HR management complexity.

The last factor that is mentioned in the previous paragraph raises the importance and necessity to determine the various technical, behavioural and contextual skills that required to have the various project team members in order to fulfil project goals. It is evident that as this list become longer, the load and complexity that falls in the shoulders of HR managers is increased. It is no coincidence that researchers have include this factor in their models for measuring project complexity. (Fitsilis et al., 2010; Vidal et al., 2011).

Projects by their very nature, are considered as temporary endeavours that are set up to achieve specific objectives (Diallo and Thuillier, 2005; Turner and Muller, 2003). The project organization is composed of the organizations that take part in this project and hence a number of the project staff are coming from the staff of these organizations. Nowadays, many companies are project oriented and can have a portfolio of different projects that are carried out simultaneously. This may result in some staff members working on more than one project simultaneously, even having different roles (Fabi and Pettersen, 1992; Huemann et al., 2007). Thus, the number of employees working part-time in the project can be a significant complexity factor as employees may have different priorities and expectations which entail less commitment and so a greater uncertainty to a project results. In addition, due to the uniqueness of the project nature and other project nature related factors it is difficult to complete project staffing based only on internal sources. For that reason, new recruitments or outsourcing are common practice. However, this adds another layer of complexity in HR management due to recruitment procedures, incorporation of new staff to existing staff, homogenization of the staff etc. According to Raiden et al. (2004) staffing a project with completely new personnel can be too risky resulting in the need for extending staff reforming during the execution of the project. Outsourcing does not implies abdication of management responsibilities, on the contrary is a managerial challenge (Fink et al., 2017) as dedicated management personnel is needed for keep records, schedule and track maintenance and keep historical records. Furthermore, it is increased the likelihood to appeared overlapping roles between organizations, extra cost, contractual workload, conflicting priorities confusion and increased time response to changes requests. The extent of new recruitments or outsourcing affects the tautness of these processes and as such the HR management complexity. Modern projects, especially IT projects, operate in a dynamic environment in which frequent changes both in technological and marketplace are the mainstream. This dynamic environment and the imperative need of business organizations to successfully respond to these continuous rising challenges, lead to continuous changes to HR configuration both in terms of assigned roles within project and staff turnovers, as well as the challenges of maintaining employees' well-being and ethical treatment (Huemann et al., 2007) affecting significantly the complexity of HR management process. Thus, the degree to which project should be initially staffed and the degree of staff turnovers during project execution are factors that can affect the HR management complexity.

Nowadays projects teams are becoming global and in many cases virtual (Daim et al., 2011). This introduces problems and complexity issues arising from geographical dispersion, cultural barriers, diversities and nationality differences. Geographical dispersion for example, despite the improvements that have been made during the last years with the aid of ICT technologies e.g. videoconferencing etc., reduces the opportunities for face to face contacts which is among the main factors that introduce trust between parties. Beyond the cultural and nationality differences, also differences in ages, gender, background, expertise, personality etc. should be considered. These factors should be considered by the HRM management team as they can introduce uncertainty and complexity to the project and affect its performance. The above described factors can be incorporated and described with a general wide wording as the level of project team cohesion.

This multivariate and complex environment in which HRM should be operating, requires the people, who perform this operation, to have specific competences and skills such as global thinking, ability to inspire the employees towards common project goal (Buller and McEnvoy, 2012), solving problems arising from employees' differences in nationalities, cultures etc. abilities in identifying, planning and designing activities that will help employees acquire knowledge, skills and attitudes that will facilitate them to be adapted to project environment and enhance their performance (Fabi and Pettersen, 1992). It is obvious that such complex operations, require beyond a very good education level in HRM aspects, an extensive and deep knowledge in the subject matter that can be obtained from the long term occupation in the field. This knowledge is called experience and can help HR managers to take the right decisions that will enhance the project process. In addition, the need for specialized HRM tools that will support the HRM operation is evident. These tools help managers to perform routine operations such as employee record keeping, salary and benefit administration, reporting and distributing of HR information but also to provide statistical analysis, forecasting and data mining combining information about HR, customers, suppliers and business operations (Raiden et al.,2004; Dulebohn and Johnson, 2013). On the other hand, these systems may modify the source and the nature of messages conveyed. This can lead to negative behaviours towards those systems as some employees may feel that it is neglected, by the organization, their personality and well-being (Stone and Lukaszewski, 2009). However, the importance of using HRM tools for planning, monitoring and tracking HRM is acknowledged by many researchers who suggest various models to assist those operations (Huang et al., 2006; Chien and Chen, 2008; Wi et al., 2009). In many cases, these models make use of historical HRM management data along with statistical and/or fuzzy methods. So, the existence of historical HRM data beyond their general use as a useful guide in order to be revealed good or bad HRM practices are important to effective use of HRM tools.

The above indicates that HRM within a project is a complicated process consisting of a wide variety of sub-processes and procedures which require a wide range of competences, skills and tools in order to be successfully implemented. Based on that, it is worth considering that the existence of an HR department within the organization, composed of people who are focused long term in HRM equipped with the appropriate HRM tools, could be a more effective solution and could significantly reduce the complexity of the HRM process than having this process performed by an ad hoc HRM committee.

Table 8 presents the complexity factors identified within project human resource management processes.

Table 8 Identified complexity factors in the HR management area

	Human resource complexity factors
1.	Size of project team.
2.	Number of different technical, behavioural, contextual skills required.
3.	Number of new recruitments required by the project.
4.	Turnover of project staff members.
5.	Project not fully staffed.
6.	Existence of employees working part-time in the project.
7.	Low level of team cohesion (Consider geographical distribution, different nationalities, cultures etc.).
8.	Insufficient HR management experience within project management team.
9.	Availability of HR department or HR services within hosting organization.
10.	Lack of historical HR management data.
11.	Lack of tools and processes for planning, monitoring and tracking HR management.
12.	High Percentage of outsourced work within the project.
13.	Number of project sub-groups within the project.
14.	Number of different types of project groups.

3.3.7. Procurement project management area

A simple definition of procurement is that procurement is the process of acquiring or purchasing the necessary products or services in order for an organization to be able to produce another product or service. This process requires the establishment of some type of relationship between an organization's purchasing department and external suppliers, for ordering, receiving, controlling and finally approving all the procured items that are necessary for project execution. Usually, suppliers' relationships are managed using contracts. The primary objectives of the procurement process are to deliver the necessary products or services according to project schedule, at a minimum cost, and in accordance with the expected quality. The procurement process can be examined from the perspective either of the buyer or of the supplier of the product/service. However, this research examines this process from the side of the buyer since our focus is the project. Procurement management includes activities like the requirements planning, supply sourcing, negotiation, ordering and coordination with suppliers as well as inbound activities such as receiving, inspection, storage etc. (van der Vaart et al., 1996).

The procurement management process cannot be limited to the purchasing of products or services as it can include much wider operations. It is not uncommon in large and complex projects for the main contractors to concentrate only on their core activities, while outsourcing other activities to external suppliers (Miller et al., 1995). Also, according to Davis (2014) there are often cases that the main contractor distributes all work to subcontractors, keeping for himself the role of coordinator and integrator. That turns the whole project, from the perspective of main contractor, to a large procurement process.

In software projects, it is quite common that instead of building the software in-house, in its totality to use commercial off-the-self (COTS) products. The term COTS refers to a wide range of software and services that are built and delivered usually from third party vendors, as individual products. They cover a wide range of software types, from tools that support code generation to software that provide a specific functionality such as databases, word processors, GUI builders, net applications, data analysis etc. (Morisio et al., 2002). The COTS can be purchased, leased or even licensed. As such, the selection of appropriate COTS is critical to project success. However, this process is characterized by high complexity (Bali and Madan, 2015; Mohamed et al., 2007; Wanyama and Far, 2005; Ruhe, 2003). COTS selection process includes two approaches, one technical in order to understand software package functionality, determine integration and compatibility issues and another non-technical related to core procurement issues such as contracting, licensing, pricing and negotiating. (Morisio et al., 2002). In this research, we are focusing on non-technical issues as we examine the project procurement management complexity. Under that perspective, procurement in software projects is quite similar to the procurement process of other projects. However, from the above discussion it is obvious that COTS selection is not a trivial process and is strongly affected by the number and variety of items need to be procured. Generalizing that, we identify that the number/variety of supplies needed to be procured is a factor that can affect the complexity of procurement management process.

Another important aspect of procurement process is the selection of the appropriate number of suppliers which has been examined by various researchers (Basnet and Leung, 2005; Crama et al., 2007). The large number and variety of suppliers increase the challenges of integrating, coordinating and controlling them with the other project stakeholders and hence the complexity of the process (Martinsuo and Ahola, 2010; van der Vaart et al., 1996). As that, we have identified that the number/ variety of suppliers as a factor that can affect the complexity of procurement management process.

The procurement process requires the establishment of some type of relationship between the procurer and the supplier. This relationship is defined by a contract agreement between them. So, a significant aspect of the procurement process is the management of contractual agreements (van der Vaart, 1996). However, in many cases due to innovation aspects that exists in software projects it is not possible for all the details to be completed at the time contracts are agreed and as that renegotiations at later time are very often mandatory resulting in probably undesired situations (Lyon, 2000). As that, the existence of a high variety of procurement contract types in a project consist a complexity factor of procurement process which has been also identified by researches such as Bosch-Rekveldt et al., (2011).

It is generally accepted that continuous and close collaboration is required between supplier and buyer in projects, especially in software projects (Bali and Madan, 2015; Mohamed et al., 2007; Martinsuo and Ahola, 2010; Morisio et al., 2002). To achieve this, an integration effort on the systems is required in order to establish common procedures and IT systems. As such, costly procurement processes will be eliminated while at the same time visibility will be increased, leading to better procurement decisions. IT automation can improve processes such as spend analysis, sourcing or bid processes (e-Sourcing), contract management, requisition to purchase order process (e-Procurement) and accounts payable process (e-Payables). The level of automation in the procurement process provided by the number and level of integration of procurement systems is a factor that can affect the procurement management complexity.

Further, integration implies the existence of trust between procurement parties which can be achieved only through a long and successful collaboration between them (Lintukangas et al., 2009; Bals et al., 2009). In the case of a new supplier, the development of trust is based on evidence related with the quality of delivered products and services. Other evidence among others can be the company's reputation, or quality certification of the supplier, etc. (Flynn et al., 1994). As Ruiz-Torres and Mahmoodi (2005) states, the credibility of suppliers is related with the management of risks that occur to the project in cases where a supplier cannot meet its obligations. Beyond that, the initial selection of a supplier is significant and it should be based on its reputation and/or quality certificates. As that, the existence of new suppliers/subcontractors as well as the existence or not of various evidence about their product/service quality, are factors that affect the complexity of procurement management in projects.

A prerequisite for effective collaboration and procurement automation, either with new or old suppliers, is the definition of clear procurement policies and procedures by the project organization. Clear procurement policies can assist the compliance with relevant legislation, regulations and various guidelines and has a significant influence in reducing costs, improving quality of services and building on the partnership. Further, the combination of clear procurement policies with clear procurement procedures enable staff to understand their role and levels of delegated authority when carrying out procurement work which has a significant impact to the complexity of procurement management.

In order to manage effectively the procurement process, a number of tools and mechanisms should be established. They should cover the areas of procurement performance reporting and tracking, dispute resolution and contract changes both from buyers and suppliers (PMI, 2013). Specifically, the use of IT in procurements can significantly change the way procurements are made and allows better integration and coordination between buyer- supplier and more efficient cost management of procurements (Dedrick et al., 2008). It is clear that the availability or lack of such tools is a factor that can affect the complexity of procurement management process.

In order to be able for an organization to give account of its actions and function effectively it should keep records. To be specific, procurement and contract records are important as they serve as audit trails of how the procurement processes was carried out. They operate as evidence of the actions taken during the procurement in order to award contracts, monitoring and trace the contract implementation. Disorganized or incomplete records mean that reviewers and auditors will need to take an excessive amount of time to locate needed records or even not be able to hold officials accountable for their actions if needed (PPOA, 2010). In addition, the existence of procurement records can be used as a guide for similar future projects. As that, can be seen that the existence or lack of records or in other words of historical procurement data is a factor that can affect the procurement management complexity.

A critical challenge to the procurement process is the scarcity or unavailability of supplies or services. This scarcity or unavailability can occur because resources are limited or suppliers are few, due to the cost of acquiring, due to various restrictions that may limit the possession of a certain resource and can be either temporary e.g. due to market circumstances, or permanent (Verhallen and Robben, 1995). Further, due to the nature of software projects, it is not uncommon for small businesses to produce highly specialized products that lead to monopoly situations, with all the disadvantages this entails (Lyon, 2000). As that, the scarcity or unavailability of project supplies or services is a factor that affects the complexity of the procurement management process.

The global distribution of software development projects has become a common practice today (Layman et al., 2006). This introduces the concept of internationalization in procurements under the prism of buying products or services from foreign markets and as that of establishing relationships with foreign suppliers (Mol et al., 2004). However, this introduces a number of barriers in supply management that had already been identified early on by Davis et al. (1974) which identifies the distance between buyer and supplier, various government policies and regulations and nationalism as factors that affect the supply management. Quintens et al. (2006), after extended literature review, identified a number of factors that affect the supply management process due to internationalization such as the different product standards, delivery details, parallel trade, finding qualified suppliers, diverse business practices, image of origin country, custom regulations, lack of government assistance, language/cultural differences etc. In addition, there are also restrictions sourcing from project type, e.g. in public sector projects, that impose restrictions due to legislation and the need specific formal procedures to be followed that add a level of complexity in project procurement. Further, internal project restrictions may exist such as software and technological compatibility issues, e.g. due to backward compatibility, or preferred suppliers that can add complexity to the procurement process. As that, it is considered that the various procurement restrictions, is a factor that affect the complexity of procurement management process.

Procurement management is a complex process where, in many cases, critical decisions taken are based on a manager's experience and knowledge. However, this knowledge is not always taken on face value as according to Bals et al. (2009) managers do not always have exact knowledge of how the procurement process works. In addition, Lintukangas et al. (2009), state that fragmented skills and knowledge in procurement management can increase the costs and risks related to procurement processes. An experienced management team can prevent or mitigate these risks. On the other hand, according to Bals et al. (2009) experience has the positive effect of building trust between procurement different parties, enhancing by this way the relationship building between buyer and supplier. As that, we identify that the level of experience the procurement management team has, is a factor that affects the complexity of procurement management.

The Table 9 below presents the complexity factors identified within project procurement management processes.

Table 9 Identified complexity factors in the Procurement management area

	Procurement management complexity factors
1.	Number/variety of supplies.
2.	Number/variety of suppliers
3.	Procurement restriction imposed by external (legislation, regulation) and/or internal (preferred suppliers, compatible technology, similar culture) project factors.

4.	Percentage of new suppliers/subcontractors (e.g. first time selected).
5.	Unavailability/ scarcity of supplies and/or services.
6.	Variety of procurement contract types.
7.	Not clear or not existing definition of procurement policies and procedures.
8.	Number of contracts or sub contracts must be managed simultaneously.
9.	Lack of automation within the supply chain.
10.	Lack of historical procurement management data.
11.	Insufficient procurement management experience within project management team.
12.	Lack/shortage of tools for planning and monitoring and tracking procurement processes.
13.	Unknown supplier's quality (e.g. Lack of various quality certificates for suppliers, market reputation etc.).

3.3.8. Risk project management area

Typically, projects after implementation encounter risks that can potentially challenge progress and successful completion. It is important at this point to underline that risk is not a problem by itself, but is the recognition of a problem that may occur. PMI defines risk as an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives. It is important for each risk to be evaluated for its probability to occur, its impact on the project progress if it occurs and if appropriate measures are needed to be taken in order to avoid or cope with its impact on project. There are several risk sources in a project. For example, the technology used by the project, the project environment, the relationships between team members, etc. For decreasing the probability of project failure, risks should be identified and carefully managed throughout project life cycle.

Project risk management is a systematic process aiming to identify risks and manage them on their appearance by implementing systems and procedures in order to eliminate, minimize or control them or their effects in a project (Marcelino-Sadaba at al., 2014). As such, project risk management is an important aspect of project management (Bannerman, 2008), since it can assist project managers to improve project control, decreases the chances of project failure and facilitate the decision making process. It is essential that project risk management should at least include processes of risk identification, assessment, prioritization and response planning. The procedures that the management team will use to manage project risks is defined in the planning stage, documented in the project plan, and then executed throughout the project life cycle. The implementation of project risk management incorporates the phases of risk analysis and quantification, risk mitigation/avoidance planning and risk response. According to PMI, project risk management, in order to support organizational factors, requires clear roles and responsibilities, and technical analysis skills.

Software projects are considered high risk projects (Charette, 2005). According to Bannerman (2008), software projects are complex endeavours susceptible to failure. Although there are a lot factors that may lead to these failures, inadequate risk control is considered as one of the leading factors (Barros et al., 2004). For that reason, a number of techniques such as Regression Analysis, Expert Systems and Stochastic Models, Monte Carlo Simulation, Program Evaluation and Review Technique (PETR), Analytical Hierarchy Process (AHP), Neural Networks, checklists etc. and approaches such as PMBOK (PMI, 2013), Capability Maturity Model Integration (CMMI)(SEI, 2006) etc. were developed in order to help project managers in the identification of various risk types and planning risk response strategies (Na et al., 2007). However, according to Dey at al. (2007) there is evidence that project risks are not managed appropriately. This is due to the complexity of the risk management process. This complexity can be considered as a source of risk by itself and should be considered during the project risk assessment. This research is focusing on risk management complexity and is trying to identify complexity factors that affect the complexity of project risk management process.

The initial step in the risk management process is risk identification. Risks could be both exogenous or endogenous and their origin and type can differ according to the type of project (Kardes et al., 2013). Exogenous are risks that come from project political, economic, social environment, etc. while endogenous are risks that coming from project operation, project stakeholders, resources, etc. However, due to projects nature, it is not possible to identify all the risks in advance that may arise during execution. As a result, it is preferable to identify the project areas where risks can occur, following that to identify the major risks of each area and finally to manage them separately, reducing by that way the complexity of the risk identification process (Marle, 2002).

According to Marcelino-Sadaba et al., (2014) during this initial phase managers should also identify strategic project risks. These are risks that should be examined and removed before the final decision to start project is taken, as they have a significant impact on project and can lead to direct project failure. Also, the existence of other risks with major impact on the project should be identified in order for immediate measures be taken for eliminating, avoiding or reducing their consequences. Furthermore, extra caution should be placed on the possible interactions between risks sourcing from different areas as the current techniques and methods do not take this parameter into consideration (Vidal et al., 2009). It is known that not all risks have the same consequences in a project. Thus, after the risk identification stage, risk evaluation and quantification are the next stages in the risk management process. To manage each risk, appropriate measures should be taken which in turn affect the project in terms of time, cost, quality and scope. Therefore, and taking into consideration the probability of a risk to occur, its impact on the project should be evaluated and further actions should be decided accordingly. As that, the number of project risk areas, the number of major project risks and impact of risk responses to project are factors that affect the complexity of risk management process.

Decisions about the required actions need to be taken to manage project risks, require that a detailed risk management policy has been defined and that a detailed risk response strategy has been designed which may include risk elimination, avoidance, reduction or transfer of risks (Kardes et al., 2013). Lack of or no detailed definition of risk management policy and response strategy leads to bad or improper actions that sets barriers to project progress, undermine the project success and complicates the project risk management process.

Risk analysis and evaluation is a process that should be performed periodically during the project process whenever changes in the project occur or if a project has a long duration as a risk status update (Marcelino-Sadaba et al., 2014; Kardes et al., 2013). During this process, it is very likely that the need for changes in project management plan will be revealed. These changes may require the adoption of new skills and knowledge, changes in projects task, for example, in priority and sequence, changes in roles of team members, changes in required resources etc. However, in many cases, these changes cannot easily be made due to various reasons such as contractual restrictions. Contractual agreements are used to clearly define goals, rights and obligations between partners and operate as mechanisms that discourage and prevent deceptions and enforce trust between parties (Elitzur and Ganvious, 2003; Frenzen and Nakamoto, 1993). Changes to be implemented require good communication between parties, availability and transparency of information. Further, change management process is time consuming, and generally restrict the project management plan flexibility, affecting by that way the project risk management complexity.

A critical factor to implement risk management successfully is the availability and use of the proper risk management tools and methods. Further, risk management requires the continuous monitoring of project progress and the monitoring of specific risk indicators that would act as early warnings about arising risks. Periodically risk reporting is also important in the risk management process, as has already been mentioned, an efficient risk response planning requires the effective communication of risk information to various project members which require the use of appropriate tools to facilitate that. In general, risk analysis and management tools serve multiple purposes and can be used for identifying, analysing and prioritizing risks, performing threat analysis, generating metrics, developing responses, monitoring and tracking risks. As a plethora of available tools is available (Neves at al., 2014; Bannerman, 2008; Schmidt et al., 2001), it is important before selecting a tool, to develop a risk management plan, in order to select tools that best support the selected approach in terms of risk analysis type (continuous or one-time), accessibility, information granularity needed, support to decision making and integration with existing tools or processes. Thus, the lack or shortage of tools and processes for supporting risk management can affect the complexity of the risk management.

Almost all tools or processes used in risk management require the availability of data about risk, inclusive of checklists which are a popular method for identifying risk among project managers (Schmidt et al., 2001). Checklists are lists of risks that can arise during project execution and are used by project managers as a brochure to identify risks and avoid overlooking some risk factors. Several such lists are generic to all projects while others are more domain specific (Johnson et al., 2001; Schmidt et al., 2001; Boehm, 1991). It is apparent that the availability of information to project managers from similar past projects concerning the risks identified, how they were managed, their effects to the project and the project outcome is valuable information in their hands and obviously affects the complexity of risk management process.

According to Schmidt et al. (2001), most of the risk management methods assume that managers have the requisite experience to handle risk management. In addition, according to Bannerman (2008) several researches identified significant differences in the way the same risks were evaluated by different project managers according to their perspective to those risks. Also, he states that different groups of stakeholders tend to identify and rank higher risks that are outside their own responsibility domain and hence control. Thus, t*he experience of the project management team* has a significant contribution to the way risk management will be planned and executed and hence the experience of the project management team in risk management is another factor that affects the complexity of risk management process.

Table 10 presents the complexity factors identified within project risk management processes.

Table 10 Identified complexity factors in the Risk management area

	Risk management complexity factors
1.	Not clear (detailed) definition of project risk management policy and response strategy.
2.	Number high risk areas / major risks.
3.	Lack/shortage of processes and tools for analysing, accessing, quantifying risks and implementing risk responses.
4.	Lack of flexibility of project management plan for implementing risk responses.
5.	Lack/shortage of risk historical management data.
6.	Insufficient risk management experience within project management team.
7.	Lack/shortage of tools for project planning, monitoring and control.
8.	Existence of risk responses with major impact to project (or Impact of risks responses to project).

3.3.9. Scope project management area

Project scope is an activity where project stakeholders' expectations and requirements are collected in order to define the exact extent of work that has to be done during the project. Inadequate project scope definition can lead to delays, cost overruns and generally uncertainties that will increase the possibility for excessive changes and reworks during the project execution phase (Fageha and Aibinu, 2012). The challenge of this task is to bring together different requirements and expectations of project stakeholders and as this is not always possible, to find a balance between the stakeholders' expectations and concerns which will be reflected in the project outcome. The criticality and the importance of scope management is acknowledged by PMBOK, which devotes one of its ten knowledge areas in describing the processes, the tools and techniques required in order to have successful management of this project phase. According to PMBOK, the main processes of project scope management are the Plan Scope, Collect Requirements, Define Scope, Create WBS, Validate Scope and Control Scope.

A major part of the scope management process refers to the requirements collection and the definition of the project scope. Requirements collection is the basis of every project and as that, the need for successful definition and management of them becomes apparent. Requirements are called to describe the stakeholder's needs and to transform them to system processes that will satisfies these needs (He and Wu, 2012). The process of systematically eliciting, organizing and documenting requirements for complex systems are known as requirements management (Leffingwell and Widrig, 2003). Requirements management (RM) definitions vary widely according to the domains and to the system it is applied, but usually definitions contains the following procedures, a) the requirements inception or requirements elicitation, b) requirements identification, c) requirements analysis and negotiation, d) requirements specification, e) system modelling, f) requirements validation g) requirements management. (Sommerville, 2006). Due to the heterogeneity of the elements of RM and its critical contribution to future project success, it is considered as a project activity with very high complexity (Belfo, 2012). Considering software projects, the whole process become more complex due to iterative and incremental software development life cycles (Jalote et al., 2004; Beck, 2000). As such, the requirements management process is a core project management process that affects directly the scope, the schedule, the budget and the quality of each software development process.

The requirements elicitation process is the basis of every project. It is the process during which the stakeholder's needs are collected and the functionality of the deliverables are specified in order to satisfy project stakeholders needs (PMI, 2013). Requirements elicitation is dependent on factors such as the projects size in terms of scope, the numbers of stakeholders etc. It is obvious that an increase in the magnitude of these factors will positively contribute to the complexity of the elicitation process and hence to the complexity of the whole scope management process. In addition, this process can be complicated by the difficulty that often exists in stakeholders, in expressing and specifying their needs (Nuseibeh, and Easterbrook, 2000). As such, the project size in terms of scope and the number of requirement can be considered as complexity factors of the scope management process.

It is not uncommon for project stakeholders to have requirements and priorities that are in conflict with other project stakeholders (Anda and Jorgensen, 2000). For example, developers, financiers, customers, and project owners have different priorities and criteria in determining the requirements that matter to them resulting in a variety of requirements elicitation sources which in turns affects the complexity of requirements management process. Requirements prioritization is a fundamental process of requirements management and usually of high complexity as it evolves a number of parameters such as requirements number, importance, volatility, ambiguity, conflicts, interdependencies, but also parameters that expand to all project development process such cost restrictions, time restrictions, risk likelihood and impact, resource availability etc. (Fitsilis et al.,2010; Berander and Andrews, 2005; Firesmith, 2004). Requirements can be prioritized according to various dimensions such as required time or cost, risk evaluation, business value, volatility etc. In practice the prioritization takes into account multiple parameters which may be different, related or conflicting and which are evaluated differently by stakeholders (Firesmith, 2004). This is because not all requirements are of equal importance, either considering the overall projects objectives or the individual's objectives. However, in order to reach to an agreement between project stakeholders about project scope, a set of basic limitations should be set and be accepted. These limitations may be due to the availability of project resources e.g. time, budget, human resources, market conditions, legal constraints etc. (Berander and Andrews, 2005). The goal for successful requirements prioritization is to combine the wide range of stakeholder's priorities and prioritizations with the overall project objectives and constraints. An approach to deal with requirements interdependencies and prioritization issues, is to perform requirements partitioning, which means that closely correlated requirements are grouped together and implemented in the same version whereas others are implemented in subsequent releases (Carlshamre et al., 2001). Today, software projects are usually delivered sequentially in small incremental releases and not in a monolithic fashion at the end of a long development process, which makes the prioritization of the requirements easier and allows the planning of project deliverables according this prioritization. According to Stark et al., (1999) there is a strong relation between the requirements prioritization process and the number of releases required to implement them. However, as there are numerous parameters and challenges that must be addressed when prioritizing requirements, we consider that project faced delivery based on requirements prioritization is a factor that affects the complexity of scope management process.

Most requirements are not isolated but are related in various ways to each other, causing interdependences. Carlshamre et al. (2001) in their research found that about 20% of the requirements are single requirements while another 20% are identified as highly depended requirements that are responsible for 75% of the requirements interdependence. Requirements independencies are considered to occur when a requirement constrains the way another requirement is designed or implemented, or affects the cost of implementations of other requirements or affects the stakeholder's satisfaction from other requirements (Dahlstedt and Persson, 2005). Requirements Interdependencies is a factor that usually increases the complexity of the development process (Regnel et al., 2008; Carlshamre et al., 2001). In addition, Giesen and Volker, (2002) state that for successful software projects it is essential to understand the dependencies and correlations of requirements. Therefore, the interdependence of requirements is considered as a complexity factor of scope management process.

Volatility in requirements is not uncommon in most software development projects (Kavitha and Sheshasaayee, 2012; Nurmuliani et al., 2004; Stark et al., 1999). Change management has the critical role of dealing with changes, otherwise they have a huge impact in project progress. According to Sommerville, (2006) requirements volatility is the main cause for software projects failure. As requirements are the basis for cost estimation, project schedule, design specifications any change will challenge the initial project assumptions and will require the re-establishment of the agreement between project stakeholders about project parameters. The volatility in requirements can occur either due to their dependencies on external factors such as business or market changes, legal changes, users change, etc., or due to internal factors or their nature e.g. ambiguity, immaturity, etc. (Elwahab et al., 2016; Kavitha and Sheshasaayee, 2012; Sudhakar, 2005). In this context, it is proposed that the requirements dependencies of external factors and the requirements characteristics causing uncertainty are two factors that affect the complexity of the scope management process.

The complexity of an information system is determined both by its functional requirements which describes "what the system does" and by its non-functional requirements, such as performance, reliability, stability, maintainability usability etc., which describes "how the system should be" (Chung and do Prado Leite, 2009; Mylopoulos et al., 1992). Usually words ending with strings "-ility" e.g. usability, or "-ity" e.g. ambiguity, describing non-functional requirements (NFR) (Chung and do Prado Leite, 2009). NFR's are also known as quality requirements and usually are elicited and managed separately from other requirements. NFR's have a major contribution to customer satisfaction as even if the project deliverable may fulfil all the functional requirements was set, customers may refuse to accept it because it cannot fulfil their quality expectations (Rao and Gopichand, 2012). In order to be implemented, NFRs need to be transformed through some methods and operations (Chung and do Prado Leite, 2009). However, requirements transformation is not a trivial process as it requires extra effort need to placed and as any transformation introduce the risk of information loose. Considering the above it is proposed that the number of non-functional requirements is a complexity factor of scope management process.

Nowadays with the huge number of variants of software products being developed it is not uncommon to have a set of requirements common between previous versions of the software product or in a series of related projects (Dahlstedt and Persson, 2005). The re-use of these requirements can decrease the time, cost and error rate of the requirements elicitation process in comparison with a project that does not reuse software components. However, not all similar requirements can be reused without further analysis (Knethen et al., 2002). The similarities between projects undertaken by project organizations, is a factor that has been incorporated in other models e.g. COCOMO II (Boehm et al., 2000). Based on this and considering that requirements management in terms of eliciting, analysing, prioritizing, controlling, etc. is a complex process, it is stated that the availability of historical scope management data can affect the complexity of the scope management and hence it is identified a complexity factor of this process.

Modern software product development has evolved as a more complex process, as it involves increased numbers of customers, end users, developers, product features and interfaces with other systems, resulting in producing continuously larger and more complicated products. This has led to a scaling up of the size of a typical software project which is reflected in the scaling up of the requirements management process, leading to increased complexity of the requirements engineering process (Wnuk et al., 2011; Regnell et al., 2008; Boehm, 2000). The identified requirements should be unambiguous, consistent, traceable etc., otherwise they can be evolved to another complexity source of requirements management. For that reason, the low quality of the identified product or service requirements should be considered as another complexity factor of scope management.

Information exchange can be between software, hardware, various peripherals devices, autonomous software systems, humans or combinations of these. Modern software incorporates a wide variety of interconnections with other systems and in various forms such as communication, synchronization, data translation, resource sharing etc. Interconnections should fulfil characteristics such as transparency, efficiency, security, integrity etc. The identification and management of interconnections has become an important part of the development process as it evolves protocols that are usually complex (Dellarocas, 1997). Interconnection is implemented through interfaces. According to the Cambridge dictionary, interface is a way or situation where two things come together and affect each other either between electronic equipment or human and computer. The user interface is a point of interaction between a computer and a human where data is exchanged using various forms e.g. text, graphics, sounds, video, movements, clicks, taps etc. Software interfaces are a set of functions, procedures and methods that allows the interaction between software components or systems. Interfaces can be considered in relation to a project as internal or external. Internal interfaces concern the way system parts interact with each other and all aspects are under the control of project members (Wheatcraft, 2010). External interfaces should be approached carefully as they may introduce risks due to lack of standardization implementation, missing or incomplete interface documentation, unexpected changes and generally factors that are beyond the control of those needing to interface. This entails increased complexity in the requirements elicitation process. Further, the identification of external interfaces early on, makes it possible for the identification of key elements that should be addressed in the requirements elicitation phase (Wheatcraft, 2010). As such, we identify the number of interfaces with other systems as a complexity factor of scope management.

In order to deal with requirements management complexity, various tools have been proposed for managing requirements known as Computer Aided Software Engineering (CASE) tools (Sommerville, 2006). Although these tools cannot be applied to all activities of requirements management and in all cases (He and Wu, 2012; Laporti et al., 2009) they are valuable tools for project managers in managing requirements since their use can decrease management complexity. Consequently, the availability or lack of specialized tools for managing requirements is identified as another complexity factor.

From the above, it is apparent that scope management is a project management process of high complexity and critical to future project success, both in terms of project deliverable functionality and customer's satisfaction. Despite the progress in tools that are available to project managers, the nature of the scope management process is such that it requires a decisive and critical contribution of a project management team to ensure success. According to Belfo (2012) "requirements specification is mainly a social interaction between people". Project managers are those who motivate, inspire and increase the commitment of team members to project goals (Khan and Spang, 2011). An experienced management team can identify flaws, errors, deficiencies, ambiguities, conflicts etc. and consider the appropriate measures that will insure project success. Hence, the experience of the project management team in scope management can be considered as a factor that can affect the complexity of scope management process.

Table 11 presents the complexity factors identified within project scope management processes.

Table 11 Identified complexity factors in the Scope management area

	Scope management complexity Factors
1.	Number of sources for eliciting requirements.
2.	Project size.
3.	Number of requirements.
4.	Percentage of requirements interdependencies.
5.	Project faced delivery is based on requirements prioritization.
6.	Insufficient scope management experience within project management team.
7.	Lack/shortage of specialized tools and processes in defining requirements.
8.	Requirements dependencies from external factors.
9.	Requirements characteristics causing uncertainty.
10.	Number of interfaces with other systems.
11.	Number of non-functional requirements.
12.	Lack of historical scope management data.
13.	Low quality of product/service requirements specifications.

3.3.10. Integration project management area

A project is a complex endeavour which incorporates many different components which need to be combined and coordinated in order to operate as a single system. For that reason, the concept of integration which, exists in many other fields such as mathematics, Information technology, business etc., is imperative in projects. PMI acknowledging that, consider integration management as one of the ten knowledge areas in PMBOK (PMI, 2013). According to PMI, project integration management is evident in situations where individual processes interact. Integration includes the processes and activities to identify, define, combine, unify, and coordinate the various processes and project management activities within the Project Management Process groups. According to Kirsila et al., (2007) the issue of integration becomes more imperative in projects where innovation in products and services are present in order to satisfy the customer's needs. Software projects are a typical example of this type of projects.

Projects as dynamic endeavours are susceptible to changes, at any of their stages, due to various internal or external causes and these changes have considerable impact in the project process and outcome (Motawa et al., 2007). As that, these changes should be handled as early as possible, in order to minimize the negative impact on the project (Hwang and Low, 2012). This brings up the notion of change management which includes the processes of reviewing all change requests, approving or rejecting changes, managing changes to deliverables, communicating changes and updating project documentation in order to reduce risks that may occur from these changes. The sources of project change can be either internal or external. Internal sources can be considered project organizational issues, such as inefficient communication between project stakeholders, lack of coordination between organizational departments, various stakeholders related issues such as modifications to project scope, design errors, poor communication, poor project management etc. External sources can be considered as unforeseeable circumstances, such as economic conditions, legal changes or other project environment related issues (Hwang et al., 2009).

Changes are always cause modification, positive or negative in relation to the initial planning and project implementation process. These changes may affect project scope, time, cost, quality, human resource and procurement initial planning which in turn affect wide areas of project management and requires changes to them resulting in increased project management complexity. All changes should be made in a structured way in order to achieve the minimization of negative impacts to a project or risks that may occur and be able to gain from possible positive effects. As that, and because changes are common in projects, the importance of change management in projects is more than obvious in order for the project management team to be able to identify, evaluate, and adapt to changes as early as possible and prevent disruption of the project progress (Zhao et al., 2009). According to Motawa et al. (2007) inconsistent change management can lead to many disruptive effects.

Integration management, as has been already mentioned, aims at bringing different things together to make them something whole and entire. In order to achieve that, the different elements should have a degree of stability. In projects that means that the project scope and requirements should have been defined, in order to be able to create the planning for project cost, time, quality, HR etc. This requires that the rights, duties and expectations of project stakeholders have been acknowledged, communicated and agreed and that they have been incorporated in the project scope (McLeod and McDonnell, 2011). This ensures a degree of stability in project scope and requirements. In accordance to this Hass (2007) has acknowledged the stability of project requirements as one of the factors that can affect complexity of projects. Instability can occur due to poor requirements communication, largely undefined requirements and the belief that requirements can change at any later stage. As that, it is considered that the volatility in project requirements and the deficiencies in defining project scope and requirements are factors that can affect the complexity of integration management process.

As changes in a project are inevitable, not only at the initial stage where the project design is taking place but even if the design is completed (Li et al., 2011), the ability to respond to these changes requires the existence of an effective identification and problem solving mechanism that will ensure the project success (Jiang et al., 2009). Change management aims at resolving problems when changes occur, forecasts possible changes, coordinates changes across the entire project stakeholders, and addresses the impact of changes in other areas of the project as in time, cost quality etc. (Hwang and Low, 2012). The existence of the change management process in projects, especially in software projects which are prone to changes in comparison to other projects due to their nature, is critical to project success. As that, it is identified that the existence or non-existence of a well-designed change management process within integration management is a factor that will affect the complexity of integration management process.

The identification of stakeholders needs in order to meet project objectives and the transformation of them into requirements is a difficult and complex process considering that stakeholders have different requirements and priorities which can be conflicting (Anda, and Jorgensen, 2000) and because often stakeholders have difficulties in expressing and specifying these needs (Nuseibeh, and Easterbrook, 2000). In addition, very often, the requirements posed by stakeholders are ambiguous fuzzy, equivocal or require subjective interpretation (Li at al., 2011). Also, according to Walz et al. (1993) the understanding of requirements between project stakeholders can be characterized as an interacting process among project stakeholders which is chaotic, nonlinear and continuous. That makes an environment where it is easy for conflicts of interest to arise between project stakeholders. As that, it can easily be concluded that the diversity and conflicts of interests between project stakeholders is a complexity factor in the process of integration management.

The environment in which software projects operate have changed dramatically during the last decades. This is happened due to two basic reasons, the advances in hardware and telecommunications and the radical lowering of computing cost. This allowed the incorporation of systems in our everyday life and activities, both in terms of hardware and software that has had a significant impact in the way we work, entertain ourselves, and communicate. For example, the great population of smartphones and other smart devices in comparison to classic PCs during the previous years. These changes have also significantly affected business. The advances in networks and the lowering of communications costs for example, has led to a higher level of integration between different systems e.g. the moving of software and data services to "the cloud". All these changes have as common point the shift from the standalone individual computing to highly integrated systems consisting of software, hardware human, organizational agent's, business process and more (Jarke et al., 2011). This has led to changes in the way the software is developed and more importantly to the requirements of software. Increased functionality, higher reliability and performance and quick adaptation to market changes are the main objectives for new software development (Trendowicz and Munch, 2009). That results in increased system architecture complexity in terms of technology being used, functionality, data management, interface complexity etc. On the other hand, businesses, in their effort to stay in front of the competition try to produce products or services that have an additional significant degree of innovation either in terms of technical innovation or business innovation. To succeed in that and at the same time to maintain low project costs and stick within schedule and maintain agreed level of quality, businesses may be forced to use new or unproven technology. It is inevitable that all these factors will have an impact on requirements quality in terms of requirements definition, stability, ambiguity, clearness and feasibility. As that, requirements management becomes more complex and hence a degree of complexity is added in the integration management process. Consequently, it is identified that the project technical / business innovative, the system architecture complexity and the new or unproven technology being used are complexity factors of project integration management.

The external project environment is a significant source of uncertainty, as usually situations that occur are beyond the control of the project management team, especially for software projects which are projects with many interactions and dependencies and need to operate in a continuously changing environment. Time-to-market, for example, is the most critical factor in developing commercial software projects as market conditions are changing fast and the need for changes in the project scope or requirements can occur anytime (Kwak and Stoddard, 2004). The technological changes that may occur during project execution may result in great changes in product /service design in order to maintain its modernity, competitiveness and effectiveness. Changes in the economic environment is also another factor that can affect a project either in terms of financial viability or budget changes. Legal changes can result in project scope changes in order to conform to the new regulations and laws. As that, the uncertainty in project product development caused by external factors is considered a factor that affects the complexity of project integration management process.

Modern software development projects are complex as they have to satisfy a great number of requirements in order to produce high quality systems that will meet the stakeholder's expectations. To achieve that a number of development methodologies have been developed such as the "spiral" model (Boehm, 1986), "Agile software development model" (Beck et al., 2001) etc. The basic idea of these models is to deliver systems by moving through clearly defined phases in an incremental way. Software development projects have to satisfy a great number of requirements that cannot be controlled all at once. To cope with this situation, modern software product /services are developed in an iterative/incremental way and are continuously improved during the project's life cycle. That allows the easier identification and prioritization of requirements, adds flexibility to the project in order to adapt to market or condition changes, reduces the possibility of rework, enables early conflict resolution, better control and management of project time and cost. All these are strongly related and affects integration management. As that, the way the project deliverables are controlled and delivered and the number of project intermediate deliverables are identified as complexity factors of integration management process.

According to PMBOK (PMI, 2013) the basic technique that is used in change management and general in integration management is expert judgment. This "expertise" can be achieved using specialized knowledge, training and experience obtained during a managers working live. Expert judgment is used to assess the various inputs of integration management, produces the project execution plan and manages it. The above operation is performed by the project management team. To achieve better possible results in their job they need to have as much information as possible and at that point the existence of integration data from previous similar projects is important. Although expert judgment is widely used, it is a serious disadvantage. The human mind cannot process the great amount of internal and external factors that influence project progress. In addition, continuous monitoring and effective analyse of project progress data is needed, in order to achieve a better view of project progress and to be able to identify as early as possible project flaws and hence the need for modifications. Therefore, a number of frameworks and tools were developed to support either the project integration process as a whole or components of this process such as change management (Hwang and Low, 2012). In accordance to these, it is proposed that the lack/shortage of historical management data, the experience of the project management team performing integration management, and the availability of tools for supporting integration management, monitoring and measuring project performance, are factors that affect the complexity of integration management.

Table 12 presents the complexity factors identified within project integration management processes.

Table 12 Identified complexity factors in the Integration management area

	Integration management complexity factors
1.	Project technical /business innovative.
2.	System architecture complexity.
3.	Not fully defined project scope and requirements.
4.	Volatility in project requirements.
5.	Lack/shortage of historical Integration management data.

6.	Insufficient integration management experience within project management team.
7.	Uncertainty of project product development due to external changes.
8.	Lack/shortage of tools and processes for supporting change management.
9.	Lack of change management processes.
10.	Lack shortage of tools for monitoring and measuring performance of various project stages.
11.	Number of intermediate deliverables.
12.	Control of deliverables.
13.	Diversity and conflicts of interests of project stakeholders.
14.	New or unproven technology being used.

3.3.11. Stakeholders project management area

The concept of stakeholders' management has been acknowledged for decades (Freeman, 1984). However until relatively recently an investigation related to the applicability of stakeholders management theory to real word projects has not been taken place (Mitchell et al., 1997). During the last years, it became common that a key issue in project success is the identification of project stakeholders and their role in projects (Yang et al., 2011; Achterkamp and Vos, 2008) in order to achieve a successful project outcome. Following this common view and acknowledging the importance of the stakeholder's management in project, PMI in its fifth version of PMBOK (PMI, 2013) created a new project management area devoted to stakeholder's management.

The term "stakeholders" refers to either a person or group who influence or are influenced by a project (Jepsen and Eskerod, 2009). PMI expanding this approach defines project stakeholders as users, groups or organizations that can affect, be affected or perceive themselves affected by a decision or activity or outcome of a project. Bourne (2016) defines stakeholders as individuals or groups that can influence the success or failure of an organization's activities. Therefore, the processes required to identify those groups, to analyse their impact on a project and to develop the appropriate strategies to enable and control their engagement to project decisions and execution is called stakeholder's management. Stakeholder's management includes the handling of stakeholder's requests, expectations and project resources in a balanced way within a project environment of uncertainty and complexity which make this effort more difficult (Turner and Muller, 2003).

The first step in stakeholders' management is the identification of project stakeholders. It is critical at this stage for the project manager to identify all project stakeholders early on, to analyse their level of interest (Karlesn, 2002), their expectations, their importance and influence to the project (Young, 2006). By the same token Kolk and Pinkse (2006), consider the identification of nature of stakeholders, their influence in project decisions, operations and implementation of different strategies, as the core themes in initial steps of stakeholder management. Failure to identify all stakeholders and/or underestimation of their ability to influence the project can lead to unexpected and problematic situations that can undermine the project success (Achterkamp and Vos, 2008). In order to identify project stakeholders, various methods are used either in form of brainstorming, which participants are asked to name stakeholders or asking specific persons to identify the stakeholders by asking them specific types of questions or using lists of possible stakeholders (Jepsen and Eskerod, 2009; Achterkamp and Vos, 2008). An integral but also distinct part of stakeholders' identification is the stakeholders' categorization. A first categorization is the distinction of stakeholders by those who can affect the project and those who are affected by the project (Freeman, 1984). Clarkson (1995) divides stakeholders into primary and secondary and suggests that more attention should be placed on primary stakeholders as they are essential to projects. Mitchel et al. (1997) suggest that stakeholders categorization should be based on three attributes: power, legitimacy and urgency. Another approach is to categorize stakeholders using a power/interest matrix (Johnson and Scholes, 1999). In the same way, Bourne and Walker (2005) suggest the use of the impact/interest matrix to categorize stakeholders. Olander and Landin (2008) base their approach on the stakeholder's position towards the project and identify five types of stakeholders: those who actively support it, passively support it, are not committed to it, passively oppose it and actively oppose it. From the number of different approaches mentioned above it can be concluded that the stakeholder's classification is not a trivial process. In fact, it is a complex and crucial process of stakeholder management as this classification will be the guide that project managers will use to implement strategies in order to enable stakeholders to the project, to share the limited project resources among stakeholders and to design a payment back strategy for them, not necessary in the narrow sense of term "payment", as "payment" can be considered any type of reward now or in the future (Jepsen and Eskerod, 2009). It is apparent that the number of different stakeholder's categories is a factor that can affect the complexity of the stakeholders' management process, as suggested also by other researchers (Vidal et al., 2011), and as such it is identified in this research too as a complexity factor of stakeholders management area.

Different stakeholders and stakeholders' categories can have different perceptions of project success as they usually have different criteria. (Davis, 2014; Turner et al., 2009). The existence of stakeholders with conflicting interests or with negative attitudes about the project are factors that can add complexity to the stakeholder management process (Bourne, 2010). As that, extra measures should be taken and specific actions should be implemented, in order to blunt the conflicts and change their attitude about the project, which in turn add a layer of complexity in stakeholders' management.

Many researchers (Bourne, 2010; Yang et al., 2011; Olander and Landin, 2008; Jepsen and Eskerod, 2009; Meintjes and Grobler, 2014) identify the need for applying specific strategies in stakeholders' management indicating the fields of stakeholders' identification, prioritization, characterization, impact analysis, relationships management, communication and engagement monitoring as the most significant in this process. Lack of clear strategy in managing stakeholders will slow the project process and will end up in a continuous effort to handle stakeholders' claims (Olander and Landin, 2008). Further, the use of structured methodologies and tools at every stage of the stakeholder's management is important to successful management (Bourne, 2010). Therefore, the lack of specific strategy in stakeholders' management and the lack of use of structured methodologies in the various stages of stakeholders' management are considered that add another layer of complexity to the management process.

A key element to any strategy followed for effective stakeholders engagement and stakeholders' relations management, is effective communication between project stakeholders. This allow to set common goals, objectives, priorities, negotiate their differences' and generally to manage their relationships (Bakens et al., 2005; Young, 2006; Aaltonen et al., 2008). PMI (2013) considers stakeholders' communication a key point in the process of the stakeholders' management as the means to convey various stakeholder’s needs, requirements, analysis results, action plans and to influence them in a positive way, considering their engagement and attitude towards project success. Lack of communication can become the starting point for opposition to the project (Olander and Landin, 2008). The existence of barriers in communication between stakeholders that are caused either by psychological, cultural, physical or environmental barriers can severely complicate the communication process, adding another layer of complexity to stakeholders’ management process.

Table 13 presents the complexity factors identified within project stakeholders management processes.

Table 13 Identified complexity factors in the Stakeholders management area

	Stakeholders management complexity factor
1.	Number of stakeholders.
2.	Number of different stakeholders categories.
3.	Existence of stakeholders with different/conflicting interests.
4.	Existence of stakeholders with negative attitude about the project.
5.	Lack of structured methodology and tools in stakeholder management (identification, prioritization).
6.	Lack of specific strategy to enhance stakeholders’ engagement to project.
7.	Existence of communication barriers between groups of stakeholders.

3.4. Technical software development complexity factors

It has been mentioned in previous chapters that as IT technology evolves and becomes part of every aspect of our everyday life, the demand for more powerful and reliable software becomes a necessity. However, this leads to software programs becoming larger and more complex in terms of development and maintenance. As a result, almost half of IT projects cannot fulfil their initial requirements in terms of time, cost and quality (Bolat et al., 2017; Altahtooh and Emsley, 2017). The consequences of the increased software complexity has been identified and studied early on especially from the aspect of cost. (Boehm, 1981). Beyond cost, the impact of software complexity has also been identified in other aspects of software project development such as schedule delays, quality deficiencies and increased error rates (Banker et al., 1989). It is not surprising that some experts state that software are the most complex entities among the human products (Brooks, 1995). According to Jones (2000) projects are usually affected by 10-20 major factors while software projects are affected by almost 250 factors. The complexity of software projects is multidimensional and according to Da-Wei (2007) the fact that it is created over time makes it difficult to be defined and measured. There are various attempts and approaches to measure software complexity such the Lines of Code (LOC), McCabe Cyclomatic Complexity etc. However, these attempts focus on the complexity of the product and not the complexity of the whole project process. This research focuses on studying software development complexity from a most holistic view. It will identify factors that affect the whole software development process, based on various properties of the software system being developed.

One of the most acknowledged factors that affect software development complexity is the software size (Banker et al., 1989). Many approaches in evaluating software complexity are based on size e.g. LOC, McCabe cyclomatic complexity etc. Software size has also been a major estimator in many software project estimation models, either concerning cost (Boehm et al., 2000) or effort (Jiang and Naude, 2007) or productivity (Wagner and Ruhe, 2008; Trendowicz and Munch, 2009). Therefore, software (code) size is identified as a factor that can affect the complexity of software development process.

Data and database size are also important aspects of software development (Wagner and Ruhe, 2008; Trendowicz and Munch, 2009). As the software increase in size, the data required to be manipulated increases also, leading to a significant increase in back-end development complexity. The higher amount of data appearing in a database the higher number of relationships, constraints, views, triggers and data entry forms needed to be defined, resulting in an increased database size, affecting the complexity of the database in terms of development effort (Mishra et al., 2010). Therefore, it is considered that the size and complexity of the application database is a factor that affects the complexity of software development.

During the last decades a number of programming languages have been developed. Starting from low level programming languages to the modern fourth or fifth generation programming languages, a great number of programming languages were developed. They cover a wide area of software development domain, from general purpose languages to languages designed to enhance the development of specific types of software, in order to facilitate programmers work. The main feature of high-level programming languages is that they provide a strong level of abstraction to the programmer, allowing the use of natural language elements and hiding the technical details or even automating the implementation of specific parts of code that will be executed by the computer hardware. This results in less code needing to be implemented and, as that, to easier development and debugging. However, the importance of programing languages in software development has been questioned by some researchers such as Brooks (1987), as he stated that the coding phase is only a small proportion of the total software development process and as that, it cannot significantly affect software development. However, the role of programming language generation in software development has been identified over time in various other researches (Harrison and Adrangi, 1986; Church and te Braake, 2001; Jiang and Naude, 2007). As that, the selection of programing language generation being used is identified as a factor that could affect the complexity of software development process.

