UNIVERSIDADE DE LISBOA
Instituto Superior de Economia e Gestão

PhD in Management

LEADERSHIP COMPETENCIES IN THE REQUIREMENTS PHASE OF IS/IT DEVELOPMENT PROJECTS

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Abstract

While the successful implementation of an Information Systems/Information Technology (IS/IT) project is widely recognised as being a key research topic, yet recent surveys continue to show significant failure rates. Inadequate requirements management together with inadequate project management have frequently been identified as the principal causes of failure. As a result, the requirements phase has been considered to be one of the most critical phases of the IS/IT project life cycle, especially in relation to software development projects, where new systems must be defined. Moreover, a review of the literature suggests that management leadership is considered to be one of the most important factors in team, project and organisational effectiveness. Management leadership is regarded as being a vital factor in achieving project success, namely in the field of IS/IT. Further research acknowledges that leadership effectiveness may depend on contingency factors, such as the project type, or the project life cycle phase. However, few studies have focussed on the impact of leadership along the software project life cycle, and the literature review found no study that focusses on any particular phase. This is surprising, as the literature suggests that each phase has specific characteristics which are distinguishable by the activities that must be performed.

Thus, this research study aims to integrate all these elements within a framework, through a multiple case study using exploratory research. Therefore, this framework will identify which leadership competencies are considered to be relevant to the requirements phase of software development projects' life cycle. Contingency factors are also be identified and discussed, as well as their impact on the set of identified competencies. Finally, the practical and theoretical contribution of the results are presented, as well as new insights into the requirements and leadership research streams.

Keywords: software development project life cycle, requirements phase, leadership competencies, contingency factors

Resumo

O estudo da gestão de projetos de Sistemas e Tecnologias de Informação (SI/TIs) é largamente reconhecido como um tópico de investigação atual e relevante. No entanto, estudos empíricos recentes continuam a demonstrar um elevado nível de falhas no processo. Algumas das principais causas mais frequentemente identificadas envolvem a gestão inadequada de requisitos, bem como práticas inadequadas ao nível da gestão global do projeto. Assim, não é surpreendente que a fase que envolve as atividades dos requisitos seja considerada como uma das mais criticas fases de todo o ciclo de vida dos projetos de SI/TI, nomeadamente dos projetos de desenvolvimento de *software* onde se define um novo sistema a implementar. Para além disso, a revisão da literatura sugere que a liderança é considerada como um dos fatores mais importantes para a obtenção de eficácia das equipas, dos projetos e ainda das organizações. A liderança da gestão é considerada como um fator vital na obtenção do sucesso do projeto, nomeadamente na área dos SI/TIs. Adicionalmente, a literatura reconhece que a eficácia da liderança depende de fatores contingenciais, tais como o tipo de projeto ou a fase do ciclo de vida a que se aplica. No entanto, apenas uma pequena parte desses estudos focam o impacto da liderança ao longo do ciclo de vida do projeto. Surpreendentemente, não foi encontrado nenhum estudo que foque alguma fase em particular, mesmo considerando que a literatura sugere que diferentes fases têm características e atividades que as distingue das demais.

Assim, este projeto de investigação pretende explorar a integração de todos estes elementos num quadro de análise comum, através da execução de múltiplos casos de estudos. Este quadro de análise pretende identificar quais as competências de liderança relevantes para a execução da fase de requisitos do ciclo de vida de projetos de desenvolvimento de *software*. Também se pretende explorar os fatores contingenciais que influenciam o conjunto de competências encontradas, bem como compreender a forma como isso se processa. Finalmente, são apresentadas as contribuições teóricas e práticas, e ainda enumerados os tópicos de investigação futura decorrentes dos resultados obtidos.

Palavras-chave: Ciclo de vida de projetos de desenvolvimento de *software*, fase de requisitos, engenharia de requisitos, competências de liderança, fatores de contingência.

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List of Acronyms

IS – Information Systems

IT – Information Technology

RE – Requirements Engineering

RCA – Requirements Capture and Analysis

GT – Grounded Theory

CRM – Customer Relationship Management

ERP – Enterprise Resource Planning

ISBSG – International Software Benchmarking Standards Group

UML – Unified Modelling Language

CMMI - Capability Maturity Model - Integration

ISO – International Organisation for Standardisation

SPICE - Software Process Improvement and Capability dEtermination

R-CMM – Requirement Capability Maturity Model

REPM - Requirements Engineering Process Maturity Model

OO – Object Oriented

SSM - Soft System Methodologies

OOSE - Object Oriented Software Engineering

SADT - Structure Analysis and Design Technique

SSADM – Structured systems analysis and design method

XP – Extreme Programming

JAD - Joint Application Development

IQ – Intellectual Competencies

MQ – Managerial Competencies

EQ – Emotional Competencies

1 Introduction

This chapter provides an overview of the proposed research, starting with a description of a brief motivation for the study that led to the subject selection. The research questions are then presented, the assessment of that which constitutes the main objective of the research, and a short description of each step making up the research process is provided. Finally, the structure of this document is presented.