As the complexity of software development was increasing, aid-development engineering tools known e.g. CASE tools, code test tools, Integrated Developer Environments (IDE) tools were developed in order to support all aspects of the software development lifecycle. They offer quicker development phase, reduction of defects, savings in required resources and a higher degree of standardization that increase the possibilities of software re-use (Zea et al., 2016). However, despite the improvement they offered in product quality, documentation quality, development procedures, system standardization and adaptability their effectiveness were questioned as they didn’t offer the required boost in productivity despite the heavy investments in such tools (Jiang and Naude, 2007; Iivari, 1996;). The main causes for this situation were identified as the tools complexity, the requirements for training in their use and the resistance of developers to adapt new development approaches because they consider that new approaches will be more lengthy and complex (Jiang and Naude; 2007) than the traditional. Despite all these, nowadays CASE tools cover a wide area of software development providing an automation in designing, documenting, developing of computer code in the preferred programming language and carrying out system analysis and optimization (Berdonosov and Redkolis, 2011). According to Garcia–Magarino et al.

(2010) it very common for a developer to work with several tools at the same time, which in addition, does not always allow flawless data interchangeable between them. From the above it can be considered that the use of CASE tools has a great influence in software development either positively or negatively and as such, their use is considered as a factor that may influence the complexity of software development process.

The continuous rapid changes in technology, the increase in software size and scale and the high number of requirements, functional or non-functional, that modern software is required to incorporate, makes it necessary to adopt a development processes that is manageable, predictable and not chaotic. Because of that, a number of software development models were introduced in order to provide a formal set of procedures or best practices, at an abstract level, that can guide the software development process (Sommerville, 2006). Such models are the Waterfall model, Incremental model, Agile model etc. The use of an appropriate development model, especially in large or complex projects, can enhance the development process and its outcome (Butler and Fitzgerald 1997; Kim and Peterson, 2003; Peterson et al., 2002). Although the use of such models does not assure the project success, the lack or inappropriate use of such models can lead to increased risk failures (McLeod and MacDonnel, 2011) in software development. Therefore, the use or not, of well-known and modern development models is a factor that can affect the complexity of development process.

The close relationship of hardware with software exists from the era of the first steps in computing, where software was developed for a specific type of microprocessor and was strictly dependent on it. As decades passed, this changed dramatically, but there are always cases in which the software being developed will be embedded in the hardware or strictly related to it. This is a factor that can significantly affect the software development lifecycle in case it requires the concurrent software/hardware development. The main barrier in concurrent software development is the instability of requirements (Blackburn et al., 2000). This is due to complex interfaces between hardware and software that makes changes in one affect the other. Also, the nature of hardware development makes it less flexible to changes, as that would require a great amount of rework and redesign. Further, hardware usually cannot break into smaller parts that can be developed separately in order the early testing of them to be made easier, as can happen with software. However, the existence of tight time-to-market restrictions forces hardware and software developers to work concurrently. This requires special techniques in development to be applied e.g. virtual prototyping, virtual platforms, in order for the necessary synchronization, concurrency in development and flawlessly operation to be finally achieved (Teich, 2012). As that, it is considered that the need for concurrent hardware development is a factor that can affect the complexity of software development process.

The idea of software reuse is quite old and is going back decades. That is because many believe that software reuse provides the chance for big saving, shorter lifecycle software developments and increased productivity (Paliwal et al., 2014; Blackburn et al., 2000; Poulin, 1994). This is the reason of the existence of a wide range of software products or services called Commercial of the Self (COTS) that can be purchased and used with or without customization by developers. However, the development of software components for reuse requires the adoption and implementation of specific characteristics that the software components should have. Poulin (1994), after an extended literature review, identified a set of attributes that a reusable software should have. These are: ease of understanding, functional completeness, reliability, good error and exception handling, internal information (implementation) hiding, high cohesion, low coupling and portability. These attributes seem to be still over time as Paliwal et al. (2014), state that understandability, maintainability, adaptability, coupling and cohesion are the main properties that affect the reusability of a software. It is apparent that emending these properties into a software is not easy, resulting in increased software development complexity.

A common requirement of today’s software is for to it operate over a number of different platforms either in hardware or in software. This may concern the simultaneous development of software for different platforms or the time span between major changes. Software portability and platform volatility have already been identified as affecting the software development cost (COCOMO II), productivity (Wagner and Ruhe, 2008) and development effort (Jiang and Naude, 2007). That is because the target system are they determine the characteristic of software that should be implemented by the developer. Mainframe computers, midrange computers personal computers and various operating systems have different characteristics that require more effort by developers in terms of repeated work in building and testing all these platforms (Jiang and Naude, 2007). According to Pflüger et al., (2016) the challenge is how to retain software efficiency, scalability, maintainability and readability of software in different and heterogeneous platforms as many times there are contradicting requirements e.g. use of low level languages for better code vs an abstraction level for software portability. Therefore, the software portability and platform volatility is identified as a complexity factor of software development process.

Reliability is another important property of software. According to IEEE (IEEE, 2010) "Software Reliability" is "the probability that software will not cause the failure of a system for a specified time under specified conditions." Software Reliability has a unique characteristic compared to the reliability of other systems which is that it is not dependent on time meaning that software cannot wear out during its life cycle (Kaur and Bahl, 2014). That means that software errors are created during software implementation or due to modifications or due to various hardware failures that cause software corruption and not due to its use. The close relationship between software complexity and software defects have been investigated by many researchers (Rizvi et al., 2016). To increase software reliability is to add redundancy using various fault tolerance and error handling techniques, which however in turn increases the amount of code in software and, by that, the complexity of the development. (Gupta and Kumar, 2015; Lew et al., 1988). Consequently, the required software reliability is a factor that can affect the complexity of software development process.

Modern software development is a complex process, as it must satisfy a high number of aspects and requirements in order to fulfil its expectations. To achieve that, a careful design of the software and software development should be made. Rehder et al. (1997) state that different designers will produce different designs and solutions for the same problem. This means that a unique route to reach software development targets does not exist. The first step in software design is to understand the problem that the software system should solve and in continuation, to define the specifications of the design. MacCormack et al. (2003) identifies two main types of specification, the "Functional requirements specification" which describes how various software features work and the "Detailed design specifications" which describes in detail the module structures and outlines the algorithms that will be used. In the same research, it is identified that the completeness of the design can significantly improve the productivity of the software development and decrease the error rates even in a smaller function. Productivity increases as high level of design completeness offers a clear plan to programmers of what should be coded, reducing by that way the need for rework and incompatibilities between various code modules. Therefore, the completeness of design is identified as a complexity factor of software development process.

Software architecture, is a high-level representation of the software system that defines its structure and interactions of its internal components and the interactions with the environment (Gustafsson et al., 2002). Architecture is a core part of a software system and has a critical role in the successful development and evolution of software systems (Slyngstad et al., 2008). During the risk analysis phase, a number of risks are identified that should be mitigated by the system architecture. Mitigating risk requires changes in software architecture in order to reduce the possibility of a risk to appear or reduce its impact. For example, changing the authentication method from classic username/password to a method based on cryptography can significantly increase the security of authentication. However, it is a more complex approach that may require extensive changes. If changes affect the software architecture, then the initial architecture model should be updated adding significant complexity (Broniatowski and Moses, 2016). The changes in software architecture in order to deal with architectural flaws is a complex process as it affects multiple modules, systems etc. which may have implemented or are managed by different teams. In order to understand changes and their impact, it is necessary to provide developers with a detailed view of changes, with their requirements and impacts on a system because changes can increase the architectural complexity and introduce new risks (Williams and Carver, 2010). As that it is considered that the architecture risk resolution is a factor that affects the complexity of software development.

Flexibility is defined as the property of a system that measures system tolerance in unplanned modifications (Fink et al. 2017, Port and Huang, 2003). System flexibility is reduced by late life-cycle changes that affect the initial design of a system. Late changes can occur due to various reasons such as changes in user requirements, market conditions, project environment, technology changes etc. When late changes occur usually there is not enough time to fully evaluate their impact on software architecture resulting in increased possibility of flaws and increased difficulty in future changes (Williams and Carver, 2010). Therefore, low development flexibility is considered as a factor that affects the complexity of the software development process.

The outcome of a software project is a software product or a service. A number of researchers identify the close relationships between software product complexity and software project complexity (Fitsilis, 2009; Schaffer and Schleich, 2008; Williams, 1999). The assessment of software product complexity is made by models that are rely on measuring aspects of software code. However, according to Sharma and Kushwaha (2010), this is not a helpful if we would like to have a proactive approach in assessing complexity, as software code is produced at late stages of software development. Further, these models are mainly interested in measuring technical aspects of the code for example the number of code lines, the number of control paths, the number of operators and operands etc. In order to be able to make estimations about product complexity at early stages, even before analysis and design has been carried out, we should focused on identified requirements both functional and non-functional (Sharma and Kushwaha, 2010). Functional requirements describe what a system should do, referring to technical details, data manipulation and processing and other specific calculations. Functional requirements determine the product functional complexity that should be resolved by the software code. On the other hand, non-functional requirements, which are also known as quality requirements, describe how a system works in terms of performance, security, reliability, maintainability etc. (Chung and do Prado Leite, 2009; Mylopoulos et al., 1992). The existence of large number of non-functional requirements, their degree of importance and the compulsion to implement them, can add a high degree of complexity in software development process (Keshavarz et al., 2011). Furthermore, non-functional requirements very often do not taken into consideration at the early stages of design although often affect system architecture more than functional requirements (Khan et al., 2016b). Therefore, the required product functional complexity and the number of non-functional requirements are identified as factors that affect the complexity of software development process.

Today, software is everywhere, in every aspect of our everyday life and the concern for security in computer systems and networks is an important matter that continuously increase (Salini and Kamnani, 2012; Schneier, 2000; Stallings, 1999). Organizations store private or sensitive information in their computer systems which are being increasingly exposed to threats due to their connectivity with various other systems e.g. through Internet. According to Allen (2007), the security of computer systems and networks is strongly dependent on the quality and security of their software. Security requirements are very often in trade-off with the functional or non-functional requirements of the software which makes them difficult to analyze (Bresciani et al., 2004). To develop a secure software system, two basic security aspects must be considered. Security during development and security during the operation of the system (Allen, 2007). Usually security is considered as part of the software development issues only at the later stages of software development as supplementary e.g. firewalls (Khan and Zulkernine, 2008). This leads to software vulnerabilities that in turn lead to increased reworks that are costly and may lead to schedule delays. Therefore, the consideration of software security aspects should be made during the whole software development and for that reason a number of tools and approaches have been introduced to support this (Mohammed et al., 2017). However, the early stage incorporation of security aspects in software development is a painful and time-consuming process that requires software and security engineering expertise which are not always available (Bresciani et al., 2004). Consequently, the software security requirements and constraints are considered as a factor that affect the complexity of development process.

The cognitive level of software professionals, in terms of knowledge, experience, expertise, and other skills, can influence the software development process and its outcome, especially due to its complex nature (McLeod and MacDonell, 2011). Software development teams are formed in order to satisfy the project specific characteristics and requirements for knowledge, expertise, and experience, by taking into account the availability of those resources, and usually are dissolved after the project completion. According to Faraj and Sproull (2000), the most important resource in software projects development is expertise. This expertise could be either domain or technical expertise. Technical expertise is required by programmers in order to be able to quickly produce efficient, effective and error free code, while domain expertise is required by those who design the software architecture and deals with also management / marketing subjects. The extensive knowledge of the application domain is important for the successful implementation of large, complex software projects in order to be able to interpret domain specific requirements (Curtis et al., 1988). Therefore, the level of technical expertise and the level of domain knowledge that exists in the development team are identified as factors that affect the complexity of software development.

Table 14 presents the identified software development technical factors that affect software project complexity.

Table 14 Identified complexity factors in the Technical aspects of software development area

	Technical software development complexity factors
1.	Size of application database.
2.	Developed for reusability.
3.	Software (code) size.
4.	Low development flexibility.
5.	Architecture risk resolution.
6.	Platform volatility, software portability.
7.	Completeness of design.
8.	Hardware concurrent development.
9.	Lack /not use of software tools that aid the development.
10.	Programming language level/generation.
11.	Not use of well-known and modern development models.
12.	Required high software reliability.
13.	Product functional complexity.
14.	Number of non-functional requirements.
15.	Number of security requirements / constrains.
16.	Low level of technical expertise of development team.
17.	Low level of domain/application knowledge of development teams.

3.5. Summary

In this chapter, the literature review and the rational for selecting the specific complexity factors for each one of the software project complexity dimensions identified in this research were presented.

In the next chapter, the research approach, the research design, methodology, the various methods and tools that were used in each step and the reasoning for their appropriateness of their selection are presented.

4. Research Approach, Design and Methodology

4.1. Introduction

This chapter presents in detail the research approach, strategy, design and methods followed to deal will the research problem set. Initially the approach is presented and the main aspects of this approach are discussed. The adopted research strategy and methodology are presented in order to implement the described approach. Finally, the discussion herein focuses on methods, tools and techniques necessary in the Dissertation's research processes and data collection.

4.2. Research aims and Objectives

Before presenting our approach, it is important to recall the aims and objectives described in Chapter 1. In brief, the aim of this research is to define the concept of complexity in software projects from the perspective of the project management process and to develop a complexity framework able to assess the complexity of software projects. The framework will consist of a suitable complexity typology, a model for measuring complexity of software projects and the design of a software tool that will used to develop complexity models, aiming to assist the practical assessment of software project complexity.

The overall scope of this research is to provide a framework for understanding, managing and measuring project complexity which is well matched with the way project managers are approaching software projects. The goal is to determine the sources of complexity, which appear within the management processes and affect them causing management misfires that challenge the success of a project.

4.3. Proposed complexity typology and assessment approach

The approach of this research in assessing software project complexity, as it is described in this section and in section 2.3, is a holistic approach. By the term holistic, we imply that this research is attempting at building a project complexity framework that incorporates all project management areas and allows project managers to assess the complexity of projects even at the early stages (Damasiotis and Fitsilis, 2014). Furthermore, this framework will be accompanied by a software tool, which automates the whole process, and makes the framework easy to use while revealing its strengths and advantages.

The key elements of this effort are the following:

1. To approach project complexity through the different perspectives of project management and to define the dimensions of project complexity that are compatible with this view.
2. To select an appropriate project management framework. As complexity affects the execution of project processes, this research is going to use a process based management framework for identifying the complexity aspects within project management processes.
3. Identify the complexity factors. To achieve that, the complexity sources in the project management process and in technical aspects of SDP should first be identified. This will allow the determination of the complexity factors sourcing from these processes.
4. Determine complexity assessors. Based on the identified complexity factors, appropriate complexity assessors that satisfy a set of requirements such as, being reliable, easy to use, consistent and independent should be determined.
5. To create a composite index for assessing the complexity of software projects.

The overall approach to measuring project complexity can be seen in Figure 12.

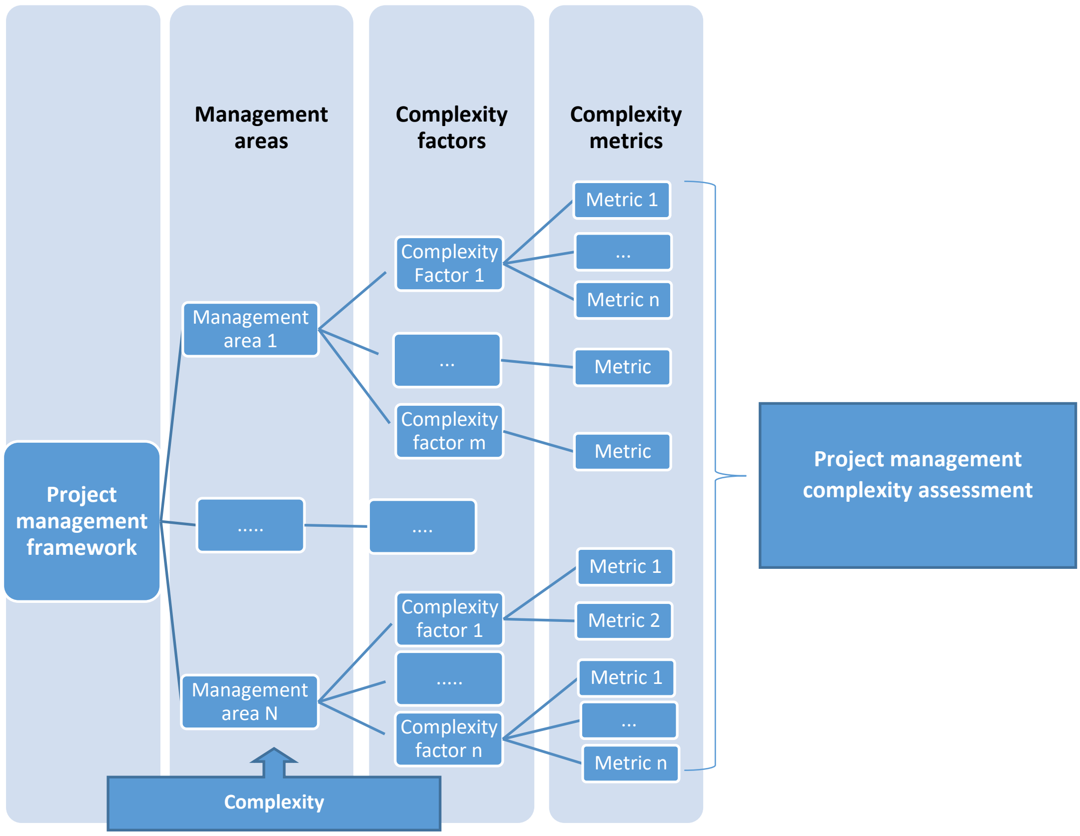

Figure 12 Proposed project complexity approach

For achieving the above stated objectives, PMBOK was selected as the reference project management framework (see Chapter 3). However, since the focus of this interest is particularly the assessment of software projects' complexity, in addition to these ten project management subject areas, another area is added, including factors that cover aspects of software project development not able to be captured by a generic framework. The result is the formation of a complexity typology that has eleven dimensions. The Figure 13 presents the proposed complexity typology.

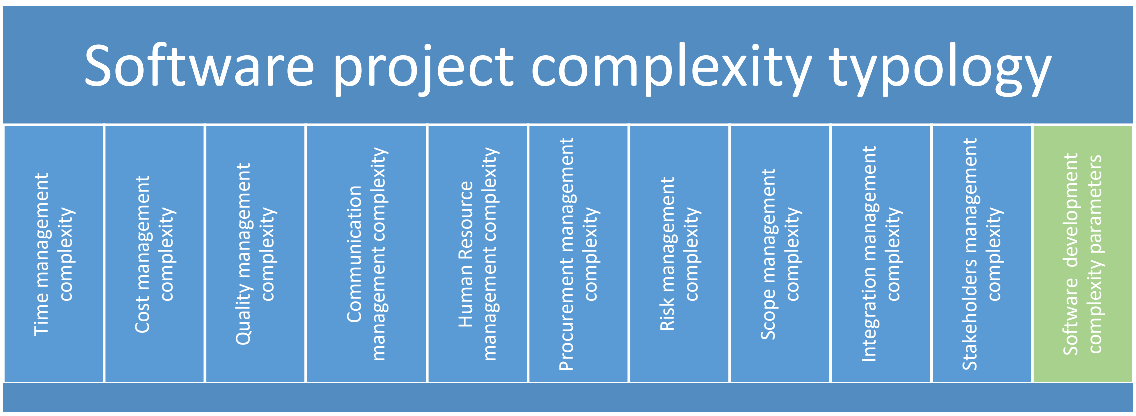

Figure 13 Proposed software project complexity typology

The advantage of the proposed typology model is that it consists of two major modules. The first module, named "Management Complexity Module" (MCMod), is aimed at capturing the management aspects of project complexity that challenge the successful project management. The second module, named "Domain Complexity Module" (DCMod) captures the project complexity sourcing from the particular project domain. This dichotomy makes the proposed model flexible, adaptive and easily modified in order to be adjusted to various project types. Managers need only to detect the domain specific complexity characteristics that will form the DCMod module as it is usually similar for all projects following the PMBOK management framework. The notion of the proposed model is presented in Figure 14.

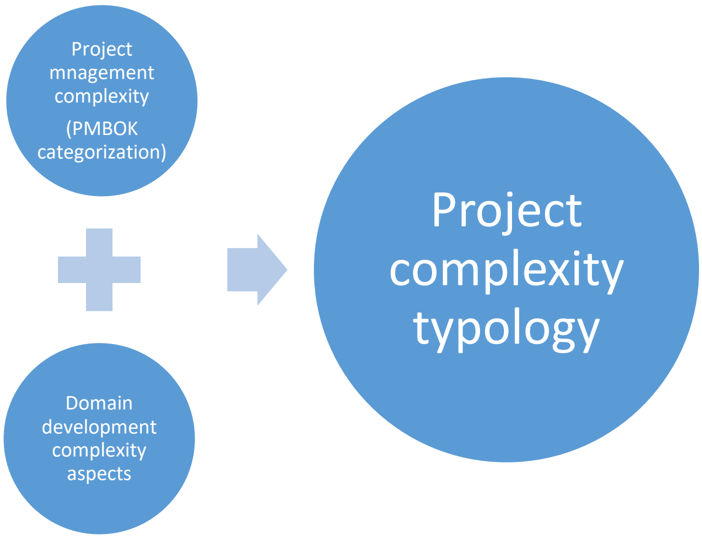

Figure 14 Proposed Software Project Complexity Typology

4.4. Research design and methodology

The design of this research is inductive, exploratory and divided in three phases. In the first phase, the aim is twofold. Firstly, to develop a clear concept of complexity both for projects, in general and in particular for software projects. This is done by identifying possible gaps and deficiencies and propose alternatives that addresses these problems. Secondly, to determine a list of complexity assessors suitable for software projects based on the proposed approach.

The first phase includes the determination of the appropriate methodology for achieving this aim. Initially, a literature review will be done to determine the notion and sources of complexity in software development management process. Through this review an initial list of complexity factors affecting software project complexity will be identified.

In the second phase, surveys supported by data collection techniques such as questionnaires and statistical methods for analysing and validating the responses will be used. Specifically, two rounds of surveys will be conducted. As the number of the initially identified factors is expected to be high, the first survey is aiming at reducing the set of factors to a more manageable number by grouping common factors and/or deleting some of them as statistically insignificant. A large group of project management experts will be engaged during this survey. This is a requirement of the factors' reduction method (see section 4.5.2.2) and more specifically from the targets set for sampling adequacy (see section 4.5.2.8). Survey's panel will consist of project managers with professional and/or academic experience mainly but not limited to software projects (see section 4.5.2.6). The survey's results will be evaluated for their validity and then statistical methods suitable for factor reduction will be applied. The results of the statistical analysis will form the final set of complexity factors. Afterwards, a second survey will be performed which will determine the relative contribution of these factors, to the total project complexity through the use of expert judgement and multi-criteria decision making techniques. This panel will consist of experts with significant professional and/or academic experience in software project management (see section 4.5.4.3). According to similar past researches (Qazi et al., 2016; Nguyen et al., 2015; Sedaghat-Seresht et al., 2012) a panel of experts with 10-20 members is considered adequate.

The third phase of this research is based on case studies, aiming at validating the proposed complexity assessment model. The method of case study for model validation is widely used by various researchers (Antoniadis et al., 2011; Vidal et al., 2011; Nguyen et al., 2015; Chapman, 2016), with the number of cases examined varying from 1 to 7 with an average of 4 projects. Furthermore, as (Yin, 2003 p.33) states, "if two or more cases are shown to support the same theory replication may be claimed". As that, the five cases (see section 6.4.1) selected in this research are considered as adequate. The validation process will be based on empirical data comparing the level of project complexity as perceived during the execution of projects by the project manager of the respective project, with the results obtained by the new developed model.

Enumerating the steps that will be followed in this research for achieving the aims set are the following:

1. Conduct an extensive literature review to construct the initial list of complexity factors.
2. Use a focus group to filter the initial list of the complexity factors.
3. Do a first survey, by widely distributing a questionnaire and performing subsequently statistical analysis, to limit the initial expected extensive list of complexity factors, either by grouping them or by eliminating them as statistically insignificant.
4. Use a multi-criteria decision technique to perform a second survey, in order to assign weights to these complexity factors.
5. Develop an algorithm to assess complexity
6. Validate the model through a number of case studies/projects, by comparing the proposed model results with the perceived by project manager's, complexity.
7. Develop a prototype software tool based on the proposed model for constructing complexity models according to the needs of each project or organization.

4.5. Research Methods and Tools

This section presents the methods and tools examined and finally selected in order to implement the methodology steps described in the previous section.

4.5.1. Literature review method and tools

As a first step in this research, an extensive literature review was performed and the properties of projects and the project management process were identified in order to determine the appropriate complexity factors according to the described approach. The appropriate literature was determined, using mainly e-resources such as e-databases and web search engines. A number of electronic databases were used such as: Science

Direct, Emerald, IEEE Xplore, Taylor online, ACM Digital Library, Google Scholar and general web search engines such as Google and Bing. A set of relevant papers were identified using various search criteria. For example, search strings used for finding papers relevant to the concept of project complexity, were “software complexity”, “project complexity”, “project management complexity”, “management complexity”, “project success factors”, “project failure factors” etc. A similar approach was followed in the literature review performed, in order to identify the complexity factors of each area. For example, in the area of scope management some of the searching strings that were used were “scope management complexity”, “scope management”, “software complexity”, “software scope management”, “requirements management”, “successful scope management factors”, “requirements management performance”, “requirements elicitation”, “requirements engineering”, etc.

In all cases, the papers evaluated in terms of their relevance to the subject and the papers that were irrelevant to the researched topic were excluded. The period that this research was done, was the period starting from October 2011 to September 2016. In Table 15, the final number of papers selected for each subject and examined during this research is presented.

Table 15 Number of papers identified during the literature review per research area

Areas investigate through literature	Number of selected papers
Project complexity	37
Project management	21
Software project complexity	25
Time management complexity	18
Cost management complexity	14
Quality management complexity	15
Communication management complexity	31
Human resources management complexity	19
Procurement management complexity	24
Risk management complexity	15
Scope management complexity	33

Areas investigate through literature	Number of selected papers
Integration management complexity	17
Stakeholders management complexity	19
Software development technical factors	52
Statistical Analysis (include survey design, questionnaire formation, EFA, multi-criteria methods, AHP)	59

4.5.2. Determining structured relationships and reducing factors

The number of complexity factors identified in these papers was quite large. More specifically 135 factors were identified. The incorporation of such a large number of factors in an assessment model makes the model cumbersome and unmanageable since it reduces its usability, its user friendliness and finally the model becomes unusable. Another fact is that many of these factors are interrelated and this implied that these dependencies have to be examined before ending up to concrete list of factors.

For reducing the number of factors, simple statistical methods can be used such as those based on median, mean, missing variables, high correlation and low variance. However, these methods cannot identify underlying structured relationships between factors. Therefore, the use of statistical methods able to achieve both the above goals was examined such as Q methodology (Stephenson, 1935) and Factor Analysis (FA) (Spearman, 1904).

4.5.2.1. Q methodology

Q methodology was presented by Stephenson (1935) and was used to study an individual's subjectivity on an opinion, belief, preference or attitude (Brown 1993). Its source is in psychological research and is used widely in that domain (Serfass and Sherman, 2013; Shinebourne, 2009). Q can be seen and as an inversion of FA, meaning that instead of giving a small set of tests to a large number of people, it gives a large number of tests to a small number of people (van Excel and de Graaf, 2005). In brief the Q method works as follows (Brown,1980; 1986; 1993): A set of statements, describing possible characteristics of a phenomenon or situation or item called "cards", are distributed to the survey participants in order to initially sort them in three piles e.g. agree, disagree, neither agree or disagree (neutral). Then the participant should sort the "cards" of each pile into predefined distribution according to the scale the researcher has select (template) and place them in the score sheet provided. This scale can be, for example, from -5 to +5, as seen in Figure 15.

Obviously, this process results to an almost normal distribution of cards, as very few "cards" can be placed at the edges while most of them are placed in the middle categories. These are the data that can be further processed by using statistical packages such as SPSS.

The main advantage of this method is that does not require too many participants. It is generally accepted that this method works well for a set of 40 to 80 statements given to a set of 40 to 60 participants (Shinebourne, 2009; van Excel and de Graaf, 2005).

The low number of participants has risen questions about the reliability of the

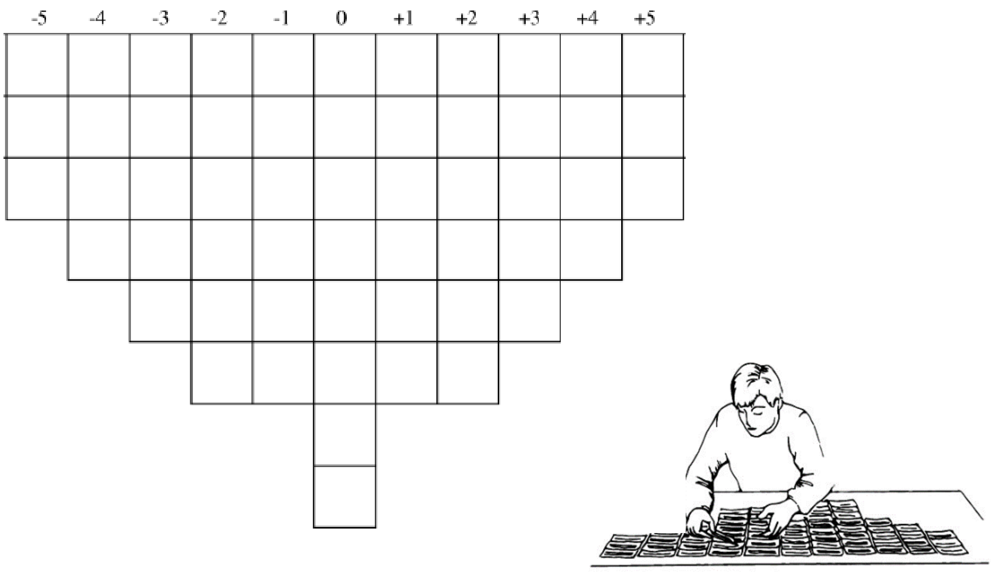

Figure 15 Placing "cards" into piles - Q methodology

method and its ability to generalise the results (Thomas and Bass, 1992). Van Excel and de Graaf (2005), based on conclusions from the studies of Brown (1980) and Thomas and Bass (1992), state that the results of Q methodology do not reflect the percentage of the sample that adhere to any of them, but only the distinct viewpoints over a topic as only a limited number of them exist in any topic. So cautious preparation of the statements can guarantee generalizations over the specific topic examined.

The weaknesses of this method are that it is a quite complex, time consuming and unfamiliar procedure for participants. It has also been risen questions about the need for in person interviewing of participants by researcher. However, van Tubergen and Olins (1979), show that there is no difference if the survey is conducted by mail or in person.

Summarizing the above, Q methodology is a very interesting technique that requires small sample sizes but is quite complex and time consuming for the participant and that may affect its results if the participant does not have the necessary commitment.

4.5.2.2. Exploratory Factor Analysis methodology

Factor Analysis (FA) was introduced by Spearman (Spearman, 1903) and its source is in physiological research (Fabrigar et al., 1999). There are two main FA techniques: the Confirmation Factor Analysis (CFA) and Exploratory Factor Analysis (EFA). CFA is used to confirm hypotheses while EFA tries to reveal the underlying structure and interdependencies between observed or even unobserved factors. EFA is used when a study involves too many variable e.g. a few hundreds, and wants to reduce it to a smaller set in order to be easier to focus on some key factors rather than considering with too many variables (Yong and Pearce, 2013) or when a researcher tries to identify the number of factors influencing the variables and to analyse which variables are grouped together (DeCoster, 1998). The information obtained from these interdependences can also be used to reduce the number of variables in a dataset (Child, 2006) while retaining as much of the original information as possible (Field, 2009). Today EFA is widely used in information systems, social sciences education, and psychology and in variety of other domains (Taherdoost, et al., 2014).

EFA is a complex procedure with few absolute guidelines and many options (Costello and Osborne, 2005). All the information required is obtained through processing the individual's opinions in a set of statements gathered using questionnaires. The formation of the questionnaires is based on measurable items called variables. The responses gathered by the questionnaires are the data that can be further processed by using statistical packages such as SPSS. The responses to the questioners are called cases and the identified latent variables, after statistical processing, are called factors. Due to its design, EFA generally requires the existence of a large size of samples (Comrey and Lee, 1992; Cudeck and O'Dell, 1994; Kline, 1994; Velicer and Jackson, 1990; Velicer et al.,1982).

4.5.2.3. Selecting method for determining structured relationships and reducing factors

Considering the above methods, Q methodology has the advantage of a small sample size but has the following disadvantages:

a) It requires from the responders to study the methodological steps as they are not straightforward, as is for example the answering of a questionnaire.
b) It is a time consuming process and requires commitment on behalf of each responder in implementing it, especially due to the large number of variables which should be examined.
c) There are not many software tools available to facilitate the process.

On the other hand, the main advantages of EFA are the following:

a) It reveals the structured relationships between variables and group these variables together reducing their number.
b) There are numerous descriptions and suggestions in the literature.
c) There are plenty of software tools that implement it and can be used.
d) It is a well-known method with numerous applications for decades.

The main problem-disadvantage of this method is the requirement of a large sample especially as the number of variables examined is high.

Considering this comparison, it was decided that EFA should be selected as the most suitable method for reducing the factors and determining the structured relationships between them.

The main problem was the large size of the required sample because of the large number of variables (complexity factors) to be examined, that was amplified if you consider the nature of the sample, which should be experts of project management domain.

However, this issue can be addressed as it will be indicated in the next section.

4.5.2.4. First survey and subsequent analysis using EFA

In this section the methods that were followed during the survey conducted and the subsequent statistical analysis of the data collected using EFA are presented. The procedures followed in the questionnaire design, panel selection and the methods applied before performing EFA are described in order to examine and verify the suitability of the gathered data. Also the rationale behind the decisions made is presented.

4.5.2.5. Questionnaire forming

Having selected the statistical method that would be used in the first stage of this research, the next step was to form the questionnaire that was used in this process. As the number of the identified complexity factors was quite high, they were grouped in categories for practical reasons. That allowed the reduction of the required sample size by ten times. As a basis for this categorisation the eleven dimensions of our model were used (see section 4.3). The number of complexity factors contained in each area can be seen in Table 16.

Table 16 Number of complexity factors identified per complexity area

Category ID	Complexity areas	Number of complexity factors
CA1	Time management	15
CA2	Cost management	11
CA3	Quality management	11
CA4	Communication management	12
CA5	Human Resources management	14
CA6	Procurement management	13
CA7	Risk management	8
CA8	Scope management	13
CA9	Integration management	14
CA10	Stakeholders management	7
CA11	Technical management	17
	Total	**135**

The aim of the survey was to identify the relative contribution of each factor to project management complexity. Responders were asked to evaluate each project complexity factor using a positive five-point Likert scale (from 1= “Very low contribution” to 5= “Very high contribution”). A preliminary questionnaire was formed and a pilot test was performed. The questionnaire was sent for review and feedback to a group of 10 experts.

All experts had more than six years of professional experience in managing software projects and more than five years’ academic experience in project management in Greece and the UK. They were asked to complete the questionnaire and provide feedback about the clarity of the survey questions. After incorporating the provided feedback, the questionnaire was finalised (see Appendix A).

4.5.2.6. Survey panel selection and questionnaire distribution

A list of over 550 responders, who have professional, academic or both project management experience in software projects either in the private or in the public sector, was formed. The sources from which this list was formed were the Greek Information Society S.A, the Federation of Hellenic ICT enterprises, Technical Chambers of Greece, Greek Project Management organizations and associations, academic organizations in Greece and in UK, various business organizations in Greece and the UK whose business scope was relative to IT development, software development and software engineering. Also, individual project managers working either in public or private organizations were included. Experts who had experience from other types of projects were not excluded as long as they had managed or had been part of the management team of at least one software project. That is because software projects despite their differences and unique characteristics are still projects that have a wide range of common characteristics with other types of projects.

The questionnaire was in electronic form and the platform used to create and collect the responses was Google Forms. The link to the questionnaire, including a brief description of it and the aims of the survey was sent to the responders via email. Access to the questionnaire was granted to everyone who had the link. The participation to the survey was anonymous as neither psychological nor other barriers to the responders that could bias their responses or prevent them from participating in the survey were wanted. Six weeks after the first message, a first reminder was sent along with a second reminder sent five weeks later.

4.5.2.7. Reliability analysis

Before proceeding, it was important to verify the scale reliability of the questionnaire in order to confirm that questionnaire measures in practice what it does in theory. To verify the scale reliability of the questionnaire it was used the Cronbach's α (Cronbach, 1951) for each one of the 11 complexity categories that formed the questionnaire. Cronbach's alpha is a measure of internal consistency. This demonstrates how closely a set of items are, as a group. The latter, is considered to be a measure of scale reliability. According to Field (2009) and Cline (1993) it is generally accepted that a value of Cronbach's α higher than 0.7 or 0.8 is acceptable.

4.5.2.8. Sample size adequacy

The herein research has examined several approaches to evaluate the adequacy of a sample size for EFA. Sample adequacy is important as otherwise EFA cannot continue as the results will be useless.

A number of different suggestions and approaches, concerning the required sample size, exists in literature (MacCallum et al., 1999), some of which rely on absolute sample size and others on the Subject to Variable (STV) ratio. For example, Lawley and Maxwell (1971) state that the number of cases required is that of the variables plus 51, Kass and Tinsley (1979) state suggest having between 5 and 10 cases per variable, Suhr (2006) suggests at least 100 cases and an STV ration of no less than 5. Also, MacCallum et al. (1999) shown that the minimum sample size is related to the communalities. They state that as the values of communalities lower, the size of the sample needed must be increased. In addition, they indicate that if all communalities are above 0.6 then even a small sample size (bellow 100) could be adequate while with communalities of a value of around 0.5 value, a sample size between 100 and 200 participants is required in order to be adequate.

Recent studies investigating the required minimum sample size have shown that this is a function of several parameters (Gagne and Hancock, 2006; MacCallum et al., 2001; MacCallum, 1999) such as the number of variables, the number of factors, the number of variables per factor and the size of the communalities. There are studies that investigate how factor analysis applies to small sample sizes e.g. sample sizes less than 50, and have shown that reliable results can still be achieved (Gagne and Hancock, 2006; Preacher and MacCallum, 2002; Geweke and Singleton, 1980; Bearden et al., 1982). However, these approaches have many limitations and results cannot be generalised and applied to situations encountered in real data. Because of that, de Winter et al. (2009) states that is better to think about the most "appropriate" rather than "correct" number of factors.

Furthermore, in order to strengthen the adequacy of the sample size, the Kaiser-Meyer-Olkin (KMO) measure was examined (Kaiser, 1970). The KMO was calculated both on all variables and individual variables. The KMO measure for individual variables is presented in the diagonal elements of Anti-image correlation matrix (Field, 2009) while the results of individual variable is presented in Chapter 5 along with the results. KMO value varies between 0 and 1, and recommendations suggest that the accepted values should be greater than 0.5. Specifically, values between 0.5 and 0.69 are mediocre, values between 0.7 and 0.79 are good, values between 0.8 and 0.89 are great and values between 0.9 and 1 are superb (Hutcheson and Sofroniou, 1999).

4.5.2.9. Factorability of data

To perform EFA, the factorability of the data was examined following the next steps. Firstly, the determinant of the correlation matrix was examined. When the determinant is equal or very close to zero, it means that either there are no linear combinations or they are infinite within the matrix, while if it does not equal to zero, then there are linear combinations within the matrix (Beavers et al., 2013). The threshold for this value is 0.00001 and the calculated determinant of the correlation matrix should be greater than this value.

Next the Bartlett's Test of Spherisity (Snedecor and Cochran, 1989) was calculated in order to evaluate if the determinant value is statistically different from zero meaning that there are relationships between the complexity factors (variables) that could be revealed during the EFA. The value of the significance of the Bartlett's test should be lower than 0.001

4.5.2.10. Initial extraction method

EFA can be performed with a number of different methods that determine the way the initial factor extraction will be performed. Two are the most common extraction methods suggested in the literature: the Principal Components Analysis (PCA) and the Common Factor Analysis (CFA) (Tabachnick and Fidell, 2001). Whilst very often both methods produce similar results (Field, 2009), there are both theoretical and mathematical differences between them. In short, PCA is used as a data reduction method, in order to summarize a large set of variables to a smaller one (Costello and Osborne, 2005; Velicer and Jackson, 1990). In this case, each variable is acting as cause for the component (DeCoster, 1998). On the other hand, CFA allows to reveal the underlying factors, which cannot be measured directly, assuming that individual items are the results of the underlying factor (DeCoster,1998). The Figure 16 illustrates these two different approaches.

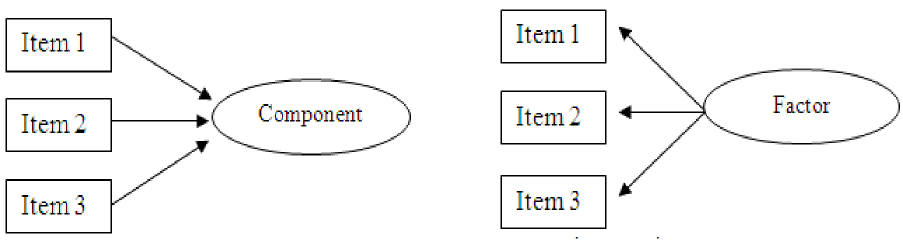

Figure 16 PCA vs CFA (Beavers et al., 2013)

For the initial factor extraction, the CFA or "principal axis factoring" as stated in SPSS (IBM, 2013) was selected, as this research is interested in reducing the number of complexity factors (variables), by revealing the underling complexity components that are not profound and can be assessed using these individual variables.

4.5.2.11. Determining the number of factors to be retained

The next step in data processing using EFA was the determination of the number of factors which should be extracted, in order to represent the initial data and the relationships between them in the most optimum way. The first extracted factor usually explains the largest amount of variance, whilst the subsequent factors represent a continuously decreased amount of variance. The key point is to extract the right number of factors as overextraction or underextraction can have bad effects on the results. The eigenvalue values associated with the variance, indicate the substantive importance of the factors (Field, 2009).

An approach to deciding which factors should be extracted, is to examine if the eigenvalue of each factor is large enough to represent a meaningful factor. The most common criterion to this approach is the Kaiser criterion (Kaiser 1970). It suggests that all factors with eigenvalues greater than one should be retained. Along the same line, Jollife (1986;1972) suggested that the Kaiser criterion is too strict and all factors with eigenvalues greater than 0.7 should be retained. Despite the small difference in absolute numbers between the two criteria, the number of factors can be extracted from the use of these two criteria can vary significantly. According to Field (2009), the Kaiser criterion is accurate when there are less than 30 variables and the communalities, after extraction, are greater than 0.7 or if the sample size exceeds 250 and the average communality is greater than 0.6. The Kaiser criterion is the most common, but when it is used with CFA extra caution is needed, since only common variance between variables is used and as such, factors with eigenvalue lower than 1 may need to be retained, as they account for significant variance otherwise underextraction of factors may occur (Beavers at al., 2013).

Another very common approach is to use the scree plot (Cattell, 1996) which is a graphical representation of each eigenvalue (on Y axis) with the corresponding factor (on X axis). In this method, it is examined the scree plot for the point there is a curve in the graph followed by a tail. It is retained the factors with eigenvalues placed before the point of the curve. However, very often the scree plot cut-off is not very clear and is quite subjective, where the precise cut point is and therefore overextraction of factors can occur (Beavers et al., 2013).

In this research as the Kaiser requirements were not completely fulfilled, scree plot was also examined. In case of differences between the suggestion of two criteria the Costello and Osborne approach was followed.

According to Costello and Osborne (2005), if there are different suggestions about the number of factors which should be retained between criteria, then the results obtained should be examined with all possible combinations between the numbers of factors proposed by the two suggestions. What should be chosen, is the number of factors that gives the "best" results in terms of few cross loadings, adequate factor loading and factor number.

4.5.2.12. Factor rotation

The selection of the appropriate rotation method was the next step in EFA analysis. Factor rotation is necessary as direct solution does not provide an easily or sufficiently interpretable solution (Tabachnick and Fidell, 2001; Fabrigar et al., 1999; Child, 1990). Factor rotation does not change the underlying solution, but presents the variables loading pattern in a way that is easier to interpret, and improves, simplifies and clarifies the data structure (Field, 2009; Costello and Osborne, 2005). There are two main approaches to factor rotation, the orthogonal rotation and the oblique rotation. Orthogonal rotation is used when the variables are considered to be uncorrelated or are not highly correlated while oblique rotation is used when variables are correlated (Tabachnick and Fidell, 2001). In case the variables are not correlated then the results produced by the two methods are similar. Oblique rotation is more complex than orthogonal as it produces two matrices that should be interpreted in conjunction. The orthogonal rotation is the most widely used and a number of different methods exist to implement it, such as Varimax, Quartimax and Equamax, with Varimax being the most common choice (Costello and Osborne, 2005). In this research orthogonal rotation was followed and more specifically, the Varimax rotation.

4.5.2.13. Evaluation of EFA solution

An indicative measure to evaluate how the model fits the data is to examine the differences between the observed correlations and the correlations based on the model

(Field, 2009). This information is held in the second half of "Correlation reproduction matrix" called "residual". In order to have a good model no more than 50% of absolute values should be greater than 0.05 in this matrix (Field, 2009).

4.5.3. Factors weighting

Having identified a number of factors affecting complexity of software projects, the next step was to identify the relative importance of each factor in relation to total project complexity. To achieve this, weights needed to be assigned to each complexity factor. The use of an appropriate multi-criteria decision method was the mean to achieve this.

4.5.3.1. Selecting a multi-criteria method

Business leader make strategic decision to satisfy their customers' demands, government regulations, minimize costs, maximize profits, etc. To make the best possible decisions, when facing such multi-criteria problems, the need of applying multi-criteria decision methods is a necessity. The basic idea of multi-criteria decision methods, is to compare a set of alternatives and to assign values according to which, the best alternative fits goals, objectives and desires of the problem.

According to Vidal et al. (2011) the selection of the appropriate multi-criteria method is not trivial and it is a multi-criteria problem itself. In their research, they identified a set of requirements that a multi-criteria method should meet in order to be used for evaluating project complexity. They used multi-criteria analysis to prove that among the various multi-criteria decision methods the Analytic Hierarchy Process (AHP) is likely to be the most suitable for complexity evaluation. Their outcome is also supported by the numerous applications of AHP, from researchers who considered it as the most appropriate and user friendly tool in a number of different contexts such as in project management, in software tool selection, technology selection, etc. (Vaidya and Kumar, 2006; Al-Habri, 2001; Ahmad and Laplante, 2006; Alhazmi and Mcaffer, 2000; Daim et al., 2011; Patanakul et al., 2007; Hongyan, 2010; Lin et al., 2008).

AHP uses as input the subjective judgment of each decision-maker and produces as output the quantified weight of each alternative. Therefore, it can easily quantify both objective and subjective issues that do not have theoretical values (Sato, 2003). This research, in order to prioritize the complexity factors, will rely on the experts' opinion. This enhances further the validity of the decision taken to use AHP at this stage of the research, as according to Daim et al. (2010) AHP suits better with expert judgement, since it is a method that tries to reveal the consensus among a group of experts on a specific subject.

4.5.3.2. Analytic Hierarchy Process (AHP)

AHP was developed initially by Saaty (1977) and has been refined by Saaty (1980), Saaty (1990) and Saaty(2008). It uses pairwise comparison judgements in order to assign priorities with respect to criteria set. AHP helps decision makers to find the answer that best fits their goal and their understanding of the problem and not the "correct" answer. It allows the integration of the quantitative and the qualitative aspects of decision making, which makes it suitable to be used in complex contexts (Saaty, 1980; Fumey; 2001). In addition, its hierarchy structure allows the division of the decision problem into a number of sub-problems, which are easier to understand, and which can be independently analysed. After the hierarchy has been created, decision makers systematically evaluate the alternatives, using pairwise comparisons with respect to their impact on each element of the hierarchy.

In a pairwise comparison, the evaluator is asked to compare the value of one alternative in comparison to another, with respect to a specific criterion. These evaluations are converted to numerical values that can be used for a range of decision problems. AHP allows the comparison of diverse or incommensurable elements in a rational and consistent way. Therefore, the essence of AHP is human judgment which is used to perform the evaluation and not just the underlying information (Saaty, 2008).

The basic steps for applying AHP methodology are as follows (Bhushan and Rai, 2004):

i. **Creation of the hierarchy.** The problem is divided into a hierarchy of goals, criteria, sub-criteria and alternatives.

ii. **Data collection.** Through pairwise comparisons, experts or decision makers rate the alternatives according to a specific criterion and scale.

iii. **Creation of a square matrix.** The pairwise comparisons are organized into a square matrix as displayed in Figure 17. The diagonal elements are all equal to one meaning that criteria ith and jth are of equal importance. Elements that have values higher than one, indicate that the ith element is more important that the jth element, while elements that have values lower than one, indicate that the ith element is of lower importance that the jth element. If the (i,j) element has value a_{ij} , the corresponding diagonal element has value $a_{ji}=1/a_{ij}$.

$$\begin{bmatrix} 1 & a_{12} & \cdot & \cdot & a_{1j} & \cdot & \cdot & a_{1n} \\ \frac{1}{a_{12}} & 1 & \cdot & \cdot & a_{2j} & \cdot & \cdot & a_{2n} \\ \cdot & & \cdot & & & & & \cdot \\ \cdot & & & \cdot & & & & \cdot \\ \frac{1}{a_{1j}} & \frac{1}{a_{2j}} & \cdot & \cdot & a_{ij} & \cdot & \cdot & a_{in} \\ \cdot & \cdot & & & & \cdot & & \cdot \\ \cdot & \cdot & & & & & \cdot & \cdot \\ \frac{1}{a_{1n}} & \frac{1}{a_{2n}} & \cdot & \cdot & \frac{1}{a_{in}} & \cdot & \cdot & 1 \end{bmatrix}$$

Figure 17 AHP square matrix

iv. **Calculating weights with respect to alternatives**. The principal eigenvalue and the corresponding normalised right eigenvector of the comparison matrix give the relative importance of the various criteria being compared. The elements of the normalised eigenvector are termed weights with respect to the criteria or sub-criteria and ratings with respect to the alternatives.

v. **Inconsistency evaluation.** The consistency of the matrix is evaluated. As the comparisons made by this method are subjective, AHP tolerates a specific level of inconsistency. If the consistency index fails to reach required level, then the answers to the comparisons may be re-examined. Saaty, (1980) suggests that the value of the inconsistency level should be less than 0.1.

vi. **Calculating global weights.** The rating of each alternative is multiplied by the weights of the sub-criteria and aggregated to get local ratings with respect to each criterion. The local ratings are then multiplied by the weights of the criteria and aggregated to get global ratings.

4.5.4. Second survey and subsequent analysis

In this section, the methods that were followed in order to implement the AHP methodology steps are presented.

4.5.4.1. Creating AHP hierarchy

The first step of AHP methodology is to create the problem hierarchy starting from the top with the goal or the decision, then moving to criteria from which the main goal is composed of, and finally to the set of alternatives that constitute the lower level. The designed hierarchy that fits the proposed model is displayed in Figure 18.

In this research, only the lower level of hierarch was quantified using expert judgement. The above criteria were assumed to have equal weights. The weighting of these criteria can be included in later model modifications.

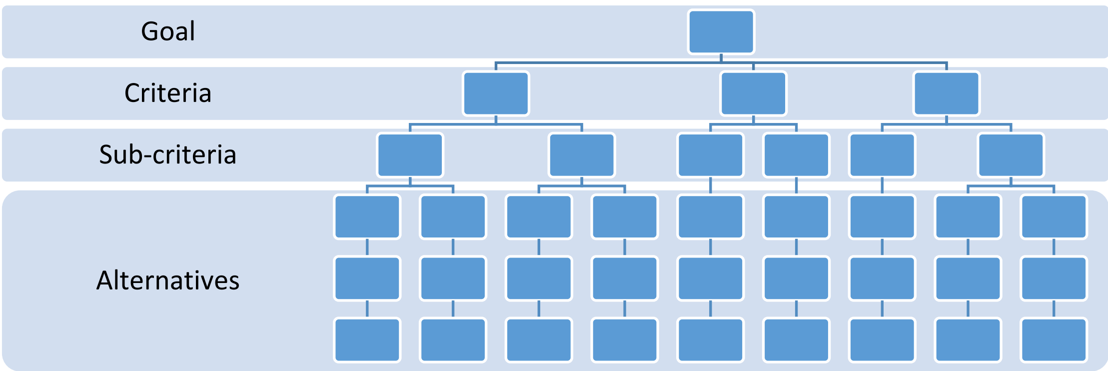

Figure 18 AHP Hierarchy model

4.5.4.2. Forming questionnaires

The next step was the forming of questionnaires for pairwise comparisons. The baseline for developing the questionnaire was the complexity factors that have resulted from the EFA, which was done at the previous stage of this research. As is presented in sections 5.2.1 to 5.2.11, 35 complexity factors are identified, sourcing from 11 complexity areas.

In AHP, the existence of a large number of elements increases the number of comparisons resulting to a very arduous process for responders (Daim et al, 2011). In addition, Simpson and Cochran (1987) state that AHP methodology can be better applied, when 2 to 15 alternatives exist, otherwise they suggested reducing the number of alternatives. In line with the above suggestion, it was decided to keep the categorisation schema of the complexity factors that had been used in the previous research step and to transform the complexity categories in criteria, and the complexity factors to alternatives resulting in having from 2 to 5 alternatives per criterion. In this way, the above suggestions were fulfilled and the importance of each complexity factor within each area was evaluated. Another advantage of this solution was the possibility to calculate the complexity of each management area, beyond the calculation of total project complexity.

Questionnaires were formed (see Appendix C) with the support of a software tool, the "Expert Choice 2000" (http://expertchoice.com) which is a tool that automates the AHP process. The use of that tool facilitated the forming of the questionnaires and allowed easy, accurate and quick calculations. Furthermore, the possibility for presenting the questionnaire using either a verbal or a numerical scale, allowed the comparison between the importance of qualitative and quantitative criteria. Experts had the opportunity to express their opinion using either a verbal scale, from equal to extreme or a numerical scale from 1 to 9. The verbal scale was transformed to numeric as follows: Equal=1, Moderate=3, Strong=5, Very strong=7 and Extreme=9. The intermediate values of 2, 4 and 6 were used to refine the answers. This approach allows the decision maker to initially capture the vague preference who had in mind and then to systematically sort them into a prioritised sequence (Daim et al., 2011).

An example of the pairwise comparison question design can be seen in Figure 19. If Alternative A is more important than Alternative B then the cursor is moved to the left, otherwise if Alternative B is more important than Alternative A then the cursor is moved to the right.

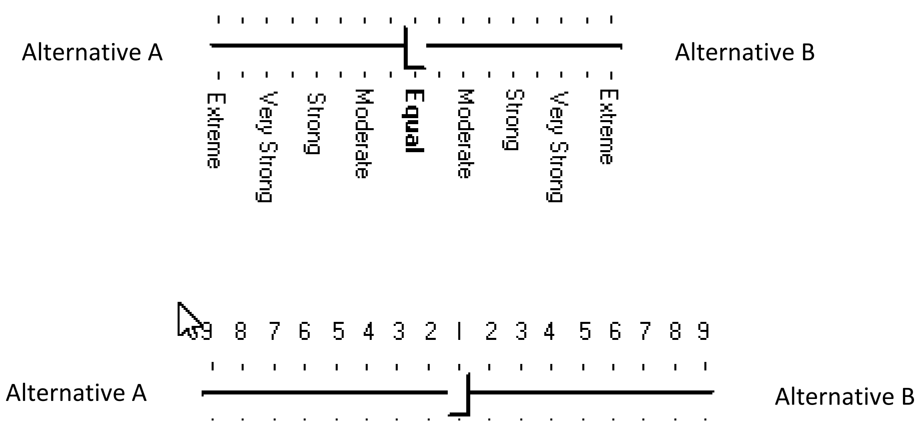

Figure 19 Pairwise comparison questionnaire design

4.5.4.3. Selecting survey panel

A group, consisting of 17 experts, was formed in order to evaluate the factors. Ten of them had also participated in the first round of survey. Concerning their educational level, 10 of them had a PhD and the rest had MSc. Their expertise was related to software development and the domain of project management. They all had at least five years' experience in managing software development projects in the public and/or the private sector. Furthermore, six members of the group had more than ten years' academic experience in the domain of project management.

4.5.4.4. Data collection

The data collected through questionnaires and the whole process was supported by the "Expert Choice 2000" software tool. The use of this tool facilitated the answering process allowing responders to express their opinion using either a verbal or a numerical scale and allows the immediate evaluation of responses consistency and automate the AHP calculations. The questionnaire was administered individually to each expert group member. So for each expert group member an interview was organised where the questionnaire was answered with the assistance of the author of this dissertation. At the beginning of each session, the experts were briefed on the objectives of this dissertation, on the research method applied and on the contents of the questionnaire. Following that, the method that will be used for answering the questionnaire (pairwise comparisons) was presented and then clarifications of the usage of the scales were given. The questionnaire was in electronic form, as it is automatically created by Expert Choice 2000. Finally, questions regarding the context and meaning of each factor that was described in the pairwise comparison, were answered. After that, the responders had one hour to answer the questionnaire using Expert choice 2000. The time was considered more than adequate as the average response time recorded was 37 minutes. The use of Expert choice 2000 tool allowed the immediate calculation of the consistency index of the responses. When inconsistences were observed, the responders had the opportunity to re-evaluate their answers if they wanted to do so.

4.5.5. Model validation

Model validation was based on case studies and empirical data. Specifically, a number of software projects was examined and five of them were selected to evaluate the validity of the proposed model. The initial list of projects was opportunistic while the criteria set for selecting the projects to be used for validation are the following:

i. Accessibility to the project manager of the project.
ii. Availability and willingness of the project manager to participate in this research.
iii. To be relatively recent.
iv. To vary in some of their characteristics (e.g. duration, cost), but also to be able to identify common characteristics (e.g. type of software, type of client) in them, if they were examined in groups of at least two or three.

Project managers of various Greek software development companies were conducted in order to examine their availability and willingness to participate in this research. Next, they were asked to submit a brief description of the projects they have managed in form of a project charter document. Project charter according to PMBOK is a statement of the scope, objectives, and participants in a project. They were asked not to refer to sensitive information such as company names, names of clients, participants and sensitive cost data. In the project charter they should describe the project's background, goals, key financiers (in form of private or public sector), budget, duration, the types of project teams, the number of project members and the main risks and assumptions. Based on this information, five projects which satisfied the above criteria set, were selected. Afterwards, project managers were asked to assess the 35 complexity factors which were identified previously. The list of factors was given to them in the form of a questionnaire. Each factor was assessed using a linear scale ranging between 0 and 10. The value 0 stated that this factor was not applicable or not significant to the project management process, while value 10 stood for an extremely high effect or significance to the project management process.

Finally, project managers were asked to assess the perceived total project complexity during its execution on a scale ranging from 0 to 10. The scale was linear starting from 0 which was equal to "no complex project", ending in 10 which was equal to "Extremely high complex project". This value was compared with the project complexity level that was calculated by the model proposed in this research. The results of this process are presented in detail in Chapter 6.

The questionnaire was electronic, developed using Google forms and it was distributed to project managers by email during December 2016.

4.6. Summary

In this chapter, the research objectives, methodology, methods and tools that were applied in each step of this research were discussed.

In the next chapter, the results of data statistical analysis are presented. Specifically, the EFA method that was used for identifying the common underlying complexity factors and the AHP method that was used for determining the contribution, of the factors resulted from EFA, to total project complexity are presented.

5. Research results

5.1. Introduction

This chapter presents in detail the research results of the 1st and 2nd survey and the subsequent analysis that was performed. The purpose of the 1st survey and subsequent analysis was to identify the contribution of each one of the 135 complexity factors that were identified through literature, in total project complexity and to reduce the number of factors by determining the structured relationships between them. The 2nd survey aimed to determine the relative contribution of each one of the 35 complexity factors, which had resulted from the 1st survey, to total project complexity by assigning weights to them.

5.2. Results of 1st survey and data analysis

The survey was distributed in the middle of October 2015 and four and half months after the first messaging, in the middle of March 2016, closed with 102 valid responses being received.

Out of 102 responders, 89.2% were men and 11.8% were women. As far as their educational level is concerned, 41.2% had a PhD, 36.3% had a MSc and 22.5 were college graduates. Concerning their working background, 55.9% was mainly from the domain of industry, 20.6% was mainly from the academic domain and 23.5% had almost equal experience both in the academic and industry domain. They were also asked to define if their experience came from the private or public sector and 58.9% of them were from private sector, 20.6% of them were from the public sector and the rest 20.5% had almost equal background from both the private and the public sector. Lastly 62.9% of the responders were involved in projects with a budget below 300.000€, 19.1% in projects with a budget between 300.000€ and 1.000.000€ and 18% in projects with a budget higher than 1.000.000€.

The reliability of the questionnaire used, was verified with the use of Cronbach's a (Cronbach, 1951) as it was described in section 4.5.2.7. The results indicated that the scale which was used was reliable as the calculated Cronbach's α was in all cases well above the 0.8 as it seen in Table 17.

Table 17 Questionnaires reliability analysis results

Category ID	Complexity Areas	Cronbach's α
CA1	Time management	0,832
CA2	Cost management	0,814
CA3	Quality management	0,845
CA4	Communication management	0,820
CA5	Human Resources management	0,871
CA6	Procurement management	0,897
CA7	Risk management	0,847
CA8	Scope management	0,854
CA9	Integration management	0,880
CA10	Stakeholders management	0,850
CA11	Technical management	0,897

The next step was the implementation of EFA having as objective to reduce the number of identified complexity factors to a more manageable size and possibly to uncover the underlying relationships among the complexity factors. The adequacy of the collected data was examined before applying EFA method. A number of criteria and suggestions were examined as described them to section 4.5.2.8. Therefore, three methods were examined, the Subject To Variables (STV) ratio, the average communalities values and the Kaiser-Meyer-Olkin (KMO) measure (Kaiser, 1970).

The sample size of this research was 102, which in relation to the number of factors included in each complexity area resulted to a STV ratio with a minimum value of 5.7 and a maximum value of 14.6, depending on the subject area examined, as presented in Table 18. Furthermore, in line with the McCallum et al. (1999) guidelines, the calculated communalities indicated that the data sample size was also adequate.

The KMO measure was calculated both for variables and individual variables. The calculated KMO values for variables indicated the adequacy of the sample size as the results fulfil the criteria described in section 4.5.2.8. The results of the three tests used to verify the sampling adequacy are presented in Table 18.

Table 18 Sample size adequacy test results

Category ID	Complexity Areas	STV ratio	Average communalities value	KMO value
CA1	Time management	6.8	0.588	0.780
CA2	Cost management	9.3	0.517	0.811
CA3	Quality management	9.3	0.549	0.779
CA4	Communication management	8.5	0.517	0.763
CA5	Human Resources management	7.3	0.573	0.819
CA6	Procurement management	7.8	0.554	0.851
CA7	Risk management	12.8	0.531	0.858
CA8	Scope management	7.8	0.554	0.809
CA9	Integration management	7.3	0.524	0.828
CA10	Stakeholders management	14.6	0.606	0.812
CA11	Technical management	6	0.602	0.836

The KMO measures for the individual variables are presented in the diagonal elements of the anti-image correlation matrix (Field, 2009) and also indicate the sampling adequacy. They are presented in detail in the next sections in which the analysis results are discussed for each subject area. Based on these findings, there should be no doubt about the adequacy of the sample size and its appropriateness to apply EFA on it.

As a next step, the factorability of the data was examined. According to the methodology described in section 4.5.2.9, the determinant of the correlation matrix for each area was examined and the Bartlett's Test of Spherisity (Snedecor and Cochran, 1989) was calculated. The results indicated that the determinant was higher than 0.00001 in all cases, as seen in Table 19.

Table 19 Data factorability test results

Category ID	Complexity Areas	Determinant
CA1	Time management	0.002
CA2	Cost management	0.036
CA3	Quality management	0.012
CA4	Communication management	0.008
CA5	Human Resources management	0.001
CA6	Procurement management	0.002
CA7	Risk management	0.047

Category ID	Complexity Areas	Determinant
CA8	Scope management	0.004
CA9	Integration management	0.001
CA10	Stakeholders management	0.038
CA11	Technical management	0.000046

In addition, the significance of the Bartlett's test was lower than 0.001 in all cases as presented in the following sections. From the above, it was concluded that EFA was applicable to the collected data.

Before proceeding with factor extraction, the table labelled communalities it was examined which describes how much of the variance each variable explains before and after extraction. Low values, below for example 0.3 or 0.4, usually indicate that the variable does not fit well with the other variables and the elimination of these variables before proceeding should be considered (Field, 2009; Pallant, 2011). However, as EFA is an exploratory tool, the above guidance is not mandatory. What should be examined is how this variable is loaded on the factor matrix. In this research, it was decided to eliminate all variables with communalities below 0.3. According to this criterion, one variable from the cost management area had to be deleted as well as one variable from the scope management area as they had communality values below 0.3 and they did not have adequate loadings with any factor in factor matrix. The accuracy of this decision was also supported by the fact that these variables had loadings lower than 0.4 on all factors in their corresponding rotated factor matrix. After deleting, the analysis was performed again from the beginning without them.

In order to determine the number of factors that should be retained after extraction, the eigenvalue of each factor was examined. A large eigenvalue implies that the specific factor represents a meaningful factor that should be retained. However, as the Kaiser requirements were not fully fulfilled, additionally we examined the scree plot. When differences were observed in the suggested results of these two criteria, then the Costello and Osborne approach was followed as it is described, in detail, in section 4.5.2.11. The scree plot for each area is presented in Appendix B. In Table 20, the number of factors that should be extracted according to the different approaches are presented.

Table 20 Proposed number of factors should extracted

Complexity Area	Scree test	Kaiser criterion
Time management	5	5
Cost management	3	3
Quality management	3	2
Communication management	4	3
Human Resources management	4	4
Procurement management	3	3
Risk management	2	2
Scope management	3	3
Integration management	3	3
Stakeholders management	2	2
Technical management	4	4

In most cases, there was an agreement between both criteria, about the number of factors that should be extracted. In two cases, in quality and communication complexity areas, there was a conflict between these two criteria. In these cases, the Costello and Osborn approach was followed as presented in section 5.2.3 and 5.2.4 accordingly.

The next sections presents the results of EFA per complexity area are.

5.2.1. Time management complexity area

Principal axis factoring with orthogonal (Varimax) rotation was applied over the 15 variables of this area. The Kaiser-Meyer-Olkin measure was calculated to verify the adequacy of the sample. The KMO test was conducted both on all variables and individual variables and the results indicated a KMO value equal to 0.780 for all variables and a KMO value greater than 0.56 for all individual variables. The approximate of Chi-square was 597.976 with 105 degrees of freedom, which is significant at a 0.001 level of significance as $p=0.000 < 0.001$, meaning that the data were sufficient for EFA.

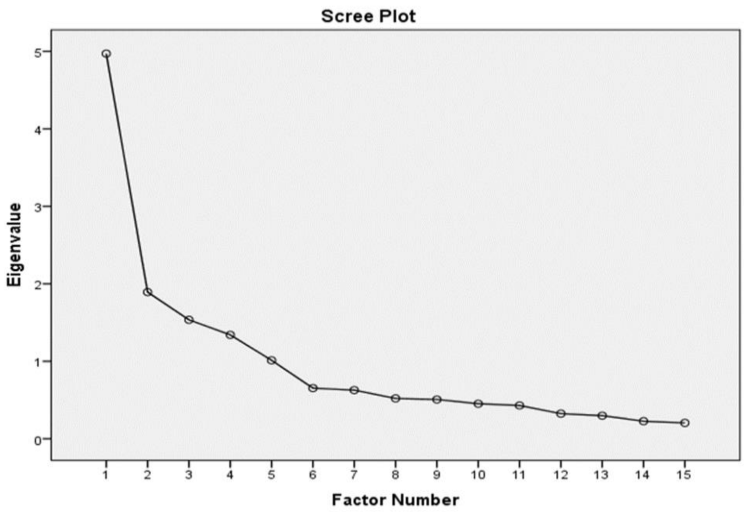

Figure 20 Scree plot - Time management complexity area

Table 21 Total variance explained-Time management complexity area

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,971	33,137	33,137	4,555	30,368	30,368	2,328	15,518	15,518
2	1,893	12,617	45,754	1,543	10,285	40,652	2,208	14,723	30,241
3	1,536	10,237	55,991	1,210	8,066	48,719	1,735	11,567	41,808
4	1,341	8,941	64,932	,942	6,282	55,001	1,479	9,859	51,667
5	1,013	6,750	71,682	,568	3,785	58,786	1,068	7,119	58,786
6	,654	4,358	76,040						
7	,628	4,189	80,229						
8	,521	3,474	83,703						
9	,507	3,382	87,085						
10	,452	3,016	90,101						
11	,430	2,865	92,966						
12	,325	2,164	95,129						
13	,299	1,991	97,121						
14	,227	1,514	98,634						
15	,205	1,366	100,000						

Extraction Method: Principal Axis Factoring.

According to the scree plot the number of factors which should have been extracted was 5. The Kaiser criterion also indicated that 5 factors had eigenvalues greater than 1 which in combination explained 58.78% of the variance (see Figure 20 and Table 21). As a result, there was an agreement between the two criteria about the number of factors that should be extracted and retained. The fact that the residual matrix had only 6% of values greater than 0.05 which is less than 50% was an encouraging indication for the fitness of the model (Field, 2009). The “Rotated factor matrix” shows the factor loadings after rotation (see Appendix B).

Table 22 presents the factors extracted with their clustered variables.

Table 22 EFA results - Time management complexity area

	Extracted factors	Variables
1.	Density of project activities	Number of project activities. Number of critical activities. Variance in project activities duration. Large number of dependences between activities.
2.	Project activities resource constraints	Number of activities with overlapping resource requirements (shared activities). Number of activities that require high variety of resources types. Low availability of project resources. Number of activities that require highly specialized resources types.
3.	Density of project schedule	Number of project activities executed in parallel. Number of intermediate deliverables should be delivered. High project deliverable density (ratio, number of deliverables / project duration).
	Protracted project /activities duration	Number of long project activities. Long project duration.
4.	Organization's time management capabilities	Insufficient time management experience within project time management team. Lack/shortage of tools for planning and monitoring project schedule.

5.2.2. Cost management area

Principal axis factoring with orthogonal (Varimax) rotation was applied over 10 of the 11 variables of this area as the variable named "Project budget cuts attributed to external facts" had been excluded due to low communality. The Kaiser-Meyer-Olkin measure was calculated to verify the adequacy of the sample. The KMO value for all variables was equal to 0.811 and for individual elements the KMO value was greater than 0.65. The approximate of Chi-square was 321.079 with 45 degrees of freedom, which is significant at a 0.001 level of significance as $p=0.000 < 0.001$, meaning that the data were sufficient for EFA.

According to the scree plot the number of factors which should have been extracted was 3. Kaiser criterion also indicated that 3 factors had eigenvalues greater than 1 and in combination explained 51.71% of the variance (see Figure 21 and Table 23).

Table 23 Total variance explained - Cost management complexity area

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,911	39,114	39,114	3,465	34,646	34,646	2,394	23,938	23,938
2	1,719	17,188	56,302	1,266	12,658	47,304	1,924	19,236	43,173
3	1,005	10,052	66,355	,578	5,781	53,084	,991	9,911	53,084
4	,747	7,471	73,825						
5	,617	6,166	79,991						
6	,497	4,969	84,960						
7	,477	4,769	89,730						
8	,411	4,110	93,840						
9	,337	3,371	97,211						
10	,279	2,789	100,000						

Extraction Method: Principal Axis Factoring.

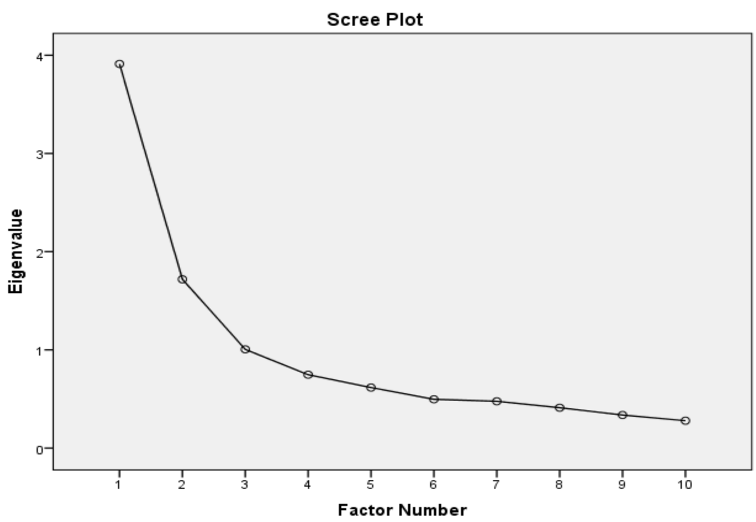

Figure 21 Scree plot - Cost management complexity area

As a result, there was an agreement between the two criteria about the number of factors that should have been extracted and retained. The fact that the residual matrix had only 4% of values greater than 0.05, which is less than 50%, was an encouraging indication for the fitness of the model (Field, 2009).

The "Rotated factor matrix" shows the factor loadings after rotation (see Appendix B).

In Table 24, the extracted factors with their clustered variables are presented.

Table 24 EFA results - Cost management complexity area

	Extracted factors	Variables
1.	Organization's cost management capabilities	Low accuracy of analytical cost estimates due to project external dependencies (e.g. time restrictions, economic condition, political environment etc.). Lack/shortage of specialized cost estimation method and tools (e.g. use of well-known methods, availability of specialized software etc.). Insufficient cost management experience within project management team. Lack/shortage of historical cost estimation data Irregularities in project cash flows (e.g. frequency of delay, diversities in delay duration etc.). Lack/shortage of tools and processes for tracing, monitoring and reporting project cost progress.
2.	Complicated financial structure and processes	Project is financed by large number of stakeholders (Consider if as number of stakeholders that finance project increases, project cost management complexity increases also). Time consuming processes for project payments approvals. Intensive and time consuming project financial reporting.
3.	Long project duration	Long project duration.

5.2.3. Quality management area

Principal axis factoring with orthogonal (Varimax) rotation was applied over the 11 variables of this area. The Kaiser-Meyer-Olkin measure was calculated to verify the adequacy of the sample. The KMO value for all variables was equal to 0.779 and for individual elements the KMO value was greater than 0.63. The approximate of Chi-square was 427.283 with 55 degrees of freedom, which is significant at a 0.001 level of significance as $p=0.000 < 0.001$, meaning that the data were sufficient for EFA.

According to scree plot the number of factors which should have been extracted was 3. The Kaiser criterion indicated that 2 factors had eigenvalues greater than 1 and should have been extracted (see Figure 22 and Table 25).

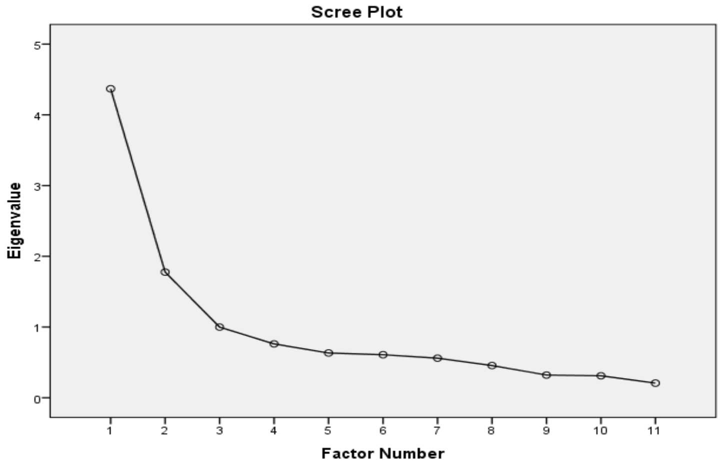

Figure 22 Scree plot – Quality management complexity area

Table 25 Total Variance explained – Quality management complexity area

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,369	39,716	39,716	3,919	35,626	35,626	2,389	21,720	21,720
2	1,777	16,152	55,868	1,362	12,382	48,008	1,837	16,696	38,416
3	,999	9,080	64,948	,757	6,884	54,892	1,812	16,476	54,892
4	,761	6,919	71,866						
5	,633	5,752	77,618						
6	,608	5,532	83,150						
7	,560	5,090	88,240						
8	,455	4,138	92,379						
9	,321	2,918	95,297						
10	,310	2,821	98,118						
11	,207	1,882	100,000						

Extraction Method: Principal Axis Factoring.

However, the third factor had an eigenvalue equal to 0.999 which is marginally less to 1. Therefore, considering that the two conditions that provide high credibility to the Kaiser criterion (as described in a previous section) were partially satisfied, the suggestion of scree test, to extract 3 factors seemed as more accurate. To resolve that conflict, the suggestion by Costello and Osborne (2005) was followed and analysis was performed by extracting either 2 or 3 factors. The results were profoundly better in terms of interpretation, eliminating cross loadings variables and in total variance explained from the extracted factors in solution with 3 extracted factors. Therefore 3 factors were extracted, which in combination explained 54.89% of the variance. The fact that the residual matrix had only 20% of values greater than 0.05, which is less than 50%, was an encouraging indication for the fitness of the model (Field, 2009).

The “Rotated factor matrix” shows the factor loadings after rotation (see Appendix B).

In Table 26, the extracted factors with their clustered variables are displayed.

Table 26 EFA results - Quality management area

	Extracted factors	Variables
1.	Inadequacies in quality management design	Insufficient communication of quality goals, policies and responsibilities within project organization. Lack/shortage of historical quality management data. Not use of well-known quality management procedures. Lack of tools and processes for planning, tracing, monitoring and reporting project quality management result. Process immaturity (consider the progressive development of a wide project management approach, methodology, strategy, and decision-making process).
2.	Organization’s quality management capabilities	Low management commitment to project quality management (e.g. management preference to retain time - cost restrictions versus quality restrictions). Lack of quality culture of project stakeholders (e.g. stakeholders’ training, experience, commitment to quality management). Missing of QA organization department
3.	Rigorous quality control procedures	Quality requirements as stated in project quality plan. Existence of external quality audits. Existence of thorough quality management procedures within customer/contractor organization.

5.2.4. Communication management area

Principal axis factoring with orthogonal (Varimax) rotation was applied over the 12 variables of this area. The Kaiser-Meyer-Olkin measure was calculated to verify the adequacy of the sample. The KMO value for all variables was equal to 0.763 and for individual elements the KMO value was greater than 0.54. The approximate of Chi-square was 464.962 with 66 degrees of freedom, which is significant at a 0.001 level of significance as p=0.000 < 0.001, meaning that the data were sufficient for EFA.

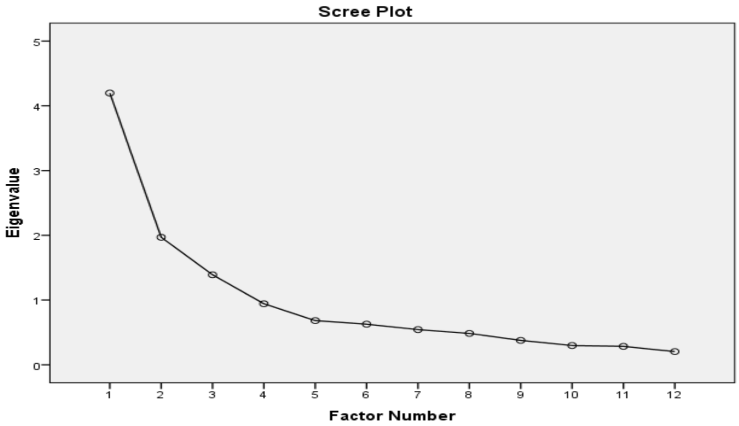

Figure 23 Scree plot – Communication management complexity area

Table 27 Total variance explained - Communication management complexity area

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,196	34,971	34,971	3,746	31,216	31,216	2,649	22,076	22,076
2	1,970	16,416	51,386	1,546	12,883	44,099	2,093	17,445	39,521
3	1,390	11,585	62,971	,909	7,571	51,670	1,458	12,149	51,670
4	,943	7,857	70,828						
5	,682	5,687	76,516						
6	,627	5,226	81,741						
7	,543	4,529	86,270						
8	,485	4,041	90,311						
9	,377	3,141	93,452						
10	,297	2,476	95,928						
11	,285	2,372	98,300						
12	,204	1,700	100,000						

Extraction Method: Principal Axis Factoring.

According to scree plot the number of factors which should have been extracted was 4. The Kaiser criterion indicated that 3 factors had eigenvalues greater than 1 and should have been extracted (see Figure 23 and Table 27). As scree-test often overestimates the number of factors for extraction, while the Kaiser criterion underestimates the number of factors needed to be extracted, it was decided, (following the suggestion of Costello and Osborne), to perform the analysis by extracting either 4 or 3 factors and compare the results. The analysis results, based on extracting 4 factors, wasn't better than the results of extracting 3 factors. The extra factor that was extracted contained only one variable which was clustered very well with the other variables in the solution with 3 extracted factors. Therefore, the 3 factors solution was selected. These factors in combination explained 51.67% of the variance. The fact that the residual matrix had only

24% of values greater than 0.05 which is less than 50% was an encouraging indication for the fitness of the model (Field, 2009).

The "Rotated factor matrix" shows the factor loadings after rotation (see Appendix B).

In Table 28, the extracted factors with their clustered variables are shown.

Table 28 EFA results - Communication management comple4xity area

	Extracted factors	Variables
1.	Organization's communication management capabilities	Insufficient communication management experience within project management team. Shortage in communication media tools (Consider availability of media tools for various communication types e.g. face to face, oral, written etc.). Not clear communication lines (refers to lack of definition of communication hierarchy, structure and preferred type of communication between project organizational levels and teams). Not clear job description and work assignment.
2.	Communication constraints due to project structure and staffing	Geographical distribution of project stakeholders. Diversity in project stakeholders' nationalities. Culture differences between project stakeholders. Number of organizations composing the project team.
3.	Density of project communication	Labour time spend in communication processes by project team members (consider time for preparing, participating and evaluating communication process). Heavy and frequent project reporting. Frequency of formal in person communication / meetings / presentations. Requirements for communication due to high project visibility (consider local communities, authorities, public etc.).

5.2.5. Human Resources management area

Principal axis factoring with orthogonal (Varimax) rotation was applied over the 14 variables of this area. The Kaiser-Meyer-Olkin measure was calculated to verify the adequacy of the sample. The KMO value for all variables was equal to 0.819 and for individual elements the KMO value was greater than 0.74. The approximate of Chi-square was 637.724 with 91 degrees of freedom, which is significant at a 0.001 level of significance as p=0.000 < 0.001, meaning that the data were sufficient for EFA.

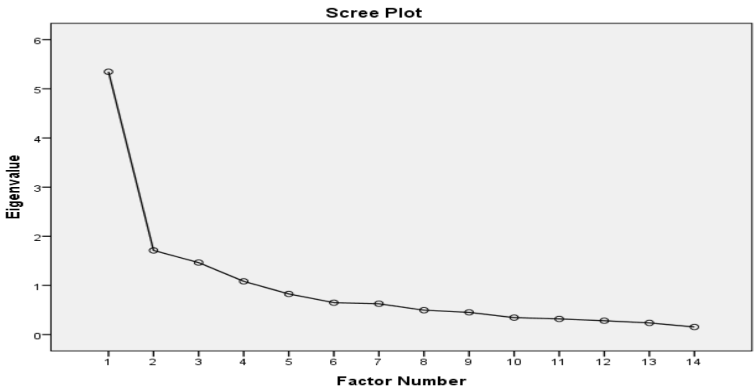

Figure 24 Scree plot - HR management area

Table 29 Total variance explained - HR management complexity area

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,348	38,197	38,197	4,942	35,300	35,300	2,495	17,819	17,819
2	1,712	12,229	50,426	1,302	9,300	44,600	2,150	15,354	33,173
3	1,465	10,462	60,888	1,151	8,218	52,819	2,039	14,568	47,741
4	1,084	7,742	68,630	,625	4,461	57,280	1,335	9,539	57,280
5	,827	5,909	74,539						
6	,650	4,640	79,179						
7	,628	4,484	83,662						
8	,496	3,545	87,207						
9	,452	3,231	90,438						
10	,346	2,470	92,908						
11	,318	2,275	95,182						
12	,282	2,011	97,193						
13	,238	1,698	98,892						
14	,155	1,108	100,000						

Extraction Method: Principal Axis Factoring.

According to scree plot, the number of factors which should have been extracted was 4. The Kaiser criterion also indicated that 4 factors had eigenvalues greater than 1 which in combination explained 57.28% of the variance (see Figure 24 and Table 29). As a result, there was an agreement between these two criteria about the number of factors that should have been extracted and retained. The fact that the residual matrix had only the 15% of values greater than 0.05, which is less than 50%, was an encouraging indication for the fitness of the model (Field, 2009)

The “Rotated factor matrix” shows the factor loadings after rotation (see Appendix B). From this table, we can notice that there were three cross loading variables, variable 3 in factor 1 and 4, variable 8 in factor 1 and 2 and variable 9 in factor 2 and 4 ,which indicate that these three variables should be considered for exclusion. However, all variables had a significant difference in the loadings between the factors and in terms of interpretation, they fitted well on the factor with the higher loadings and with the other clustered variables on that factor and therefore it was decided to keep them.

In Table 30, the extracted factors with their clustered variables are presented.

Table 30 EFA results - HR management complexity area

	Extracted factors	Variables
1.	Project team cohesion	Number of new recruitments required by the project. Turnover of project staff members (Consider frequent changes in project staffing). Project not fully staffed. Existence of employees working part-time in the project. Low level of team cohesion. (Consider geographical distribution, different nationalities, cultures etc.).
2.	Organization's HR management capabilities	Insufficient HR management experience within project management team. Availability of HR department or HR services within hosting organization. Lack of historical HR management data. Lack of tools and processes for planning, monitoring and tracking HR management.
3.	HR management constraints due to team structure	High percentage of outsourced work within the project. Number of project sub-groups within the project. Number of different types of project groups.
4.	Project team size and skill diversity	Size of project team. Number of different technical, behavioural, contextual skills required.

5.2.6. Procurement management area

Principal axis factoring with orthogonal (Varimax) rotation was applied over the 13 variables of this area. The Kaiser-Meyer-Olkin measure was calculated to verify the adequacy of the sample. The KMO value for all variables was equal to 0.851 and for individual elements the KMO value was greater than 0.719. The approximate of Chi-square was 620.661 with 78 degrees of freedom, which is significant at a 0.001 level of significance as p=0.000 < 0.001, meaning that the data were sufficient for EFA.

According to scree plot, the number of factors that should have been extracted was 3. The Kaiser criterion also indicated that 3 factors had eigenvalues greater than 1 and in combination explained 55.36% of the variance (see Figure 25 and Table 31). As a result, there was an agreement between the two criteria about the number of factors that should have been extracted and retained. The fact that the residual matrix had only 16% of values greater than 0.05, which is less than 50%, was an encouraging indication for the fitness of the model (Field, 2009)

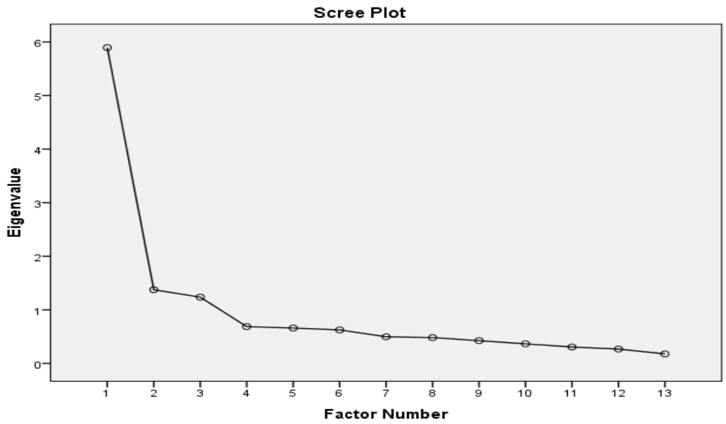

Figure 25 Scree plot – Procurement management complexity area

Table 31 Total variance explained - Procurement management complexity area

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,894	45,340	45,340	5,452	41,940	41,940	2,899	22,300	22,300
2	1,375	10,578	55,919	,916	7,048	48,988	2,482	19,089	41,389
3	1,237	9,513	65,432	,828	6,372	55,360	1,816	13,971	55,360
4	,687	5,287	70,719						
5	,660	5,078	75,796						
6	,626	4,813	80,609						
7	,497	3,824	84,433						
8	,482	3,709	88,142						
9	,424	3,265	91,407						
10	,365	2,811	94,218						
11	,306	2,358	96,575						
12	,268	2,062	98,638						
13	,177	1,362	100,000						

Extraction Method: Principal Axis Factoring.

The "Rotated factor matrix" shows the factor loadings after rotation (see Appendix B).

In Table 32, the extracted factors with their clustered variables are presented.

Table 32 EFA results - Procurement management complexity area

	Extracted factors	Variables
1.	Density of procurement process	Number/variety of supplies. Number/variety of suppliers. Percentage of new suppliers/subcontractors (e.g. first time selected). Variety of procurement contract types. Number of contracts or sub contracts must be managed simultaneously.
2.	Organization's procurement management capabilities	Not clear or not existing definition of procurement policies and procedures. Lack of automation within the supply chain. Lack of historical procurement management data. Lack/shortage of tools for planning and monitoring and tracking procurement processes. Insufficient procurement management experience within project management team.
3.	External barriers in project procurement process	Procurement restriction imposed by external (legislation, regulation) and internal (preferred suppliers, compatible technology, similar culture) project factors. Unavailability/scarcity of supplies and/or services. Unknown supplier's quality.

5.2.7. Risk management area

Principal axis factoring with orthogonal (Varimax) rotation was applied over the 8 variables of this area. The Kaiser-Meyer-Olkin measure was calculated to verify the adequacy of the sample. The KMO value for all variables was equal to 0.858 and for individual elements the KMO value was greater than 0.74. The approximate of Chi-square was 297.375 with 28 degrees of freedom, which is significant at a 0.001 level of significance as $p=0.000 < 0.001$, meaning that data were sufficient for EFA.

According to scree plot the number of factors which should have been extracted was 2. The Kaiser criterion also indicated that 2 factors had eigenvalues greater than 1 and in combination explained 53.06% of the variance (see Figure 26 and Table 33). As a result, there was an agreement between the two criteria about the number of factors that should have been extracted and retained. The fact that the residual matrix had only 10% of values greater than 0.05, which is less than 50%, was an encouraging indication for the fitness of the model (Field, 2009).

Table 33 Total variance explained – Risk management complexity area

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,960	49,495	49,495	3,492	43,647	43,647	2,471	30,882	30,882
2	1,183	14,783	64,277	,754	9,422	53,069	1,775	22,186	53,069
3	,615	7,689	71,966						
4	,563	7,039	79,005						
5	,510	6,380	85,385						
6	,475	5,935	91,320						
7	,369	4,617	95,937						
8	,325	4,063	100,000						

Extraction Method: Principal Axis Factoring.

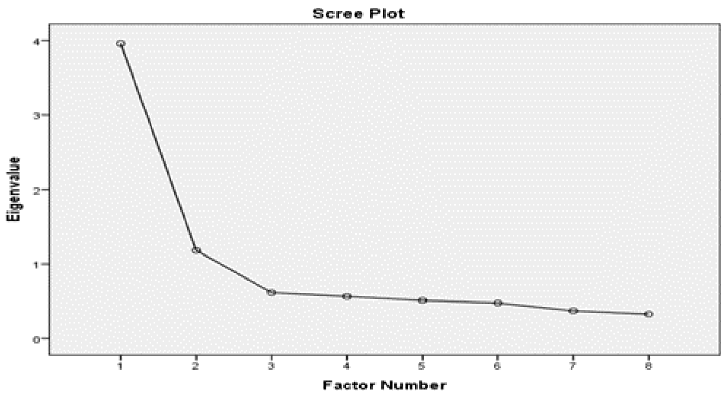

Figure 26 Scree plot - Risk management complexity area

The “Rotated factor matrix” shows the factor loadings after rotation (see Appendix B). From this table we can notice that there is one cross loading variable, the variable 1 in the factor 1 and 2, which is a factor that indicates that this variable should be considered for exclusion. However, the variable has a significant difference in the loadings between the two factors and in terms of interpretation, it fits well on the factor with the higher loadings and with the other clustered variables on that factor and because of that, it was decided to keep it.

In Table 34, the extracted factors with their clustered variables are shown.

Table 34 EFA results - Risk management complexity area

	Extracted factors	Variables
1.	Organization’s risk management capabilities	Lack/shortage of processes and tools for analysing, accessing, quantifying risks and implementing risk responses. Lack/shortage of risk historical management data.

	Extracted factors	Variables
		Insufficient risk management experience within project management team. Lack/shortage of tools for project planning, monitoring and control.
2.	Project risk density	Not clear (detailed) definition of project risk management policy and response strategy. Number of high risk areas /major risks. Lack of flexibility of project management plan for implementing risk responses (e.g. Due to contractual restrictions). Existence of risk responses with major impact to project.

5.2.8. Scope management area

Principal axis factoring with orthogonal (Varimax)) rotation was applied over 12 of the 13 variables of this area (variable named “project phaced delivery is based on requirements prioritisation” had been excluded due to low communality as described in a previous section). The Kaiser-Meyer-Olkin measure was calculated to verify the adequacy of the sample. The KMO value for all variables was equal to 0.809 and for the individual elements the KMO value was greater than 0.61. The approximate of Chi-square was 520.855 with 66 degrees of freedom, which is significant at a 0.001 level of significance as p=0.000 < 0.001, meaning that data were sufficient for EFA.

According to scree plot the number of factors which should have been extracted was 3. The Kaiser criterion also indicated that 3 factors had eigenvalues greater than 1 and in combination explained 55.38% of the variance (see Figure 27 and Table 35). As a result, there was an agreement between the two criteria about the number of factors that should have been extracted and retained. The fact that the residual matrix had only the 16% of values greater than 0.05, which is less than 50%, was an encouraging indication for the fitness of the model (Field, 2009).

The “Rotated factor matrix” shows the factor loadings after rotation (see Appendix B).

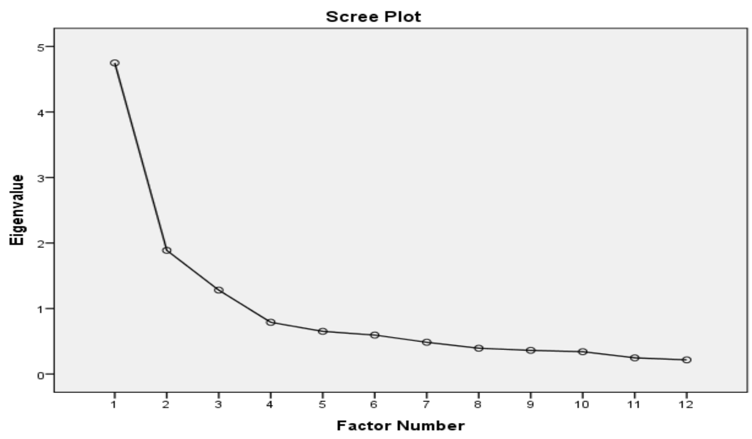

Figure 27 Scree plot – Scope management complexity area

Table 35 Total variance explained - Scope management complexity area

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,749	39,573	39,573	4,310	35,919	35,919	3,452	28,771	28,771
2	1,888	15,733	55,306	1,505	12,539	48,458	1,803	15,025	43,796
3	1,281	10,675	65,980	,830	6,919	55,377	1,390	11,581	55,377
4	,789	6,578	72,558						
5	,652	5,432	77,990						
6	,595	4,957	82,947						
7	,485	4,044	86,991						
8	,394	3,286	90,277						
9	,362	3,015	93,291						
10	,341	2,844	96,136						
11	,247	2,061	98,197						
12	,216	1,803	100,000						

Extraction Method: Principal Axis Factoring.

In Table 36, the extracted factors with their clustered variables are presented.

Table 36 EFA results - Scope management complexity area

	Extracted factors	**Variables**
1.	Density of project requirements	Number of sources for eliciting requirements. Project size. Number of requirements. Percentage of requirements interdependencies. Requirements dependencies from external factors (e.g. Technological changes, economic changes, dependencies from law and regulations, organizational changes etc.). Number of interfaces with other systems. Number of non-functional requirements.
2.	Organization's scope management capabilities	Insufficient scope management experience within project management team. Lack/shortage of specialized tools and processes in defining requirements.

	Extracted factors	Variables
		Lack of historical scope management data.
3.	Quality of requirements	Requirements characteristics causing uncertainty (e.g. requirements volatility, ambiguity, immaturity, conflicts etc.). Low quality of product/service requirements specifications (e.g. requirements ambiguity, inconsistency, traceability etc.).

5.2.9. Integration management area

Principal axis factoring with orthogonal (Varimax) rotation was applied over the 14 variables of this area. The Kaiser-Meyer-Olkin measure was calculated to verify the adequacy of the sample. The KMO value for all variables was equal to 0.828 and for the individual elements the KMO value was greater than 0.64. The approximate of Chi-square was 629.520 with 91 degrees of freedom, which is significant at a 0.001 level of significance as p=0.000 < 0.001, meaning that data were sufficient for EFA.

According to scree plot the number of factors which should have been extracted was 3. The Kaiser criterion also indicated that 3 factors had eigenvalues greater than 1, which in combination explained 52.42% of the variance (see Figures 28 and 37). The fact that the residual matrix had only 26% of values greater than 0.05, which is less than 50%, was an encouraging indication for the fitness of the model (Field, 2009).

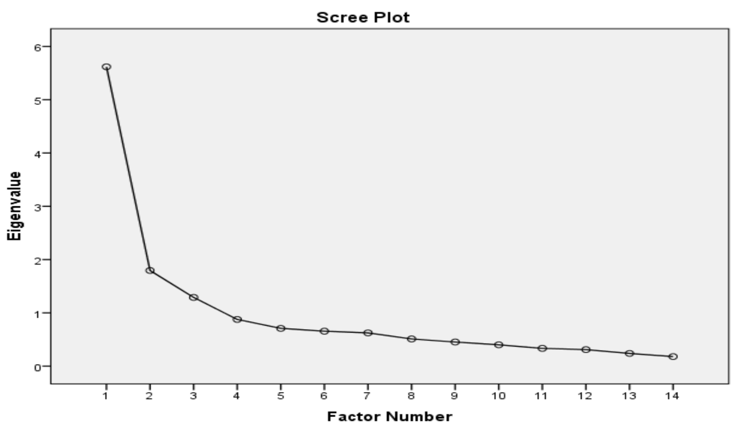

Figure 28 Scree plot – Integration management complexity area

Table 37 Total variance explained – Integration management complexity area

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,619	40,135	40,135	5,154	36,813	36,813	3,291	23,504	23,504
2	1,796	12,825	52,960	1,359	9,705	46,518	2,898	20,702	44,206
3	1,290	9,216	62,177	,827	5,908	52,426	1,151	8,220	52,426
4	,877	6,266	68,442						
5	,709	5,066	73,509						
6	,657	4,689	78,198						
7	,625	4,464	82,662						
8	,511	3,648	86,310						
9	,453	3,235	89,545						
10	,400	2,860	92,405						
11	,334	2,388	94,793						
12	,310	2,215	97,007						
13	,239	1,710	98,717						
14	,180	1,283	100,000						

Extraction Method: Principal Axis Factoring.

The "Rotated factor matrix" shows the factor loadings after rotation (see Appendix B).

In Table 38, the factors extracted with their clustered variables are displayed.

Table 38 EFA results - Integration management complexity area

	Extracted factors	Variables
1.	Integration constraints due project characteristics	Project technical /business innovative. System architecture complexity (e.g. Technology, functional, data, interface complexity etc.). Volatility in project requirements. Insufficient integration management experience within project management team (e.g. change management). Uncertainty of project product development due to external changes. Diversity and conflicts of interests of project stakeholders. New or unproven technology being used.
2.	Organization's integration management capabilities	Not fully defined project scope and requirements. Lack/shortage of historical Integration management data. Lack/shortage of tools and processes for supporting change management (e.g. configuration tools). Lack of change management processes. Lack shortage of tools for monitoring and measuring performance of various project stages.
3.	Density of deliverables	Number of intermediate deliverables. Control of deliverables (e.g. lifecycle of acceptance).

5.2.10. Stakeholders management area

Principal axis factoring with orthogonal (Varimax)) rotation was applied over the 7 variables of this area. The Kaiser-Meyer-Olkin measure was calculated to verify the adequacy of the sample. The KMO value for all variables was equal to 0.812 and for individual elements the KMO value was greater than 0.73. The approximate of Chi-square was 320.485 with 21 degrees of freedom, which is significant at a 0.001 level of significance as p=0.000 < 0.001, meaning that data were sufficient for EFA.

According to scree plot the number of factors which should have been extracted was 2. The Kaiser criterion also indicated that 2 factors had eigenvalues greater than 1 and in combination explained 60.61% of the variance (see Figure 29 and Table 39). As a result, there was an agreement between the two criteria about the number of factors that should have been extracted and retained. The fact that the residual matrix had only 19% of values greater than 0.05, which is less than 50%, was an encouraging indication for the fitness of the model (Field, 2009)

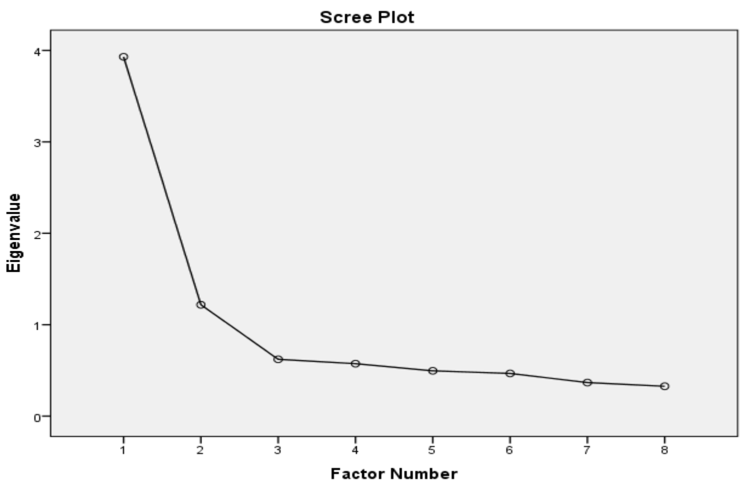

Figure 29 Scree plot - Stakeholders management complexity area

The “Rotated factor matrix” shows the factor loadings after rotation (see Appendix B).

Table 39 Total variance explained - Stakeholders management complexity area

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,931	49,133	49,133	3,464	43,296	43,296	2,325	29,062	29,062
2	1,218	15,228	64,361	,774	9,677	52,973	1,913	23,911	52,973
3	,621	7,766	72,127						
4	,574	7,172	79,299						
5	,495	6,190	85,489						
6	,467	5,835	91,325						
7	,367	4,589	95,913						
8	,327	4,087	100,000						

Extraction Method: Principal Axis Factoring.

In Table 40, the factors extracted with their clustered variables are presented.

Table 40 EFA results - Stakeholders management area

	Extracted factors	Variables
1.	Density of stakeholders management	Number of stakeholders. Number of different stakeholders' categories. Existence of stakeholders with different/conflicting interests. Existence of stakeholders with negative attitude about the project. Existence of communication barriers between groups of stakeholders.
2.	Organization's stakeholders management capabilities	Lack of structured methodology and tools in stakeholder management (identification, prioritization). Lack of specific strategy to enhance stakeholders' engagement to project.

5.2.11. Technical factors

Principal axis factoring with orthogonal (Varimax) rotation was applied over the 17 variables of this area. The Kaiser-Meyer-Olkin measure was calculated to verify the adequacy of the sample. The KMO value for all variables was equal to 0.836 and for individual elements the KMO value was greater than 0.68. The approximate of Chi-square was 943.290 with 136 degrees of freedom, which is significant at a 0.001 level of significance as p=0.000 < 0.001, meaning that data were sufficient for EFA.

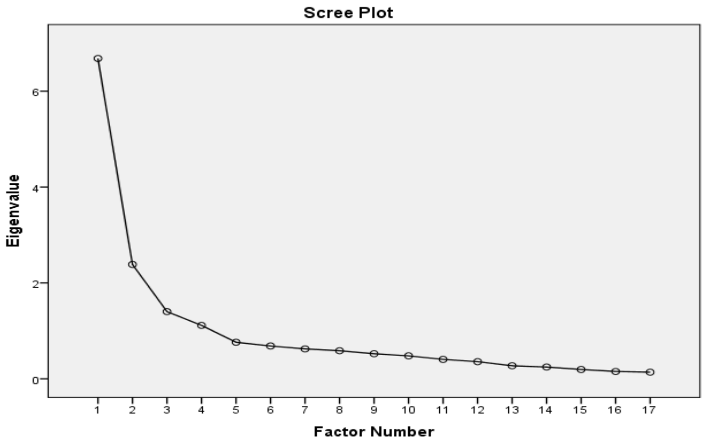

Figure 30 Scree plot - Software development Technical factors complexity area

Table 41 Total variance explained - Software development Technical factors complexity area

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6,682	39,306	39,306	6,283	36,956	36,956	3,709	21,815	21,815
2	2,385	14,028	53,334	2,044	12,023	48,979	3,116	18,330	40,145
3	1,401	8,243	61,577	1,120	6,587	55,565	2,014	11,846	51,991
4	1,114	6,551	68,128	,795	4,677	60,242	1,403	8,251	60,242
5	,763	4,486	72,614						
6	,684	4,025	76,639						
7	,623	3,666	80,305						
8	,584	3,438	83,743						
9	,523	3,075	86,817						
10	,479	2,816	89,633						
11	,405	2,380	92,013						
12	,357	2,097	94,111						
13	,272	1,602	95,712						
14	,245	1,443	97,155						
15	,194	1,141	98,296						
16	,153	,898	99,194						
17	,137	,806	100,000						

Extraction Method: Principal Axis Factoring.

According to scree plot the number of factors which should have been extracted was 4. The Kaiser criterion also indicated that 4 factors had eigenvalues greater than 1 and in combination explained 60.24% of the variance (see Figures 30 and Table 41). As a result, there was an agreement between the two criteria about the number of factors that should have been extracted and retained. The fact that the residual matrix had only 15% of values greater than 0.05, which is less than 50%, was an encouraging indication for the fitness of the model (Field, 2009)

The “Rotated factor matrix” shows the factor loadings after rotation (see Appendix B).

In Table 42, the extracted factors with their clustered variables are presented.

Table 42 EFA results - Software development Technical factors complexity area

	Extracted factors	Variables
1.	Organization's technological capabilities	Architecture risk resolution (How are the risks mitigated by architecture). Lack / not use of software tools that aid the development. Programming language level/generation. Not use of well-known and modern development models (software engineering methods). Low level technical expertise of development team. Low level domain/application knowledge of development team.
2.	Product development constraints	Developed for reusability (Consider to what extend the components should be reusable). Low development flexibility (How strong are the constraints of the system e.g. cost, time, quality). Platform volatility, software portability (Time span between major changes). Completeness of design (The amount of design is completed when starting coding). Hardware concurrent development. Product functional complexity.
3.	Product quality requirements	Required high software reliability. Number of non-functional requirements. Number of security requirements / constrains.
4.	Software size	Size of application database. Software (code) size.

5.3. Results of 2nd survey and data analysis

The identification of structured relationships between the complexity factors of the initial list of 135 complexity factors (variables) in the previous stage allowed their reduction to a final list of 35 complexity factors. The next step was the determination of their relative importance in relation to total project complexity. This was achieved by assigning weights to each complexity factor by conducting a survey and applying the AHP multi-criteria decision method.

The first step of AHP methodology was to create the problem hierarchy starting from the top with the goal or the decision, defining next the criteria based on which the main goal was composed of, and finally defining the set of alternatives that constituted the lower level. The designed hierarchy can be seen in Figure 31.

In this research, only the lower level of hierarch was quantified using expert judgement. The above criteria were assumed to have equal weights. The weighting of these criteria can be included in later model modifications.

As a next step, a questionnaire was formed according to the criteria discussed in section 4.5.4.2. The survey was carried out during September and October 2016, through personal interviews with the responders. At the beginning, a brief description of the scope and the aims of the survey was given followed by a presentation of the alternatives. Then, experts were asked to provide their answers.

The answers were evaluated for their consistency and the majority of them had an inconsistency level below 0.1. In few cases, where the inconsistency index was above that threshold, it was asked from the responders to review and refine their judgements, in order to reduce the inconsistency in their responses.

In Figure 32, the results of AHP analysis are presented giving the weight of each complexity factor with respect to its parent criterion.

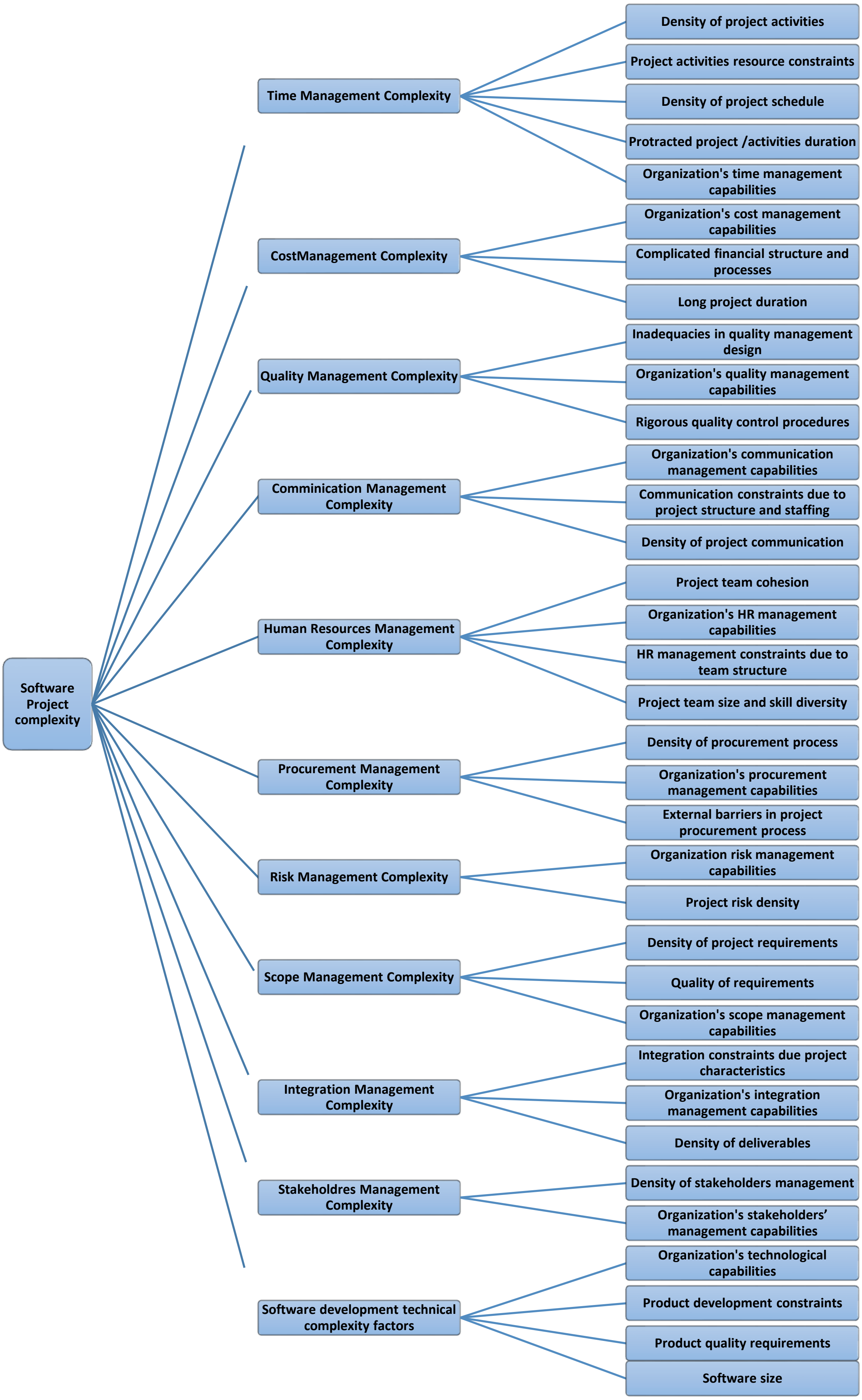

Figure 31 AHP hierarchy of the proposed model

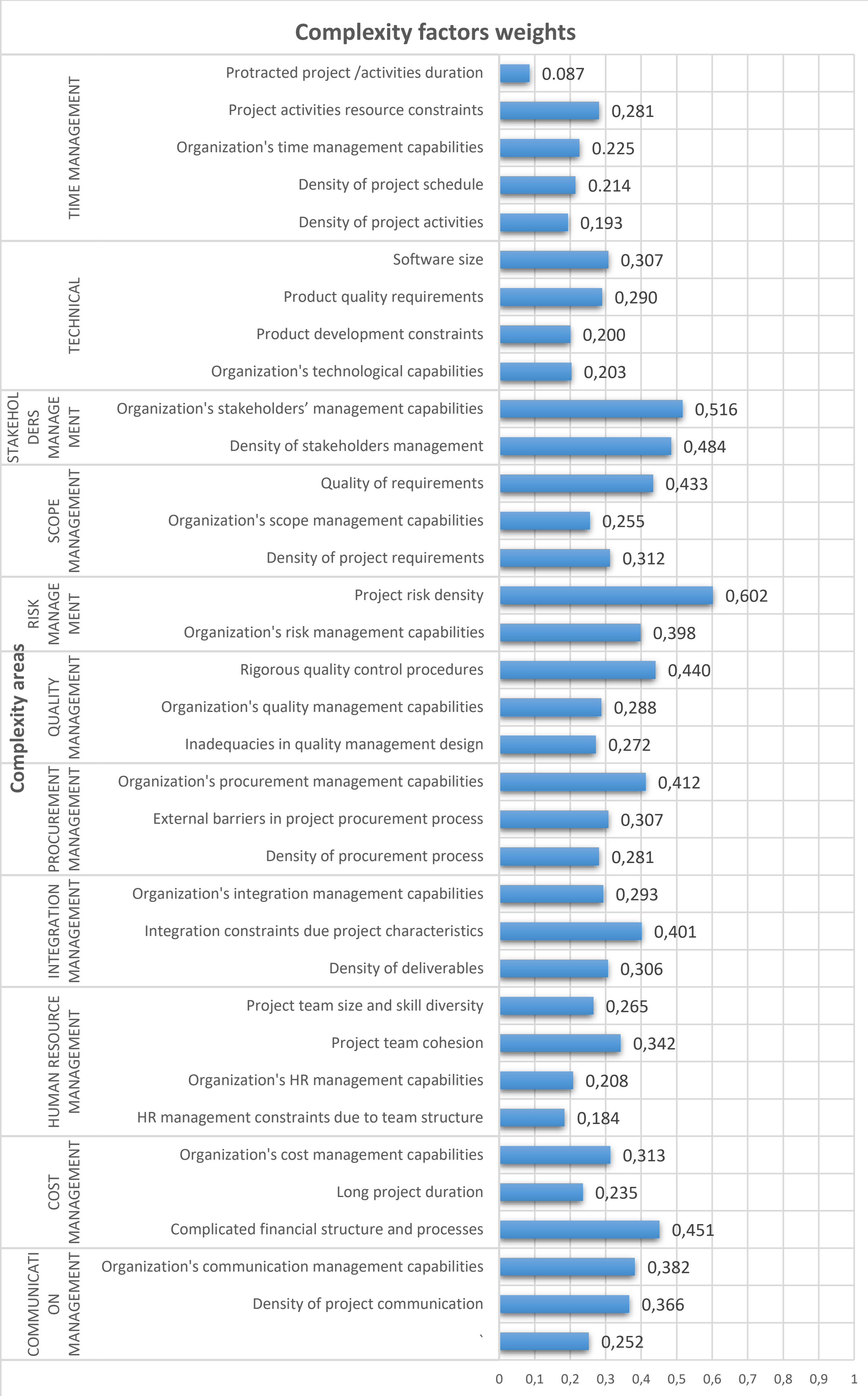

Figure 32 AHP results - Complexity factors weights with respect to their parent criterion

5.4. Summary

In this chapter, the surveys conducted during this research and the results of the statistical analysis were presented. These results guided us in the selection of the set of factors that are affecting software project complexity.

In the next chapter, the model for assessing software project complexity is presented. Subsequently, the validation results from applying the proposed model to five selected software projects are given and discussed.

6. Project management complexity framework

6.1. Introduction

In this chapter, the development of the complexity framework is presented in detail. The framework is composed of a list of complexity factors, a complexity model and a software tool, which implement this model and assist the complexity assessment process in projects. The list of complexity factors being used has been presented in Chapter 5. In this chapter the basic principles, parameters and mathematical formulas of the model and accompanied tool are defined. In continuation, the data and methods in form of tools and techniques that was used to examine model validation, as described in section 4.5.5, are presented in detail. Finally, the results of the validation process are discussed.

6.2. Modelling project complexity

This research proposes a linear scale to evaluate each one of the 35 complexity factors identified. The scale ranges between 0 and 10, where 0 stands for no contribution or no applicability or no significance of this factor to the project management process while 10 stands for extremely high contribution or applicability or significance of this factor to project process. Based on the above, a questionnaire was formed using google forms. It should be noted that the questionnaire included two questions, in reverse format than the rest, the “Project team cohesion” and “Quality of requirements” in order to improve understanding. In these questions, higher values indicated lower contribution or significance of these factors to project complexity. The values of these questions, before used in model calculations, were transformed according the following formula:

Factor_value = 10 – responder_value

As such, project managers can evaluate each complexity factor in a consistent way. An example of a question can be seen in Figure 33, while the whole questionnaire can be seen in Appendix E.

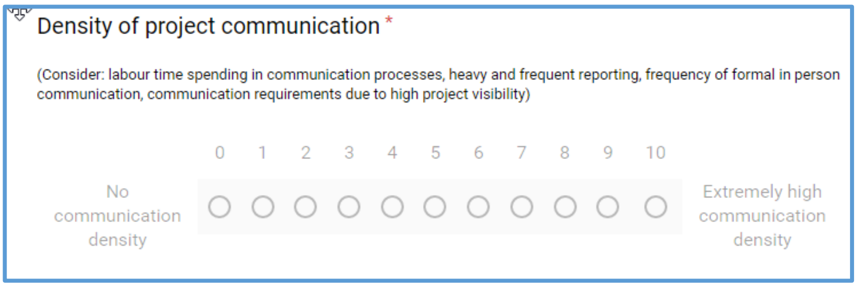

Figure 33 Example of question

The scales used to assess the complexity factors are not fully quantitative, in terms that they are not defined by specific boundaries for each choice. For example, for the factor displayed in the previous picture, there are not set specific boundaries that correspond to the numerical values. Because of that, the scale can be characterised as semi-quantitative, allowing a level of subjectivity on the answers. However, as it has been discussed in Chapter 2, complexity in projects is subjective. Different users with different experience, knowledge level, background and personality may have different perceptions of complexity. Furthermore, different organisations with different characteristics in size, domain knowledge, human resources, experience etc., will evaluate the complexity of a specific project differently because of all these different characteristics. When each one of these organisations need to evaluate the complexity of two or more projects that they are interested in undertaking, it will evaluate each complexity factor proposed in this model using the same subjective criteria. This will allow each organisation to compare the expected complexity of projects in order to make the most suitable selection using the same subjective approach. The fact that different organisations will probably evaluate the complexity of a project differently is not significant for the organisation itself. Thus, the model proposed in this research should grasp this subjectivity, and the structure of the scale used to assess the complexity factors allows that.

It is worth noting that if a project manager considers that these factors are complex and cannot be assessed directly, they can be broken into a set of simpler variables. This is due to CFA method was followed (see section 4.5.2.10), which allows each factor to be evaluated by it's constituent variables. As such, every complexity factor proposed can be considered as composite factor and can be decomposed, if needed, into a set of simpler factors/variables. It is proposed that the scale used to assess the constituent variables/factors to be the same as the one used for the initial composite factor.

Finally, the complexity level of the overall project is assessed in values between 0 and 10 with higher values indicating higher complexity. Specifically, a value of 0 indicates "No project complexity" while a value of 10 indicates "Extremely high project complexity".

Overall project complexity (OPC) is calculated by the use of the following formula:

$$OPC = \sum_{j=1}^{35} CFVj * CFGWj$$

where

$CFGW_j$: is the Complexity Factor Global Weight of j factor, and

CFV_j: is the Complexity Factor Value of j factor.

In case of composite Complexity Factors, the CFV is calculated similarly by the following formula:

$$CFVj = \sum_{i=1}^{n} MtrVi * MtrWi$$

where n is the number of constituent factor/variables called Metrics in this model.

$MtrV_i$: is the value of metric i, and

$MtrW_i$: is the weight of metric i

In every case, the weights of metrics ($MtrW_i$) that correspond to a complexity factor are summarized to 1. The same applies for the weights (CFV_j) of all complexity factors.

6.3. Modelling Project Management Complexity Assessment Tool (PMCAT)

One of the main objectives for the design of the Project Management Complexity Assessment Tool (PMCAT), beyond the automation of complexity assessment process, was to design an overall software service that will allow project managers to experiment, develop their own complexity models if needed, and to apply these models in the evaluated projects. The intention was to use this tool as a collaborative tool for the PM community either for complexity model development and validation or for project complexity assessment.

Five basic concepts/entities were defined and used, namely: Project, Model, Complexity Factor, Metric and Evaluation Scale. The Project entity is used to describe each project under evaluation. Each project is evaluated by the use of one or more models. These models can be custom developed models, for the needs of the specific project, or can be selected by of pool of models available to project management community.

Each Model is composed of several Complexity Factors, factors combined in a unique way for the needs of a specific project or for categories of projects. In every Model, each Complexity Factor is correlated with a specific weight that represents the contribution of this factor to the project complexity. It is not unlikely that the same factor has different weights when it is participating in different models. The calculation of the Complexity Factor's weight can be done with the use of statistical methods and group decision techniques.

Similarly, a Complexity Factor is correlated with a number of Metrics. In a simple case a Complexity Factor corresponds to a Metric. However, it is not uncommon to have composite Complexity Factors that require more than one metric to be measured. Finally, an evaluation scale is used to indicate how Metric is assessed and can be numerical, ordinal, scale, yes/no, etc. Predetermined evaluation scales satisfy the need for consistency and homogeneity in metrics evaluation.

By using this structure, a project can be associated with different models allowing the execution of different scenarios in order to evaluate different project conditions and the impact to the expected project complexity.

Furthermore, an "advanced user" may introduce new complexity factors, metrics and evaluation scales that will allow the PM community to fully parameterize the tool according to their project type and the specific project requirements.

The logical structure of the tool, as described above, is presented in Figure 34, while a sample implementation of PMCAT tool can be seen at http://pmc.teilar.gr/pmctool .

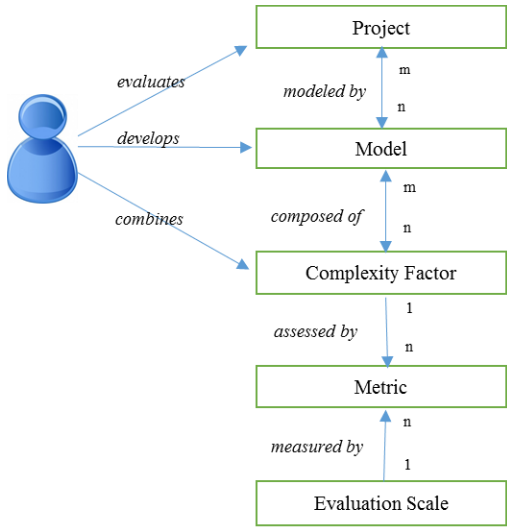

Figure 34 PMCAT model

In this research, a model based on the final 35 identified complexity factors it is proposed. Each complexity factor is considered as a simple factor that can be evaluated with the use of one metric which is the factor itself. However it is clear that the usefulness and practical implication of the proposed tool is more wide and can be used to implement various models and different approaches in complexity assessment that are beyond the scope of this research.

6.4. Model validation

In this section, the evaluation and validation process of the proposed model it is presented by applying the model to a set of software projects. The method of case study was followed as described in section 4.5.6.

6.4.1. Case study design

Five software development projects were selected, projects that were aiming at delivering diverse software products and implemented during the 3 last years in Greece and other EU member states. In general, sources of complexity in these projects, as described in section 2.1.2 are the dependencies from their environment, the conflicting interests of their stakeholders, the requirements instability and ambiguity, the interaction between the different organisations forming the project organisation and the interdependencies between various project processes as presented. Specifically, the profile of these projects is presented in short in the Table 43, while a more detailed description following the table. Furthermore, description of projects characteristics exists in the form of project charts documents in Appendix D.

Table 43 CASE study projects overview

Project Ref	Project scope	Project finance	Project client	Project budget	Project duration
Project 1	MIS for monitoring project financed by EU	Public	Ministry of finance of EU member state	~1.000.000€	11 months
Project 2	GIS for motoring and management the cadastre and city plan of major Greek city	Public (National and EU funds)	Municipality of Greek region	~500.000€	8 months
Project 3	Decision support system (DSS) for effective water management in household and urban level	Public (National and EU funds)	Municipal organizations in Greece an EU member states	~3.350.000€	36 months
Project 4	Decision support system (DSS) for personalised management of HPV related diseases	Public (National and EU funds)	Greek industries and Academic institutions	~790.000€	27 months
Project 5	IS for supporting students and companies to allocate and propose vocational placement and graduate job positions	Public (National and EU funds)	Greek University	~120.000€	16 months

Project 1 aimed at developing a Management Information System (MIS) in order to monitor and manage projects financed with EU funds. The project was financed by EU funds having a total budget of 1.000.000€ and duration of 11 months. It was implemented by a private sector company. The client was the Ministry of Finance of an

EU member state. The project was geographically dispersed as different parts of it was performed at two EU member states. The project manager had 25 years of experience in projects, 18 of them in management of software projects.

The complexity of this project is sourcing firstly, from the requirement for using a specific technology platform. This added significant technical restrictions in software development. Secondly, project was heavily bureaucratic and the project organisation structure was burdened by this. Thirdly, due to the nature of project, the probability for requirements changes caused by legislation changes imposed either from national or from EU requests was high. Finally, the geographical distribution of the project team, added another level of complexity to this project.

Project 2 aimed at developing a Geographic Information System (GIS) for supporting and monitoring the implementation of cadastre and city plans of a major Greek city. The project was financed by the public sector (National and EU funds) with a total budget of 500.000€ and it had duration of 8 months. It was implemented by a private sector industry. The client was the municipality of a Greek region. Due to its nature, the project required a variety of different specialists from the information technology domain. The project manager had 25 years of experience in projects 18 of them in the management of software projects.

The complexity of this project according to its project manager is sourcing from the low cohesion of the project team and the applicable to the project legislation. Specifically, the project team beyond software developers included several other types of specialties such as topographers, urban planners, lawyers and notaries, which not all of them were full time dedicated to project. Their work, for several of them, was different and they had a role complementary to the project. This was something that affected their commitment towards the project. On the other hand, there were too many local regulations that contradicting in many cases the general legislation, resulting in a messy and complicated legislation for cadastre and city plan. Furthermore, this legislation was prone to frequent changes, affecting the requirements specification. Furthermore, the lack of data led to manual data entry, which however it was not a trivial process, as the owner of the data (central government or municipality or other) was not known.

Project 3 aimed at developing a Decision Support System (DSS) to support better water management in households and at urban level. The project was financed by the public sector (National and EU funds) with a total budget of 3.350.000€ and it had duration of 36 months. It was implemented by a consortium of academic institutions, private industries and public organizations which where and the beneficiaries of the project. The project was geographically dispersed in five EU countries and a wide variety of members originating from different domains was involved. The project manager had 14 years of experience in managing projects.

The complexity of project 3 was sourcing mainly from the heterogeneity and the different types of project stakeholders. In addition, the number of different types of specialties within the project team was another factor that negatively affected the cohesion of the team. In a project with the above characteristics conflicts of interests could easily arise between project stakeholders, which in turn could negatively affect the project progress. Another source of complexity, in this project, was the high level of interdependences between the project processes as a delay or failure in one of them could significantly delay or fail other processes and hence to jeopardise the success of entire project. Further, the geographical distribution of the team, the lack of data related to technical aspects of the project, the lack of commitment by some stakeholders and the unstable market conditions influenced the complexity of the project.

Project 4 aimed at developing a Decision Support System (DSS) based on advanced clinical diagnostic protocols for the cost-effective, personalised management of Human Papilloma Virus (HPV) related diseases. The project was financed by the public sector (National and EU funds) with a total budget of 790.000€ and it had duration of 27 months. It was implemented by a consortium of academic institutions and private industries. The project included a variety of members originating from different domains. The project manager had almost 5 years of experience in project management.

The sources of complexity in project 4 were similar with those of project 3 despite the fact that this was a different type of project. Specifically, project 4 had also a significant level of heterogeneity in its stakeholder's team and the project team cohesion was low. Project 4 had a high level of interdependencies between its processes as software development was highly depended from the development of a series of biological or other models that were developed concurrently. These dependencies according to project manager had affected the requirements elicitation process for the software being developed. Other sources of complexity was the possible lack of data, deficiencies in data quality and the lack of commitment from some stakeholders that delayed their involvement to the project..

Project 5 aimed at developing a web-based IS for supporting students to find both vocational placement and graduate job positions, and for companies and institutions to find the appropriate candidates for the vacancies. The project examined was a system developed for a Greek University that was financed by National and EU funds, with a total budget of 120.000€ and it had a duration of 16 months. It was implemented by the university's internal IT development team consisting of faculty members and freelance developers. The project manager had a decade of experience in managing projects.

This project, although initially, does not seem to be complex mainly due to its small size and scope, according to its manager, included a significant level of complexity for the following reasons. Firstly, the development team did not had significant experience in team working. . Secondly, the project was heavily bureaucratic in its financial, procurement and various administrative processes and with many legal constraints. Thirdly, there were cash flows delays. Fourthly, there was a significantly difficulty in eliciting requirements, especially for those requirements that concern non-functional requirements. The two main types of stakeholders involved in this stage, students and employers did not have the necessary experience in expressing the requirements with clarity, accuracy and completeness. The above indicate that the project had a substantial number of dependencies from its environment either internal or external, and significant degree of uncertaintyy that could affect its complexity as described in chapter 2. Therefore and considering that this research is focusing on perceived type of complexity, which implicates that different levels of complexity can be identified by different organisations due to their different capabilities, it was decided to include this project in our case study, in order to examine if the level of complexity perceived from the project manager is verified by the model.

The projects were selected after an interview that was conducted with the project managers. The scope of this interview was to explain the purpose of this research, the method followed in measuring complexity and to gather the necessary project information. Eventually, a list of five projects implementing different type of software systems was chosen, ranging from a web-based IS, to MIS and DSS systems. Three of the five selected projects were done in Greece by Greek companies, one was developed by a Greek company for another EU member state and one was a multinational project involving organizations and industries from five EU member states including Greece. The criteria used for project selection was the availability of project managers to participate to this research, the accessibility and communication with them and the availability of project data. Further, it was taken into consideration the need to have a list of projects with similarities in some of their characteristics, in order to be able to examine the granularity of the proposed complexity model. As such, project 1 and project 2 had the same project manager, but a completely different type of software product was developed and different sources of complexity were identified. Project 3 and project 4 were related with the development of DSS systems with significant differences in their financial, scheduling and regional parameters but with great similarities in the sources of complexity as described earlier. As that, it was a good chance to examine if similar complexity sources can give similar level of complexity in projects in similar type projects with significant different characteristics. Project 2, project 3 and project 4 in their project teams included a number of specialists from different industry domains not necessarily related to software development. Projects budgets varied from tens of thousands of euros to millions of euros. According to budget size, these projects were classified as low to mid-range projects, which in fact form the majority of the European software projects. Also all projects were financed by public sector funds (National and/or EU funds), which represents the typical finance of projects being developed in Greece in recent years because of the economic environment. The duration of the selected project varied from 9 to 36 months, which includes a wide range of projects a being developed. Finally, one project manager had over two decades experience in managing software projects, two project managers had experience close to a decade and only had one a little less than five years' experience. The above characteristics of the selected projects do not limit the adequacy and the validity of the sample but form a set a baseline of common characteristics that will allow the comparative evaluation of the results extracted by the proposed model and the examination of the granularity of the model. It is argued that this approach is more appropriate than having a set of totally different projects that could not provide a basis that would allow the comparative evaluation of model results.

6.4.2. Data collection

This case study was performed in December 2016, using an electronic questionnaire that was distributed to project managers through email. All project managers were initially asked to perform an overall evaluation of the complexity of the project they had managed based on their perception of complexity during the project execution. After that, they were provided with the list of the complexity factors that had been determined in the previous stage of this research and they were asked to assess them. Finally, they were requested to reconsider their initial assessment of the overall project complexity in order to eliminate the probability of neglecting a complexity parameter from their initial assessment. Their answers were collected and the weighted scoring model described in the previous section was applied, in order to calculate project complexity using the proposed tool.

6.4.3. Analysis of results

Before analysing the results, it should be noted that a margin of error of ±15% or 1.5 unit with respect to total complexity scale is proposed for the model. The margin of error defines the accepted difference between the value of complexity level calculated by the model and the value of perceived complexity determined by project managers. The value set was considered acceptable for the following reasons: Firstly, the project manager's evaluation was based on subjective evaluation of perceived complexity that from its very nature it is less accurate. Secondly, project managers were asked to evaluate project complexity using a linear scale with integer values e.g. 1, 2, 3 etc., while model calculation allows the use of real number values in outcome. Third, due to previous reason a margin error of ±5% already exists because of the rounding from real numbers to integer numbers (e.g. all numbers from 4.5 to 5.4 are rounded up to 5, if rounded with no decimals). Forth the model is applied to the initial steps of projects where uncertainties are still high. Therefore, the margin of error suggested for the model considered acceptable if not too strict.

The results of the case study concerning the project complexity calculated by the model and project complexity that was initially determined by the project managers are presented in Table 44.

Table 44 Case study - Results of model validation process

Project name	Project complexity value calculated by the model	Perceived project complexity value determined by the project's managers	Difference between the two complexity values (considering the margin of error)
Project 1	5.78	7	12.2% (or 1.22 units)
Project 2	3.70	6	23.0% (or 2.3 units)
Project 3	5.72	6	2.8% (or 0.28 units)
Project 4	5.68	7	13.2% (or 1.32 units)
Project 5	5.17	6	8.3% (or 0.83 units)

The results of the case study presented in previous table, was encouraging about model validity. In 4 of 5 cases examined, the difference between the level of complexity calculated by the model and the level of perceived complexity experienced by project managers was less than 15% while in one case it was 23%. Specifically project 3 had a difference of only 2.8%, as the values of calculated and perceived complexity was 5.71 and 6 respectively. Project 5 gave the next best value about the fitness of the model with a difference level between two values of 8.3%. Projects 1 and 4 had a difference of 12.2% and 13.2% respectively that was also within the defined interval. On the other hand, in project 2 the difference between the two values was 23%, which was outside the defined interval, although it cannot be considered too big. In order to investigate the causes for this miss, the basic projects characteristics were re-examined as they described in the project chart document. From that, it was identified that among the main risks and constraints of this project was the significant lack of digital data and the variety in legislation that lead to messy legal foundation of the city plan and broke the basic assumption of a stable city plan and solid legislation. The result was that complicated requirements and software design existed, which probably affected the whole project process. In the proposed model, two factors had been identified, aiming to capture these situations. The first is into integration area named "Integration constraints due to project characteristics" and the second in technical aspects of software development area, named "Product development constraints" that can encompass situations like this. The first factor was assessed quite high, while the second factor was assessed very low by the project manager, meaning that probably there was a misunderstanding in the factor semantics or a failure in assessment by the project manager. A higher assessment of this value would improve results, although it would not eliminate the difference between calculated and perceived complexity. This may indicate a problem in factors weighting, that needs to be further examined, but the other results weaken this case. Another reason could be that the density of this problem overshadowed the whole project process and affected the judgement of the project manager. However, the above twenty years of experience of the project manager questions this explanation. Thus, accurate estimates of the real causes cannot be safely extracted from the current case study results and, as such, further examination is needed by applying the model to more projects having similar problems in order to clarify, if the model underestimates these situations or the problem must be identified elsewhere.

Another point that this case study indicates, is the validity of the approach that project complexity is subjective and dependent on the cognitive level of the observer. Project complexity was evaluated at level 6 or 7 in all projects examined, despite their differences. For example, project 3 and project 5 had both been evaluated with complexity level 6 despite their huge differences in duration, budget, number and type of stakeholders, geographical distribution and type of software being developed. This does not mean in general that a relatively small project with strict constraints cannot be more complex that a larger one with more relaxed constraints. However, this is not this case as can be concluded by the study of project charter. The encouraging point was that the model captured this subjective evaluation of complexity by project managers while simultaneously it managed to capture and to indicate the difference in complexity levels between projects as can be seen from the results.

Summarising the above can be concluded that case study results indicate model validity and that the proposed framework achieved initial objectives. It managed to successfully identify project complexity in 4 of the 5 cases. In one case, that there was a difference in complexity level larger than the accepted interval between model calculation and manager evaluation, it cannot be clearly determined if it was due to model failure, or to project managers' inability to apply it or to both. Further investigation on similar projects is needed in order to come up with more detailed and accurate results.

6.5. Summary of research objectives, methodology and findings

The main objective of this research was to develop a complexity management framework to assess the complexity of software projects and in that way providing project managers with a tool that will assist their efforts for handling project complexity and enhance the possibilities for project success. The developed framework approaches project complexity from the perspective of project management, identifying project complexity as a subjective property of projects and proposes several factors that can be used for evaluating project complexity. A practicalmodel was also defined which assesses complexity and a parametric software tool for assisting and automating the assessment process was introduced. Chapter 2 explored the notion of complexity in projects and its special characteristics in software projects. The various approaches in defining characteristics of project complexity during the last two decades was briefly presented and were discussed the various approaches in evaluating and measuring project complexity. Furthermore, the approach of this research in assessing project complexity was presented and discussed. The detailed literature review in Chapter 3 included identification of several factors that affect project complexity sourcing from the project management knowledge areas as they were defined into the PMBOK guide. In addition, the specific factors of software development projects that affect development complexity were presented and discussed. The research methodology and the argumentation on the research decisions taken in this study presented in detail in Chapters 4 and 5. In Chapter 6, the complexity model formation and the implementation of the complexity assessment tool were described. At the end of this chapter, model validity and actuality was examined using a case study. Table 45 presents the research areas that were explored.

Table 45 Areas explored during research

Research focus areas	Chapter examined	Methodology used
Notion of project complexity / software project complexity.	Chapter 2	Literature review.
Complexity assessment approaches.	Chapter 2	Literature review.
Identification of factors contributing to software project complexity under the prism of project management.	Chapter 3	Literature review.

Determination of key project complexity factors and their contribution to total project complexity.	Chapter 4, 5	Two stage analyses: 1. First stage, survey and data analysis based on EFA methodology. 2. Second stage, survey and data analysis based on AHP methodology.
Definition and validation of complexity assessment model and tool.	Chapter 6	Case study.

This research was divided in four basic sequential phases as follows:

1. The first phase aimed at understanding the notion of complexity in projects in general and in software projects particularly and in identifying the current research status in the field.
2. The second phase aimed at identifying the factors that affect software project complexity and sourcing from project management and technical software development aspects.
3. The third phase aimed at identifying the key and/or underlying complexity factors of software projects and in determining the relative contribution of each factor to total project complexity.
4. The fourth phase aimed at defining and designing the complexity assessment model and its validation. It also defined the design of the complexity assessment tool that supplement model.

All phases and their results were interlinked, performed in a sequential basis with the results of one phase leading to the next phase and the conclusions were gradually built. The research objectives, their fulfilment through the study, the research methodology used in order to achieve each objective and the chapter that each objective examined are displayed in Table 46.

Table 46 Research objectives in relation to research structure

Research Objectives	Objective achieved	Research phase achieved	Methodology used	Chapter examined
Conduct a literature review on PM complexity in order to understand the concept of complexity, especially this is related in software projects.	The notion of project complexity and its concept in software projects were identified.	Phase 1	Literature review	Chapter 2
Critically review and compare current approaches, in order to determine their deficiencies and propose a typology of complexity that differentiate this approach.	The current research approaches in defining and evaluating project complexity were identified and their characteristics were discussed	Phase 1	Literature review	Chapter 2
To investigate sources of complexity in the context of project management and technical aspects of software project development process.	Complexity sources and corresponding factors within project management process and technical aspects of software development process were examined and 135 complexity factors identified.	Phase 2	Literature review	Chapter 3
To determine a set of factors, for assessing the	A set of 35-complexity factors with their relative weights and	Phase 3	Successive surveys based on questionnaires,	Chapter 4 and 5

Research Objectives	Objective achieved	Research phase achieved	Methodology used	Chapter examined
complexity of software projects.	corresponding measures were determined.		expert groups and statistical data analysis using factor reduction methods and multi-criteria decision making techniques	
To define an empirical model based on complexity factors tuned to address software project aspects.	A complexity assessment model for assessing software project complexity was defined.	Phase 4	Definition of appropriate mathematical formulas.	Chapter 6
Utilise the developed model to calculate the complexity of selected software projects.	Model utilised by applying it to a set of projects.	Phase 4	Case study.	Chapter 6
To validate the developed model by applying it to a number of software projects and evaluate the results.	Model validated through applying it to set of projects.	Phase 4	Compared the complexity calculated by the model with the overall project perceived complexity by project managers during project execution.	Chapter 6
Defining a software tool that implement the assessment model	Tool design, concepts, entities and functionality were defined.	Phase 4	Elaborating project complexity assessment	Chapter 6

Research Objectives	Objective achieved	Research phase achieved	Methodology used	Chapter examined
in order to automate the process.			requirements and developing corresponding software.	

6.6. Key findings of this research with respect to objectives set

The key characteristics of each research objective that were identified are discussed below.

6.6.1. Notion of project complexity and concepts of software project complexity

The notion of complexity was explored and the differences between the terms complex/complexity and complicated in projects were identified. The term complicated, refers to a project that is difficult, knotty, hard but is well defined, well-structured and can be resolved through following structured steps. The term complex refers to a project that has high dependencies from its environment either internal or external and due to interactions occur between various project elements. Further, it was identified that project complexity can be described either as a property of a system named descriptive complexity or as perceived complexity which depends on the cognitive level of the observer and as that is considered subjective to the observer. The assessing of complexity in software projects is currently based on software characteristics but the need for the use of alternative methods that will based in project management aspects of software development process is increasingly acknowledged. This finding became the initiation point of this research and formed the basis for its future development.

6.6.2. Current approaches in project complexity definition and evaluation

A number of project complexity typologies that were proposed during the last two decades were examined. They approached and defined project complexity from various perspectives. Despite their different approaches, the majority of them were based on sources of complexity stemming from uncertainty in projects and various project organisational and technological aspects. However, this research argues that these approaches are not sufficient since they are not in line with the way projects are managed and executed. Because of that, it was decided to approach project complexity through the perspective of project management and sources of complexity to be investigated within project management aspects. Moreover, this research is based on the assumption that project management is a typical process and as such, empirical approaches such as “Extreme Programming” (XP), SCRUM etc. are not appropriate.

6.6.3. Sources of project complexity

In order to identify the sources of complexity within project management aspects an appropriate project management framework should be selected. The PMBOK framework was selected due to its popularity and because it is process based, which makes it compliant with the assumption followed in this research. The ten project management areas of PMBOK were considered as sources of complexity and they were accompanied with another area concerning the technical aspects of software development. Thus, eleven complexity areas were identified for further examination.

6.6.4. Factors contributing to software project complexity

This was among one of the most important objectives of this research. Having performed an extended literature review in project management aspects and in technical aspects of software development, a number of 135 complexity factors were identified stemming from the eleven complexity areas. These factors formed a pool of complexity factors that cover an extended range of complexity sources in projects, not only in software projects but in general also. Therefore, they can be used as a source in order to build different complexity assessment models.

6.6.5. Determine set of measures for assessing complexity

The number of identified factors was high and that was something that made their practical usage difficult. In similar cases, other researchers used factor reduction methods based on simple statistical methods such as median and by setting arbitrary thresholds kept factors that exceeded threshold. This research followed a different approach in factor reduction. Emphasis was given to the revealing of underlying structures between factors and by that way to achieve factor reduction while at the same time keep as much as possible of the complexity information. Therefore, EFA with CFA was selected as the most appropriate method to achieve that, resulting in determining a list of 35 complexity factors. The next step concerned the weighting of these factors and a multi-criteria decision method was used to implement it. AHP was selected as the most appropriate multi-criteria method. Finally, a set of 35 complexity factors were defined that can be assessed using a linear scale ranging from 0 to 10, with values indicating higher contribution to project complexity.

6.6.6. Define an empirical model for assessing complexity

The proposed model uses empirical data, as it is based on the assessment of complexity factors, by project managers. The assessment depends to some degree on the subjective view of project managers. That is because no absolute borders is defined for each value of the ranging scale and in that way giving the freedom or flexibility for project managers to assess complexity factor according to their cognitive level and organisational background. This even though may result in situations where different organisations evaluating differently the complexity of a project, it does not affect model validity as it reflects each organisations maturity, capability, expertise and knowledge to execute the specific project. In the case of multiple project evaluation by organisations, all projects will be evaluated with the same criteria within each organisation.

The overall project complexity is calculated by adding the product of complexity factor weight and value provided for each one by project manager.

6.6.7. Utilise and validate complexity model

Five projects were selected for utilising the model and examining its validity. Projects selected concerned the development of various types of software types, with different durations and budgets. Similarities can be identified within projects either in their entirety or in groups, such as in financier, in type of software developed, in budget size, in project managers' experience, etc. That allowed the forming of a set of common characteristics for comparative evaluation of model results and examination of model granularity.

6.6.8. Definition of PMCAT tool

A software tool named Project Management Complexity Assessment Tool (PMCAT) was proposed in order to not only automate the assessment process, but to provide a software service that will allow project managers to experiment in complexity assessment by forming their own experimental complexity models and use them to evaluate project complexity. These models may differ in the number and the type of complexity factors and in the evaluation method of these factors, allowing by that way the better adjustment of the complexity assessment process to the specific project and organisational needs.

6.7. Limitations of the study

A number of limitations should be taken into account in this research, as discussed below:

- The initial plan of this research was to engage responders outside Greece, especially from Europe region. However, this was only partially achieved, since in the first survey respondents outside Greece State were only 10% of the total sample and this was mainly originated from UK. In the second survey there were only responders from Greece. Considering the case study, an effort was made to use projects that were international and to a degree. This aim was achieved as two of five projects were geographically dispersed in various EU Member States. The 1st project was implemented in Greece and in another EU Member State. The 3rd project was executed in five EU Member State including Greece. Furthermore, this project was executed from a consortium of Greek and EU Member States companies and organisations while the rest projects were executed by Greek companies and organisations. Therefore, the responses mainly represent the experience and status existing in the Greek software development industry and academia. This may be a reason that restrict the potentials for generalisation and globalisation of the results.

However, it is argued that software development is following methods and practices that are common around the globe and as such, since it is a global business, the probability to have captured only the Greek status is limited.

- Responses in the first survey, although adequate for the selected statistical processing as determined using at least three different criteria, was not to high and may that had an impact to the results.

- The projects that were used in the case study although it was tied to cover a wide area of software development projects in terms of duration, budget, stakeholders and type of software development were not able to cover all variations of software development projects. As that, although the selected project provide a good indication about model validity, further examination may be needed.

- Regardless of the amount of different complexity typologies and models identified in this research by means of literature review, there is always the probability some complexity models are not included in this research. However, due to the extent of the literature on the project complexity and time constraints of the research, it was impossible to have knowledge of all the literature pertaining to project complexity.

- Time was one of the constraints of the research, as it had to be completed within a specific duration due to academic regulations and financial restrictions.

6.8. Summary

In this chapter, initially the model formation was presented. Next, the validation of the model was examined by applying it to five software projects and the results obtained were discussed. Finally, the summary of the findings and the limitations of this research were presented.

In the next chapter, the conclusions drawn from this research, the contribution of the findings of this research to current knowledge and the implications for future research are presented.

7. Conclusions, Implications and Recommendations

7.1. Introduction

This chapter initially presents the conclusions of this research. Next, the findings of this research and their implications to academia and industry are highlighted. Finally, at the end of this chapter, the limitations of this study are discussed and recommendations for future work are made.

7.2. Conclusions

The conclusions of this research are based on analysis of the literature review, data collected and statistical processing which was performed. Key elements in this process were the understanding of complexity sources in software projects from the perspective of project management and technical aspects of software development. During this process a better understanding of project complexity was achieved, inadequacies of current complexity typologies and evaluation approaches were identified and a number of complexity sources affecting project management were identified. Specifically, the conclusion that were drawn for each element are described below.

7.2.1. Project complexity

Based on the literature review the following conclusion were drawn about project complexity.

- The understanding of complexity in projects is cumbersome subject by itself, due to various forms and facets that it has. However, the interacting, structural and dynamic character of complexity is commonly identified in many researches.

- In projects, the uncertainty stemming from various sources, the interaction between various project elements and the various organisational and technological aspects are traditionally identified among the main sources of project complexity.

- Aspects of project management are increasingly identified among the main sources of project complexity and the role of project management in managing complexity is increasingly acknowledged.

- The perception of complexity is greatly subjective as it is influenced by the cognitive level of the observer. This approach becomes extremely important in case where the observer is the one that will be called to deal with it.

7.2.2. Project complexity evaluation

During the literature review, a number of approaches in project complexity definition and evaluation were identified and the main conclusions extracted were the following:

- Most studies are limited to only a conceptual approach to project complexity.

- Very few of them suggest a model to evaluate project complexity, without proposing a specific assessment model.

- Only few of them, beyond the conceptual definition of project complexity, define a specific model to evaluate complexity by assessing it.

- It has not been proposed a model for assessing the management complexity in software development projects.

7.2.3. Sources of project complexity

This research argues that current approaches to project complexity are difficult to have practical implications in projects, as their approach is different to the way projects are managed and executed. The worldwide acknowledgement of PMBOK as the dominant project management framework implies that a project is managed through the management areas such as time, cost, quality, scope etc. Project managers do not try to manage projects through the areas defined in complexity studies such as uncertainty, interdependencies, structural, organisational and technological areas. This research argues that elements of these areas undoubtedly should be taken into consideration but within and to the extent they affect the areas of project management as defined earlier.

Under that prism, an extended literature review was conducted in each PMBOK management area in order to identify the sources of complexity in these areas that affect the complexity of management process, resulting in the identification of an extended list of complexity factors.

As this research is particularly interested in software projects, a list of complexity factors based on technical aspects of software development process was identified through literature. They supplement the list of complexity factors stemming from project management areas, resulting in the definition of eleven project complexity areas.

The first survey helped in getting a better understanding of the contribution and the importance of each factor to project complexity. Responders assessed each factor according to their experience. The subsequent statistical analysis allowed the evaluation and examination of responses validity and revealed the underlying structure and commonalities between identified factors. The result was the determination of a final set of complexity factors, much smaller, more concrete and comprehensive in its structure and understanding. The main conclusions of this process is:

- Three factors were identified that affect almost all complexity areas. First, the "organisation's management capability", which is defined as the capability of a project organisation to perform the various project management and technical tasks of software development efficiently and effectively. Second, the "density of various project processes", which is referred to the number, variance, frequency and interdependencies of project elements and third, the "existence of various constraints", which is referred to the various constraints exists in project management and software development processes.

- The rest factors identified were more specific to aspects of each complexity area.

- The analysis of data collected from the survey indicated that organisation's management capabilities was identified as the factor that mostly explains the variance in almost all areas, meaning that is the factor that grouped the most variables (initial complexity factors).

- The density of various project management processes and the existence of various constraints and barriers in project management and software development processes were the next most important factors in terms of total variance explained.

The second survey and the subsequent data processing determined the relative contribution of each one of the identified factors to total project complexity by assigning weights to them. The factors that have the higher contribution to project complexity, meaning that they have weight values higher than the average weight value of the complexity area they belong are displayed in Table 47.

Table 47 Factors with higher contribution to software project complexity

Complexity area	Complexity factors
Time management	Project activities resource constraints. Density of project schedule. Organization's time management capabilities.
Cost management	Complicated financial structure and processes.
Quality management	Rigorous quality control procedures.
Communication management	Organization's communication management capabilities Density of project communication.
Human resource management	Project team cohesion. Project team size and skill diversity.
Procurement management	Organization's procurement management capabilities.
Risk management	Project risk density.
Scope management	Quality of requirements.
Integration management	Integration constraints due project characteristics.
Stakeholders management	Organization's stakeholders management capabilities.
Software development technical area	Product quality requirements. Software size.

It can be easily be concluded from the above table that:

- "Organization's management capabilities" to perform project management tasks and the "density of various project processes" are identified as the factors with higher contribution to project complexity in most complexity areas.

- The remaining complexity factors with high contribution to total project complexity are factors that are related to the existence of various project elements constraints, project quality related issues and project size.

7.2.4. Assessment model

The definition of the proposed complexity model has the following characteristics:

- The methodology followed allowed the evaluation of project complexity not as an entity but through the eleven complexity areas. Due to the correspondence of complexity areas with PMBOK management areas, this approach allows project managers to evaluate the complexity of each management area. By that way, they can determine management areas that are of higher complexity in comparison with other areas and, as that, to focus their efforts to handle complexity on these areas.

- Defined measures are quantitative and allow users to express their subjective evaluation.

- Simple as its structure allowing it to be easily understood by users.

- Easy to calculate as not any special mathematical knowledge's and skills are required in order to perform the calculations as it only makes use of simple mathematical operations such as addition and multiplication.

7.2.5. PMCAT tool

The definition and design of the PMCAT tool has the following characteristics:

- Automates the assessment of project complexity

- Facilitates project managers to experiment by develop their own complexity models and test/apply them to projects

- Allows the collaboration between project managers in order to develop and validate complexity models or assess projects complexity.

- Is customisable, as it allows the definition of different models, allows different weights to be assigned in complexity factors for different models, allows a variety of evaluation scales

7.2.6. Summary

Summarising the above the following conclusion about the proposed complexity framework can be extracted:

- **Reliable**. The case study indicated that model results were similar to the a-priori assessment of project complexity which was made by project managers. Participants in the case study never questioned either the numerical results or the scale used. Further, the statistical analysis of the data collected during surveys indicated the reliability and adequacy of the data collected, enhancing the credence about the reliability of the results.

- **Compatible**. It is argued that the “thinking” of the complexity model is similar and compatible to project management “thinking”. This is because the proposed complexity framework is compatible with process based project management. Data required as input to the model are already known and available to project managers during the initial stages of project and project management planning and can be used without any further processing or modifications.

- **Granular.** The proposed framework allows project complexity to be assessed either as a whole or per complexity area. The assessment of complexity per area allows project managers to determine the complexity of each area and to take more targeted actions to address it.

- **User-friendly**. The model proposed, allow calculations to be made quickly and easily, allow quick changes and evaluation of different parameters which is important for the practical implications of the framework

- **Independent of software development methods**. The proposed complexity framework allows the use of any software development model (e.g. waterfall, v-model, incremental, agile etc.) and is independent from it. This is due to its focus on project management and technical aspects of software development process that are independent from the development model.

- **Allow early management of project complexity.** Due to framework design, based on management data available at early project steps, it is possible for preventive measures to be taken in order to handle or manage project complexity or anticipate its effects.

- **Flexible.** The design of complexity framework is flexible as it allows the customization of proposed factors, in their weighting and in the collection of complexity factors that will form a model. The software tool proposed automates and facilitates the process.

- **Modifiable and Expandable.** Due to its design, the proposed complexity framework can easily be modified in order to be used in other type of projects. This is because the part of it that concern project management, is similar to all types of projects and only the part concerning the technical aspects of software development needs to be substituted with the corresponding part of the other project type e.g. for construction projects, with the technical aspect of construction projects.

7.3. Contribution of this research

In the following, the contribution of this research to academia and industry is given.

7.3.1. Academic

The role of project complexity is increasingly acknowledged by academia. This research argues that complexity is an endogenous characteristic of projects due to their nature, and it should be taken into account by project managers and project stakeholders, since it affects project success of failure.

Under these terms, this research from academic perspective:

- Provides a link between project complexity and project management and identifies project complexity from a new approach. Acknowledges the endogenous character of complexity in projects but instead of trying to identify complexity dimensions of this complexity in projects, focuses on the complexity in the interfaces between project processes, project management processes and project managers, which consists the critical point for successful project execution.

- The role of project management in addressing complexity should be further investigated by giving more importance to the link between project complexity and project management.

- Identifies the significance of peoples' knowledge and experience and generally the capabilities of an organisation in management in order to handle complexity, as this was revealed through the findings of this research.

- Considers complexity as variable that can be assessed and propose a model for it.

- Based on the proposed complexity taxonomy, provides the academic community with an extended list of 117 factors stemming from project management aspects and 18 software development technical factors that affect project complexity. Many of these factors are not cited in other studies of project complexity, thus their importance and practical implications in regards to project complexity in general and in software project complexity particularly, is significant.

- Emphasis should be given in education and training of new project managers in managing project complexity and in project management interrelations and interdependencies, in order to acquire the necessary skills that will help them to handle project complexity efficiently.

7.3.2. Industry

This research has also significant implications both for the industry in general and for software industry in particular as follows:

- Approaches project complexity from the perspective of project management that is nowadays integrated in projects, widely investigated and well known. Thus, it can be easily integrated into project design and implemented.

- Determines sources of project complexity and identifies factors that contribute to project complexity and can easily be understood and assessed at early project stages.

- Provides a complete complexity framework for measuring project complexity consisting of 135 key complexity factors, an assessment model and an aid software tool. This framework can be used in order to highlight the most significant complexity areas either organisation specific or project specific, providing in that way the necessary awareness for better, efficient and effective project management.

- Can assess project complexity at early stages of project either as a whole or per complexity area.

- The approach followed in framework design, identifies the variation of perception of complexity between different organisations

- Allow organisations to evaluate complexity of projects and provide them with an important information that will assist project selection process.

7.4. Recommendations for future research

As it was mentioned earlier, due to the limitations that exist in this research there were dimensions or areas that were not fully explored. These require further exploration in order to enhance the generalisation of this research results and in depth study of some research aspects.

- The further evaluation of surveys results by enhancing the internationalism of responders in order to validate further the research results or to investigate possible variations is useful.

- The notion of subjective complexity based on perceived complexity was not fully explored. It is recommended that further examination should be done in that field in order to investigate further causes of this situation in both organisations and people.

- This research made the assumption that during the factors weighting process all complexity areas were of equal importance with respect to complexity and, as such, the same weight was assigned to them. This assumption may need to be examined further and probably each complexity area may need to be weighted differently according to its significance in projects.

- The validity of the model should be examined further, by applying it to a wider variety of projects. Through this process, it should be examined if different types of software projects have special complexity characteristics that were missed from this research and which their identification and integration to proposed framework would enhance its validity.

7.5. Summary

In this chapter the conclusions of this research, its contribution to existing knowledge to both academic and industry community, its limitations and implications for future research were presented.

In the next sections, the references and appendices are presented.

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Appendix A

Questionnaire of 1st survey

Software Project Complexity Factors

PhD Research/Title: Software project management complexity. Towards an assessment model

Description: This research is aiming in assessing the management complexity of software projects. During this research a set of project management complexity factors were identified for each one of the ten project management knowledge areas described in PMBOK (PMI, 2013).
This questionnaire is part of this research and is aiming in assessing the complexity factors, identified for the PMBOK's project management knowledge areas, according their contribution to project management complexity (scheduling).

Short guide: The assessment of complexity factors should be done under the prism that if a change in the value of a complexity factor will affect the project management complexity significantly or not. E.g. If the "Number of project activities" increased then this affects scheduling complexity from "Very Low" ..... to ..... "Very High". Consider that higher values mean higher contribution to complexity whilst lower the opposite.

Please answer all questions

*Required

General information

1. **What is your gender? *** *Mark only one oval.*

   - ⬭ Male
   - ⬭ Female

2. **What is your age? *** *Mark only one oval.*

   - ⬭ 18 - 29 years old
   - ⬭ 30 - 49 years old
   - ⬭ 50 - 65 years old
   - ⬭ 65 years or above

3. **What is the highest level of education you have completed? *** *Mark only one oval.*

   - ⬭ High school graduate
   - ⬭ College / University graduate
   - ⬭ Postgraduate graduate (MSc)
   - ⬭ Postgraduate graduate (PhD)

4. **How many years of work experience do you have? *** *Mark only one oval.*

- 5 years or less 6-12 years
- 13 to 20 years
- 21 years or more

5. **Which of the following most closely matches your work background? *** *Tick all that apply.*

- Industry (mainly) Academia (mainly)
- Both Industry and Academia (almost equal) Private sector (mainly)
- Public sector (mainly)
- Both Private and Public (almost equal)

6. **Which of the following most closely matches your role within projects *** *Mark only one oval.*

- Senior manager
- Project manager
- Project team leader
- Project team member
- Project sponsor
- Project director
- Consultant
- Other:

7. **Number of projects you managed or participated as teams team member in the last 5 years ***

8. **Average budget of all projects you managed or participated in projectteams in the last 5 years ***

9. **What was the size of the largest project you manage or participated in monetary value? ***

10. **What was the size of the largest project you manage or participated in duration?** *

11. **What was the size of the largest project you manage or participated in terms of size of project team?***

Time management complexity

Please, for each one of the following factors consider their level of contribution to Time Management Complexity of Software projects

12. **Number of project activities *** *Mark only one oval*

Consider: As the number of project activities increases -->the complexity of project scheduling also increases

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

13. **Number of critical activities *** *Mark only one oval*

Consider: activities that belong to critical path.

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

14. **Insufficient time management experience within project management team *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

15. **Number of project activities executed in parallel *** *Mark only one oval.*

1 2 3 4 5

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

16. **Number of intermediate deliverables should be delivered** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

17. **Number of activities with overlapping resource requirements (shared activities)** * Mark only one oval.

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

18. **Number of activities that require high variety of resources types** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

19. **Number of long duration activities** * *Mark only one oval.*
(Consider: activities with duration eg 2x, 3x above average duration)

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

20. **Variance in project activities duration** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

21. **Long project duration** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

22. **High project deliverable density** * *Mark only one oval.*
(Consider the ratio, number of deliverables / project duration)

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

23. **Large number of dependencies between activities** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

24. **Low availability of project resources** * *Mark only one oval*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

25. **Lack/shortage of tools for planning and monitoring project schedule.** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

26. **Number of activities that require highly specialized resources types** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

Cost management Complexity

Please, for each one of the following factors consider their level of contribution to Cost Management Complexity of Software projects

27. **Long project duration** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

28. **Low accuracy of analytical cost estimates due to project external dependencies *** *Mark only one oval.*
Consider: time restrictions, economic condition, political environment etc.

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

29. **Lack/shortage of specialized cost estimation method and tools. *** *Mark only one oval*
Consider: the use of well-known methods, availability of specialized software etc.

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

30. **Project budget cuts attributed to external facts *** *Mark only one oval*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

31. ***Insufficient cost estimation management experience within project management team***
* *Mark only one oval*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

32. **Lack/shortage of historical cost estimation data *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

33. **Project is financed by large number of stakeholders *** *Mark only one oval.*
Consider if, as number of stakeholders that finance project increases, project cost management complexity increases also

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

34. **Irregularities in project cash flows *** *Mark only one oval.*

Consider: frequency of delays, diversities in delays duration etc.

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

35. ***Lack/shortage of tools and processes for tracing, monitoring and reporting project cost progress*** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

36. **Time consuming processes for project payments approvals *** *Mark only one oval*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

37. **Intensive and time consuming project financial reporting *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

Quality management complexity

Please, for each one of the following factors consider their level of contribution to Quality Management Complexity of Software projects

38. **Quality requirements as stated in project quality plan *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

39. **Insufficient communication of quality goals, policies and responsibilities within project organization *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

40. **Lack/shortage of historical quality management data *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

41. **Low management commitment to project quality** **Mark only one oval*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

42. **Lack of quality culture of project stakeholders. *** *Mark only one oval.*
(Consider: stakeholders' training, experience, commitment to quality management)

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

43. **Not use of well-known quality management procedures** ** Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

44. **Missing of QA organization department *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

45. **Lack of tools and processes for planning, tracing, monitoring and reporting project quality management result** **Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

46. **Existence of external quality audits *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

47. ***Existence of thorough quality management procedures within customer / contractor organization*** **Mark only one oval*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

48. ***Process immaturity **** *Mark only one oval.*

(Consider the progressive development of a wide project management approach, methodology, strategy, and decision-making process)

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

Communication management complexity

Please, for each one of the following factors consider their level of contribution to Communication Management Complexity of Software projects

49. ***Insufficient communication management experience within project management team*** **Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

50. **Geographical distribution of project stakeholders *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

51. **Labour time spending in communication processes by team members *** *Mark only one oval.*

(Consider long time for preparing, participating and evaluating communication process).

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

52. **Diversity in project stakeholders' nationalities *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

53. **Culture differences between project stakeholders*** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

54. **Shortage in communication media tools *** *Mark only one oval.*

(Consider availability of media tools for various communication types e.g. face to face, oral, written etc.)

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

55. **Heavy and frequent project reporting*** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

56. **Frequency of formal in person communication / meetings / presentations*** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

57. **Not clear communication lines *** *Mark only one oval.*

(Consider: the lack of definition of communication hierarchy, structure and preferred type of communication between project organizational levels and teams)

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

58. **Not clear job description and work assignment *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

59. **Number of organizations composing the project team *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

60. **Requirements for communication due to high project visibility *** *Mark only one oval.*
(Consider local communities, authorities, public etc.)

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

Human Resource management complexity

Please, for each one of the following factors consider their level of contribution to Human Resource Management Complexity of Software projects

61. **Size of project team *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

62. **Number of different technical, behavioural, contextual skills required *** *Mark only one*

oval.

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

63. **Number of new recruitments required by the project*** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

64. **Turnover of project staff members *** (Consider frequent changes in project staffing) *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

65. **Project not fully staffed *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

66. **Existence of employees working part-time in the project. *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

67. **Low level of team cohesion** * *Mark only one oval.*
(Consider geographical distribution, different nationalities, cultures etc.)

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

68. **Insufficient HR management experience within project management team *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

69. **Availability of HR department or HR services within hosting organization *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

70. **Lack of historical HR management data *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

71. **Lack of tools and processes for planning, monitoring and tracking HR management** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

72. **High percentage of outsourced work within the project *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

73. **Number of project sub groups within the project *** Mark only one oval.

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

74. **Number of different types of project groups *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

Procurement management complexity

Please, for each one of the following factors consider their level of contribution to Procurement Management Complexity of Software projects

75. **Number / variety of supplies *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

76. **Number / Variety of suppliers *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

77. **Procurement restriction imposed by external (legislation, regulation) and/or internal (preferred suppliers, compatible technology, geographical restrictions) *** *Mark only one oval*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

78. **Percentage of new suppliers/subcontractors *** *Mark only one oval.*
Consider: first time selected suppliers/subcontractors)

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

79. **Unavailability / scarcity of supplies and/or services *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

80. **Variety of procurement contract types *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

81. ***Not clear or not existing definition of procurement policies and procedures*** *
Mark only one oval.

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

82. **Number of contracts or sub contracts must be managed simultaneously** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

83. **Lack of historical procurement management data** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

84. **Insufficient procurement management experience within project management team** *
Mark only one oval.

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

85. **Lack of automation within the supply chain** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

86. ***Lack/shortage of tools for planning and monitoring and tracking procurement processes*** * *Mark only one oval*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

87. ***Unknown suppliers' quality **** *Mark only one oval.*
(Consider: Lack of various quality certificates for suppliers, market reputation etc.).

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

Risk management complexity

Please, for each one of the following factors consider their level of contribution to Risk Management Complexity of Software projects

88. ***Not clear (detailed) definition of project risk management policy and response strategy **** *Mark only one oval*
.

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

89. ***Number of high risk areas /major risks **** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

90. ***Lack/shortage of processes and tools for analysing, accessing, quantifying risks and implementing risk responses **** *Mark only one oval*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

91. **Lack of flexibility of project management plan for implementing risk responses *** *Mark only one oval.*
(eg. Due to contractual restrictions)

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

92. **Lack/shortage of risk historical management data.*** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

93. **Insufficient risk management experience within project management team *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

94. **Lack/shortage of tools for project planning, monitoring and control*** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

95. **Existence of risk responses with major impact to project ***
Mark only one oval.

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

Scope management complexity

Please, for each one of the following factors consider their level of contribution to Scope Management Complexity of Software projects

96. **Number of sources for eliciting requirements*** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

97. **Project size** (in man-months) **Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

98. **Number of requirements *** *Mark only one oval*

	1	2	3	4	5	
Very Low Contribution						Very High Contribution

99. **Percentage of requirements interdependencies *** *Mark only one oval*

	1	2	3	4	5	
Very Low Contribution						Very High Contribution

100. **Project faced delivery is based on requirements prioritization *** *Mark only one oval*
(Requirements flexibility)

	1	2	3	4	5	
Very Low Contribution						Very High Contribution

101. **Insufficient scope management experience within project management team***
Mark only one oval.

	1	2	3	4	5	
Very Low Contribution						Very High Contribution

102. **Lack/shortage of specialized tools and processes in defining requirements** *
Mark only one oval.

	1	2	3	4	5	
Very Low Contribution						Very High Contribution

103. **Requirements dependencies from external factors *** *Mark only one oval*
(Consider: Technological changes, economic changes, dependencies from law and regulations, organizational changes etc.)

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

104. **Requirements characteristics causing uncertainty *** *Mark only one oval.*
(Consider: requirements volatility, ambiguity, immaturity, conflicts etc.).

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

105. **Number of interfaces with other systems *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

106. **Number of non-functional requirements*** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

107. **Lack of historical scope management data*** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

108. **Low quality of product/service requirements specifications*** *Mark only one oval.*
(Consider: requirements ambiguity, inconsistency, traceability etc.).

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

Integration management complexity

Please, for each one of the following factors consider their level of contribution to Integration Management Complexity of Software projects

109. **Project technical /business innovative** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

110. **System architecture complexity** * *Mark only one oval.*

(Consider: Technology, functionality, data, interface complexity etc.).

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

111. **Not fully defined project scope and requirements** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

112. **Volatility in project requirements** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

113. **Lack/shortage of historical Integration management data** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

114. **Insufficient integration management experience within project management team** *
Mark only one oval.
(e.g. in change management)

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

115. **Uncertainty of project product development due to external changes** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

116. **Lack/shortage of tools and processes for supporting change management** * *Mark only one oval.*
(e.g. configuration tools)

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

117. **Lack of change management processes** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

118. **Lack/shortage of tools for monitoring and measuring performance of various project stages** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

119. **Number of intermediate deliverables** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

120. **Control of deliverables** * *Mark only one oval.*
(e.g lifecycle of acceptance)

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

121. **Diversity and conflicts of interests of project stakeholders *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

122. **New or unproven technology being used *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

Stakeholders management complexity

Please, for each one of the following factors consider their level of contribution to Stakeholders Management Complexity of Software projects

123. **Number of stakeholders *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

124. **Number of different stakeholders categories *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

125. **Existence of stakeholders with different / conflicting interests *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

126. **Existence of stakeholders with negative attitude about the project *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

127. **Lack of structured methodology and tools in stakeholder management *** *Mark only one oval.*
(Consider stakeholders identification, prioritization)

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

128. **Lack of specific strategy to enhance stakeholders engagement to project *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

129. **Existence of communication barriers between groups of stakeholders *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

Technical software development complexity factors

Please, for each one of the following factors consider their level of contribution to Software Development Complexity of Software projects

130. **Size of application database *** (Consider size of data compared to code) *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

131. **Developed for reusability ****Mark only one oval*
(Consider if the need that the components should be reusable increase development complexity)

	1	2	3	4	5	
Very Low Contribution	◯	◯	◯	◯	◯	Very High Contribution

132. **Software (code) size *** *Mark only one oval*
(Consider: amount of system code).

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

133. **Low development flexibility *** *Mark only one oval.*
(Consider: How strong are the constraints of the system e.g. cost, time, quality etc.).

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

134. **Architecture risk resolution *** *Mark only one oval.*
(Consider: How are the risks mitigated by architecture).

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

135. **Platform volatility, software portability *** *Mark only one oval.*
(Consider e.g. Time span between major changes).

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

136. **Completeness of design *** *Mark only one oval*
(Consider: The amount of design is completed when starting coding).

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

137. **Hardware concurrent development*** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

138. **Lack / not use of software tools that aid the development** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

139. **Programming language level/generation** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

140. **Not use of well-known and modern development models** * *Mark only one oval*
(e.g. software engineering methods)

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

141. **Required high software reliability** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

142. **Product functional complexity** * *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

143. **Number of non-functional requirements** * *Mark only one oval.*
(Consider: Ease of installation, ease of use, etc.).

1 2 3 4 5

Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

144. **Number of security requirements / constrains *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

145. **Low level technical expertise of development team*** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

146. **Low level domain/application knowledge of development team *** *Mark only one oval.*

	1	2	3	4	5	
Very Low Contribution	⬭	⬭	⬭	⬭	⬭	Very High Contribution

Appendix B

SPSS results of EFA analysis

A. TIME MANAGEMENT COMPLEXITY AREA

Correlation Matrix[a]

		VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006	VAR00007	VAR00008	VAR00009	VAR00010	VAR00011	VAR00012	VAR00013	VAR00014	VAR00015
Correlation	VAR00001	1,000	,490	,315	,315	,264	,249	,171	,196	,473	,109	,210	,570	,086	,344	,296
	VAR00002	,490	1,000	,280	,321	,173	,497	,268	,190	,461	,257	,152	,520	,139	,439	,413
	VAR00003	,315	,280	1,000	,310	,085	,250	,303	,068	,234	,065	,091	,319	,298	,506	,231
	VAR00004	,315	,321	,310	1,000	,520	,241	,273	,005	,269	,004	,386	,359	,003	,246	,142
	VAR00005	,264	,173	,085	,520	1,000	,113	,192	,067	,320	,023	,619	,220	-,031	,140	,096
	VAR00006	,249	,497	,250	,241	,113	1,000	,614	,073	,415	,228	,327	,433	,413	,257	,660
	VAR00007	,171	,268	,303	,273	,192	,614	1,000	,087	,368	,099	,282	,401	,463	,408	,535
	VAR00008	,196	,190	,068	,005	,067	,073	,087	1,000	,196	,690	,037	,200	,149	,185	,149
	VAR00009	,473	,461	,234	,269	,320	,415	,368	,196	1,000	,205	,296	,525	,076	,372	,317
	VAR00010	,109	,257	,065	,004	,023	,228	,099	,690	,205	1,000	,096	,127	,257	,191	,245
	VAR00011	,210	,152	,091	,386	,619	,327	,282	,037	,296	,096	1,000	,279	,085	,087	,202

	VAR00012	,570	,520	,319	,359	,220	,433	,401	,200	,525	,127	,279	1,000	,157	,461	,383
	VAR00013	,086	,139	,298	,003	-,031	,413	,463	,149	,076	,257	,085	,157	1,000	,233	,429
	VAR00014	,344	,439	,506	,246	,140	,257	,408	,185	,372	,191	,087	,461	,233	1,000	,359
	VAR00015	,296	,413	,231	,142	,096	,660	,535	,149	,317	,245	,202	,383	,429	,359	1,000
Sig. (1-tailed)	VAR00001		,000	,001	,001	,004	,006	,043	,024	,000	,139	,017	,000	,196	,000	,001
	VAR00002	,000		,002	,001	,041	,000	,003	,028	,000	,005	,063	,000	,082	,000	,000
	VAR00003	,001	,002		,001	,198	,006	,001	,249	,009	,259	,181	,001	,001	,000	,010
	VAR00004	,001	,001	,001		,000	,007	,003	,480	,003	,485	,000	,000	,489	,006	,078
	VAR00005	,004	,041	,198	,000		,129	,027	,251	,001	,408	,000	,013	,379	,080	,168
	VAR00006	,006	,000	,006	,007	,129		,000	,234	,000	,011	,000	,000	,000	,005	,000
	VAR00007	,043	,003	,001	,003	,027	,000		,193	,000	,161	,002	,000	,000	,000	,000
	VAR00008	,024	,028	,249	,480	,251	,234	,193		,024	,000	,357	,022	,068	,031	,067

	VAR00009	,000	,000	,009	,003	,001	,000	,000	,024		,019	,001	,000	,223	,000	,001
	VAR00010	,139	,005	,259	,485	,408	,011	,161	,000	,019		,170	,102	,005	,027	,007
	VAR00011	,017	,063	,181	,000	,000	,000	,002	,357	,001	,170		,002	,198	,193	,021
	VAR00012	,000	,000	,001	,000	,013	,000	,000	,022	,000	,102	,002		,058	,000	,000
	VAR00013	,196	,082	,001	,489	,379	,000	,000	,068	,223	,005	,198	,058		,009	,000
	VAR00014	,000	,000	,000	,006	,080	,005	,000	,031	,000	,027	,193	,000	,009		,000
	VAR00015	,001	,000	,010	,078	,168	,000	,000	,067	,001	,007	,021	,000	,000	,000	

a. Determinant = ,002

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,780
Bartlett's Test of Sphericity	Approx. Chi-Square	597,976
	df	105
	Sig.	,000

Anti-image Matrices

		VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006	VAR00007	VAR00008	VAR00009	VAR00010	VAR00011	VAR00012	VAR00013	VAR00014	VAR00015
Anti-image Covariance	VAR00001	,540	-,107	-,082	-,028	-,037	,043	,076	-,055	-,113	,051	-,005	-,159	-,025	,016	-,070
	VAR00002	-,107	,493	,017	-,070	-,017	-,133	,082	,012	-,050	-,053	,069	-,065	,038	-,115	-,022
	VAR00003	-,082	,017	,638	-,138	,054	-,026	,007	-,002	-,006	,032	,001	,012	-,139	-,218	,040
	VAR00004	-,028	-,070	-,138	,583	-,198	-,023	-,061	,038	,061	-,012	-,019	-,064	,080	,015	,046
	VAR00005	-,037	-,017	,054	-,198	,466	,071	-,021	-,039	-,088	,037	-,268	,057	,003	-,019	-,017
	VAR00006	,043	-,133	-,026	-,023	,071	,338	-,133	,061	-,066	-,048	-,091	-,034	-,051	,104	-,161
	VAR00007	,076	,082	,007	-,061	-,021	-,133	,440	-,045	-,070	,076	-,012	-,043	-,147	-,117	-,065
	VAR00008	-,055	,012	-,002	,038	-,039	,061	-,045	,473	-8,537E-5	-,313	,043	-,067	,013	,011	,001
	VAR00009	-,113	-,050	-,006	,061	-,088	-,066	-,070	-8,537E-5	,557	-,047	-,003	-,091	,096	-,045	,035
	VAR00010	,051	-,053	,032	-,012	,037	-,048	,076	-,313	-,047	,438	-,054	,061	-,093	-,045	-,025
	VAR00011	-,005	,069	,001	-,019	-,268	-,091	-,012	,043	-,003	-,054	,522	-,061	,006	,041	,015

	VAR00012	-,159	-,065	,012	-,064	,057	-,034	-,043	-,067	-,091	,061	-,061	,468	,015	-,088	-,005
	VAR00013	-,025	,038	-,139	,080	,003	-,051	-,147	,013	,096	-,093	,006	,015	,626	,008	-,079
	VAR00014	,016	-,115	-,218	,015	-,019	,104	-,117	,011	-,045	-,045	,041	-,088	,008	,528	-,073
	VAR00015	-,070	-,022	,040	,046	-,017	-,161	-,065	,001	,035	-,025	,015	-,005	-,079	-,073	,476
Anti-image Correlation	VAR00001	,833[a]	-,208	-,140	-,051	-,073	,100	,157	-,108	-,206	,106	-,009	-,316	-,042	,029	-,139
	VAR00002	-,208	,848[a]	,031	-,131	-,035	-,326	,176	,026	-,096	-,115	,135	-,136	,069	-,225	-,046
	VAR00003	-,140	,031	,780[a]	-,226	,099	-,056	,013	-,003	-,010	,061	,002	,022	-,220	-,376	,073
	VAR00004	-,051	-,131	-,226	,795[a]	-,380	-,051	-,121	,072	,107	-,024	-,035	-,123	,133	,028	,088
	VAR00005	-,073	-,035	,099	-,380	,643[a]	,180	-,047	-,084	-,174	,081	-,544	,123	,005	-,039	-,037
	VAR00006	,100	-,326	-,056	-,051	,180	,764[a]	-,345	,151	-,151	-,126	-,217	-,086	-,111	,245	-,401
	VAR00007	,157	,176	,013	-,121	-,047	-,345	,806[a]	-,098	-,142	,174	-,026	-,096	-,280	-,243	-,142
	VAR00008	-,108	,026	-,003	,072	-,084	,151	-,098	,567[a]	,000	-,687	,087	-,142	,024	,022	,002

	VAR00009	-,206	-,096	-,010	,107	-,174	-,151	-,142	,000	,885[a]	-,095	-,006	-,178	,163	-,083	,067
	VAR00010	,106	-,115	,061	-,024	,081	-,126	,174	-,687	-,095	,572[a]	-,113	,134	-,178	-,094	-,054
	VAR00011	-,009	,135	,002	-,035	-,544	-,217	-,026	,087	-,006	-,113	,717[a]	-,124	,010	,079	,031
	VAR00012	-,316	-,136	,022	-,123	,123	-,086	-,096	-,142	-,178	,134	-,124	,877[a]	,027	-,177	-,010
	VAR00013	-,042	,069	-,220	,133	,005	-,111	-,280	,024	,163	-,178	,010	,027	,780[a]	,014	-,144
	VAR00014	,029	-,225	-,376	,028	-,039	,245	-,243	,022	-,083	-,094	,079	-,177	,014	,793[a]	-,146
	VAR00015	-,139	-,046	,073	,088	-,037	-,401	-,142	,002	,067	-,054	,031	-,010	-,144	-,146	,867[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

	Initial	Extraction
VAR00001	,460	,514
VAR00002	,507	,537
VAR00003	,362	,499
VAR00004	,417	,421
VAR00005	,534	,814
VAR00006	,662	,827
VAR00007	,560	,602
VAR00008	,527	,576

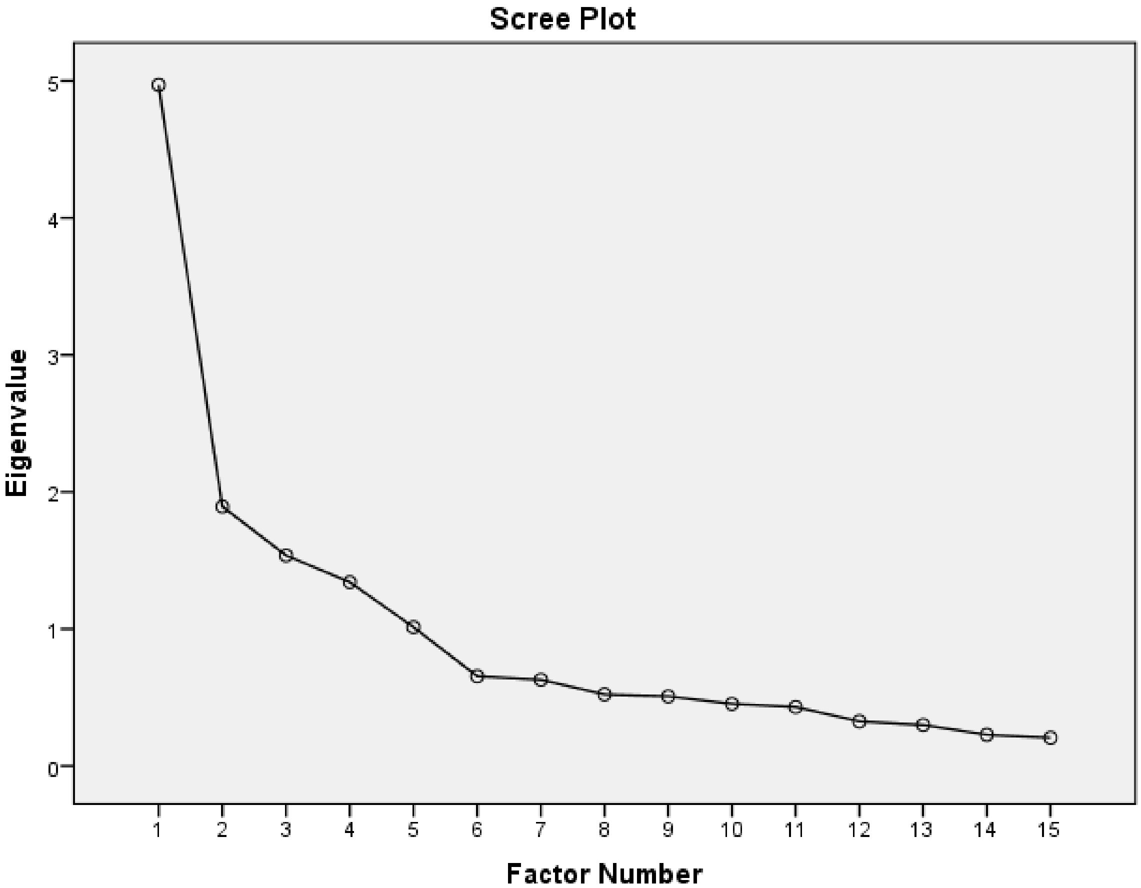
VAR00009	,443	,465
VAR00010	,562	,866
VAR00011	,478	,539
VAR00012	,532	,597
VAR00013	,374	,456
VAR00014	,472	,543
VAR00015	,524	,562

Extraction Method: Principal Axis Factoring.

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,971	33,137	33,137	4,555	30,368	30,368	2,328	15,518	15,518
2	1,893	12,617	45,754	1,543	10,285	40,652	2,208	14,723	30,241
3	1,536	10,237	55,991	1,210	8,066	48,719	1,735	11,567	41,808
4	1,341	8,941	64,932	,942	6,282	55,001	1,479	9,859	51,667
5	1,013	6,750	71,682	,568	3,785	58,786	1,068	7,119	58,786
6	,654	4,358	76,040						
7	,628	4,189	80,229						
8	,521	3,474	83,703						
9	,507	3,382	87,085						
10	,452	3,016	90,101						
11	,430	2,865	92,966						
12	,325	2,164	95,129						
13	,299	1,991	97,121						
14	,227	1,514	98,634						
15	,205	1,366	100,000						

Extraction Method: Principal Axis Factoring.



Reproduced Correlations

		VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006	VAR00007	VAR00008	VAR00009	VAR00010	VAR00011	VAR00012	VAR00013	VAR00014	VAR00015
Reproduced Correlation	VAR00001	,514[a]	,494	,292	,329	,256	,281	,215	,179	,460	,136	,201	,534	,029	,397	,259
	VAR00002	,494	,537[a]	,283	,271	,160	,450	,322	,221	,480	,229	,186	,554	,150	,407	,398
	VAR00003	,292	,283	,499[a]	,260	,113	,208	,351	,082	,243	,052	,078	,349	,271	,497	,261

	VAR00004	,329	,271	,260	,421[a]	,510	,208	,260	,019	,329	-,024	,393	,355	,044	,278	,168
	VAR00005	,256	,160	,113	,510	,814[a]	,135	,198	,060	,307	,040	,620	,256	-,046	,119	,068
	VAR00006	,281	,450	,208	,208	,135	,827[a]	,623	,090	,413	,207	,316	,452	,428	,293	,661
	VAR00007	,215	,322	,351	,260	,198	,623	,602[a]	,053	,308	,131	,295	,362	,448	,370	,534
	VAR00008	,179	,221	,082	,019	,060	,090	,053	,576[a]	,195	,688	,051	,168	,147	,195	,152
	VAR00009	,460	,480	,243	,329	,307	,413	,308	,195	,465[a]	,202	,291	,512	,111	,349	,349
	VAR00010	,136	,229	,052	-,024	,040	,207	,131	,688	,202	,866[a]	,081	,152	,258	,183	,252
	VAR00011	,201	,186	,078	,393	,620	,316	,295	,051	,291	,081	,539[a]	,249	,078	,099	,211
	VAR00012	,534	,554	,349	,355	,256	,452	,362	,168	,512	,152	,249	,597[a]	,147	,456	,399
	VAR00013	,029	,150	,271	,044	-,046	,428	,448	,147	,111	,258	,078	,147	,456[a]	,274	,408
	VAR00014	,397	,407	,497	,278	,119	,293	,370	,195	,349	,183	,099	,456	,274	,543[a]	,333
	VAR00015	,259	,398	,261	,168	,068	,661	,534	,152	,349	,252	,211	,399	,408	,333	,562[a]

Residual[b]	VAR00001		-,004	,022	-,014	,008	-,032	-,044	,018	,013	-,027	,008	,036	,056	-,053	,037
	VAR00002	-,004		-,003	,050	,013	,047	-,054	-,031	-,019	,028	-,034	-,034	-,011	,033	,015
	VAR00003	,022	-,003		,050	-,028	,042	-,048	-,014	-,008	,013	,013	-,030	,027	,010	-,030
	VAR00004	-,014	,050	,050		,010	,033	,013	-,014	-,060	,028	-,006	,003	-,042	-,032	-,027
	VAR00005	,008	,013	-,028	,010		-,022	-,006	,008	,013	-,017	,000	-,037	,015	,021	,029
	VAR00006	-,032	,047	,042	,033	-,022		-,009	-,017	,002	,021	,011	-,019	-,016	-,036	-,001
	VAR00007	-,044	-,054	-,048	,013	-,006	-,009		,034	,060	-,032	-,013	,039	,015	,038	,000
	VAR00008	,018	-,031	-,014	-,014	,008	-,017	,034		,001	,002	-,014	,032	,002	-,010	-,003
	VAR00009	,013	-,019	-,008	-,060	,013	,002	,060	,001		,003	,004	,013	-,035	,023	-,032
	VAR00010	-,027	,028	,013	,028	-,017	,021	-,032	,002	,003		,014	-,025	-,001	,008	-,008
	VAR00011	,008	-,034	,013	-,006	,000	,011	-,013	-,014	,004	,014		,030	,007	-,012	-,010
	VAR00012	,036	-,034	-,030	,003	-,037	-,019	,039	,032	,013	-,025	,030		,010	,005	-,016

	VAR00013	,056	-,011	,027	-,042	,015	-,016	,015	,002	-,035	-,001	,007	,010		-,041	,021
	VAR00014	-,053	,033	,010	-,032	,021	-,036	,038	-,010	,023	,008	-,012	,005	-,041		,026
	VAR00015	,037	,015	-,030	-,027	,029	-,001	,000	-,003	-,032	-,008	-,010	-,016	,021	,026	

Extraction Method: Principal Axis Factoring.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 7 (6,0%) nonredundant residuals with absolute values greater than 0.05.

Rotated Factor Matrix[a]

	Factor				
	1	2	3	4	5
VAR00001	,663				
VAR00002	,663				
VAR00003					,637
VAR00004			,520		
VAR00005			,889		
VAR00006		,814			
VAR00007		,676			
VAR00008				,739	
VAR00009	,582				
VAR00010				,908	
VAR00011			,687		
VAR00012	,682				
VAR00013		,582			

VAR00014					,570
VAR00015		,662			

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 6 iterations.

B. COST MANAGEMENT COMPLEXITY AREA

Correlation Matrix[a]

		VAR00001	VAR00002	VAR00003	VAR00005	VAR00006	VAR00007	VAR00008	VAR00009	VAR00010	VAR00011
Correlation	VAR00001	1,000	,354	,316	,017	,138	-,077	,200	,219	,241	-,037
	VAR00002	,354	1,000	,432	,298	,396	,029	,392	,427	,187	,111
	VAR00003	,316	,432	1,000	,317	,237	,003	,411	,501	,180	,036
	VAR00005	,017	,298	,317	1,000	,426	,205	,482	,559	,273	,389
	VAR00006	,138	,396	,237	,426	1,000	,160	,445	,408	,317	,266
	VAR00007	-,077	,029	,003	,205	,160	1,000	,244	,199	,373	,527
	VAR00008	,200	,392	,411	,482	,445	,244	1,000	,533	,438	,442
	VAR00009	,219	,427	,501	,559	,408	,199	,533	1,000	,302	,302
	VAR00010	,241	,187	,180	,273	,317	,373	,438	,302	1,000	,613
	VAR00011	-,037	,111	,036	,389	,266	,527	,442	,302	,613	1,000
Sig. (1-tailed)	VAR00001		,000	,001	,434	,084	,220	,022	,014	,007	,357
	VAR00002	,000		,000	,001	,000	,388	,000	,000	,030	,134
	VAR00003	,001	,000		,001	,008	,487	,000	,000	,035	,360
	VAR00005	,434	,001	,001		,000	,020	,000	,000	,003	,000
	VAR00006	,084	,000	,008	,000		,054	,000	,000	,001	,003

	VAR00007	,220	,388	,487	,020	,054		,007	,022	,000	,000
	VAR00008	,022	,000	,000	,000	,000	,007		,000	,000	,000
	VAR00009	,014	,000	,000	,000	,000	,022	,000		,001	,001
	VAR00010	,007	,030	,035	,003	,001	,000	,000	,001		,000
	VAR00011	,357	,134	,360	,000	,003	,000	,000	,001	,000	

a. Determinant = ,036

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,811
Bartlett's Test of Sphericity	Approx. Chi-Square	321,079
	df	45
	Sig.	,000

Anti-image Matrices

		VAR00001	VAR00002	VAR00003	VAR00005	VAR00006	VAR00007	VAR00008	VAR00009	VAR00010	VAR00011
Anti-image Covariance	VAR00001	,746	-,164	-,091	,092	,016	,067	-,025	-,046	-,172	,089
	VAR00002	-,164	,649	-,123	-,015	-,153	,021	-,060	-,069	,033	-,002
	VAR00003	-,091	-,123	,624	-,047	,048	,019	-,107	-,158	-,034	,090
	VAR00005	,092	-,015	-,047	,571	-,121	,021	-,073	-,176	,031	-,096

	VAR00006	,016	-,153	,048	-,121	,678	-,011	-,098	-,050	-,077	,023
	VAR00007	,067	,021	,019	,021	-,011	,706	-,003	-,047	-,057	-,194
	VAR00008	-,025	-,060	-,107	-,073	-,098	-,003	,524	-,085	-,061	-,094
	VAR00009	-,046	-,069	-,158	-,176	-,050	-,047	-,085	,502	,004	-,018
	VAR00010	-,172	,033	-,034	,031	-,077	-,057	-,061	,004	,522	-,230
	VAR00011	,089	-,002	,090	-,096	,023	-,194	-,094	-,018	-,230	,439
Anti-image Correlation	VAR00001	,655[a]	-,236	-,134	,142	,022	,092	-,041	-,076	-,276	,155
	VAR00002	-,236	,843[a]	-,193	-,024	-,230	,032	-,103	-,120	,056	-,004
	VAR00003	-,134	-,193	,806[a]	-,078	,074	,029	-,188	-,282	-,060	,172
	VAR00005	,142	-,024	-,078	,837[a]	-,194	,034	-,133	-,329	,057	-,191
	VAR00006	,022	-,230	,074	-,194	,867[a]	-,016	-,165	-,086	-,130	,042
	VAR00007	,092	,032	,029	,034	-,016	,799[a]	-,004	-,079	-,095	-,348
	VAR00008	-,041	-,103	-,188	-,133	-,165	-,004	,899[a]	-,166	-,117	-,196
	VAR00009	-,076	-,120	-,282	-,329	-,086	-,079	-,166	,854[a]	,007	-,039
	VAR00010	-,276	,056	-,060	,057	-,130	-,095	-,117	,007	,755[a]	-,480
	VAR00011	,155	-,004	,172	-,191	,042	-,348	-,196	-,039	-,480	,709[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

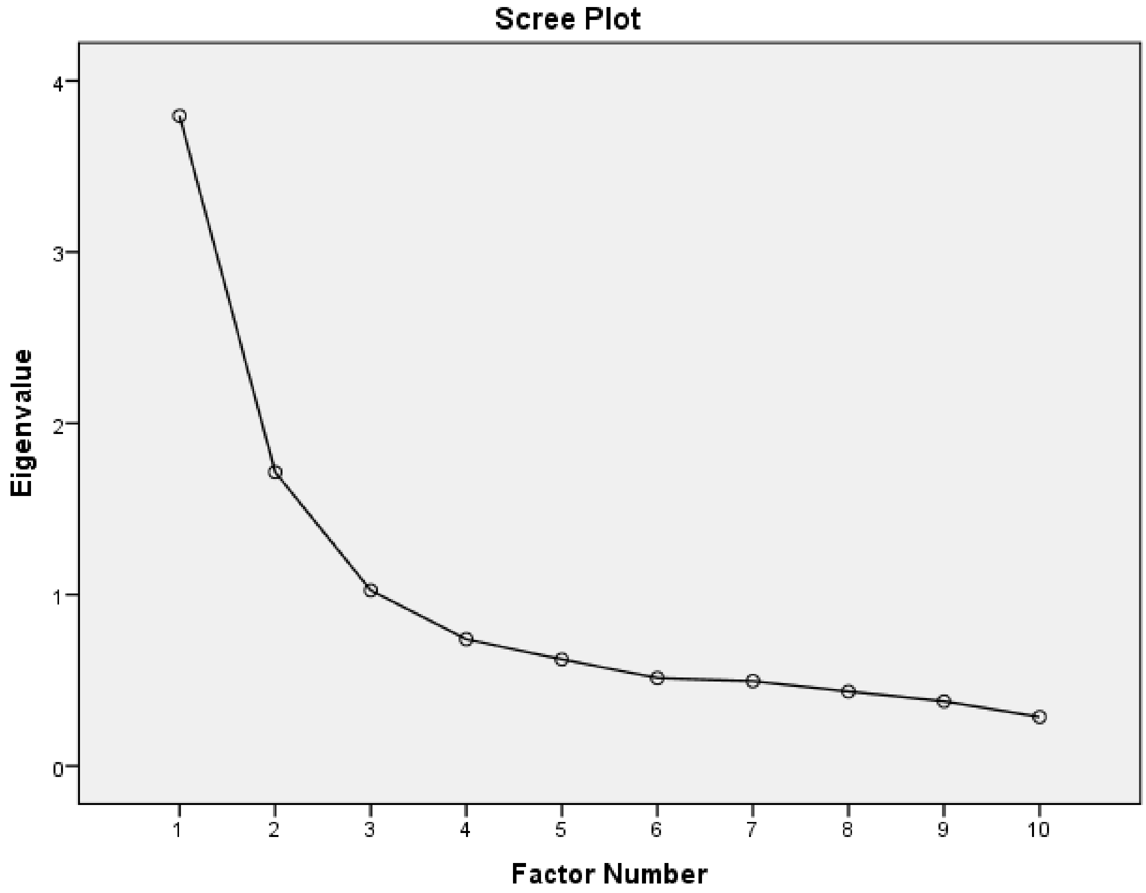
	Initial	Extraction
VAR00001	,254	,509
VAR00002	,351	,430
VAR00003	,376	,437
VAR00005	,429	,562
VAR00006	,322	,330
VAR00007	,294	,333
VAR00008	,476	,547
VAR00009	,498	,606
VAR00010	,478	,616
VAR00011	,561	,802

Extraction Method: Principal Axis Factoring.

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,795	37,950	37,950	3,337	33,369	33,369	2,360	23,599	23,599
2	1,715	17,153	55,103	1,261	12,610	45,979	1,854	18,543	42,142
3	1,025	10,249	65,352	,574	5,740	51,719	,958	9,577	51,719
4	,740	7,397	72,749						
5	,621	6,212	78,961						
6	,513	5,127	84,089						
7	,495	4,948	89,037						
8	,434	4,342	93,379						
9	,377	3,769	97,147						
10	,285	2,853	100,000						

Extraction Method: Principal Axis Factoring.



Reproduced Correlations

		VAR00 001	VAR00 002	VAR00 003	VAR00 005	VAR00 006	VAR00 007	VAR00 008	VAR00 009	VAR00 010	VAR00 011
Reproduced Correlation	VAR00 001	,509[a]	,345	,325	,007	,152	-,066	,215	,207	,230	-,039
	VAR00 002	,345	,430[a]	,430	,321	,320	,023	,400	,452	,223	,090
	VAR00 003	,325	,430	,437[a]	,328	,316	-,006	,387	,456	,172	,043
	VAR00 005	,007	,321	,328	,562[a]	,400	,233	,494	,542	,269	,380
	VAR00 006	,152	,320	,316	,400	,330[a]	,171	,421	,441	,290	,297

	VAR00 007	-,066	,023	-,006	,233	,171	,333[a]	,255	,167	,377	,514
	VAR00 008	,215	,400	,387	,494	,421	,255	,547[a]	,549	,432	,438
	VAR00 009	,207	,452	,456	,542	,441	,167	,549	,606[a]	,309	,303
	VAR00 010	,230	,223	,172	,269	,290	,377	,432	,309	,616[a]	,619
	VAR00 011	-,039	,090	,043	,380	,297	,514	,438	,303	,619	,802[a]
Residual[b]	VAR00 001		,008	-,009	,009	-,015	-,011	-,014	,012	,011	,002
	VAR00 002	,008		,002	-,024	,076	,006	-,008	-,025	-,036	,021
	VAR00 003	-,009	,002		-,012	-,078	,009	,024	,044	,007	-,007
	VAR00 005	,009	-,024	-,012		,026	-,028	-,012	,016	,004	,009
	VAR00 006	-,015	,076	-,078	,026		-,011	,024	-,033	,027	-,031
	VAR00 007	-,011	,006	,009	-,028	-,011		-,011	,032	-,004	,013
	VAR00 008	-,014	-,008	,024	-,012	,024	-,011		-,015	,006	,004
	VAR00 009	,012	-,025	,044	,016	-,033	,032	-,015		-,007	-,001
	VAR00 010	,011	-,036	,007	,004	,027	-,004	,006	-,007		-,006
	VAR00 011	,002	,021	-,007	,009	-,031	,013	,004	-,001	-,006	

Extraction Method: Principal Axis Factoring.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 2 (4,0%) nonredundant residuals with absolute values greater than 0.05.

Rotated Factor Matrix[a]

	Factor		
	1	2	3
VAR00001			,699
VAR00002	,530		
VAR00003	,558		
VAR00005	,691		
VAR00006	,513		
VAR00007		,557	
VAR00008	,608		
VAR00009	,741		
VAR00010		,700	
VAR00011		,867	

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 6 iterations.

C. QUALITY MANAGEMENT COMPLEXITY AREA

Correlation Matrix[a]

		VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006	VAR00007	VAR00008	VAR00009	VAR00010	VAR00011
Correlation	VAR00001	1,000	,287	,050	,414	,273	,141	,362	,373	,396	,337	,157
	VAR00002	,287	1,000	,352	,298	,450	,637	,416	,576	,227	,344	,563
	VAR00003	,050	,352	1,000	-,038	,236	,539	,175	,314	-,034	,205	,469
	VAR00004	,414	,298	-,038	1,000	,513	,059	,507	,366	,174	,251	,206
	VAR00005	,273	,450	,236	,513	1,000	,271	,580	,514	,375	,437	,402
	VAR00006	,141	,637	,539	,059	,271	1,000	,356	,364	,133	,157	,469
	VAR00007	,362	,416	,175	,507	,580	,356	1,000	,395	,376	,404	,282
	VAR00008	,373	,576	,314	,366	,514	,364	,395	1,000	,360	,332	,347
	VAR00009	,396	,227	-,034	,174	,375	,133	,376	,360	1,000	,521	,086
	VAR00010	,337	,344	,205	,251	,437	,157	,404	,332	,521	1,000	,224
	VAR00011	,157	,563	,469	,206	,402	,469	,282	,347	,086	,224	1,000
Sig. (1-tailed)	VAR00001		,002	,308	,000	,003	,079	,000	,000	,000	,000	,057
	VAR00002	,002		,000	,001	,000	,000	,000	,000	,011	,000	,000
	VAR00003	,308	,000		,351	,009	,000	,039	,001	,369	,019	,000
	VAR00004	,000	,001	,351		,000	,279	,000	,000	,040	,005	,019

	VAR00 005	,003	,000	,009	,000		,003	,000	,000	,000	,000	,000
	VAR00 006	,079	,000	,000	,279	,003		,000	,000	,092	,058	,000
	VAR00 007	,000	,000	,039	,000	,000	,000		,000	,000	,000	,002
	VAR00 008	,000	,000	,001	,000	,000	,000	,000		,000	,000	,000
	VAR00 009	,000	,011	,369	,040	,000	,092	,000	,000		,000	,195
	VAR00 010	,000	,000	,019	,005	,000	,058	,000	,000	,000		,012
	VAR00 011	,057	,000	,000	,019	,000	,000	,002	,000	,195	,012	

a. Determinant = ,012

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,779
Bartlett's Test of Sphericity	Approx. Chi-Square	427,283
	df	55
	Sig.	,000

Anti-image Matrices

		VAR00 001	VAR00 002	VAR00 003	VAR00 004	VAR00 005	VAR00 006	VAR00 007	VAR00 008	VAR00 009	VAR00 010	VAR00 011
Anti-image Covariance	VAR00 001	,676	-,020	-,008	-,176	,090	,005	-,044	-,081	-,148	-,055	-,008
	VAR00 002	-,020	,371	,084	-,025	-,016	-,197	-,002	-,155	,046	-,088	-,148

	VAR00003	-,008	,084	,549	,104	-,040	-,197	,005	-,117	,149	-,130	-,160
	VAR00004	-,176	-,025	,104	,539	-,146	,066	-,156	-,062	,120	,000	-,029
	VAR00005	,090	-,016	-,040	-,146	,460	,030	-,135	-,100	-,079	-,068	-,092
	VAR00006	,005	-,197	-,197	,066	,030	,431	-,110	,027	-,052	,097	-,023
	VAR00007	-,044	-,002	,005	-,156	-,135	-,110	,510	,022	-,068	-,060	,024
	VAR00008	-,081	-,155	-,117	-,062	-,100	,027	,022	,515	-,109	,045	,044
	VAR00009	-,148	,046	,149	,120	-,079	-,052	-,068	-,109	,563	-,230	,017
	VAR00010	-,055	-,088	-,130	,000	-,068	,097	-,060	,045	-,230	,588	,014
	VAR00011	-,008	-,148	-,160	-,029	-,092	-,023	,024	,044	,017	,014	,570
Anti-image Correlation	VAR00001	,819[a]	-,040	-,013	-,291	,161	,009	-,075	-,138	-,240	-,087	-,013
	VAR00002	-,040	,772[a]	,186	-,056	-,038	-,493	-,006	-,354	,101	-,188	-,323
	VAR00003	-,013	,186	,635[a]	,192	-,080	-,405	,009	-,221	,268	-,228	-,287
	VAR00004	-,291	-,056	,192	,734[a]	-,293	,137	-,298	-,119	,217	,000	-,052
	VAR00005	,161	-,038	-,080	-,293	,847[a]	,067	-,279	-,205	-,155	-,130	-,180
	VAR00006	,009	-,493	-,405	,137	,067	,709[a]	-,234	,057	-,106	,193	-,046
	VAR00007	-,075	-,006	,009	-,298	-,279	-,234	,860[a]	,043	-,126	-,109	,045
	VAR00008	-,138	-,354	-,221	-,119	-,205	,057	,043	,840[a]	-,203	,082	,081

	VAR00009	-,240	,101	,268	,217	-,155	-,106	-,126	-,203	,683[a]	-,399	,031
	VAR00010	-,087	-,188	-,228	,000	-,130	,193	-,109	,082	-,399	,778[a]	,024
	VAR00011	-,013	-,323	-,287	-,052	-,180	-,046	,045	,081	,031	,024	,841[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

	Initial	Extraction
VAR00001	,324	,303
VAR00002	,629	,639
VAR00003	,451	,449
VAR00004	,461	,872
VAR00005	,540	,536
VAR00006	,569	,605
VAR00007	,490	,489
VAR00008	,485	,463
VAR00009	,437	,808
VAR00010	,412	,408
VAR00011	,430	,468

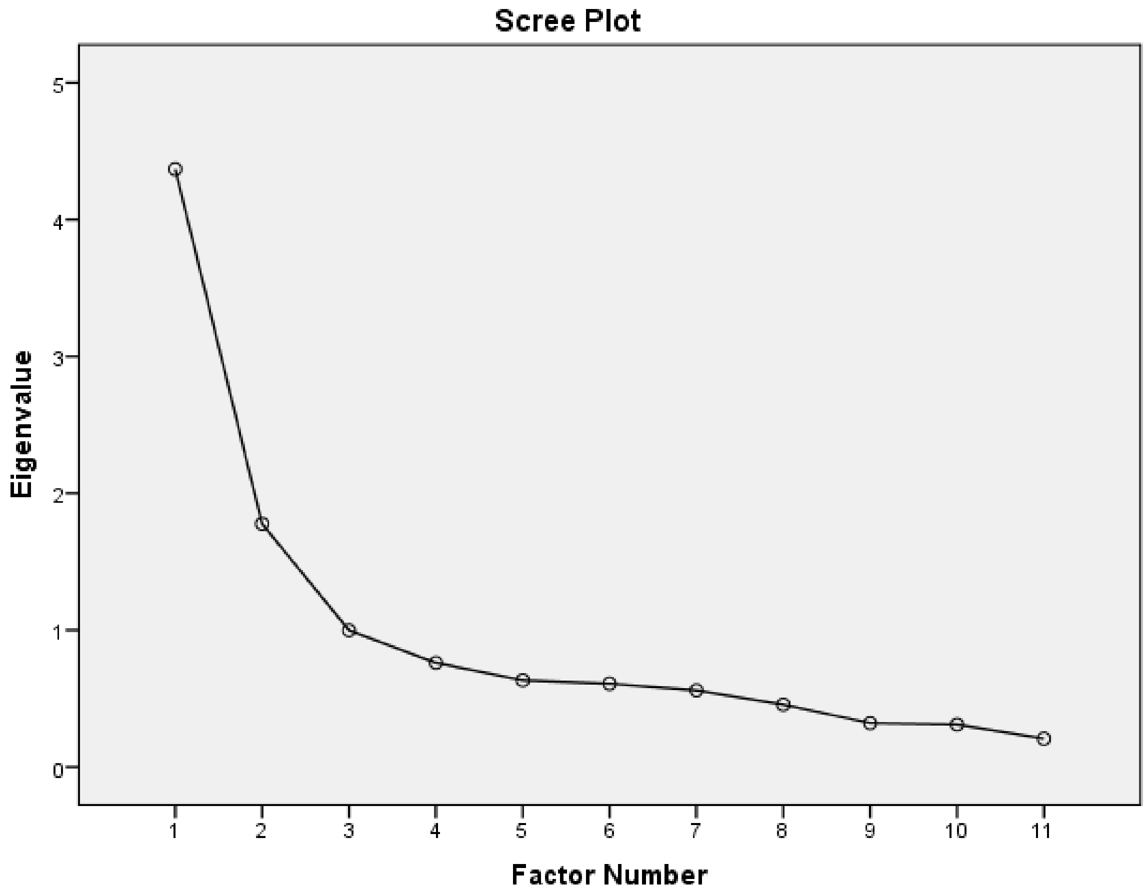
Extraction Method: Principal Axis Factoring.

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,369	39,716	39,716	3,919	35,626	35,626	2,389	21,720	21,720

2	1,777	16,152	55,868	1,362	12,382	48,008	1,837	16,696	38,416
3	,999	9,080	64,948	,757	6,884	54,892	1,812	16,476	54,892
4	,761	6,919	71,866						
5	,633	5,752	77,618						
6	,608	5,532	83,150						
7	,560	5,090	88,240						
8	,455	4,138	92,379						
9	,321	2,918	95,297						
10	,310	2,821	98,118						
11	,207	1,882	100,000						

Extraction Method: Principal Axis Factoring.



Reproduced Correlations

		VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006	VAR00007	VAR00008	VAR00009	VAR00010	VAR00011
Reproduced Correlation	VAR00001	,303[a]	,272	,054	,382	,375	,131	,366	,320	,388	,326	,165
	VAR00002	,272	,639[a]	,460	,302	,490	,577	,449	,509	,237	,344	,533
	VAR00003	,054	,460	,449[a]	-,034	,217	,514	,182	,289	,002	,133	,427
	VAR00004	,382	,302	-,034	,872[a]	,524	,048	,508	,373	,173	,264	,199
	VAR00005	,375	,490	,217	,524	,536[a]	,329	,511	,481	,380	,399	,359
	VAR00006	,131	,577	,514	,048	,329	,605[a]	,288	,398	,098	,226	,514
	VAR00007	,366	,449	,182	,508	,511	,288	,489[a]	,454	,386	,388	,321
	VAR00008	,320	,509	,289	,373	,481	,398	,454	,463[a]	,354	,376	,389
	VAR00009	,388	,237	,002	,173	,380	,098	,386	,354	,808[a]	,523	,076
	VAR00010	,326	,344	,133	,264	,399	,226	,388	,376	,523	,408[a]	,216
	VAR00011	,165	,533	,427	,199	,359	,514	,321	,389	,076	,216	,468[a]
Residual[b]	VAR00001		,015	-,003	,032	-,103	,010	-,004	,053	,008	,011	-,007
	VAR00002	,015		-,109	-,004	-,041	,059	-,033	,067	-,011	-9,507E-5	,030
	VAR00003	-,003	-,109		-,005	,019	,024	-,007	,025	-,036	,072	,042
	VAR00004	,032	-,004	-,005		-,012	,011	-,001	-,007	,001	-,013	,007

	VAR00005	-,103	-,041	,019	-,012		-,058	,069	,032	-,005	,038	,043
	VAR00006	,010	,059	,024	,011	-,058		,068	-,034	,035	-,069	-,045
	VAR00007	-,004	-,033	-,007	-,001	,069	,068		-,059	-,010	,016	-,039
	VAR00008	,053	,067	,025	-,007	,032	-,034	-,059		,006	-,044	-,043
	VAR00009	,008	-,011	-,036	,001	-,005	,035	-,010	,006		-,001	,010
	VAR00010	,011	-9,507E-5	,072	-,013	,038	-,069	,016	-,044	-,001		,009
	VAR00011	-,007	,030	,042	,007	,043	-,045	-,039	-,043	,010	,009	

Extraction Method: Principal Axis Factoring.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 11 (20,0%) nonredundant residuals with absolute values greater than 0.05.

Rotated Factor Matrix[a]

	Factor		
	1	2	3
VAR00001			,402
VAR00002	,698		
VAR00003	,669		
VAR00004		,927	
VAR00005		,521	
VAR00006	,768		
VAR00007		,503	
VAR00008	,443		

VAR00009			,895
VAR00010			,567
VAR00011	,647		

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 4 iterations.

D. COMMUNICATION MANAGEMENT COMPLEXITY AREA

Correlation Matrix[a]

		VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006	VAR00007	VAR00008	VAR00009	VAR00010	VAR00011	VAR00012
Correlation	VAR00001	1,000	-,063	,170	,274	,294	,445	,043	,317	,500	,599	,252	,226
	VAR00002	-,063	1,000	-,076	,538	,436	-,070	,227	,103	-,027	-,101	,389	-,015
	VAR00003	,170	-,076	1,000	,054	,154	,337	,295	,266	,395	,226	,015	,344
	VAR00004	,274	,538	,054	1,000	,671	,305	,197	,187	,342	,205	,360	,364
	VAR00005	,294	,436	,154	,671	1,000	,389	,162	,154	,379	,354	,490	,346
	VAR00006	,445	-,070	,337	,305	,389	1,000	,205	,356	,649	,471	,279	,408
	VAR00007	,043	,227	,295	,197	,162	,205	1,000	,339	,192	-,039	,052	,354
	VAR00008	,317	,103	,266	,187	,154	,356	,339	1,000	,514	,404	,006	,192
	VAR00009	,500	-,027	,395	,342	,379	,649	,192	,514	1,000	,610	,294	,408
	VAR00010	,599	-,101	,226	,205	,354	,471	-,039	,404	,610	1,000	,224	,292
	VAR00011	,252	,389	,015	,360	,490	,279	,052	,006	,294	,224	1,000	,196
	VAR00012	,226	-,015	,344	,364	,346	,408	,354	,192	,408	,292	,196	1,000
Sig. (1-tailed)	VAR00001		,264	,044	,003	,001	,000	,335	,001	,000	,000	,005	,011
	VAR00002	,264		,224	,000	,000	,243	,011	,151	,393	,156	,000	,441
	VAR00003	,044	,224		,295	,061	,000	,001	,003	,000	,011	,440	,000

	VAR0 0004	,003	,000	,295		,000	,001	,024	,030	,000	,019	,000	,000
	VAR0 0005	,001	,000	,061	,000		,000	,052	,061	,000	,000	,000	,000
	VAR0 0006	,000	,243	,000	,001	,000		,020	,000	,000	,000	,002	,000
	VAR0 0007	,335	,011	,001	,024	,052	,020		,000	,027	,348	,302	,000
	VAR0 0008	,001	,151	,003	,030	,061	,000	,000		,000	,000	,477	,027
	VAR0 0009	,000	,393	,000	,000	,000	,000	,027	,000		,000	,001	,000
	VAR0 0010	,000	,156	,011	,019	,000	,000	,348	,000	,000		,012	,001
	VAR0 0011	,005	,000	,440	,000	,000	,002	,302	,477	,001	,012		,024
	VAR0 0012	,011	,441	,000	,000	,000	,000	,000	,027	,000	,001	,024	

a. Determinant = ,008

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,763
Bartlett's Test of Sphericity	Approx. Chi-Square	464,960
	df	66
	Sig.	,000

Anti-image Matrices

	VAR0 0001	VAR0 0002	VAR0 0003	VAR0 0004	VAR0 0005	VAR0 0006	VAR0 0007	VAR0 0008	VAR0 0009	VAR0 0010	VAR0 0011	VAR0 0012

Anti-image Covariance	VAR00001	,568	,079	,005	-,087	,021	-,055	-,024	-,034	-,022	-,192	-,081	,052
	VAR00002	,079	,448	-,005	-,187	-,074	,094	-,114	-,108	,057	,031	-,191	,132
	VAR00003	,005	-,005	,732	,085	-,050	-,046	-,115	-,010	-,107	,008	,075	-,115
	VAR00004	-,087	-,187	,085	,389	-,172	-,025	,035	,010	-,063	,056	,073	-,136
	VAR00005	,021	-,074	-,050	-,172	,417	-,065	-,008	,051	,009	-,098	-,114	-,024
	VAR00006	-,055	,094	-,046	-,025	-,065	,496	-,047	-,031	-,137	-,007	-,063	-,042
	VAR00007	-,024	-,114	-,115	,035	-,008	-,047	,662	-,175	,003	,135	,035	-,199
	VAR00008	-,034	-,108	-,010	,010	,051	-,031	-,175	,576	-,142	-,111	,135	,049
	VAR00009	-,022	,057	-,107	-,063	,009	-,137	,003	-,142	,362	-,106	-,088	-,023
	VAR00010	-,192	,031	,008	,056	-,098	-,007	,135	-,111	-,106	,438	-,002	-,060
	VAR00011	-,081	-,191	,075	,073	-,114	-,063	,035	,135	-,088	-,002	,612	-,055
	VAR00012	,052	,132	-,115	-,136	-,024	-,042	-,199	,049	-,023	-,060	-,055	,607
Anti-image Correlation	VAR00001	,827[a]	,156	,007	-,185	,042	-,103	-,038	-,059	-,048	-,386	-,137	,089
	VAR00002	,156	,543[a]	-,008	-,448	-,172	,200	-,208	-,213	,142	,070	-,364	,253
	VAR00003	,007	-,008	,812[a]	,159	-,091	-,076	-,165	-,015	-,208	,014	,112	-,173
	VAR00004	-,185	-,448	,159	,701[a]	-,428	-,057	,070	,021	-,168	,136	,149	-,280
	VAR00005	,042	-,172	-,091	-,428	,814[a]	-,143	-,015	,105	,023	-,228	-,226	-,047

	VAR0 0006	-,103	,200	-,076	-,057	-,143	,883[a]	-,082	-,059	-,324	-,015	-,114	-,077
	VAR0 0007	-,038	-,208	-,165	,070	-,015	-,082	,616[a]	-,284	,006	,251	,055	-,314
	VAR0 0008	-,059	-,213	-,015	,021	,105	-,059	-,284	,730[a]	-,312	-,221	,228	,083
	VAR0 0009	-,048	,142	-,208	-,168	,023	-,324	,006	-,312	,833[a]	-,266	-,187	-,049
	VAR0 0010	-,386	,070	,014	,136	-,228	-,015	,251	-,221	-,266	,779[a]	-,004	-,117
	VAR0 0011	-,137	-,364	,112	,149	-,226	-,114	,055	,228	-,187	-,004	,707[a]	-,090
	VAR0 0012	,089	,253	-,173	-,280	-,047	-,077	-,314	,083	-,049	-,117	-,090	,766[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

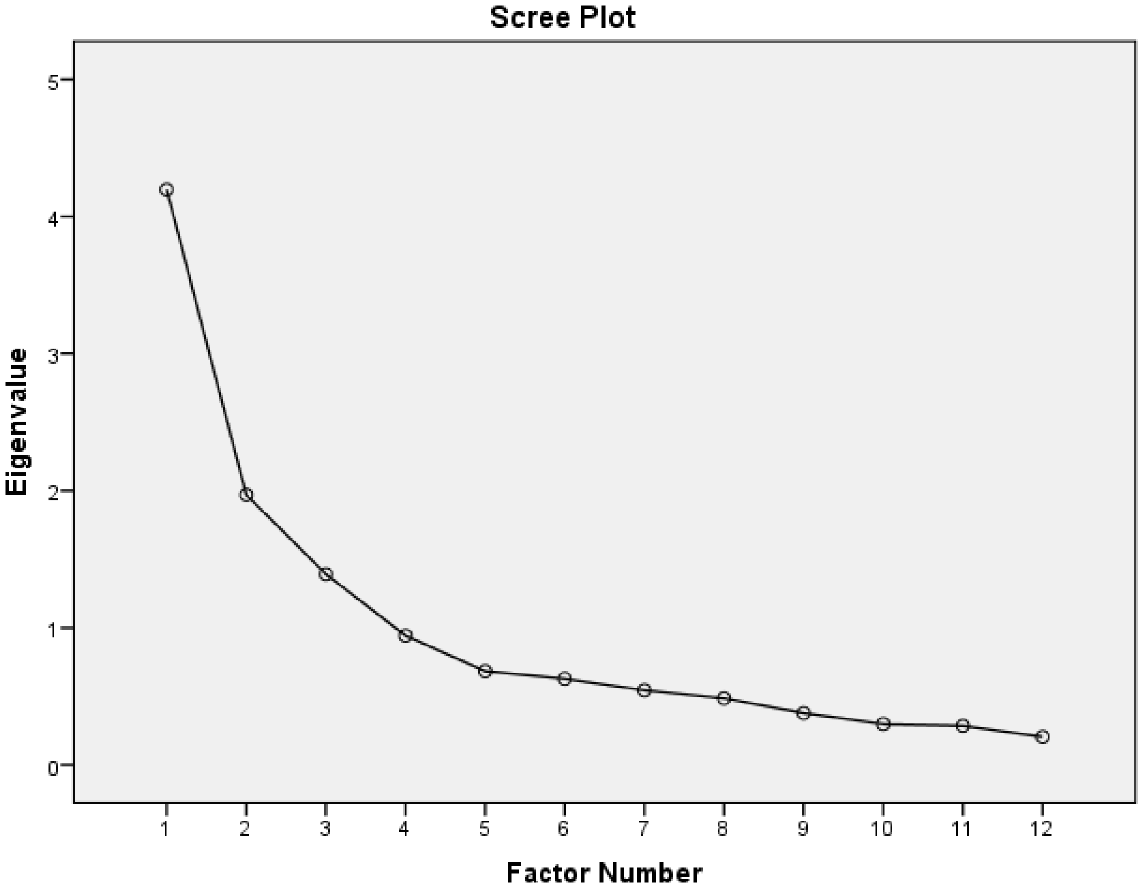
	Initial	Extraction
VAR00001	,432	,454
VAR00002	,552	,610
VAR00003	,268	,303
VAR00004	,611	,638
VAR00005	,583	,668
VAR00006	,504	,535
VAR00007	,338	,613
VAR00008	,424	,317
VAR00009	,638	,726
VAR00010	,562	,650
VAR00011	,388	,353
VAR00012	,393	,334

Extraction Method: Principal Axis Factoring.

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,196	34,971	34,971	3,746	31,216	31,216	2,649	22,076	22,076
2	1,970	16,416	51,386	1,546	12,883	44,099	2,093	17,445	39,521
3	1,390	11,585	62,971	,909	7,571	51,670	1,458	12,149	51,670
4	,943	7,857	70,828						
5	,682	5,687	76,516						
6	,627	5,226	81,741						
7	,543	4,529	86,270						
8	,485	4,041	90,311						
9	,377	3,141	93,452						
10	,297	2,476	95,928						
11	,285	2,372	98,300						
12	,204	1,700	100,000						

Extraction Method: Principal Axis Factoring.



Reproduced Correlations

		VAR0 0001	VAR0 0002	VAR0 0003	VAR0 0004	VAR0 0005	VAR0 0006	VAR0 0007	VAR0 0008	VAR0 0009	VAR0 0010	VAR0 0011	VAR0 0012
Reproduced Correlation	VAR0 0001	,454[a]	-,055	,205	,247	,329	,456	-,001	,277	,536	,540	,233	,265
	VAR0 0002	-,055	,610[a]	-,073	,519	,469	-,012	,204	-,020	-,039	-,129	,335	,102
	VAR0 0003	,205	-,073	,303[a]	,095	,110	,327	,319	,299	,378	,241	,023	,285
	VAR0 0004	,247	,519	,095	,638[a]	,643	,304	,230	,186	,334	,235	,451	,290
	VAR0 0005	,329	,469	,110	,643	,668[a]	,368	,173	,213	,412	,338	,476	,307

	VAR0 0006	,456	-,012	,327	,304	,368	,535[a]	,215	,384	,622	,532	,228	,381
	VAR0 0007	-,001	,204	,319	,230	,173	,215	,613[a]	,288	,230	-,036	,036	,329
	VAR0 0008	,277	-,020	,299	,186	,213	,384	,288	,317[a]	,444	,321	,105	,313
	VAR0 0009	,536	-,039	,378	,334	,412	,622	,230	,444	,726[a]	,630	,256	,436
	VAR0 0010	,540	-,129	,241	,235	,338	,532	-,036	,321	,630	,650[a]	,241	,295
	VAR0 0011	,233	,335	,023	,451	,476	,228	,036	,105	,256	,241	,353[a]	,172
	VAR0 0012	,265	,102	,285	,290	,307	,381	,329	,313	,436	,295	,172	,334[a]
Residual[b]	VAR0 0001		-,008	-,035	,027	-,035	-,011	,044	,040	-,037	,059	,019	-,040
	VAR0 0002	-,008		-,003	,019	-,033	-,058	,023	,123	,012	,028	,054	-,117
	VAR0 0003	-,035	-,003		-,041	,045	,010	-,023	-,033	,018	-,014	-,008	,060
	VAR0 0004	,027	,019	-,041		,028	,001	-,033	,001	,008	-,030	-,091	,074
	VAR0 0005	-,035	-,033	,045	,028		,021	-,011	-,059	-,032	,016	,014	,039
	VAR0 0006	-,011	-,058	,010	,001	,021		-,010	-,028	,027	-,061	,051	,027
	VAR0 0007	,044	,023	-,023	-,033	-,011	-,010		,052	-,038	-,003	,016	,025
	VAR0 0008	,040	,123	-,033	,001	-,059	-,028	,052		,071	,084	-,099	-,121
	VAR0 0009	-,037	,012	,018	,008	-,032	,027	-,038	,071		-,020	,038	-,028
	VAR0 0010	,059	,028	-,014	-,030	,016	-,061	-,003	,084	-,020		-,017	-,002

	VAR00011	,019	,054	-,008	-,091	,014	,051	,016	-,099	,038	-,017		,024
	VAR00012	-,040	-,117	,060	,074	,039	,027	,025	-,121	-,028	-,002	,024	

Extraction Method: Principal Axis Factoring.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 16 (24,0%) nonredundant residuals with absolute values greater than 0.05.

Rotated Factor Matrix[a]

	Factor		
	1	2	3
VAR00001	,657		
VAR00002		,734	
VAR00003			,467
VAR00004		,754	
VAR00005		,737	
VAR00006	,633		
VAR00007			,762
VAR00008			,415
VAR00009	,753		
VAR00010	,800		
VAR00011		,542	
VAR00012			,433

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 5 iterations.

E. HUMAN RESOURCES MANAGEMENT COMPLEXITY AREA

Correlation Matrix[a]

		VAR 00001	VAR 00002	VAR 00003	VAR 00004	VAR 00005	VAR 00006	VAR 00007	VAR 00008	VAR 00009	VAR 00010	VAR 00011	VAR 00012	VAR 00013	VAR 00014
Correlation	VAR 00001	1,000	,481	,513	,280	,295	,304	,316	,268	,366	,119	,300	,328	,336	,489
	VAR 00002	,481	1,000	,398	,181	,211	,323	,230	,388	,292	,165	,224	,200	,184	,271
	VAR 00003	,513	,398	1,000	,461	,456	,492	,494	,462	,318	,260	,347	,353	,342	,413
	VAR 00004	,280	,181	,461	1,000	,476	,315	,427	,292	,140	,207	,244	,325	,169	,199
	VAR 00005	,295	,211	,456	,476	1,000	,525	,389	,268	,121	,244	,269	,250	,175	,238
	VAR 00006	,304	,323	,492	,315	,525	1,000	,493	,425	,091	,089	,254	,398	,337	,281
	VAR 00007	,316	,230	,494	,427	,389	,493	1,000	,411	,024	,210	,371	,336	,372	,301
	VAR 00008	,268	,388	,462	,292	,268	,425	,411	1,000	,414	,465	,632	,290	,308	,232
	VAR 00009	,366	,292	,318	,140	,121	,091	,024	,414	1,000	,533	,537	,274	,344	,462
	VAR 00010	,119	,165	,260	,207	,244	,089	,210	,465	,533	1,000	,658	,083	,277	,295
	VAR 00011	,300	,224	,347	,244	,269	,254	,371	,632	,537	,658	1,000	,246	,341	,286
	VAR 00012	,328	,200	,353	,325	,250	,398	,336	,290	,274	,083	,246	1,000	,542	,531
	VAR 00013	,336	,184	,342	,169	,175	,337	,372	,308	,344	,277	,341	,542	1,000	,790
	VAR 00014	,489	,271	,413	,199	,238	,281	,301	,232	,462	,295	,286	,531	,790	1,000
Sig. (1-tailed)	VAR 00001		,000	,000	,002	,001	,001	,001	,003	,000	,116	,001	,000	,000	,000

	VAR 00002	,000		,000	,035	,017	,000	,010	,000	,001	,049	,012	,022	,032	,003
	VAR 00003	,000	,000		,000	,000	,000	,000	,000	,001	,004	,000	,000	,000	,000
	VAR 00004	,002	,035	,000		,000	,001	,000	,001	,080	,018	,007	,000	,044	,023
	VAR 00005	,001	,017	,000	,000		,000	,000	,003	,113	,007	,003	,006	,039	,008
	VAR 00006	,001	,000	,000	,001	,000		,000	,000	,182	,187	,005	,000	,000	,002
	VAR 00007	,001	,010	,000	,000	,000	,000		,000	,403	,017	,000	,000	,000	,001
	VAR 00008	,003	,000	,000	,001	,003	,000	,000		,000	,000	,000	,002	,001	,010
	VAR 00009	,000	,001	,001	,080	,113	,182	,403	,000		,000	,000	,003	,000	,000
	VAR 00010	,116	,049	,004	,018	,007	,187	,017	,000	,000		,000	,204	,002	,001
	VAR 00011	,001	,012	,000	,007	,003	,005	,000	,000	,000	,000		,006	,000	,002
	VAR 00012	,000	,022	,000	,000	,006	,000	,000	,002	,003	,204	,006		,000	,000
	VAR 00013	,000	,032	,000	,044	,039	,000	,000	,001	,000	,002	,000	,000		,000
	VAR 00014	,000	,003	,000	,023	,008	,002	,001	,010	,000	,001	,002	,000	,000	

a. Determinant = ,001

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,819
Bartlett's Test of Sphericity	Approx. Chi-Square	637,724
	df	91
	Sig.	,000

Anti-image Matrices

		VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006	VAR00007	VAR00008	VAR00009	VAR00010	VAR00011	VAR00012	VAR00013	VAR00014
Anti-image Covariance	VAR00001	,515	-,190	-,109	-,027	-,031	,016	-,036	,048	-,066	,117	-,080	,008	,038	-,095
	VAR00002	-,190	,661	-,038	,023	,018	-,071	,002	-,126	-,041	-,020	,059	,016	,034	-,016
	VAR00003	-,109	-,038	,474	-,104	-,058	-,072	-,090	-,076	-,045	-,008	,032	,012	,017	-,035
	VAR00004	-,027	,023	-,104	,631	-,171	,055	-,112	-,021	-,003	-,039	,025	-,123	,025	,023
	VAR00005	-,031	,018	-,058	-,171	,562	-,207	-,007	,052	,040	-,080	-,024	,008	,054	-,035
	VAR00006	,016	-,071	-,072	,055	-,207	,496	-,086	-,097	,030	,068	,007	-,083	-,049	,023
	VAR00007	-,036	,002	-,090	-,112	-,007	-,086	,515	-,044	,165	-,016	-,085	-,013	-,051	-,007
	VAR00008	,048	-,126	-,076	-,021	,052	-,097	-,044	,441	-,053	-,043	-,139	-,030	-,029	,053
	VAR00009	-,066	-,041	-,045	-,003	,040	,030	,165	-,053	,452	-,114	-,101	-,053	,028	-,082
	VAR00010	,117	-,020	-,008	-,039	-,080	,068	-,016	-,043	-,114	,440	-,173	,107	-,006	-,049

	VAR 0001 1	-,080	,059	,032	,025	-,024	,007	-,085	-,139	-,101	-,173	,365	-,024	-,036	,051
	VAR 0001 2	,008	,016	,012	-,123	,008	-,083	-,013	-,030	-,053	,107	-,024	,567	-,076	-,067
	VAR 0001 3	,038	,034	,017	,025	,054	-,049	-,051	-,029	,028	-,006	-,036	-,076	,308	-,194
	VAR 0001 4	-,095	-,016	-,035	,023	-,035	,023	-,007	,053	-,082	-,049	,051	-,067	-,194	,264
Anti-image Correlation	VAR 0000 1	,816[a]	-,325	-,220	-,048	-,057	,032	-,070	,101	-,136	,245	-,185	,015	,095	-,259
	VAR 0000 2	-,325	,837[a]	-,067	,036	,030	-,123	,004	-,232	-,075	-,036	,120	,026	,075	-,039
	VAR 0000 3	-,220	-,067	,913[a]	-,190	-,113	-,148	-,183	-,165	-,098	-,018	,077	,023	,045	-,099
	VAR 0000 4	-,048	,036	-,190	,841[a]	-,288	,098	-,196	-,039	-,006	-,074	,051	-,205	,057	,056
	VAR 0000 5	-,057	,030	-,113	-,288	,808[a]	-,391	-,012	,104	,079	-,161	-,053	,014	,130	-,090
	VAR 0000 6	,032	-,123	-,148	,098	-,391	,830[a]	-,170	-,208	,063	,146	,017	-,156	-,125	,063
	VAR 0000 7	-,070	,004	-,183	-,196	-,012	-,170	,853[a]	-,093	,341	-,033	-,196	-,025	-,128	-,019
	VAR 0000 8	,101	-,232	-,165	-,039	,104	-,208	-,093	,854[a]	-,119	-,098	-,347	-,061	-,079	,156

	VAR00009	-,136	-,075	-,098	-,006	,079	,063	,341	-,119	,802[a]	-,255	-,248	-,104	,075	-,237
	VAR00010	,245	-,036	-,018	-,074	-,161	,146	-,033	-,098	-,255	,756[a]	-,431	,214	-,016	-,143
	VAR00011	-,185	,120	,077	,051	-,053	,017	-,196	-,347	-,248	-,431	,795[a]	-,053	-,108	,164
	VAR00012	,015	,026	,023	-,205	,014	-,156	-,025	-,061	-,104	,214	-,053	,886[a]	-,183	-,172
	VAR00013	,095	,075	,045	,057	,130	-,125	-,128	-,079	,075	-,016	-,108	-,183	,762[a]	-,683
	VAR00014	-,259	-,039	-,099	,056	-,090	,063	-,019	,156	-,237	-,143	,164	-,172	-,683	,745[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

	Initial	Extraction
VAR00001	,485	,591
VAR00002	,339	,379
VAR00003	,526	,597
VAR00004	,369	,344
VAR00005	,438	,413
VAR00006	,504	,523
VAR00007	,485	,528
VAR00008	,559	,542
VAR00009	,548	,650
VAR00010	,560	,632

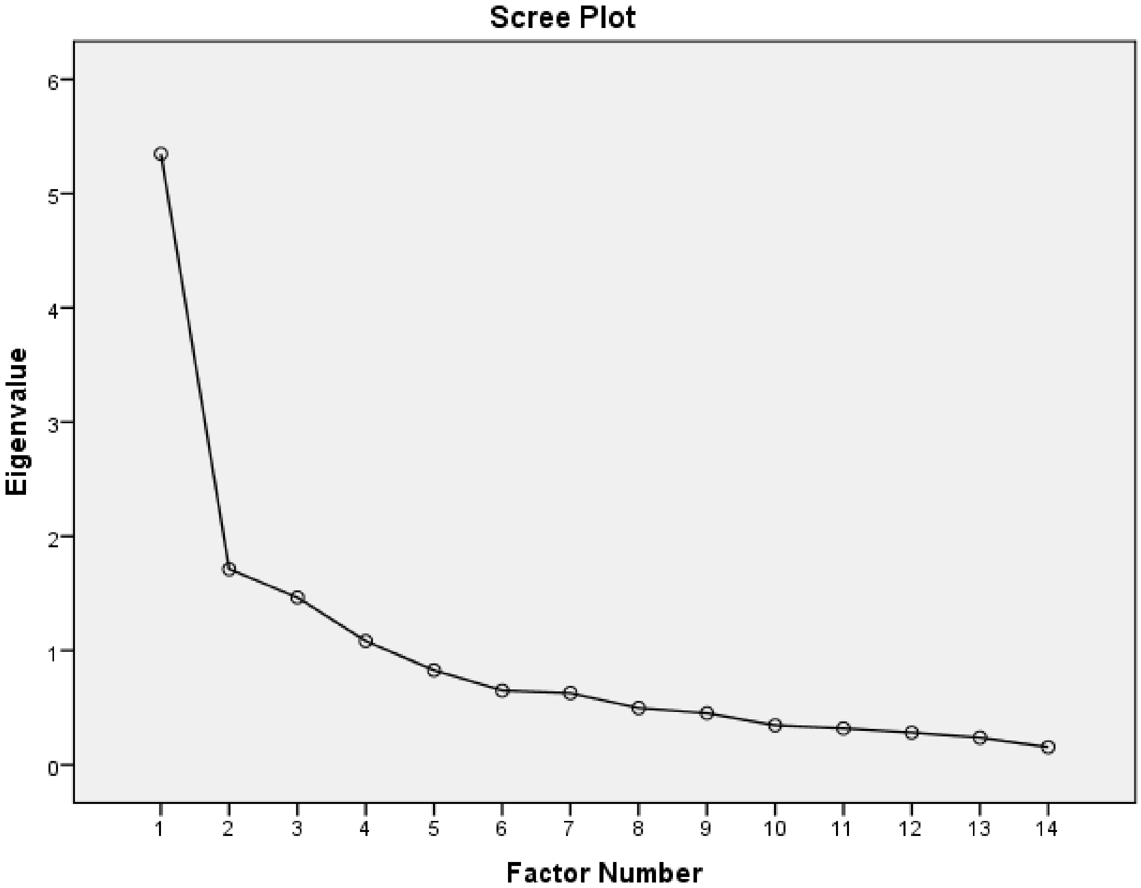
VAR00011	,635	,734
VAR00012	,433	,422
VAR00013	,692	,827
VAR00014	,736	,836

Extraction Method: Principal Axis Factoring.

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,348	38,197	38,197	4,942	35,300	35,300	2,495	17,819	17,819
2	1,712	12,229	50,426	1,302	9,300	44,600	2,150	15,354	33,173
3	1,465	10,462	60,888	1,151	8,218	52,819	2,039	14,568	47,741
4	1,084	7,742	68,630	,625	4,461	57,280	1,335	9,539	57,280
5	,827	5,909	74,539						
6	,650	4,640	79,179						
7	,628	4,484	83,662						
8	,496	3,545	87,207						
9	,452	3,231	90,438						
10	,346	2,470	92,908						
11	,318	2,275	95,182						
12	,282	2,011	97,193						
13	,238	1,698	98,892						
14	,155	1,108	100,000						

Extraction Method: Principal Axis Factoring.



Reproduced Correlations

		VAR 00001	VAR 00002	VAR 00003	VAR 00004	VAR 00005	VAR 00006	VAR 00007	VAR 00008	VAR 00009	VAR 00010	VAR 00011	VAR 00012	VAR 00013	VAR 00014
Reproduced Correlation	VAR 00001	,591[a]	,455	,509	,274	,292	,346	,276	,316	,381	,144	,242	,347	,334	,480
	VAR 00002	,455	,379[a]	,418	,238	,255	,276	,224	,302	,315	,167	,250	,219	,165	,283
	VAR 00003	,509	,418	,597[a]	,420	,455	,509	,479	,458	,299	,248	,382	,384	,343	,399

	VAR00004	,274	,238	,420	,344[a]	,376	,415	,412	,340	,109	,172	,277	,262	,210	,197
	VAR00005	,292	,255	,455	,376	,413[a]	,454	,450	,363	,099	,172	,288	,277	,211	,195
	VAR00006	,346	,276	,509	,415	,454	,523[a]	,512	,359	,083	,130	,260	,364	,319	,301
	VAR00007	,276	,224	,479	,412	,450	,512	,528[a]	,394	,098	,208	,331	,362	,354	,297
	VAR00008	,316	,302	,458	,340	,363	,359	,394	,542[a]	,415	,498	,593	,260	,282	,279
	VAR00009	,381	,315	,299	,109	,099	,083	,098	,415	,650[a]	,517	,546	,220	,366	,458
	VAR00010	,144	,167	,248	,172	,172	,130	,208	,498	,517	,632[a]	,667	,150	,277	,247
	VAR00011	,242	,250	,382	,277	,288	,260	,331	,593	,546	,667	,734[a]	,232	,337	,311
	VAR00012	,347	,219	,384	,262	,277	,364	,362	,260	,220	,150	,232	,422[a]	,540	,538
	VAR00013	,334	,165	,343	,210	,211	,319	,354	,282	,366	,277	,337	,540	,827[a]	,791
	VAR00014	,480	,283	,399	,197	,195	,301	,297	,279	,458	,247	,311	,538	,791	,836[a]
Residual[b]	VAR00001		,026	,003	,006	,003	-,043	,039	-,048	-,015	-,025	,057	-,018	,002	,010

	VAR00002	,026		-,020	-,057	-,045	,048	,006	,085	-,024	-,002	-,026	-,019	,019	-,012
	VAR00003	,003	-,020		,041	,001	-,017	,015	,005	,018	,012	-,035	-,031	-,001	,015
	VAR00004	,006	-,057	,041		,099	-,100	,015	-,048	,031	,036	-,033	,064	-,040	,002
	VAR00005	,003	-,045	,001	,099		,071	-,061	-,095	,022	,071	-,019	-,027	-,036	,042
	VAR00006	-,043	,048	-,017	-,100	,071		-,019	,065	,008	-,041	-,006	,034	,018	-,020
	VAR00007	,039	,006	,015	,015	-,061	-,019		,018	-,074	,001	,039	-,026	,019	,004
	VAR00008	-,048	,085	,005	-,048	-,095	,065	,018		,000	-,034	,038	,031	,026	-,048
	VAR00009	-,015	-,024	,018	,031	,022	,008	-,074	,000		,016	-,009	,054	-,022	,004
	VAR00010	-,025	-,002	,012	,036	,071	-,041	,001	-,034	,016		-,008	-,067	,000	,048
	VAR00011	,057	-,026	-,035	-,033	-,019	-,006	,039	,038	-,009	-,008		,013	,004	-,024
	VAR00012	-,018	-,019	-,031	,064	-,027	,034	-,026	,031	,054	-,067	,013		,002	-,007
	VAR00013	,002	,019	-,001	-,040	-,036	,018	,019	,026	-,022	,000	,004	,002		-,001

	VAR 0001 4	,010	-,012	,015	,002	,042	-,020	,004	-,048	,004	,048	-,024	-,007	-,001	

Extraction Method: Principal Axis Factoring.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 14 (15,0%) nonredundant residuals with absolute values greater than 0.05.

Rotated Factor Matrix[a]

	Factor			
	1	2	3	4
VAR00001				,663
VAR00002				,539
VAR00003	,577			,433
VAR00004	,547			
VAR00005	,608			
VAR00006	,674			
VAR00007	,678			
VAR00008	,425	,562		
VAR00009		,625		,413
VAR00010		,780		
VAR00011		,795		
VAR00012			,523	
VAR00013			,861	
VAR00014			,834	

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 6 iterations.

F. PROCUREMENT MANAGEMENT COMPLEXITY AREA

Correlation Matrix[a]

		VAR00002	VAR00003	VAR00005	VAR00006	VAR00007	VAR00009	VAR00010	VAR00011	VAR00012	VAR00013	VAR00014	VAR00015	VAR00016
Correlation	VAR00002	1,000	,466	,366	,518	,145	,551	,325	,500	,285	,307	,351	,360	,274
	VAR00003	,466	1,000	,312	,486	,314	,468	,344	,472	,389	,400	,357	,349	,260
	VAR00005	,366	,312	1,000	,383	,539	,301	,324	,156	,207	,235	,382	,283	,543
	VAR00006	,518	,486	,383	1,000	,353	,453	,308	,496	,260	,426	,331	,450	,288
	VAR00007	,145	,314	,539	,353	1,000	,288	,391	,291	,325	,312	,428	,397	,535
	VAR00009	,551	,468	,301	,453	,288	1,000	,498	,518	,462	,466	,414	,457	,288
	VAR00010	,325	,344	,324	,308	,391	,498	1,000	,350	,530	,511	,680	,524	,503
	VAR00011	,500	,472	,156	,496	,291	,518	,350	1,000	,328	,414	,425	,356	,387
	VAR00012	,285	,389	,207	,260	,325	,462	,530	,328	1,000	,549	,510	,580	,314
	VAR00013	,307	,400	,235	,426	,312	,466	,511	,414	,549	1,000	,538	,680	,421
	VAR00014	,351	,357	,382	,331	,428	,414	,680	,425	,510	,538	1,000	,656	,472
	VAR00015	,360	,349	,283	,450	,397	,457	,524	,356	,580	,680	,656	1,000	,429
	VAR00016	,274	,260	,543	,288	,535	,288	,503	,387	,314	,421	,472	,429	1,000
Sig. (1-tailed)	VAR00002		,000	,000	,000	,073	,000	,000	,000	,002	,001	,000	,000	,003
	VAR00003	,000		,001	,000	,001	,000	,000	,000	,000	,000	,000	,000	,004

	VAR00005	,000	,001		,000	,000	,001	,000	,059	,019	,009	,000	,002	,000
	VAR00006	,000	,000	,000		,000	,000	,001	,000	,004	,000	,000	,000	,002
	VAR00007	,073	,001	,000	,000		,002	,000	,002	,000	,001	,000	,000	,000
	VAR00009	,000	,000	,001	,000	,002		,000	,000	,000	,000	,000	,000	,002
	VAR00010	,000	,000	,000	,001	,000	,000		,000	,000	,000	,000	,000	,000
	VAR00011	,000	,000	,059	,000	,002	,000	,000		,000	,000	,000	,000	,000
	VAR00012	,002	,000	,019	,004	,000	,000	,000	,000		,000	,000	,000	,001
	VAR00013	,001	,000	,009	,000	,001	,000	,000	,000	,000		,000	,000	,000
	VAR00014	,000	,000	,000	,000	,000	,000	,000	,000	,000	,000		,000	,000
	VAR00015	,000	,000	,002	,000	,000	,000	,000	,000	,000	,000	,000		,000
	VAR00016	,003	,004	,000	,002	,000	,002	,000	,000	,001	,000	,000	,000	

a. Determinant = ,002

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,851
Bartlett's Test of Sphericity	Approx. Chi-Square	620,661
	df	78
	Sig.	,000

Anti-image Matrices

		VAR0 0002	VAR0 0003	VAR0 0005	VAR0 0006	VAR0 0007	VAR0 0009	VAR0 0010	VAR0 0011	VAR0 0012	VAR0 0013	VAR0 0014	VAR0 0015	VAR0 0016
Anti-image Covariance	VAR0 0002	,497	-,082	-,121	-,104	,148	-,129	-,003	-,109	,000	,057	-,013	-,040	-,005
	VAR0 0003	-,082	,597	-,043	-,091	-,051	-,039	-,006	-,084	-,085	-,052	-,005	,037	,047
	VAR0 0005	-,121	-,043	,471	-,098	-,167	-,049	,045	,170	,014	,022	-,081	,060	-,184
	VAR0 0006	-,104	-,091	-,098	,509	-,066	-,005	-,016	-,124	,078	-,061	,063	-,094	,074
	VAR0 0007	,148	-,051	-,167	-,066	,531	-,018	-,014	-,050	-,042	,049	-,024	-,046	-,108
	VAR0 0009	-,129	-,039	-,049	-,005	-,018	,483	-,114	-,114	-,064	-,043	,053	-,032	,073
	VAR0 0010	-,003	-,006	,045	-,016	-,014	-,114	,418	,062	-,085	-,031	-,175	,035	-,116
	VAR0 0011	-,109	-,084	,170	-,124	-,050	-,114	,062	,472	-,006	-,031	-,098	,073	-,141
	VAR0 0012	,000	-,085	,014	,078	-,042	-,064	-,085	-,006	,529	-,081	-,013	-,101	,031
	VAR0 0013	,057	-,052	,022	-,061	,049	-,043	-,031	-,031	-,081	,440	-,013	-,146	-,065
	VAR0 0014	-,013	-,005	-,081	,063	-,024	,053	-,175	-,098	-,013	-,013	,367	-,136	,029
	VAR0 0015	-,040	,037	,060	-,094	-,046	-,032	,035	,073	-,101	-,146	-,136	,356	-,046
	VAR0 0016	-,005	,047	-,184	,074	-,108	,073	-,116	-,141	,031	-,065	,029	-,046	,465
Anti-image Correlation	VAR0 0002	,835[a]	-,150	-,250	-,207	,288	-,263	-,006	-,224	,001	,122	-,030	-,095	-,009
	VAR0 0003	-,150	,928[a]	-,082	-,166	-,091	-,073	-,012	-,159	-,151	-,102	-,010	,080	,089
	VAR0 0005	-,250	-,082	,719[a]	-,201	-,334	-,103	,102	,361	,029	,047	-,195	,146	-,393

	VAR00006	-,207	-,166	-,201	,858[a]	-,127	-,011	-,034	-,252	,150	-,130	,145	-,221	,151
	VAR00007	,288	-,091	-,334	-,127	,845[a]	-,036	-,030	-,099	-,080	,102	-,054	-,107	-,216
	VAR00009	-,263	-,073	-,103	-,011	-,036	,893[a]	-,254	-,238	-,126	-,094	,126	-,077	,155
	VAR00010	-,006	-,012	,102	-,034	-,030	-,254	,858[a]	,141	-,181	-,071	-,446	,091	-,263
	VAR00011	-,224	-,159	,361	-,252	-,099	-,238	,141	,784[a]	-,012	-,068	-,236	,178	-,300
	VAR00012	,001	-,151	,029	,150	-,080	-,126	-,181	-,012	,916[a]	-,169	-,028	-,234	,062
	VAR00013	,122	-,102	,047	-,130	,102	-,094	-,071	-,068	-,169	,905[a]	-,032	-,370	-,143
	VAR00014	-,030	-,010	-,195	,145	-,054	,126	-,446	-,236	-,028	-,032	,849[a]	-,377	,070
	VAR00015	-,095	,080	,146	-,221	-,107	-,077	,091	,178	-,234	-,370	-,377	,847[a]	-,114
	VAR00016	-,009	,089	-,393	,151	-,216	,155	-,263	-,300	,062	-,143	,070	-,114	,812[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

	Initial	Extraction
VAR00002	,503	,574
VAR00003	,403	,440
VAR00005	,529	,672
VAR00006	,491	,507
VAR00007	,469	,504
VAR00009	,517	,544
VAR00010	,582	,565

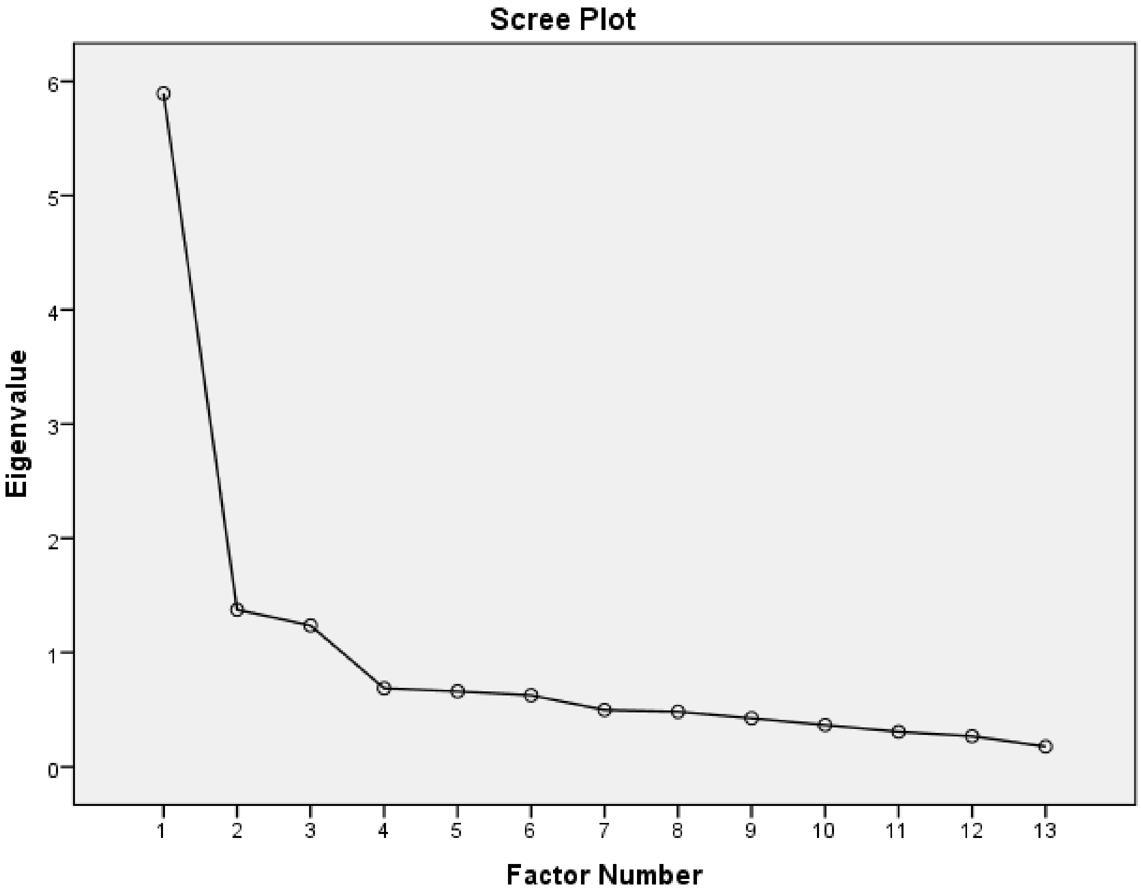
VAR00011	,528	,475
VAR00012	,471	,510
VAR00013	,560	,584
VAR00014	,633	,631
VAR00015	,644	,647
VAR00016	,535	,544

Extraction Method: Principal Axis Factoring.

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,894	45,340	45,340	5,452	41,940	41,940	2,899	22,300	22,300
2	1,375	10,578	55,919	,916	7,048	48,988	2,482	19,089	41,389
3	1,237	9,513	65,432	,828	6,372	55,360	1,816	13,971	55,360
4	,687	5,287	70,719						
5	,660	5,078	75,796						
6	,626	4,813	80,609						
7	,497	3,824	84,433						
8	,482	3,709	88,142						
9	,424	3,265	91,407						
10	,365	2,811	94,218						
11	,306	2,358	96,575						
12	,268	2,062	98,638						
13	,177	1,362	100,000						

Extraction Method: Principal Axis Factoring.



Reproduced Correlations

		VAR0 0002	VAR0 0003	VAR0 0005	VAR0 0006	VAR0 0007	VAR0 0009	VAR0 0010	VAR0 0011	VAR0 0012	VAR0 0013	VAR0 0014	VAR0 0015	VAR0 0016
Reproduced Correlation	VAR0 0002	,574[a]	,490	,312	,530	,241	,520	,303	,504	,290	,353	,315	,341	,264
	VAR0 0003	,490	,440[a]	,305	,467	,273	,480	,353	,454	,333	,387	,369	,388	,300
	VAR0 0005	,312	,305	,672[a]	,374	,544	,276	,338	,268	,189	,234	,366	,282	,544
	VAR0 0006	,530	,467	,374	,507[a]	,310	,496	,347	,475	,312	,371	,364	,373	,333
	VAR0 0007	,241	,273	,544	,310	,504[a]	,282	,418	,253	,299	,335	,449	,388	,521
	VAR0 0009	,520	,480	,276	,496	,282	,544[a]	,432	,505	,426	,482	,451	,484	,320

	VAR00010	,303	,353	,338	,347	,418	,432	,565[a]	,370	,517	,555	,597	,597	,465
	VAR00011	,504	,454	,268	,475	,253	,505	,370	,475[a]	,363	,418	,386	,416	,284
	VAR00012	,290	,333	,189	,312	,299	,426	,517	,363	,510[a]	,543	,543	,571	,350
	VAR00013	,353	,387	,234	,371	,335	,482	,555	,418	,543	,584[a]	,583	,611	,388
	VAR00014	,315	,369	,366	,364	,449	,451	,597	,386	,543	,583	,631[a]	,628	,498
	VAR00015	,341	,388	,282	,373	,388	,484	,597	,416	,571	,611	,628	,647[a]	,443
	VAR00016	,264	,300	,544	,333	,521	,320	,465	,284	,350	,388	,498	,443	,544[a]
Residual[b]	VAR00002		-,023	,054	-,012	-,096	,031	,022	-,003	-,005	-,045	,036	,019	,010
	VAR00003	-,023		,007	,018	,041	-,013	-,009	,017	,056	,012	-,013	-,040	-,041
	VAR00005	,054	,007		,009	-,005	,024	-,014	-,112	,018	,001	,016	,001	-,001
	VAR00006	-,012	,018	,009		,043	-,043	-,039	,021	-,052	,055	-,033	,077	-,045
	VAR00007	-,096	,041	-,005	,043		,007	-,028	,038	,026	-,023	-,021	,008	,014
	VAR00009	,031	-,013	,024	-,043	,007		,066	,013	,037	-,016	-,036	-,028	-,032
	VAR00010	,022	-,009	-,014	-,039	-,028	,066		-,020	,013	-,044	,083	-,073	,037
	VAR00011	-,003	,017	-,112	,021	,038	,013	-,020		-,034	-,004	,039	-,060	,103
	VAR00012	-,005	,056	,018	-,052	,026	,037	,013	-,034		,006	-,033	,009	-,036
	VAR00013	-,045	,012	,001	,055	-,023	-,016	-,044	-,004	,006		-,044	,069	,033

	VAR00014	,036	-,013	,016	-,033	-,021	-,036	,083	,039	-,033	-,044		,028	-,026
	VAR00015	,019	-,040	,001	,077	,008	-,028	-,073	-,060	,009	,069	,028		-,013
	VAR00016	,010	-,041	-,001	-,045	,014	-,032	,037	,103	-,036	,033	-,026	-,013	

Extraction Method: Principal Axis Factoring.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 13 (16,0%) nonredundant residuals with absolute values greater than 0.05.

Rotated Factor Matrix[a]

	Factor		
	1	2	3
VAR00002		,729	
VAR00003		,585	
VAR00005			,776
VAR00006		,636	
VAR00007			,629
VAR00009		,611	
VAR00010	,647		
VAR00011		,607	
VAR00012	,661		
VAR00013	,679		
VAR00014	,679		
VAR00015	,723		
VAR00016			,618

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 5 iterations.

G. RISK MANAGEMENT COMPLEXITY AREA

Correlation Matrix[a]

		VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006	VAR00007	VAR00008
Correlation	VAR00001	1,000	,512	,550	,582	,360	,436	,420	,476
	VAR00002	,512	1,000	,202	,491	,143	,270	,192	,465
	VAR00003	,550	,202	1,000	,453	,530	,511	,545	,395
	VAR00004	,582	,491	,453	1,000	,370	,348	,402	,447
	VAR00005	,360	,143	,530	,370	1,000	,484	,483	,352
	VAR00006	,436	,270	,511	,348	,484	1,000	,559	,308
	VAR00007	,420	,192	,545	,402	,483	,559	1,000	,324
	VAR00008	,476	,465	,395	,447	,352	,308	,324	1,000
Sig. (1-tailed)	VAR00001		,000	,000	,000	,000	,000	,000	,000
	VAR00002	,000		,021	,000	,076	,003	,026	,000
	VAR00003	,000	,021		,000	,000	,000	,000	,000
	VAR00004	,000	,000	,000		,000	,000	,000	,000
	VAR00005	,000	,076	,000	,000		,000	,000	,000
	VAR00006	,000	,003	,000	,000	,000		,000	,001
	VAR00007	,000	,026	,000	,000	,000	,000		,000

	VAR00008	,000	,000	,000	,000	,000	,001	,000	

a. Determinant = ,047

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,858
Bartlett's Test of Sphericity	Approx. Chi-Square	297,375
	df	28
	Sig.	,000

Anti-image Matrices

		VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006	VAR00007	VAR00008
Anti-image Covariance	VAR00001	,471	-,156	-,143	-,129	,011	-,050	-,025	-,064
	VAR00002	-,156	,596	,093	-,155	,066	-,074	,037	-,178
	VAR00003	-,143	,093	,489	-,058	-,127	-,085	-,108	-,061
	VAR00004	-,129	-,155	-,058	,549	-,064	,027	-,067	-,056
	VAR00005	,011	,066	-,127	-,064	,612	-,126	-,088	-,091
	VAR00006	-,050	-,074	-,085	,027	-,126	,575	-,182	,016
	VAR00007	-,025	,037	-,108	-,067	-,088	-,182	,562	-,025
	VAR00008	-,064	-,178	-,061	-,056	-,091	,016	-,025	,644

Anti-image Correlation	VAR00001	,860[a]	-,294	-,298	-,254	,021	-,097	-,048	-,115
	VAR00002	-,294	,745[a]	,172	-,271	,109	-,126	,064	-,287
	VAR00003	-,298	,172	,854[a]	-,112	-,232	-,160	-,205	-,109
	VAR00004	-,254	-,271	-,112	,882[a]	-,111	,047	-,120	-,094
	VAR00005	,021	,109	-,232	-,111	,874[a]	-,212	-,151	-,145
	VAR00006	-,097	-,126	-,160	,047	-,212	,865[a]	-,320	,026
	VAR00007	-,048	,064	-,205	-,120	-,151	-,320	,874[a]	-,041
	VAR00008	-,115	-,287	-,109	-,094	-,145	,026	-,041	,889[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

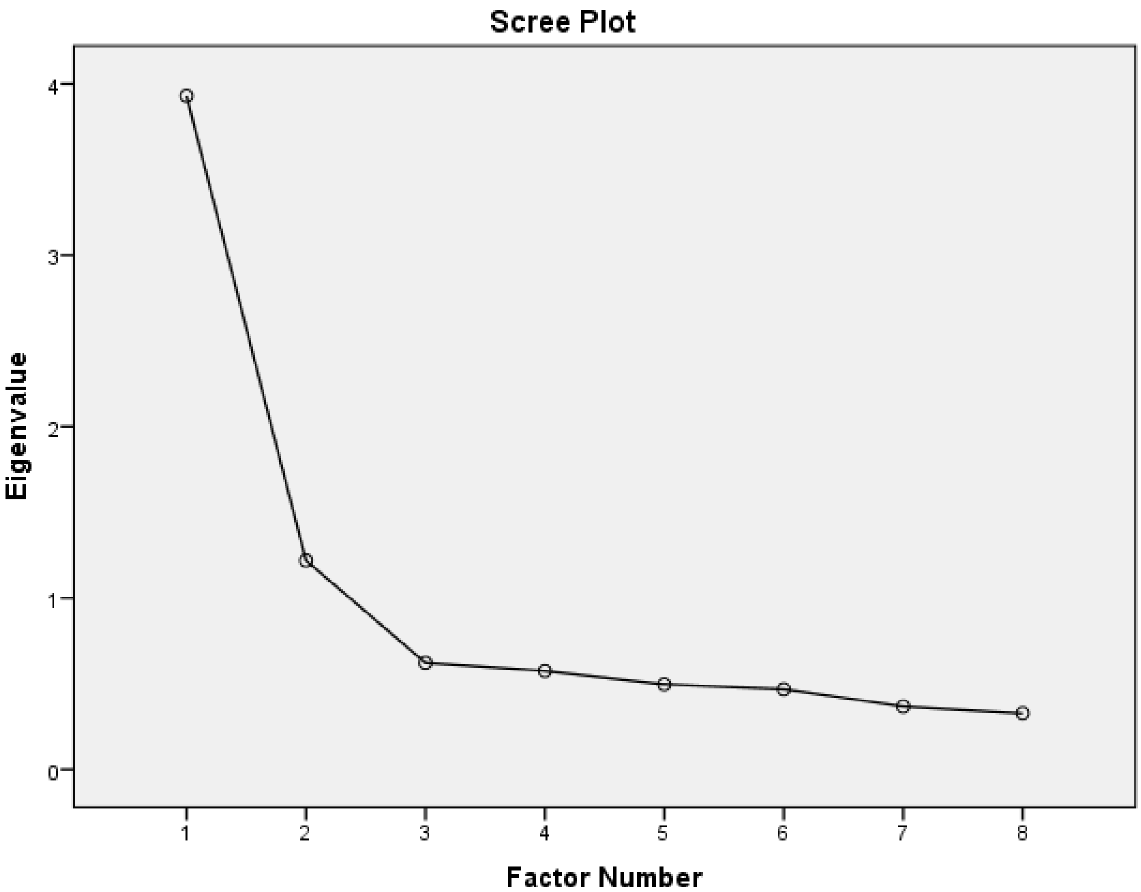
	Initial	Extraction
VAR00001	,529	,605
VAR00002	,404	,626
VAR00003	,511	,600
VAR00004	,451	,519
VAR00005	,388	,470
VAR00006	,425	,479
VAR00007	,438	,537
VAR00008	,356	,403

Extraction Method: Principal Axis Factoring.

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,931	49,133	49,133	3,464	43,296	43,296	2,325	29,062	29,062
2	1,218	15,228	64,361	,774	9,677	52,973	1,913	23,911	52,973
3	,621	7,766	72,127						
4	,574	7,172	79,299						
5	,495	6,190	85,489						
6	,467	5,835	91,325						
7	,367	4,589	95,913						
8	,327	4,087	100,000						

Extraction Method: Principal Axis Factoring.



Reproduced Correlations

		VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006	VAR00007	VAR00008
Reproduced Correlation	VAR00001	,605[a]	,523	,497	,559	,399	,440	,438	,492
	VAR00002	,523	,626[a]	,246	,497	,156	,215	,184	,445
	VAR00003	,497	,246	,600[a]	,446	,527	,536	,566	,384
	VAR00004	,559	,497	,446	,519[a]	,355	,395	,391	,457
	VAR00005	,399	,156	,527	,355	,470[a]	,471	,502	,304
	VAR00006	,440	,215	,536	,395	,471	,479[a]	,506	,340
	VAR00007	,438	,184	,566	,391	,502	,506	,537[a]	,335
	VAR00008	,492	,445	,384	,457	,304	,340	,335	,403[a]
Residual[b]	VAR00001		-,011	,054	,023	-,039	-,005	-,018	-,016
	VAR00002	-,011		-,045	-,006	-,013	,055	,009	,020
	VAR00003	,054	-,045		,008	,003	-,025	-,020	,010
	VAR00004	,023	-,006	,008		,015	-,046	,011	-,010
	VAR00005	-,039	-,013	,003	,015		,012	-,020	,048
	VAR00006	-,005	,055	-,025	-,046	,012		,053	-,033

	VAR00007	-,018	,009	-,020	,011	-,020	,053		-,011
	VAR00008	-,016	,020	,010	-,010	,048	-,033	-,011	

Extraction Method: Principal Axis Factoring.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 3 (10,0%) nonredundant residuals with absolute values greater than 0.05.

Rotated Factor Matrix[a]

	Factor	
	1	2
VAR00001	,440	,641
VAR00002		,790
VAR00003	,723	
VAR00004		,611
VAR00005	,665	
VAR00006	,648	
VAR00007	,705	
VAR00008		,548

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 3 iterations.

H. SCOPE MANAGEMENT COMPLEXITY AREA

Correlation Matrix[a]

		VAR0 0001	VAR0 0002	VAR0 0003	VAR0 0004	VAR0 0006	VAR0 0007	VAR0 0008	VAR0 0009	VAR0 0010	VAR0 0011	VAR0 0012	VAR0 0013
Correlation	VAR0 0001	1,000	,366	,517	,583	,251	,202	,502	,276	,455	,443	,218	,047
	VAR0 0002	,366	1,000	,513	,408	,197	,181	,496	,151	,309	,310	,337	,093
	VAR0 0003	,517	,513	1,000	,690	,232	,175	,548	,390	,488	,459	,291	,216
	VAR0 0004	,583	,408	,690	1,000	,114	,119	,657	,503	,579	,557	,178	,312
	VAR0 0006	,251	,197	,232	,114	1,000	,611	,080	,072	,129	,114	,413	,193
	VAR0 0007	,202	,181	,175	,119	,611	1,000	,031	,214	,046	,092	,582	,116
	VAR0 0008	,502	,496	,548	,657	,080	,031	1,000	,342	,483	,538	,216	,275
	VAR0 0009	,276	,151	,390	,503	,072	,214	,342	1,000	,389	,364	,319	,549
	VAR0 0010	,455	,309	,488	,579	,129	,046	,483	,389	1,000	,618	,133	,241
	VAR0 0011	,443	,310	,459	,557	,114	,092	,538	,364	,618	1,000	,220	,365
	VAR0 0012	,218	,337	,291	,178	,413	,582	,216	,319	,133	,220	1,000	,206
	VAR0 0013	,047	,093	,216	,312	,193	,116	,275	,549	,241	,365	,206	1,000
Sig. (1-tailed)	VAR0 0001		,000	,000	,000	,005	,021	,000	,003	,000	,000	,014	,319
	VAR0 0002	,000		,000	,000	,024	,034	,000	,065	,001	,001	,000	,176
	VAR0 0003	,000	,000		,000	,010	,039	,000	,000	,000	,000	,002	,015

	VAR00004	,000	,000	,000		,127	,117	,000	,000	,000	,000	,036	,001
	VAR00006	,005	,024	,010	,127		,000	,213	,236	,097	,128	,000	,026
	VAR00007	,021	,034	,039	,117	,000		,378	,015	,324	,180	,000	,124
	VAR00008	,000	,000	,000	,000	,213	,378		,000	,000	,000	,015	,003
	VAR00009	,003	,065	,000	,000	,236	,015	,000		,000	,000	,001	,000
	VAR00010	,000	,001	,000	,000	,097	,324	,000	,000		,000	,091	,007
	VAR00011	,000	,001	,000	,000	,128	,180	,000	,000	,000		,013	,000
	VAR00012	,014	,000	,002	,036	,000	,000	,015	,001	,091	,013		,019
	VAR00013	,319	,176	,015	,001	,026	,124	,003	,000	,007	,000	,019	

a. Determinant = ,004

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,809
Bartlett's Test of Sphericity	Approx. Chi-Square	520,855
	df	66
	Sig.	,000

Anti-image Matrices

	VAR00001	VAR00002	VAR00003	VAR00004	VAR00006	VAR00007	VAR00008	VAR00009	VAR00010	VAR00011	VAR00012	VAR00013

Anti-image Covariance	VAR00001	,532	-,015	-,036	-,098	-,097	-,015	-,073	-,037	-,036	-,067	,006	,149
	VAR00002	-,015	,616	-,134	-,001	-,003	-,010	-,141	,074	-,021	,013	-,116	,016
	VAR00003	-,036	-,134	,427	-,142	-,065	,032	-,015	-,040	-,029	-,011	-,042	,032
	VAR00004	-,098	-,001	-,142	,316	,037	-,035	-,111	-,083	-,059	-,032	,067	-,027
	VAR00006	-,097	-,003	-,065	,037	,531	-,253	,021	,131	-,062	,045	-,040	-,156
	VAR00007	-,015	-,010	,032	-,035	-,253	,461	,059	-,076	,049	-,011	-,211	,063
	VAR00008	-,073	-,141	-,015	-,111	,021	,059	,448	,016	-,011	-,076	-,044	-,052
	VAR00009	-,037	,074	-,040	-,083	,131	-,076	,016	,489	-,083	,045	-,105	-,256
	VAR00010	-,036	-,021	-,029	-,059	-,062	,049	-,011	-,083	,505	-,198	,035	,048
	VAR00011	-,067	,013	-,011	-,032	,045	-,011	-,076	,045	-,198	,486	-,049	-,130
	VAR00012	,006	-,116	-,042	,067	-,040	-,211	-,044	-,105	,035	-,049	,548	-,001
	VAR00013	,149	,016	,032	-,027	-,156	,063	-,052	-,256	,048	-,130	-,001	,570
Anti-image Correlation	VAR00001	,880[a]	-,026	-,076	-,239	-,182	-,031	-,151	-,072	-,070	-,132	,011	,270
	VAR00002	-,026	,857[a]	-,262	-,002	-,005	-,018	-,269	,135	-,038	,024	-,199	,027
	VAR00003	-,076	-,262	,886[a]	-,388	-,137	,071	-,033	-,087	-,062	-,025	-,087	,064
	VAR00004	-,239	-,002	-,388	,856[a]	,091	-,092	-,296	-,210	-,148	-,081	,161	-,064
	VAR00006	-,182	-,005	-,137	,091	,614[a]	-,512	,042	,257	-,119	,088	-,073	-,283

	VAR00007	-,031	-,018	,071	-,092	-,512	,634[a]	,130	-,160	,102	-,023	-,420	,123
	VAR00008	-,151	-,269	-,033	-,296	,042	,130	,889[a]	,034	-,024	-,163	-,089	-,102
	VAR00009	-,072	,135	-,087	-,210	,257	-,160	,034	,739[a]	-,166	,093	-,202	-,484
	VAR00010	-,070	-,038	-,062	-,148	-,119	,102	-,024	-,166	,871[a]	-,400	,066	,089
	VAR00011	-,132	,024	-,025	-,081	,088	-,023	-,163	,093	-,400	,859[a]	-,094	-,248
	VAR00012	,011	-,199	-,087	,161	-,073	-,420	-,089	-,202	,066	-,094	,767[a]	-,002
	VAR00013	,270	,027	,064	-,064	-,283	,123	-,102	-,484	,089	-,248	-,002	,624[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

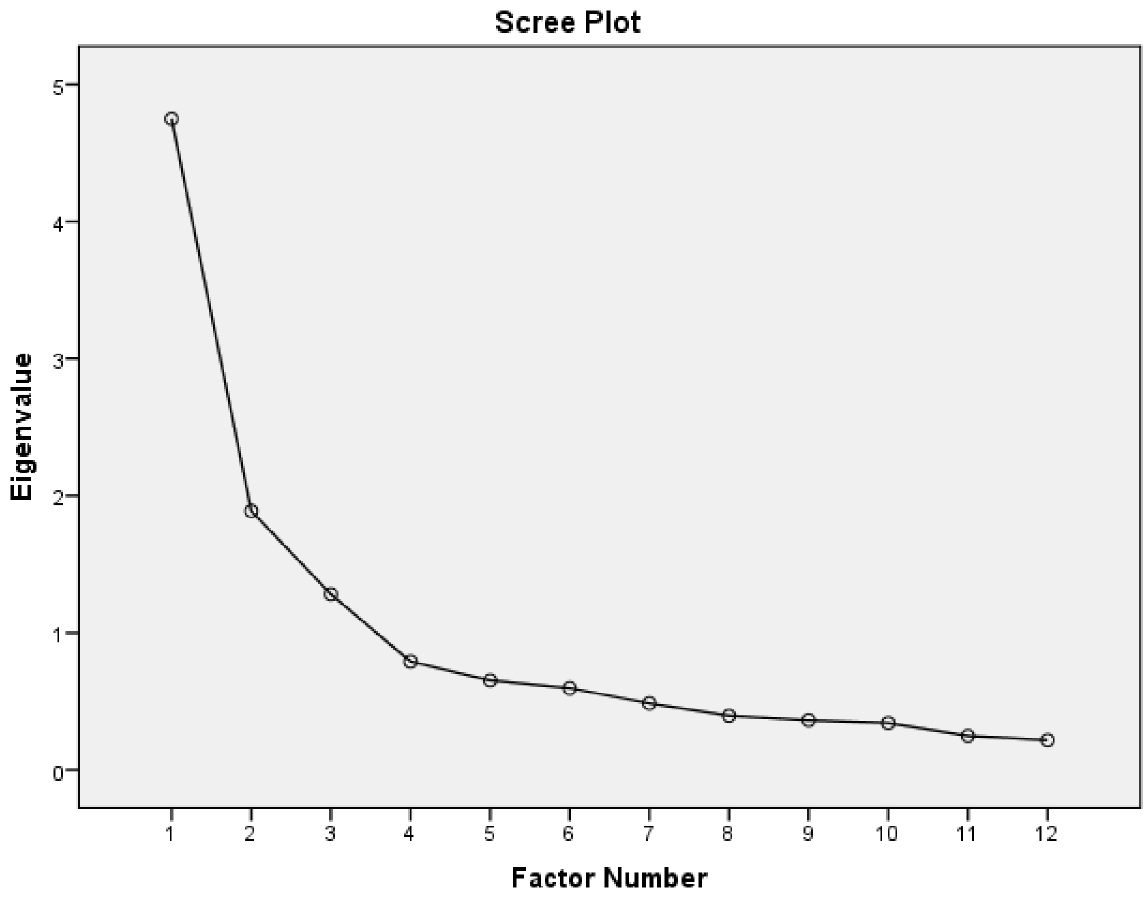
	Initial	Extraction
VAR00001	,468	,502
VAR00002	,384	,365
VAR00003	,573	,600
VAR00004	,684	,737
VAR00006	,469	,443
VAR00007	,539	,808
VAR00008	,552	,589
VAR00009	,511	,553
VAR00010	,495	,485
VAR00011	,514	,500
VAR00012	,452	,465
VAR00013	,430	,599

Extraction Method: Principal Axis Factoring.

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,749	39,573	39,573	4,310	35,919	35,919	3,452	28,771	28,771
2	1,888	15,733	55,306	1,505	12,539	48,458	1,803	15,025	43,796
3	1,281	10,675	65,980	,830	6,919	55,377	1,390	11,581	55,377
4	,789	6,578	72,558						
5	,652	5,432	77,990						
6	,595	4,957	82,947						
7	,485	4,044	86,991						
8	,394	3,286	90,277						
9	,362	3,015	93,291						
10	,341	2,844	96,136						
11	,247	2,061	98,197						
12	,216	1,803	100,000						

Extraction Method: Principal Axis Factoring.



Reproduced Correlations

		VAR0 0001	VAR0 0002	VAR0 0003	VAR0 0004	VAR0 0006	VAR0 0007	VAR0 0008	VAR0 0009	VAR0 0010	VAR0 0011	VAR0 0012	VAR0 0013
Reproduced Correlation	VAR0 0001	,502[a]	,424	,538	,553	,206	,192	,507	,243	,436	,425	,252	,095
	VAR0 0002	,424	,365[a]	,449	,445	,217	,224	,409	,192	,349	,341	,250	,065
	VAR0 0003	,538	,449	,600[a]	,642	,218	,203	,577	,360	,512	,512	,289	,216
	VAR0 0004	,553	,445	,642	,737[a]	,131	,079	,655	,460	,597	,600	,232	,324
	VAR0 0006	,206	,217	,218	,131	,443[a]	,592	,105	,160	,087	,113	,442	,117

	VAR0 0007	,192	,224	,203	,079	,592	,808[a]	,049	,187	,039	,079	,582	,156
	VAR0 0008	,507	,409	,577	,655	,105	,049	,589[a]	,369	,529	,525	,187	,236
	VAR0 0009	,243	,192	,360	,460	,160	,187	,369	,553[a]	,383	,429	,269	,549
	VAR0 0010	,436	,349	,512	,597	,087	,039	,529	,383	,485[a]	,489	,172	,278
	VAR0 0011	,425	,341	,512	,600	,113	,079	,525	,429	,489	,500[a]	,205	,337
	VAR0 0012	,252	,250	,289	,232	,442	,582	,187	,269	,172	,205	,465[a]	,225
	VAR0 0013	,095	,065	,216	,324	,117	,156	,236	,549	,278	,337	,225	,599[a]
Residual[b]	VAR0 0001		-,059	-,021	,031	,045	,009	-,005	,033	,019	,018	-,034	-,048
	VAR0 0002	-,059		,063	-,038	-,021	-,042	,087	-,040	-,039	-,030	,087	,028
	VAR0 0003	-,021	,063		,048	,014	-,028	-,030	,030	-,024	-,053	,002	,000
	VAR0 0004	,031	-,038	,048		-,018	,040	,002	,042	-,017	-,043	-,054	-,012
	VAR0 0006	,045	-,021	,014	-,018		,019	-,025	-,088	,042	,001	-,029	,076
	VAR0 0007	,009	-,042	-,028	,040	,019		-,018	,027	,007	,013	,000	-,041
	VAR0 0008	-,005	,087	-,030	,002	-,025	-,018		-,027	-,046	,012	,028	,039
	VAR0 0009	,033	-,040	,030	,042	-,088	,027	-,027		,007	-,066	,051	,001
	VAR0 0010	,019	-,039	-,024	-,017	,042	,007	-,046	,007		,129	-,039	-,037
	VAR0 0011	,018	-,030	-,053	-,043	,001	,013	,012	-,066	,129		,015	,029

	VAR00012	-,034	,087	,002	-,054	-,029	,000	,028	,051	-,039	,015		-,018
	VAR00013	-,048	,028	,000	-,012	,076	-,041	,039	,001	-,037	,029	-,018	

Extraction Method: Principal Axis Factoring.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 11 (16,0%) nonredundant residuals with absolute values greater than 0.05.

Rotated Factor Matrix[a]

	Factor		
	1	2	3
VAR00001	,680		
VAR00002	,554		
VAR00003	,734		
VAR00004	,802		
VAR00006		,655	
VAR00007		,896	
VAR00008	,741		
VAR00009			,655
VAR00010	,641		
VAR00011	,614		
VAR00012		,631	
VAR00013			,758

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 5 iterations.

I. INTEGRATION MANAGEMENT COMPLEXITY AREA

Correlation Matrix[a]

		VAR 00001	VAR 00002	VAR 00003	VAR 00004	VAR 00005	VAR 00006	VAR 00007	VAR 00008	VAR 00009	VAR 00010	VAR 00011	VAR 00012	VAR 00013	VAR 00014
Correlation	VAR 00001	1,000	,551	,423	,444	,152	,304	,543	,235	,291	,107	,230	,388	,531	,432
	VAR 00002	,551	1,000	,525	,493	,273	,435	,618	,221	,302	,128	,209	,272	,374	,350
	VAR 00003	,423	,525	1,000	,506	,359	,476	,531	,431	,432	,366	,287	,174	,382	,321
	VAR 00004	,444	,493	,506	1,000	,306	,383	,618	,176	,328	,139	,186	,284	,548	,442
	VAR 00005	,152	,273	,359	,306	1,000	,452	,369	,480	,469	,440	,076	,221	,187	,180
	VAR 00006	,304	,435	,476	,383	,452	1,000	,366	,498	,626	,510	,102	,221	,417	,214
	VAR 00007	,543	,618	,531	,618	,369	,366	1,000	,291	,400	,372	,189	,273	,561	,487
	VAR 00008	,235	,221	,431	,176	,480	,498	,291	1,000	,623	,603	,040	,161	,342	,297
	VAR 00009	,291	,302	,432	,328	,469	,626	,400	,623	1,000	,573	,153	,240	,447	,350
	VAR 00010	,107	,128	,366	,139	,440	,510	,372	,603	,573	1,000	,193	,235	,409	,223
	VAR 00011	,230	,209	,287	,186	,076	,102	,189	,040	,153	,193	1,000	,453	,149	,023
	VAR 00012	,388	,272	,174	,284	,221	,221	,273	,161	,240	,235	,453	1,000	,204	,140
	VAR 00013	,531	,374	,382	,548	,187	,417	,561	,342	,447	,409	,149	,204	1,000	,441
	VAR 00014	,432	,350	,321	,442	,180	,214	,487	,297	,350	,223	,023	,140	,441	1,000
Sig. (1-tailed)	VAR 00001		,000	,000	,000	,064	,001	,000	,009	,002	,143	,010	,000	,000	,000

	VAR 00002	,000		,000	,000	,003	,000	,000	,013	,001	,099	,018	,003	,000	,000
	VAR 00003	,000	,000		,000	,000	,000	,000	,000	,000	,000	,002	,040	,000	,001
	VAR 00004	,000	,000	,000		,001	,000	,000	,038	,000	,082	,031	,002	,000	,000
	VAR 00005	,064	,003	,000	,001		,000	,000	,000	,000	,000	,223	,013	,030	,035
	VAR 00006	,001	,000	,000	,000	,000		,000	,000	,000	,000	,153	,013	,000	,015
	VAR 00007	,000	,000	,000	,000	,000	,000		,002	,000	,000	,029	,003	,000	,000
	VAR 00008	,009	,013	,000	,038	,000	,000	,002		,000	,000	,347	,053	,000	,001
	VAR 00009	,002	,001	,000	,000	,000	,000	,000	,000		,000	,063	,008	,000	,000
	VAR 00010	,143	,099	,000	,082	,000	,000	,000	,000	,000		,026	,009	,000	,012
	VAR 00011	,010	,018	,002	,031	,223	,153	,029	,347	,063	,026		,000	,068	,409
	VAR 00012	,000	,003	,040	,002	,013	,013	,003	,053	,008	,009	,000		,020	,080
	VAR 00013	,000	,000	,000	,000	,030	,000	,000	,000	,000	,000	,068	,020		,000
	VAR 00014	,000	,000	,001	,000	,035	,015	,000	,001	,000	,012	,409	,080	,000	

a. Determinant = ,001

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,828
Bartlett's Test of Sphericity	Approx. Chi-Square	629,520
	df	91
	Sig.	,000

Anti-image Matrices

		VAR 00001	VAR 00002	VAR 00003	VAR 00004	VAR 00005	VAR 00006	VAR 00007	VAR 00008	VAR 00009	VAR 00010	VAR 00011	VAR 00012	VAR 00013	VAR 00014
Anti-image Covariance	VAR 00001	,450	-,084	-,065	,060	,031	-,022	-,070	-,043	,007	,121	-,019	-,163	-,152	-,092
	VAR 00002	-,084	,450	-,089	,007	-,011	-,129	-,147	-,003	,023	,096	-,034	-,027	,025	-,023
	VAR 00003	-,065	-,089	,477	-,117	-,004	-,047	-,037	-,096	-,001	-,048	-,143	,124	,059	,013
	VAR 00004	,060	,007	-,117	,417	-,080	-,070	-,110	,050	,002	,128	-,008	-,093	-,149	-,098
	VAR 00005	,031	-,011	-,004	-,080	,605	-,058	-,068	-,109	-,056	-,061	,042	-,051	,108	,042
	VAR 00006	-,022	-,129	-,047	-,070	-,058	,440	,079	-,008	-,143	-,102	,074	-,003	-,031	,085
	VAR 00007	-,070	-,147	-,037	-,110	-,068	,079	,351	,053	-,013	-,112	,028	,016	-,049	-,061
	VAR 00008	-,043	-,003	-,096	,050	-,109	-,008	,053	,445	-,125	-,124	,086	-,006	-,016	-,057
	VAR 00009	,007	,023	-,001	,002	-,056	-,143	-,013	-,125	,422	-,041	-,041	-,015	-,042	-,074
	VAR 00010	,121	,096	-,048	,128	-,061	-,102	-,112	-,124	-,041	,387	-,077	-,080	-,118	-,024

	VAR 0001 1	-,019	-,034	-,143	-,008	,042	,074	,028	,086	-,041	-,077	,692	-,257	-,006	,077
	VAR 0001 2	-,163	-,027	,124	-,093	-,051	-,003	,016	-,006	-,015	-,080	-,257	,629	,074	,028
	VAR 0001 3	-,152	,025	,059	-,149	,108	-,031	-,049	-,016	-,042	-,118	-,006	,074	,439	-,030
	VAR 0001 4	-,092	-,023	,013	-,098	,042	,085	-,061	-,057	-,074	-,024	,077	,028	-,030	,633
Anti-image Correlation	VAR 0000 1	,811[a]	-,187	-,139	,139	,059	-,050	-,177	-,096	,017	,291	-,033	-,307	-,342	-,172
	VAR 0000 2	-,187	,848[a]	-,192	,017	-,022	-,290	-,370	-,006	,052	,231	-,061	-,052	,055	-,044
	VAR 0000 3	-,139	-,192	,870[a]	-,263	-,008	-,103	-,092	-,209	-,003	-,112	-,249	,227	,130	,024
	VAR 0000 4	,139	,017	-,263	,798[a]	-,159	-,163	-,287	,116	,004	,318	-,014	-,182	-,349	-,191
	VAR 0000 5	,059	-,022	-,008	-,159	,879[a]	-,113	-,148	-,210	-,111	-,127	,065	-,082	,209	,069
	VAR 0000 6	-,050	-,290	-,103	-,163	-,113	,845[a]	,201	-,018	-,333	-,248	,134	-,007	-,070	,160
	VAR 0000 7	-,177	-,370	-,092	-,287	-,148	,201	,850[a]	,135	-,034	-,305	,057	,033	-,126	-,130
	VAR 0000 8	-,096	-,006	-,209	,116	-,210	-,018	,135	,846[a]	-,289	-,298	,156	-,010	-,035	-,108

	VAR 0000 9	,017	,052	-,003	,004	-,111	-,333	-,034	-,289	,901[a]	-,103	-,076	-,030	-,097	-,143
	VAR 0001 0	,291	,231	-,112	,318	-,127	-,248	-,305	-,298	-,103	,731[a]	-,148	-,163	-,285	-,049
	VAR 0001 1	-,033	-,061	-,249	-,014	,065	,134	,057	,156	-,076	-,148	,642[a]	-,390	-,011	,117
	VAR 0001 2	-,307	-,052	,227	-,182	-,082	-,007	,033	-,010	-,030	-,163	-,390	,700[a]	,142	,045
	VAR 0001 3	-,342	,055	,130	-,349	,209	-,070	-,126	-,035	-,097	-,285	-,011	,142	,829[a]	-,057
	VAR 0001 4	-,172	-,044	,024	-,191	,069	,160	-,130	-,108	-,143	-,049	,117	,045	-,057	,892[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

	Initial	Extraction
VAR00001	,550	,537
VAR00002	,550	,513
VAR00003	,523	,467
VAR00004	,583	,557
VAR00005	,395	,358
VAR00006	,560	,520
VAR00007	,649	,667
VAR00008	,555	,618
VAR00009	,578	,643
VAR00010	,613	,613

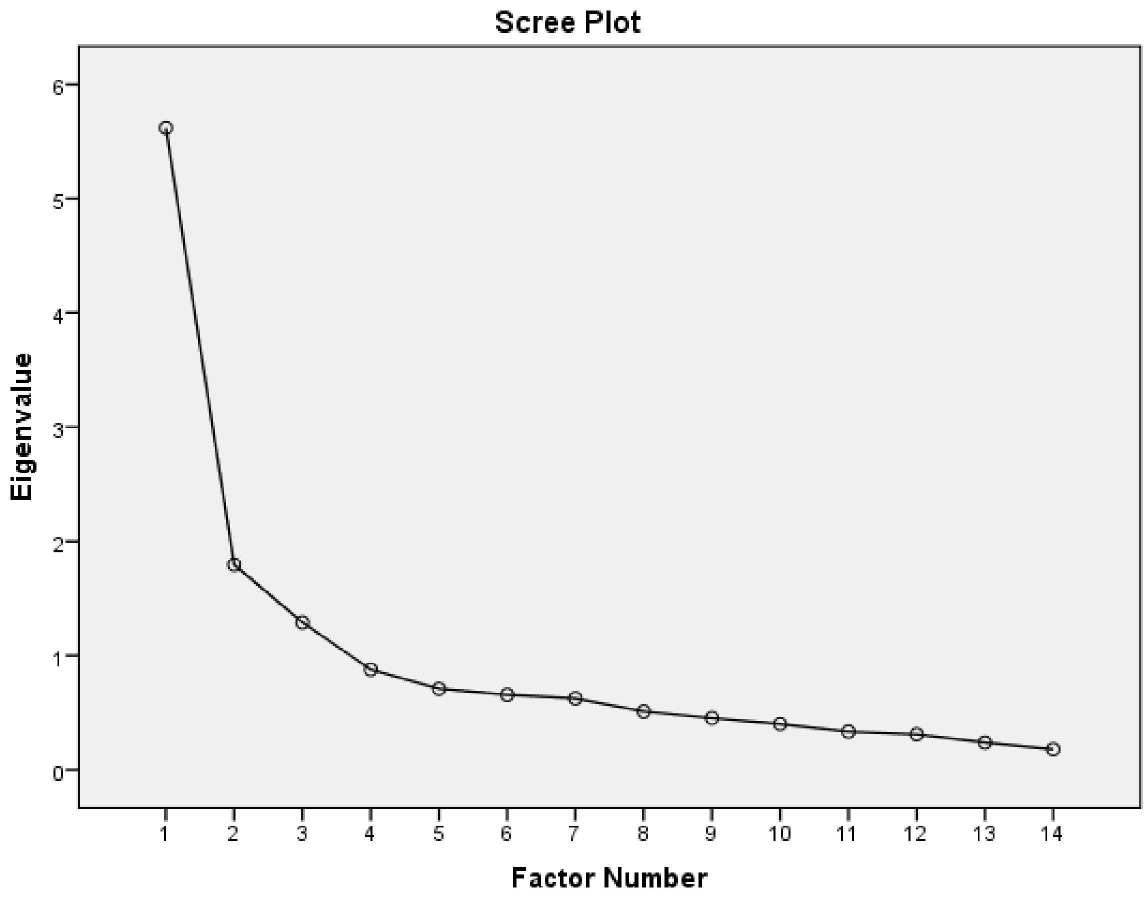
VAR00011	,308	,651
VAR00012	,371	,362
VAR00013	,561	,474
VAR00014	,367	,359

Extraction Method: Principal Axis Factoring.

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,619	40,135	40,135	5,154	36,813	36,813	3,291	23,504	23,504
2	1,796	12,825	52,960	1,359	9,705	46,518	2,898	20,702	44,206
3	1,290	9,216	62,177	,827	5,908	52,426	1,151	8,220	52,426
4	,877	6,266	68,442						
5	,709	5,066	73,509						
6	,657	4,689	78,198						
7	,625	4,464	82,662						
8	,511	3,648	86,310						
9	,453	3,235	89,545						
10	,400	2,860	92,405						
11	,334	2,388	94,793						
12	,310	2,215	97,007						
13	,239	1,710	98,717						
14	,180	1,283	100,000						

Extraction Method: Principal Axis Factoring.



Reproduced Correlations

		VAR 00001	VAR 00002	VAR 00003	VAR 00004	VAR 00005	VAR 00006	VAR 00007	VAR 00008	VAR 00009	VAR 00010	VAR 00011	VAR 00012	VAR 00013	VAR 00014
Reproduced Correlation	VAR 00001	,537[a]	,521	,437	,538	,205	,306	,576	,176	,283	,158	,260	,300	,459	,390
	VAR 00002	,521	,513[a]	,448	,532	,236	,340	,578	,226	,325	,200	,223	,282	,469	,399
	VAR 00003	,437	,448	,467[a]	,459	,343	,444	,528	,390	,464	,377	,229	,288	,456	,362

	VAR00004	,538	,532	,459	,557[a]	,241	,350	,604	,234	,333	,195	,180	,261	,492	,427
	VAR00005	,205	,236	,343	,241	,358[a]	,427	,315	,461	,479	,454	,113	,176	,309	,224
	VAR00006	,306	,340	,444	,350	,427	,520[a]	,439	,540	,574	,523	,137	,224	,415	,314
	VAR00007	,576	,578	,528	,604	,315	,439	,667[a]	,332	,432	,289	,191	,289	,555	,474
	VAR00008	,176	,226	,390	,234	,461	,540	,332	,618[a]	,618	,599	,050	,153	,349	,251
	VAR00009	,283	,325	,464	,333	,479	,574	,432	,618	,643[a]	,604	,139	,231	,422	,310
	VAR00010	,158	,200	,377	,195	,454	,523	,289	,599	,604	,613[a]	,173	,220	,309	,194
	VAR00011	,260	,223	,229	,180	,113	,137	,191	,050	,139	,173	,651[a]	,456	,130	,020
	VAR00012	,300	,282	,288	,261	,176	,224	,289	,153	,231	,220	,456	,362[a]	,229	,134
	VAR00013	,459	,469	,456	,492	,309	,415	,555	,349	,422	,309	,130	,229	,474[a]	,401
	VAR00014	,390	,399	,362	,427	,224	,314	,474	,251	,310	,194	,020	,134	,401	,359[a]
Residual[b]	VAR00001		,029	-,014	-,095	-,054	-,002	-,033	,059	,008	-,051	-,029	,088	,072	,042

	VAR00002	,029		,078	-,040	,037	,095	,040	-,005	-,023	-,072	-,014	-,010	-,095	-,049
	VAR00003	-,014	,078		,047	,016	,032	,003	,041	-,032	-,011	,059	-,115	-,075	-,041
	VAR00004	-,095	-,040	,047		,065	,033	,014	-,058	-,004	-,056	,005	,022	,056	,015
	VAR00005	-,054	,037	,016	,065		,025	,053	,019	-,011	-,014	-,037	,045	-,122	-,044
	VAR00006	-,002	,095	,032	,033	,025		-,073	-,042	,052	-,013	-,034	-,003	,002	-,100
	VAR00007	-,033	,040	,003	,014	,053	-,073		-,041	-,032	,083	-,002	-,016	,006	,013
	VAR00008	,059	-,005	,041	-,058	,019	-,042	-,041		,005	,004	-,010	,008	-,007	,046
	VAR00009	,008	-,023	-,032	-,004	-,011	,052	-,032	,005		-,032	,013	,009	,024	,041
	VAR00010	-,051	-,072	-,011	-,056	-,014	-,013	,083	,004	-,032		,020	,015	,100	,029
	VAR00011	-,029	-,014	,059	,005	-,037	-,034	-,002	-,010	,013	,020		-,002	,018	,003
	VAR00012	,088	-,010	-,115	,022	,045	-,003	-,016	,008	,009	,015	-,002		-,025	,006
	VAR00013	,072	-,095	-,075	,056	-,122	,002	,006	-,007	,024	,100	,018	-,025		,040

	VAR 0001 4	,042	-,049	-,041	,015	-,044	-,100	,013	,046	,041	,029	,003	,006	,040	

Extraction Method: Principal Axis Factoring.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 24 (26,0%) nonredundant residuals with absolute values greater than 0.05.

Rotated Factor Matrix[a]

	Factor		
	1	2	3
VAR00001	,687		
VAR00002	,673		
VAR00003	,517		
VAR00004	,718		
VAR00005		,557	
VAR00006		,631	
VAR00007	,758		
VAR00008		,769	
VAR00009		,743	
VAR00010		,763	
VAR00011			,800
VAR00012			,533
VAR00013	,602		
VAR00014	,561		

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 5 iterations.

J. STAKEHOLDERS MANAGEMENT COMPLEXITY AREA

Correlation Matrix[a]

		VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006	VAR00007
Correlation	VAR00001	1,000	,784	,646	,521	,233	,283	,578
	VAR00002	,784	1,000	,635	,475	,299	,304	,503
	VAR00003	,646	,635	1,000	,570	,269	,301	,602
	VAR00004	,521	,475	,570	1,000	,262	,351	,431
	VAR00005	,233	,299	,269	,262	1,000	,569	,326
	VAR00006	,283	,304	,301	,351	,569	1,000	,441
	VAR00007	,578	,503	,602	,431	,326	,441	1,000
Sig. (1-tailed)	VAR00001		,000	,000	,000	,009	,002	,000
	VAR00002	,000		,000	,000	,001	,001	,000
	VAR00003	,000	,000		,000	,003	,001	,000
	VAR00004	,000	,000	,000		,004	,000	,000
	VAR00005	,009	,001	,003	,004		,000	,000
	VAR00006	,002	,001	,001	,000	,000		,000
	VAR00007	,000	,000	,000	,000	,000	,000	

a. Determinant = ,038

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,812
Bartlett's Test of Sphericity	Approx. Chi-Square	320,485
	df	21
	Sig.	,000

Anti-image Matrices

	VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006	VAR00007

Anti-image Covariance	VAR00001	,316	-,202	-,048	-,072	,033	,016	-,100
	VAR00002	-,202	,347	-,089	-,004	-,060	-,012	,017
	VAR00003	-,048	-,089	,427	-,155	-,016	,030	-,149
	VAR00004	-,072	-,004	-,155	,607	-,009	-,099	,003
	VAR00005	,033	-,060	-,016	-,009	,654	-,299	-,024
	VAR00006	,016	-,012	,030	-,099	-,299	,587	-,142
	VAR00007	-,100	,017	-,149	,003	-,024	-,142	,515
Anti-image Correlation	VAR00001	,786[a]	-,609	-,131	-,165	,073	,036	-,249
	VAR00002	-,609	,791[a]	-,231	-,010	-,126	-,027	,041
	VAR00003	-,131	-,231	,861[a]	-,305	-,030	,061	-,318
	VAR00004	-,165	-,010	-,305	,890[a]	-,014	-,165	,005
	VAR00005	,073	-,126	-,030	-,014	,736[a]	-,482	-,041
	VAR00006	,036	-,027	,061	-,165	-,482	,731[a]	-,258
	VAR00007	-,249	,041	-,318	,005	-,041	-,258	,860[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

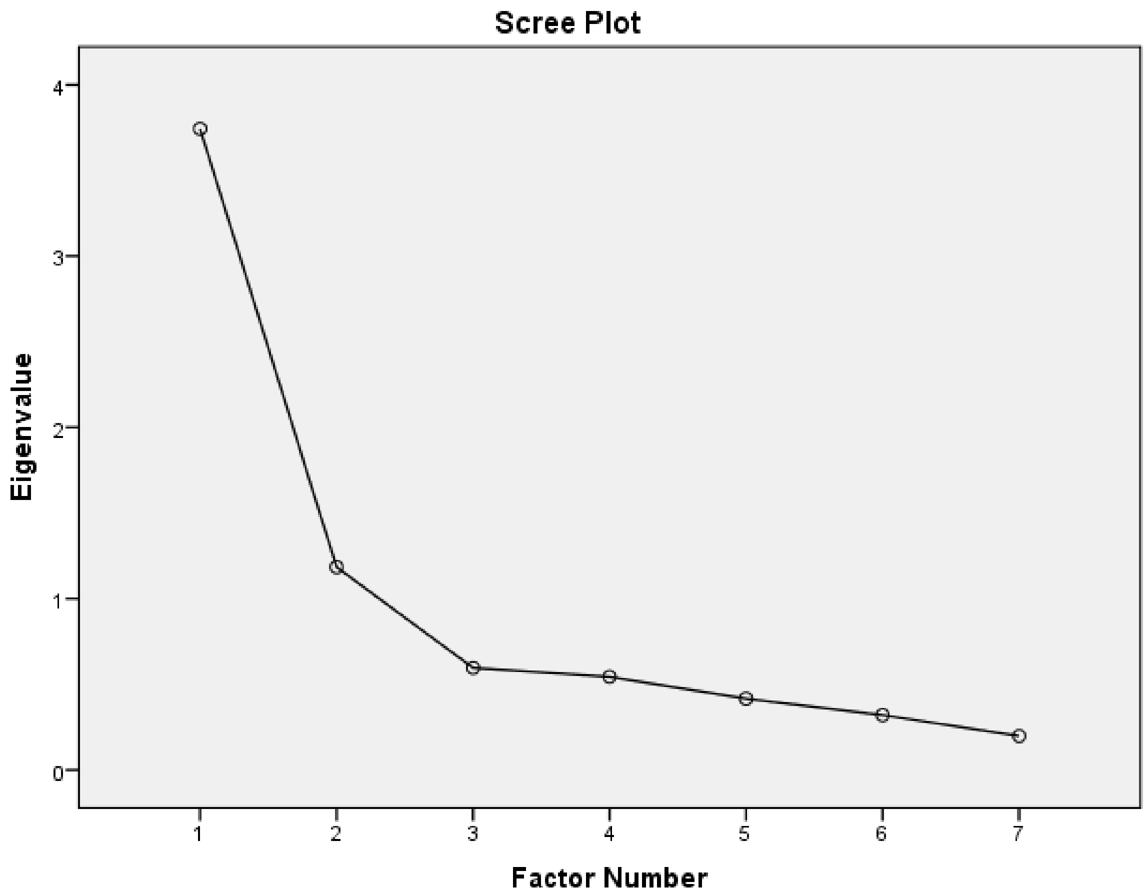
	Initial	Extraction
VAR00001	,684	,775
VAR00002	,653	,670
VAR00003	,573	,645
VAR00004	,393	,405
VAR00005	,346	,377
VAR00006	,413	,872
VAR00007	,485	,499

Extraction Method: Principal Axis Factoring.

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3,743	53,474	53,474	3,369	48,129	48,129	2,774	39,625	39,625
2	1,184	16,912	70,387	,874	12,480	60,610	1,469	20,985	60,610
3	,596	8,510	78,897						
4	,544	7,765	86,661						
5	,416	5,941	92,602						
6	,320	4,569	97,172						
7	,198	2,828	100,000						

Extraction Method: Principal Axis Factoring.



Reproduced Correlations

		VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006	VAR00007
Reproduced Correlation	VAR00001	,775[a]	,719	,703	,537	,250	,269	,575
	VAR00002	,719	,670[a]	,657	,509	,264	,303	,549
	VAR00003	,703	,657	,645[a]	,503	,276	,325	,546
	VAR00004	,537	,509	,503	,405[a]	,271	,346	,447
	VAR00005	,250	,264	,276	,271	,377[a]	,567	,331
	VAR00006	,269	,303	,325	,346	,567	,872[a]	,437
	VAR00007	,575	,549	,546	,447	,331	,437	,499[a]
Residual[b]	VAR00001		,066	-,057	-,016	-,016	,014	,003
	VAR00002	,066		-,022	-,034	,035	,001	-,046
	VAR00003	-,057	-,022		,067	-,008	-,025	,056
	VAR00004	-,016	-,034	,067		-,009	,006	-,016
	VAR00005	-,016	,035	-,008	-,009		,002	-,006
	VAR00006	,014	,001	-,025	,006	,002		,004
	VAR00007	,003	-,046	,056	-,016	-,006	,004	

Extraction Method: Principal Axis Factoring.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 4 (19,0%) nonredundant residuals with absolute values greater than 0.05.

Rotated Factor Matrix[a]

	Factor	
	1	2
VAR00001	,871	
VAR00002	,799	
VAR00003	,776	

VAR00004	,578	
VAR00005		,580
VAR00006		,917
VAR00007	,607	

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 3 iterations.

K. TECHNICAL SOFTWARE DEVELOPMENT COMPLEXITY FACTORS

Correlation Matrix[a]

		VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006	VAR00007	VAR00008	VAR00009	VAR00010	VAR00011	VAR00012	VAR00013	VAR00015	VAR00016	VAR00017	VAR00018
Correlation	VAR00001	1,000	,186	,560	,193	,308	,363	,242	,141	,171	,369	,176	,255	,255	,196	,159	,186	,193
	VAR00002	,186	1,000	,259	,385	,339	,503	,496	,352	,250	,295	,365	,357	,368	,190	,288	,231	,206
	VAR00003	,560	,259	1,000	,244	,094	,388	,289	,259	-,037	,183	,159	,273	,386	,223	,169	,019	-,001
	VAR00004	,193	,385	,244	1,000	,418	,520	,463	,451	,206	,300	,331	,481	,585	,378	,505	,239	,173
	VAR00005	,308	,339	,094	,418	1,000	,488	,419	,355	,616	,671	,594	,280	,455	,191	,497	,618	,637
	VAR00006	,363	,503	,388	,520	,488	1,000	,403	,542	,217	,343	,353	,471	,591	,407	,431	,181	,263
	VAR00007	,242	,496	,289	,463	,419	,403	1,000	,387	,305	,363	,496	,338	,467	,191	,353	,385	,404
	VAR00008	,141	,352	,259	,451	,355	,542	,387	1,000	,151	,290	,274	,343	,415	,251	,312	,271	,200
	VAR00009	,171	,250	-,037	,206	,616	,217	,305	,151	1,000	,435	,419	,142	,277	,098	,234	,649	,771
	VAR00010	,369	,295	,183	,300	,671	,343	,363	,290	,435	1,000	,540	,212	,315	,045	,243	,516	,550

	VAR00011	,176	,365	,159	,331	,594	,353	,496	,274	,419	,540	1,000	,332	,476	,230	,391	,727	,556
	VAR00012	,255	,357	,273	,481	,280	,471	,338	,343	,142	,212	,332	1,000	,506	,700	,532	,210	,326
	VAR00013	,255	,368	,386	,585	,455	,591	,467	,415	,277	,315	,476	,506	1,000	,421	,440	,340	,319
	VAR00015	,196	,190	,223	,378	,191	,407	,191	,251	,098	,045	,230	,700	,421	1,000	,592	,124	,228
	VAR00016	,159	,288	,169	,505	,497	,431	,353	,312	,234	,243	,391	,532	,440	,592	1,000	,324	,319
	VAR00017	,186	,231	,019	,239	,618	,181	,385	,271	,649	,516	,727	,210	,340	,124	,324	1,000	,707
	VAR00018	,193	,206	-,001	,173	,637	,263	,404	,200	,771	,550	,556	,326	,319	,228	,319	,707	1,000
Sig. (1-tailed)	VAR00001		,030	,000	,026	,001	,000	,007	,079	,043	,000	,039	,005	,005	,024	,055	,030	,026
	VAR00002	,030		,004	,000	,000	,000	,000	,000	,006	,001	,000	,000	,000	,028	,002	,010	,019
	VAR00003	,000	,004		,007	,173	,000	,002	,004	,354	,033	,055	,003	,000	,012	,045	,425	,497
	VAR00004	,026	,000	,007		,000	,000	,000	,000	,019	,001	,000	,000	,000	,000	,000	,008	,041
	VAR00005	,001	,000	,173	,000		,000	,000	,000	,000	,000	,000	,002	,000	,027	,000	,000	,000

	VAR00006	,000	,000	,000	,000	,000		,000	,000	,014	,000	,000	,000	,000	,000	,000	,034	,004
	VAR00007	,007	,000	,002	,000	,000	,000		,000	,001	,000	,000	,000	,000	,027	,000	,000	,000
	VAR00008	,079	,000	,004	,000	,000	,000	,000		,065	,002	,003	,000	,000	,005	,001	,003	,022
	VAR00009	,043	,006	,354	,019	,000	,014	,001	,065		,000	,000	,078	,002	,164	,009	,000	,000
	VAR00010	,000	,001	,033	,001	,000	,000	,000	,002	,000		,000	,016	,001	,326	,007	,000	,000
	VAR00011	,039	,000	,055	,000	,000	,000	,000	,003	,000	,000		,000	,000	,010	,000	,000	,000
	VAR00012	,005	,000	,003	,000	,002	,000	,000	,000	,078	,016	,000		,000	,000	,000	,017	,000
	VAR00013	,005	,000	,000	,000	,000	,000	,000	,000	,002	,001	,000	,000		,000	,000	,000	,001
	VAR00015	,024	,028	,012	,000	,027	,000	,027	,005	,164	,326	,010	,000	,000		,000	,107	,011
	VAR00016	,055	,002	,045	,000	,000	,000	,000	,001	,009	,007	,000	,000	,000	,000		,000	,001
	VAR00017	,030	,010	,425	,008	,000	,034	,000	,003	,000	,000	,000	,017	,000	,107	,000		,000
	VAR00018	,026	,019	,497	,041	,000	,004	,000	,022	,000	,000	,000	,000	,001	,011	,001	,000	

a. Determinant = 4,62E-005

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,836
Bartlett's Test of Sphericity	Approx. Chi-Square	943,290
	df	136
	Sig.	,000

Anti-image Matrices

		VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006	VAR00007	VAR00008	VAR00009	VAR00010	VAR00011	VAR00012	VAR00013	VAR00015	VAR00016	VAR00017	VAR00018
Anti-image Covariance	VAR00001	,533	,047	-,275	,021	-,054	-,079	-,042	,107	-,015	-,099	,075	-,044	,054	-,038	,050	-,058	,031
	VAR00002	,047	,580	-,032	,007	,011	-,129	-,163	-,007	-,092	-,036	-,044	-,092	,044	,045	-,004	,006	,077
	VAR00003	-,275	-,032	,528	,030	,069	-,025	-,047	-,064	,011	-,024	-,032	,008	-,113	,000	-,023	,030	,020
	VAR00004	,021	,007	,030	,463	-,022	-,035	-,108	-,062	-,055	-,055	,025	-,075	-,116	-7,411E-5	-,083	-,010	,093
	VAR00005	-,054	,011	,069	-,022	,272	-,071	,014	-,020	-,067	-,125	-,034	,034	-,029	,042	-,122	-,013	-,020
	VAR00006	-,079	-,129	-,025	-,035	-,071	,378	,037	-,160	,008	,021	-,033	,004	-,095	-,040	-,001	,085	-,025
	VAR00007	-,042	-,163	-,047	-,108	,014	,037	,515	-,076	,033	,032	-,075	,019	-,045	,053	-,036	,026	-,087

	VAR00008	,107	-,007	-,064	-,062	-,020	-,160	-,076	,587	,040	-,042	,080	-,028	,006	-,008	,023	-,100	,022
	VAR00009	-,015	-,092	,011	-,055	-,067	,008	,033	,040	,303	,049	,065	,062	-,023	-,008	,033	-,069	-,150
	VAR00010	-,099	-,036	-,024	-,055	-,125	,021	,032	-,042	,049	,425	-,069	-,006	,028	,061	,045	,013	-,078
	VAR00011	,075	-,044	-,032	,025	-,034	-,033	-,075	,080	,065	-,069	,322	-,010	-,054	-,022	,000	-,165	-,003
	VAR00012	-,044	-,092	,008	-,075	,034	,004	,019	-,028	,062	-,006	-,010	,374	-,051	-,182	-,032	,018	-,080
	VAR00013	,054	,044	-,113	-,116	-,029	-,095	-,045	,006	-,023	,028	-,054	-,051	,434	-,030	,026	-,013	,012
	VAR00015	-,038	,045	,000	-7,411E-5	,042	-,040	,053	-,008	-,008	,061	-,022	-,182	-,030	,388	-,162	,022	-,027
	VAR00016	,050	-,004	-,023	-,083	-,122	-,001	-,036	,023	,033	,045	,000	-,032	,026	-,162	,442	-,028	,009
	VAR00017	-,058	,006	,030	-,010	-,013	,085	,026	-,100	-,069	,013	-,165	,018	-,013	,022	-,028	,264	-,059
	VAR00018	,031	,077	,020	,093	-,020	-,025	-,087	,022	-,150	-,078	-,003	-,080	,012	-,027	,009	-,059	,231
Anti-image Correlation	VAR00001	,688[a]	,084	-,519	,043	-,142	-,176	-,081	,191	-,037	-,208	,182	-,099	,112	-,084	,104	-,155	,090
	VAR00002	,084	,837[a]	-,057	,014	,027	-,276	-,299	-,012	-,219	-,072	-,103	-,197	,087	,095	-,008	,015	,211

	VAR00003	-,519	-,057	,730[a]	,060	,182	-,055	-,091	-,114	,028	-,050	-,078	,019	-,236	,000	-,048	,079	,057
	VAR00004	,043	,014	,060	,878[a]	-,061	-,085	-,222	-,118	-,146	-,125	,065	-,179	-,258	,000	-,183	-,029	,284
	VAR00005	-,142	,027	,182	-,061	,878[a]	-,223	,038	-,051	-,232	-,368	-,114	,107	-,085	,128	-,353	-,047	-,082
	VAR00006	-,176	-,276	-,055	-,085	-,223	,863[a]	,085	-,339	,023	,051	-,096	,010	-,234	-,103	-,003	,268	-,084
	VAR00007	-,081	-,299	-,091	-,222	,038	,085	,879[a]	-,138	,084	,068	-,185	,044	-,096	,119	-,074	,070	-,253
	VAR00008	,191	-,012	-,114	-,118	-,051	-,339	-,138	,842[a]	,094	-,084	,184	-,060	,011	-,016	,046	-,253	,059
	VAR00009	-,037	-,219	,028	-,146	-,232	,023	,084	,094	,779[a]	,136	,207	,183	-,064	-,024	,090	-,243	-,566
	VAR00010	-,208	-,072	-,050	-,125	-,368	,051	,068	-,084	,136	,865[a]	-,186	-,016	,065	,151	,105	,039	-,248
	VAR00011	,182	-,103	-,078	,065	-,114	-,096	-,185	,184	,207	-,186	,838[a]	-,029	-,145	-,063	,001	-,566	-,012
	VAR00012	-,099	-,197	,019	-,179	,107	,010	,044	-,060	,183	-,016	-,029	,838[a]	-,128	-,476	-,079	,056	-,273
	VAR00013	,112	,087	-,236	-,258	-,085	-,234	-,096	,011	-,064	,065	-,145	-,128	,914[a]	-,073	,060	-,038	,037
	VAR00015	-,084	,095	,000	,000	,128	-,103	,119	-,016	-,024	,151	-,063	-,476	-,073	,780[a]	-,391	,068	-,092

	VAR00016	,104	-,008	-,048	-,183	-,353	-,003	-,074	,046	,090	,105	,001	-,079	,060	-,391	,864[a]	-,082	,027
	VAR00017	-,155	,015	,079	-,029	-,047	,268	,070	-,253	-,243	,039	-,566	,056	-,038	,068	-,082	,815[a]	-,238
	VAR00018	,090	,211	,057	,284	-,082	-,084	-,253	,059	-,566	-,248	-,012	-,273	,037	-,092	,027	-,238	,794[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

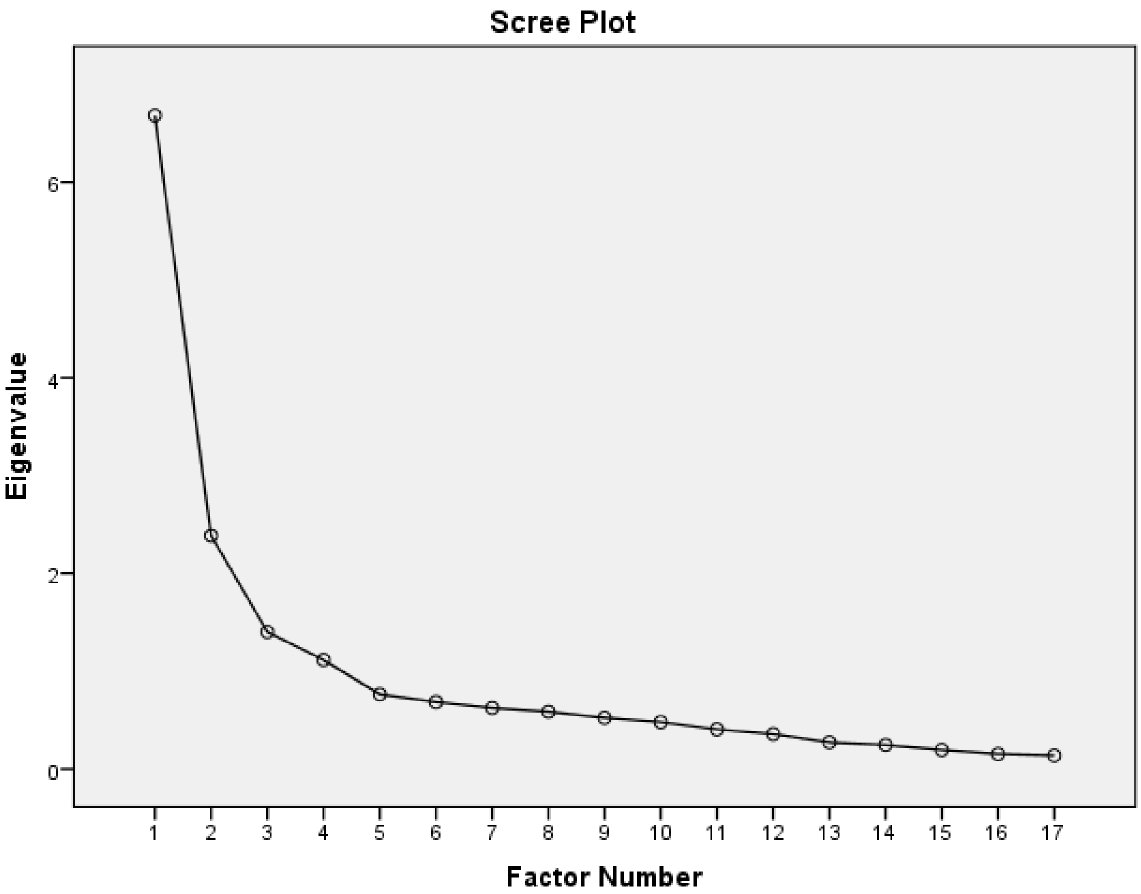
	Initial	Extraction
VAR00001	,467	,895
VAR00002	,420	,373
VAR00003	,472	,479
VAR00004	,537	,538
VAR00005	,728	,691
VAR00006	,622	,610
VAR00007	,485	,454
VAR00008	,413	,385
VAR00009	,697	,602
VAR00010	,575	,528
VAR00011	,678	,563
VAR00012	,626	,616
VAR00013	,566	,558
VAR00015	,612	,930
VAR00016	,558	,510
VAR00017	,736	,711
VAR00018	,769	,798

Extraction Method: Principal Axis Factoring.

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6,682	39,306	39,306	6,283	36,956	36,956	3,709	21,815	21,815
2	2,385	14,028	53,334	2,044	12,023	48,979	3,116	18,330	40,145
3	1,401	8,243	61,577	1,120	6,587	55,565	2,014	11,846	51,991
4	1,114	6,551	68,128	,795	4,677	60,242	1,403	8,251	60,242
5	,763	4,486	72,614						
6	,684	4,025	76,639						
7	,623	3,666	80,305						
8	,584	3,438	83,743						
9	,523	3,075	86,817						
10	,479	2,816	89,633						
11	,405	2,380	92,013						
12	,357	2,097	94,111						
13	,272	1,602	95,712						
14	,245	1,443	97,155						
15	,194	1,141	98,296						
16	,153	,898	99,194						
17	,137	,806	100,000						

Extraction Method: Principal Axis Factoring.



Reproduced Correlations

		VAR00001	VAR00002	VAR00003	VAR00004	VAR00005	VAR00006	VAR00007	VAR00008	VAR00009	VAR00010	VAR00011	VAR00012	VAR00013	VAR00015	VAR00016	VAR00017	VAR00018
Reproduced Correlation	VAR00001	,895[a]	,196	,558	,167	,287	,358	,237	,159	,163	,363	,202	,250	,280	,200	,146	,171	,215
	VAR00002	,196	,373[a]	,259	,425	,376	,456	,401	,375	,195	,309	,349	,312	,432	,188	,314	,256	,216
	VAR00003	,558	,259	,479[a]	,287	,159	,409	,252	,253	-,024	,195	,122	,280	,326	,217	,182	-,002	-,010

	VAR00004	,167	,425	,287	,538[a]	,393	,552	,446	,446	,178	,282	,379	,476	,536	,402	,452	,247	,223
	VAR00005	,287	,376	,159	,393	,691[a]	,426	,488	,352	,591	,579	,620	,331	,464	,202	,399	,664	,671
	VAR00006	,358	,456	,409	,552	,426	,610[a]	,481	,467	,185	,345	,395	,490	,571	,393	,445	,253	,230
	VAR00007	,237	,401	,252	,446	,488	,481	,454[a]	,396	,315	,405	,446	,335	,471	,198	,355	,383	,352
	VAR00008	,159	,375	,253	,446	,352	,467	,396	,385[a]	,164	,274	,333	,345	,445	,239	,339	,225	,188
	VAR00009	,163	,195	-,024	,178	,591	,185	,315	,164	,602[a]	,493	,524	,171	,256	,095	,266	,651	,685
	VAR00010	,363	,309	,195	,282	,579	,345	,405	,274	,493	,528[a]	,504	,198	,356	,047	,254	,549	,545
	VAR00011	,202	,349	,122	,379	,620	,395	,446	,333	,524	,504	,563[a]	,323	,434	,214	,386	,593	,598
	VAR00012	,250	,312	,280	,476	,331	,490	,335	,345	,171	,198	,323	,616[a]	,501	,701	,539	,218	,273
	VAR00013	,280	,432	,326	,536	,464	,571	,471	,445	,256	,356	,434	,501	,558[a]	,430	,475	,325	,317
	VAR00015	,200	,188	,217	,402	,202	,393	,198	,239	,095	,047	,214	,701	,430	,930[a]	,583	,121	,233
	VAR00016	,146	,314	,182	,452	,399	,445	,355	,339	,266	,254	,386	,539	,475	,583	,510[a]	,320	,361

	VAR00017	,171	,256	-,002	,247	,664	,253	,383	,225	,651	,549	,593	,218	,325	,121	,320	,711[a]	,738
	VAR00018	,215	,216	-,010	,223	,671	,230	,352	,188	,685	,545	,598	,273	,317	,233	,361	,738	,798[a]
Residual[b]	VAR00001		-,010	,003	,026	,021	,005	,005	-,019	,008	,005	-,026	,005	-,026	-,004	,013	,015	-,022
	VAR00002	-,010		,001	-,040	-,037	,047	,095	-,023	,055	-,014	,016	,045	-,064	,002	-,025	-,025	-,010
	VAR00003	,003	,001		-,043	-,065	-,021	,036	,005	-,013	-,012	,037	-,007	,061	,006	-,014	,021	,009
	VAR00004	,026	-,040	-,043		,025	-,031	,018	,006	,028	,018	-,048	,005	,049	-,024	,053	-,008	-,050
	VAR00005	,021	-,037	-,065	,025		,061	-,068	,004	,025	,092	-,027	-,052	-,009	-,010	,098	-,046	-,034
	VAR00006	,005	,047	-,021	-,031	,061		-,078	,075	,032	-,002	-,042	-,020	,020	,014	-,014	-,072	,033
	VAR00007	,005	,095	,036	,018	-,068	-,078		-,009	-,009	-,042	,050	,002	-,004	-,006	-,002	,002	,052
	VAR00008	-,019	-,023	,005	,006	,004	,075	-,009		-,014	,016	-,059	-,002	-,030	,012	-,027	,046	,013
	VAR00009	,008	,055	-,013	,028	,025	,032	-,009	-,014		-,058	-,105	-,030	,022	,003	-,032	-,002	,087
	VAR00010	,005	-,014	-,012	,018	,092	-,002	-,042	,016	-,058		,036	,014	-,041	-,001	-,011	-,033	,005

	VAR00011	-,026	,016	,037	-,048	-,027	-,042	,050	-,059	-,105	,036		,008	,042	,016	,005	,134	-,042
	VAR00012	,005	,045	-,007	,005	-,052	-,020	,002	-,002	-,030	,014	,008		,005	-,001	-,007	-,009	,053
	VAR00013	-,026	-,064	,061	,049	-,009	,020	-,004	-,030	,022	-,041	,042	,005		-,009	-,035	,016	,002
	VAR00015	-,004	,002	,006	-,024	-,010	,014	-,006	,012	,003	-,001	,016	-,001	-,009		,009	,003	-,005
	VAR00016	,013	-,025	-,014	,053	,098	-,014	-,002	-,027	-,032	-,011	,005	-,007	-,035	,009		,004	-,041
	VAR00017	,015	-,025	,021	-,008	-,046	-,072	,002	,046	-,002	-,033	,134	-,009	,016	,003	,004		-,031
	VAR00018	-,022	-,010	,009	-,050	-,034	,033	,052	,013	,087	,005	-,042	,053	,002	-,005	-,041	-,031	

Extraction Method: Principal Axis Factoring.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 21 (15,0%) nonredundant residuals with absolute values greater than 0.05.

Rotated Factor Matrix[a]

	Factor			
	1	2	3	4
VAR00001				,917
VAR00002		,565		
VAR00003				,577
VAR00004		,652		

VAR00005	,718			
VAR00006		,670		
VAR00007		,561		
VAR00008		,584		
VAR00009	,769			
VAR00010	,612			
VAR00011	,630			
VAR00012			,655	
VAR00013		,608		
VAR00015			,944	
VAR00016			,539	
VAR00017	,822			
VAR00018	,867			

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.[a]

a. Rotation converged in 5 iterations.

Appendix C

Questionnaire of 2^{nd} survey

Compare the relative importance with respect to:

A. TIME MANAGEMENT

Circle one number per row below using the scale:

1 = Equal 3 = Moderate 5 = Strong 7 = Very strong 9 = Extreme

1	DENSITY OF PROJECT ACTIVITIES (in terms of activities number, variance in duration, interdependencies and criticality)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PROJECT ACTIVITIES RESOURCE CONSTRAINTS (in terms of availability, specialization, variety and overlapping resources
2	DENSITY OF PROJECT ACTIVITIES (in terms of activities number, variance in duration, interdependencies and criticality)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	DENSITY OF PROJECT SCHEDULE (in terms of parallel activities, number of deliverables and deliverable density
3	DENSITY OF PROJECT ACTIVITIES (in terms of activities number, variance in duration, interdependencies and criticality)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ORGANIZATION TIME MANAGEMENT CAPABILITIES (in terms of experience and tools availability to management team)
4	DENSITY OF PROJECT ACTIVITIES (in terms of activities number, variance in duration, interdependencies and criticality)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PROTRACTED PROJECT/ACTIVITIES DURATION (in terms of long project duration and number of long duration activities)
5	PROJECT ACTIVITIES RESOURCE CONSTRAINTS (in terms of availability, specialization, variety and overlapping resources	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	DENSITY OF PROJECT SCHEDULE (in terms of parallel activities, number of deliverables and deliverable density
6	PROJECT ACTIVITIES RESOURCE CONSTRAINTS (in terms of availability, specialization, variety and overlapping resources	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ORGANIZATION TIME MANAGEMENT CAPABILITIES (in terms of experience and tools availability to management team)
7	PROJECT ACTIVITIES RESOURCE CONSTRAINTS (in terms of availability, specialization, variety and overlapping resources	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PROTRACTED PROJECT/ACTIVITIES DURATION (in terms of long project duration and number of long duration activities)
8	DENSITY OF PROJECT SCHEDULE (in terms of parallel activities, number of deliverables and deliverable density	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ORGANIZATION TIME MANAGEMENT CAPABILITIES (in terms of experience and tools availability to management team)
9	DENSITY OF PROJECT SCHEDULE (in terms of parallel activities, number of deliverables and deliverable density	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PROTRACTED PROJECT/ACTIVITIES DURATION (in terms of long project duration and number of long duration activities)

10	ORGANIZATION TIME MANAGEMENT CAPABILITIES (in terms of experience and tools availability to management team)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PROTRACTED PROJECT/ACTIVITIES DURATION (in terms of long project duration and number of long duration activities)

B. COST MANAGEMENT

Circle one number per row below using the scale:

1 = Equal 3 = Moderate 5 = Strong 7 = Very strong 9 = Extreme

1	ORGANIZATION COST MANAGEMENT CAPABILITIES (in terms of experience and tools available to management team and due barriers from external dependencies)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	COMPLICATED FINANCIAL STRUCTURE AND PROCESSES (in terms of number of financiers and time consuming processes for payment approvals and financial reporting)
2	ORGANIZATION COST MANAGEMENT CAPABILITIES (in terms of experience and tools available to management team and due barriers from external dependencies)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	LONG PROJECT DURATION
3	COMPLICATED FINANCIAL STRUCTURE AND PROCESSES (in terms of number of financiers and time consuming processes for payment approvals and financial reporting)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	LONG PROJECT DURATION

C. QUALITY MANAGEMENT

Circle one number per row below using the scale:

1 = Equal 3 = Moderate 5 = Strong 7 = Very strong 9 = Extreme

1	INADEQUECIES IN QUALITY MANAGEMENT DESIGN (in terms of insufficient communication of quality goals, not use of well-known quality management procedures and tools, process immaturity)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ORGANIZATION QUALITYMANAGEMENT CAPABILITIES (in terms of management commitment to quality, quality culture, existence of QA department)
2	INADEQUECIES IN QUALITYMANAGEMENT DESIGN (in terms of insufficient communication of quality goals, not use of well-known quality management procedures and tools, process immaturity)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	RIGOROUS QUALITY CONTROL PROCEDURES (in terms of existence of external audits and thorough quality control procedures within organization)
3	ORGANIZATION QUALITY MANAGEMENT CAPABILITIES (in terms of management commitment to quality, quality culture, existence of QA department)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	RIGOROUS QUALITYCONTROL PROCEDURES (in terms of existence of external audits and thorough quality control procedures within organization)

D. COMMUNICATION MANAGEMENT

Circle one number per row below using the scale:

1 = Equal 3 = Moderate 5 = Strong 7 = Very strong 9 = Extreme

1	ORGANIZATION COMMUNICATION MANAGEMENT CAPABILITIES (in terms of experience within management team, availability of communication tools, clear communication lines and work assignment)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	COMMUNICATION CONSTRAINTS DUE TO PROJECT STRUCTURE AND STAFFING (in terms of geographical distribution, diversity in stakeholders' nationalities and culture)
2	ORGANIZATION COMMUNICATION MANAGEMENT CAPABILITIES (in terms of experience within management team, availability of communication tools, clear communication lines and work assignment)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	DENSITY OF PROJECT COMMUNICATION (in terms of labour time spending to communication, reporting frequency, frequency of meetings, /presentations)
3	COMMUNICATION CONSTRAINTS DUE TO PROJECT STRUCTURE AND STAFFING (in terms of geographical distribution, diversity in stakeholders' nationalities and culture)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	DENSITY OF PROJECT COMMUNICATION (in terms of labour time spending to communication, reporting frequency, frequency of meetings, /presentations)

E. HUMAN RESOURCES MANAGEMENT

Circle one number per row below using the scale:

1 = Equal 3 = Moderate 5 = Strong 7 = Very strong 9 = Extreme

1	PROJECT TEAM COHESION (in terms of staff turnovers, new recruitments, existence of part-time employees, different nationalities, cultures, geographical distribution)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ORGANIZATION HR MANAGEMENT CAPABILITIES (in terms of management team experience, availability of tools to support HR management tasks, existence of Department)
2	PROJECT TEAM COHESION (in terms of staff turnovers, new recruitments, existence of part-time employees, different nationalities, cultures, geographical distribution)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	HR MANAGEMENT CONSTRAINTS DUE TO TEAM STRUCTURE (in terms of number and diversity of project teams, high percentage of outsourced work)
3	PROJECT TEAM COHESION (in terms of staff turnovers, new recruitments, existence of part-time employees, different nationalities, cultures, geographical distribution)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ROJECT TEAM, SIZE AND SKILL DIVERSITY (in terms of project team size and variety of skills required)
4	ORGANIZATION HR MANAGEMENT CAPABILITIES (in terms of management team experience, availability of tools to support HR management tasks, existence of HR department)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	HR MANAGEMENT CONSTRAINTS DUE TO TEAM STRUCTURE (in terms of number and diversity of project teams, high percentage of outsourced work)
5	ORGANIZATION HR MANAGEMENT CAPABILITIES (in terms of management team experience, availability of tools to support HR management	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ROJECT TEAM, SIZE AND SKILL DIVERSITY (in terms of project team size and variety of skills required)

	tasks, existence of department)																		
6	HR MANAGEMENT CONSTRAINTS DUE TO TEAM STRUCTURE (in terms of number and diversity of project teams, high percentage of outsourced work)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ROJECT TEAM, SIZE AND SKILL DIVERSITY (in terms of project team size and variety of skills required)

F. PROCUREMENT MANAGEMENT

Circle one number per row below using the scale:

1 = Equal 3 = Moderate 5 = Strong 7 = Very strong 9 = Extreme

1	DENSITY OF PROCUREMENT PROCESS (in terms of number and variety of supplies and suppliers, number and variety of contracts)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	EXTERNAL BARRIERS IN PROJECT PROCUREMENT PROCESS (in terms of unknown supplier's quality, unavailability or scarce supplies, and procurement restrictions)
2	DENSITY OF PROCUREMENT PROCESS (in terms of number and variety of supplies and suppliers, number and variety of contracts)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ORGANIZATION PROCUREMENT MANAGEMENT CAPABILITIES (in terms of clear procurement policies and procedures, lack of automation in supply chain, experience within management team and tools availability to support procurement management)
3	EXTERNAL BARRIERS IN PROJECT PROCUREMENT PROCESS (in terms of unknown supplier's quality, unavailability or scarce supplies, and procurement restrictions)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ORGANIZATION PROCUREMENT MANAGEMENT CAPABILITIES (in terms of clear procurement policies and procedures, lack of automation in supply chain, experience within management team and tools availability to support procurement management)

G. RISK MANAGEMENT

Circle one number per row below using the scale:

1 = Equal 3 = Moderate 5 = Strong 7 = Very strong 9 = Extreme

1	ORGANIZATION RISK MANAGEMENT CAPABILITIES (in terms of management team experience, availability of tools to support management procedures)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PROJECT RISK DENSITY (in terms of number of risks, impact of risks, lack of flexibility in implementing risk responses, not clear definition of response strategy)

H. SCOPE MANAGEMENT

Circle one number per row below using the scale:

1 = Equal 3 = Moderate 5 = Strong 7 = Very strong 9 = Extreme

1	DENSITY OF PROJECT REQUIREMENTS (in terms of number of requirements, interdependencies, dependencies from external factors, number of non-functional requirements and number of interfaces with other systems)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	QUALITY OF REQUIREMENTS (in terms of requirements characteristics such as volatility, ambiguity, immaturity, conflicts, inconsistency etc.)
2	DENSITY OF PROJECT REQUIREMENTS (in terms of number of requirements, interdependencies, dependencies from external factors, number of non-functional requirements and number of interfaces with other systems)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ORGANIZATION SCOPE MANAGEMENT CAPABILITIES (in terms of experience within management team and availability of tools to support management process)
3	QUALITY OF REQUIREMENTS (in terms of requirements characteristics such as volatility, ambiguity, immaturity, conflicts, inconsistency etc.)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ORGANIZATION SCOPE MANAGEMENT CAPABILITIES (in terms of experience within management team and availability of tools to support management process)

I. INTEGRATION MANAGEMENT

Circle one number per row below using the scale:

1 = Equal 3 = Moderate 5 = Strong 7 = Very strong 9 = Extreme

1	INTEGRATION CONSTRAINTS DUE TO PROJECT CHARACTERISTICS (in terms of project technical/business innovative, volatility in requirements, architecture complexity, new or unproven technology being used, uncertainty due to external changes)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ORGANIZATION INTEGRATION MANAGEMENT CAPABILITIES (in terms of experience within management team, availability of tools to support the process, lack of change management process)
2	INTEGRATION CONSTRAINTS DUE TO PROJECT CHARACTERISTICS (in terms of project technical/business innovative, volatility in requirements, architecture complexity, new or unproven technology being used, uncertainty due to external changes)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	DENSITY OF DELIVERABLES (in terms of number of intermediate deliverables and control of deliverable e.g. lifecycle of acceptance)
3	ORGANIZATION INTEGRATION MANAGEMENT CAPABILITIES (in terms of experience within management team, availability of tools to support the process, lack of change management process)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	DENSITY OF DELIVERABLES (in terms of number of intermediate deliverables and control of deliverable e.g. lifecycle of acceptance)

J. STAKEHOLDERS MANAGEMENT (L: ,091)

Circle one number per row below using the scale:

1 = Equal 3 = Moderate 5 = Strong 7 = Very strong 9 = Extreme

1	DENSITY OF STAKEHOLDERS MANAGEMENT (in terms of number of stakeholders, different stakeholders' categories, existence of stakeholders with different /conflicting interests or negative attitude about the project)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ORGANIZATION STAKEHOLDERS' MANAGEMENT CAPABILITIES (in terms of defining specific strategy to enhance stakeholders' engagement and availability of means to support that)

K. SOFTWARE DEVELOPMENT TECHNICAL FACTORTS

Circle one number per row below using the scale:

1 = Equal 3 = Moderate 5 = Strong 7 = Very strong 9 = Extreme

1	ORGANIZATION TECHNOLOGICAL CAPABILITIES (in terms of use of well-known development models, programming language generation, lack of tools to aid the development, low level technical expertise and/or knowledge of domain)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PRODUCT DEVELOPMENT CONSTRAINTS (in terms of platform volatility, completeness of design, hardware concurrent development, low development flexibility etc.)
2	ORGANIZATION TECHNOLOGICAL CAPABILITIES (in terms of use of well-known development models, programming language generation, lack of tools to aid the development, low level technical expertise and/or knowledge of domain)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PRODUCT QUALITY REQUIREMENTS (in terms of required reliability, execution running and response constraints, number of non-functional requirements)
3	ORGANIZATION TECHNOLOGICAL CAPABILITIES (in terms of use of well-known development models, programming language generation, lack of tools to aid the development, low level technical expertise and/or knowledge of domain)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PRODUCT SIZE (in terms of software (code) and database size)
4	PRODUCT DEVELOPMENT CONSTRAINTS (in terms of platform volatility, completeness of design, hardware concurrent development, low development flexibility etc.)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PRODUCT QUALITY REQUIREMENTS (in terms of required reliability, execution running and response constraints, number of non-functional requirements)
5	PRODUCT DEVELOPMENT CONSTRAINTS (in terms of platform volatility, completeness of design, hardware concurrent development, low development flexibility etc.)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PRODUCT SIZE (in terms of software (code) and database size)
6	PRODUCT QUALITY REQUIREMENTS(in terms of required reliability, execution running and response constraints, number of non-functional requirements)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PRODUCT SIZE (in terms of software (code) and database size)

Appendix D

Charter documents of projects used in case study

Project Ref: Project 1

Subject: Management Information System (MIS) for Ministry of Finance of an EU Member State

Background

The Project aimed to create an MIS for the management and the monitoring of the projects financed from the EU Structural Funds, the EU Cohesion Fund, and the European Maritime and Fisheries Fund.

Goals

- [Management Information for the top hierarchy users]
- [Monitoring of each managed project at the lower level of detail]
- [Tracing and accountability of each user action]

Scope

Inception

Elaboration

Construction and Testing

Key Stakeholders

Client	Ministry of Finance of an EU Member State
Sponsor	Ministry of Finance of an EU Member State
Project manager	25 years of experience in project management 18 of which in managing software projects, PhD in Computer Science
Project team members	Teams of 3-5 persons, Senior και Medium Level, distributed in two sites in Greece and another EU member state, working full time in project.

Project Duration

Project duration: 11 months

(Delivered, Accepted, and paid in full without any penalties)

Project Budget

Project budget: ~1.000.000€

Constraints, Assumptions, Risks and Dependencies

Constraints	Specific technology platform requirements that have restricted the flexibility to take some more efficient design decisions.
Assumptions	Client stakeholders with decision making power able to quickly resolve any misinterpretations/ conflicts of the user requirements. Uninterruptable financial flow.
Risks and Dependencies	Changes of the requirements amid the construction phase (Changes in the EU or National Legislation). Client stakeholders was spread to many departments, resulting in rising bureaucracy obstacles in the Quality Assurance that were very difficult to overcame in a timely manner.

Project Ref: Project 2

Subject: Geographic Information System (GIS) for a major Greek city

Background
The Project aimed to create a GIS for the management and the monitoring of the cadastre and city plan data of a major Greek city.

Goals

- To offer Management Information reporting to the top hierarchy users
- To offer Information exchange and application submission facility to special authorized third party users, and the public
- Tracing and accountability of each user action

Scope
Inception

Elaboration

Construction and Testing

Key Stakeholders

Client	Major Greek municipality
Sponsor	Greek state and EU funds
Project manager	25 years of experience in project management 18 of which in managing software projects, PhD in Computer Science
Project team members	Teams of 3-5 persons, Senior και Medium Level, distributed in one sites in Greece, working full time in project. Every team consisted of a various specialties such as software developers, topographers, urban planners etc.

Project Duration
Project duration: 8 months

(Delivered, Accepted, and paid in full without any penalties)

Project Budget
Project budget: ~500.000€

Constraints, Assumptions, Risks and Dependencies

Constraints	Lack of digital data. Partially completed or missing digital data. Not clearly defined owner of the data (Central government or municipality).
Assumptions	A stable situation of the city plan based on a solid legislation foundations (many times this assumption is broken due to many local regulations or decisions that contradict with the general legislation).
Risks and Dependencies	Large percentage of missing digital data, therefore manual entry was needed. Messy legal foundation of the city plan.

Project Ref: Project 3

Subject: Integrated Support System for Efficient Water Usage and Resources Management

Background

Better water management in households and urban level

Goals

At household level:

a) An information system for gathering data about water usage is planned to increase the awareness of water consumption; the data will be interpreted and presented to household consumers in an understandable way using mobile devices (smartphones, tablets),
b) A household Decision Support System (DSS) will be developed for mobile devices to reduce water consumption. Recommendations regarding water-saving devices and behaviour will be produced,
c) A social-media platform will be developed to reinforce water-saving behaviour of consumers via the social
Interactions among users (and between consumers and experts of water-saving techniques).
At urban level:
a) An innovative decision support system for reducing leaks in the water delivery system will be built based on the dynamic modifications of pumping schedules to reduce leakages at municipal level,
b) An adaptive pricing policy will be developed, as the economic instrument to induce water-saving behaviour and reduce peaks in water and energy distribution loads.

Scope
The overall goal will be achieved by developing an innovative, multi-factor system capable to optimise water management and reduce water usage.

Key Stakeholders

Client	Municipal organisations in Greece and EU member states
Sponsor	National and EU funds
Project manager	14 years of experience in managing projects, PhD holder and faculty member. In addition, local managers exists in each country.
Project team members	33 persons, 10 specialties, Distributed in 5 countries across Europe, Various groups consisted of analysts, developers, project managers, soft engineers, civil engineers, mechanical engineers, telecommunications and networks, Hydrologists, Decision makers, Administrative employees.

Project Duration
Project duration:36 months

Project Budget
Project budget: ~3.350.000€

Project Milestones

- Project set-up
- Spatio-temporal data available
- DSS at household level
- DSS at urban level
- Social-media platform
- Adaptive pricing model and simulation software
- Completion of ISS-EWATUS validation and evaluation

Deliverables

- Dissemination plan: ISS-EWATUS dissemination will be described in details [month 2]
- Dissemination results: report on the dissemination activities will be prepared [month 11]
- Dissemination results: report on the dissemination activities will be prepared [month 23]
- Dissemination results: report on the dissemination activities will be prepared [month 35]
- Exploitation plan: exploitation plan will describe the perspective of future exploitation of the ISS-EWATUS
- by third parties and business [month 30]
- Impact assessment: report will cover all issues of impact assessment of the ISS-EWATUS [month 36]

Constraints, Assumptions, Risks and Dependencies

Constraints	Network or its part is in bad condition, lack of information about geometry of the network. Technical parameters, pressure control issue, adjusting of pressure of water to the real demand. Quality issue, either data are sparse, so there is no monitoring of water quality or water is very low quality.
Assumptions	All parties are committed to the project.
Risks and Dependencies	Partner risks (e.g. a partner underperforms or a key partner leaves the project). Project execution risks (e.g. key milestones or critical deliverables are delayed). Agreement risks (e.g. partners cannot reach an agreement on important issues, e.g. due to conflicts of interest). Problem with installations at households. Delay in implementation of DSS at the household or city level, social-media platform. ISS-EWATUS system cannot be made ready for the implementation at the pilot sites. Competitive technology appears. Poor quality of the scientific content of the delivered document. Contact person is not available i.e. does not respond to emails over the period of the declared availability

Project Ref: Project 4

Subject: Decision Support System (DSS) based on advanced clinical theranostics protocols for the cost-effective, personalised management of HPV related diseases

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Background

To develop a software product that consists of a knowledge-intensive service that will allow the design of screening programs with personalised parameters, Personalised Based Screening (PBS), for every anticipating woman.

Goals

The expected goals of this project can be categorised as follows:

1. Medical

- Balance the scale between sensitivity and specificity of each biomarker-method-medical practice in identification of women at true risk of CxCa development.
- Reduce unnecessary referrals for colposcopy.
- Minimise unnecessary surgical therapeutic interventions that are possible to create side-effects.
- Define in-time and with credibility the cumulative risk of cervical cancer development within 5 years in women that have been treated for intra-epithelial lesions.
- Intercalate personalised medical and biological data in the definition of the necessary follow-up intervals and aid in outlining triaging strategies for population based screening programs, based on the rational calculation of the cumulative risk of progression of the current clinical state to a pre-cancerous lesion.

2. Technological

- Design of a multiplex mRNA analysis assay targeting the quantification of different CxCa related biomarkers at a single cell analysis level (Cytomics).
- Design of a Bead based multiplex – Polymerase Chain Reaction (PCR) detection assay targeting DNA methylation profiling of CxCa (Methylomics).
- Design of a FC based platform allowing Cytomics and Methylomics analysis in a single instrument.
- Development of a 3-classifier/predictor weighted majority voting system composed by advanced intelligent systems, such as an Optimised NeuroFuzzy Artificial Neural Network by Genetic Algorithms, a Fuzzy Bayesian Network, and a Fuzzy SVM, or even a predictor based on Quantum Computing (Bioinformatics and Artificial Intelligence).

3. Social

- Flexible design of population based screening programs according to the specific requirements of each involved catchment area and country.
- Optimised allocation of resources especially under stringent economic conditions.
- Reduction of the social cost due to the increased accuracy of the PBS program and due to the reduction of the un-necessary therapeutic treatments and the associated psychological overhead of the involved women.

4. Commercial

- Exploitation of the usage of Cytomics and Methylomics in CxCa early detection and PBS.
- Exploitation of the software product the DSS potentials in the medical market addressed to healthcare providers, insurance companies and public investment national health decision makers.
- Exploitation of software product for the creation of case-based reasoning Organised Screening Programs **(**OSP).

Scope

The scope of the proposed project is the development of a complete Decision Support System based on advanced diagnostic tests, intelligent classification and prediction models and a cost-effectiveness model. The system will be developed from data obtained under the monitoring of a company, aiming to manage future OSPs using developed software and the experience gained from this project

Key Stakeholders

Client	A consortium of public and private organisations and universities
Sponsor	Greek state and EU funds
Project manager	5 years of experience in managing software projects, MSc holder in business.
Project team members	36 team members, from Universities and Industry, with various specialties. 6 Basic specialties such as biologists, cytologists, economists, engineers, software developers.

Project Duration

Project duration: 27 months

Project Budget

Project budget: ~790.000€

Project Milestones

- Analysis of requirements
- Data collection/ Diagnostics / New markers' research
- Development of informational infrastructures
- Research and development of C/P models and cost effectiveness model
- Components integration
- Study monitoring and quality assurance
- Software product validation

Constraints, Assumptions, Risks and Dependencies

Constraints	Possible lack of data. Concurrent research and development of models required to be implemented by software.
Assumptions	Progress of necessary research within schedule. Clear datasets from patients. Efficient and effective collaboration between all stakeholders.

Risks and Dependencies	Low attendance of follow-up cases and or low patient compliance. Failure to develop Cytomics and or Methylomics. Failure to collect the minimum number of complete cases. Many missing or noisy values in the collected dataset. Failure to integrate the cost-effectiveness model.

Project Ref: Project 5

Subject: Career and Employment Structure (DASTA) IT System

Background
The Career and Employment Structure (DASTA) is an administrative structure aiming in helping students and companies alike in the process of vocational training and employment allocation. Moreover, DASTA cooperates closely and assists the Career Office, The Vocational Placement Office and the Entrepreneurship Unit in delivering their goals.

Goals

The process of finding and allocating both vocational placement and graduate job positions is a very fragmented, tedious and time consuming process. Hence the simplification, standardization and (to an extent) the automation of the whole process in favour of students, staff and participating companies and institutions is the goal of the project.

Scope
To create an IT system that will assist students and staff in the process of finding and allocating both vocational placement and graduate job positions, and help participating companies and institutions find the appropriate candidate for a job opening or placement.

Key Stakeholders

Client	All students of Technological Education Institute (TEI) of Thessaly that are to undertake the placement part of their studies. Public and private companies and institutions.
Sponsor	National Strategic Reference Framework (NSRF)
Project manager	A 10 year of expertise in managing projects, PhD holder in Business and Management having managed projects with total budget in excess of 2M€
Project team members	Project manager x 1. Assistant Project manager x 1, Engineer/MBA. IT system designer x 3, IT professionals with PhD, Engineer. IT system programmer x 1, IT professionals with MSc. IT system tech support x 1, IT professionals with MSc.

Project Duration
Project duration: 16 months

Project Budget
Project budget: 120.000€

Project Milestones
- Assess current status in terms of available resources
- Study the processes/procedures/bureaucracy necessary to follow
- Design the operations’ flowchart
- Design/code the IT system
- Design/ implement the GUI of the system

- Procure new equipment
- Test run the system
- Train the end users and create user guides
- Provide tech support to users

Constraints, Assumptions, Risks and Dependencies

Constraints	Pressing timeframes for deliverables. Funding limits. Legal framework regarding staff outsourcing procedures. Legal framework regarding procurement procedures. Legal framework regarding project management procedures.
Assumptions	The bureaucratic and legal procedures involved will not change significantly during the course of the project's evolution. The project will receive funding uninterruptedly, in a periodic manner.
Risks and Dependencies	The changing bureaucratic and legal procedures involved. Non-timely receipt of funding.

Appendix E

Questionnaire used for Project Complexity Assessment

Evaluating Project Complexity

Please assess the level of complexity for each one of the following factors that related to project management. The assessment is based on the perceived level of value of each factor as you experienced it during the project execution.

*Required

Time management

1. **Density of project activities** *
(Consider: large number of activities/critical activities, large number of interdependencies, high variance in activities duration)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No activities density	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Extremely high activities density

2. **Project activities resource capabilities** *
(Consider: low availability of resources, highly specialised resources required , high variety of resource types, overlapping resource requirements)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No resource constraints	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Extremely high resource constraints

3. **Density of project schedule** *
(Consider: number of parallel activities, deliverable density, number of intermediate deliverables)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No schedule density	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Extremely high schedule density

4. **Organisation time management capabilities** *
(Consider: insufficient time management experience within project management team, lack/shortage of tools for planning and monitoring project schedule)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No time management immaturity	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Extremely high time management immaturity

5. **Protracted project/activities duration** *
(Consider: long project duration, number of activities with long duration)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No protracted duration	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	⬭	Extremely high protracted duration

Cost management

6. **Organisation cost management capabilities** *
(Consider: low project management team experience, lack/shortage of tools for cost estimations, lack/shortage of historical cost estimation data from similar projects, accuracy of cost estimates due to project external dependencies, irregularities in project cash flows)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No cost management immaturity	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high cost management immaturity

7. **Complicated financial structure and processes** *
(Consider: Time consuming processes for project payments approvals, intensive and time consuming financial reporting, large number of project financiers)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No financial complication	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high financial complication

8. **Protracted project duration** *
(Consider protracted duration in relation to cost management)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No protracted duration	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high protracted duration

Quality management

9. **Inadequacies in quality management design** *
(Consider: insufficient communication of quality goals, policies and responsibilities, process immaturity, not use of well-known quality management procedures, lack of tools and processes for tracing, monitoring and reporting project quality management results)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No quality management inadequecies	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high quality management inadequecies

10. **Organisation quality management capabilities** *
(Consider: low management commitment to quality management, lack of quality culture within project stakeholders, Missing of QA department)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No quality management immaturity	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high quality management immaturity

11. **Rigorous quality control procedures** *
(Consider: existence of external quality audits, strict quality requirements as stated in project quality plan, existence of thorough quality management procedures within customer/contractor organisation)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No rigorus quality control procedures	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high rigorous quality control procedures

Communication management

12. **Organisation communication management** capabilities *

(Consider: insufficient communication management experience within project management team, shortage in commination media, not clear communication lines, not clear job descriptions and work assignment)

Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No communiction immaturity	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high communication immaturity

13. **Communication constraints due to project structure and staffing** *

(Consider: Geographical distribution of project stakeholders, diversity in nationalities and cultures, number of organisations composing the project team)

Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No communication constraints	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high communication constraints

14. **Density of project communication** *

(Consider: labour time spending in communication processes, heavy and frequent reporting, frequency of formal in person communication, communication requirements due to high project visibility)

Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No communication density	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high communication density

Human resources

15. **Project team cohesion** *

(Consider: Turnover of project staff members, new recruitments, existence of part time employees, project not fully staffed)

Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No team cohesion	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high team cohesion

16. **Organisation HR management** capabilities *

(Consider: insufficient HR management experience, lack/shortage of historical HR management data, lack/shortage of tools and processes for planning, monitoring and tracking HR management, Existence of HR department or Hr services within hosting organisation)

Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No HR immaturity	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high HR immaturity

17. **HR management constraints due to team structure** *

(Consider: high percentage of outsourced work, number of project sub-groups within the project, number of different type of project groups)

Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No HR management constraints	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high HR management constraints

18. **Project team size and skill diversity** *

(Consider: large size of project team, number of different technical, behavioural and contextual skills required)

Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No diversity	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high diversity

Procurement management

19. **Density of procurement process** *

(Consider: number/variety of supplies and suppliers, new suppliers/subcontractors, variety of contract types, number of contracts must be managed simultaneously)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No procurement density	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high procurement density

20. **Organisation procurement management** capabilities *

(Consider: lack or not clear definition of procurement policies and procedures, lack of automation within supply chain, insufficient procurement management experience, lack of historical procurement data, lack of tools and processes for planning, monitoring and tracking processes)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No procurement immaturity	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high procurement immaturity

21. **External barriers in project procurement process** *

(Consider: restriction imposed by external (e.g. legislation, regulation) and internal (e.g. preferred suppliers, compatible technology) project factors, unavailability/scarcity of supplies and/or services, unknown suppliers quality)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No barriers in procurement processes	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high barriers in procurement processes

Risk management

22. **Organisation risk management** capabilities *

(Consider: insufficient risk management experience, lack/shortage of historical risk management data, lack/shortage of tools for analysing, accessing, quantifying and implementing risk responses)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No risk management immaturity	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high risk management immaturity

23. **Project risk density** *

(Consider: number of major risk, not clear definition of risk management policy and response strategy, lack of flexibility of project management plan for implementing risk responses, existing of risk responses with major impact to project)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No risk density	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high risk density

Scope management

24. **Density of project requirements** *

(Consider: number of requirements, requirements interdependencies, number of sources for eliciting requirements, number of interfaces with other systems, number of non-functional requirements
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No requirements density	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high requirements density

25. **Quality of requirements** *
(Consider: requirements characteristics causing uncertainty, low quality of product/service requirements specification)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No requirements quality	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high requirements quality

26. **Organisation scope management capabilities** *
(Consider: insufficient scope management experience, lack of historical scope management data, lack/shortage of specialised tools in defining requirements)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No scope management immaturity	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high scope management immaturity

Integration management

27. **Integration constraints due to project characteristics** *
(Consider: project technical/business innovative, system architecture complexity, volatility in project requirements, diversity and conflicts of interests of project stakeholders, uncertainty of project product development due to external changes)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No integration constraints	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high integration constraints

28. **Organisation integration management capabilities** *
(Consider: insufficient integration management experience, lack/shortage of historical integration management data, not fully defined scope and requirements, lack/shortage of tools and processes for supporting change management, lack /shortage of tools and processes for monitoring and measure performance of various project stages)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No integration immaturity	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high integration immaturity

29. **Density of deliverables** *
(Consider: number of intermediate deliverables, control of deliverables)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No deliverable density	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high deliverable density

Stakeholders management

30. **Density of stakeholders management** *
(Consider: number of stakeholders, different stakeholders' categories, existing of stakeholders with different/conflicting interests, stakeholders with negative attitude about the project, communication barriers between stakeholders)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No stakeholders density	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high stakeholders density

31. **Organisation stakeholders' management capabilities** *
(Consider: lack of structured methodology and tools in stakeholders management, lack of specific strategy to enchance stakeholders engagement to project)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No stakeholders management immaturity	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high stakeholders management immaturity

Software development technical complexity factors

32. **Organisation technological capabilities** *
(Consider: lack / not use of software tools that aid the development (CASE tools), not use of well-known development models, low level of technical expertise of development team, low level domain/application knowledge of development team)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No technological immaturity	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high technological immaturity

33. **Product development constraints** *
(Consider: low development flexibility, platform volatility, software portability, completeness of design, hardware concurrent development, product functional complexity)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No development constraints	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high development constraints

34. **Product quality requirements** *
(Consider: number of non-functional requirements, number of security requirements / constraints, required high software reliability)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No quality requirements	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely high quality requirements

35. **Software size** *
(Consider: code size, size of application database)
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
Not applicable	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extremely large software size

Overall project complexity

36. **Αξιολογήστε την συνολική πολυπλοκότητα του έργου που διαχειριστήκατε (Overall project complexity)** *
Mark only one oval.

	0	1	2	3	4	5	6	7	8	9	10	
No complex project	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	Extermely high complex project