1.1 Research Rationale

Information Systems and Information Technology (IS/IT) has been a large market with increasing relevance for organisations and the world economy, which accounted for 40% of total capital invested by American organisations in 1999 (Thorp, 1999). Reports show that a large amount is invested in IT application development ($250 billion in 2000 by U.S. companies) (Peled, 2000). As a result, it is not surprising that software development has been considered to be one of the top 10 critical IS issues in the world (Yang and Tang, 2004). Nevertheless, a significant percentage of IS/IT development projects fail (Chakraborty et al., 2010). In 2004, CHAOS reported an increase in the success rate for IS project implementation, rising from 16% in 1994, to 34% in 2004. However, despite improvements, still two thirds of all projects failed to be successfully implemented (Xu and He, 2008).

Since the 1960s, researchers have attempted to identify the factors that lead to project success, yet the results of project implementation continue to disappoint stakeholders (Cooke-Davies, 2002), and consequently, more empirical studies have been advocated (Xu and He, 2008).

The early literature focusses on technical issues, however, authors later realised that this issue is more to do with business than technology (Thorp, 1999; Thite, 2000). Some authors claim that the high rate of failure of software development projects results from a lack of principles and methods, and inadequate project management, which fail to recognise and understand what the real problems of software development are (Chatzoglou, 1997; Chatzoglou and Macaulay, 1997), and also from inadequate requirements management, which is frequently referred to as a major cause of IS/IT project failure (The Standish Group

International, 2001; Bleistein et al., 2006; Nasir and Sahibuddin, 2011; Svahnberg et al., 2015b).

The requirements phase is often considered to be one of the most critical phases of the IS project life cycle, having significant impact on software quality and costs (Eman et al., 1996; Chatzoglou, 1997; Aurum and Wohlin, 2005; Nicolás and Toval, 2009; Chakraborty et al., 2010). This is especially true for software projects, as this phase defines the system to be developed (Pressman, 2005). In fact, the definition of requirements and its underlying process have been a hot research topic for IS researchers and practitioners alike (Chakraborty et al., 2010). This activity has resulted in numerous techniques that propose to deal with the multitude of identified problems that affect this phase, which forms a "methodological jungle", which is difficult to both manage and apply (Mathiassen et al., 2007). Moreover, the literature review of problems that influence the success of this phase found that project managers and project teams play an important role (Chatzoglou, 1997). Further research concluded that team members are crucial to the requirements phase (Chatzoglou and Macaulay, 1997), through their experience, knowledge, commitment and persistence, together with users' motivation, knowledge of the purpose of the project development, and communication with the project team members (Chatzoglou and Macaulay, 1997; Xu and He, 2008; Kerzner, 2009).

Some of the factors presented are frequently associated with leadership, as leaders are responsible for creating an environment that emphasises teamwork and team building, and that fosters a spirit of cohesion, motivation and trust (PMI, 2008). Thus, it is not surprising that leadership is considered to be one of the most important factors in team, project and organisational effectiveness, and it is therefore regarded as being a vital factor in IS development group analysis (Yang and Tang, 2004).

This is convergent with the existing literature on project management, which emphasises the importance of leadership effectiveness for achieving successful projects, including IS/IT research areas (Thite, 2000; Turner and Muller, 2005; Eom, 2006; Bennett, 2009). However, the effectiveness of leadership depends on other factors, such as project type and its intrinsic characteristics (Muller and Turner, 2007; Muller and Turner, 2010), the predominant culture and the organisational context in which it appears (Ng and Walker, 2008), and also the project

life cycle phase (Turner, 1999; Russo et al., 2005; Muller and Turner, 2007; Ng and Walker, 2008). Few studies exist that examine the role and impact of leadership throughout the IS development project life cycle, and their focus is mainly on variations among phases, rather than on deeply exploring one particular phase. This may seem contradictory, as the literature shows that for each phase, different sets of activities, with different natures, are performed by different professionals (Russo et al., 2005; Skulmoski and Hartman, 2010). Moreover, the literature review found no study that attempts to understand why such differences exist, and why one stage is truly unlike any other.

While the contributions of the existing body of knowledge are significant to the discussed problems, none of the research (to the best knowledge of the author) explicitly integrated all these elements within a unifying framework. No author has previously focussed their research on identifying which leadership competencies are the most appropriate for achieving success in IS/IT projects, specifically software development projects, for each project phase separately.

1.2 Research Process

This research aims to explore those leadership competencies that are relevant to the requirements phase of software development project life cycle. The study also considers some of the most relevant contingency factors that can influence the set of competencies. Therefore, this study intends to address the following research questions:

(1) Which leadership competencies are relevant in the requirements phase?

(2) How can leadership competencies help to achieve leadership effectiveness in the requirements phase?

(3) Which factors can influence the relevance of competencies in the requirements phase?

(4) How can these factors influence the relevance of competencies in the requirements phase?

Notwithstanding the exploratory nature of this research, this study adopts the Leadership Competencies framework proposed by Dulewicz and Higgs (2003b) as a theoretical ground.

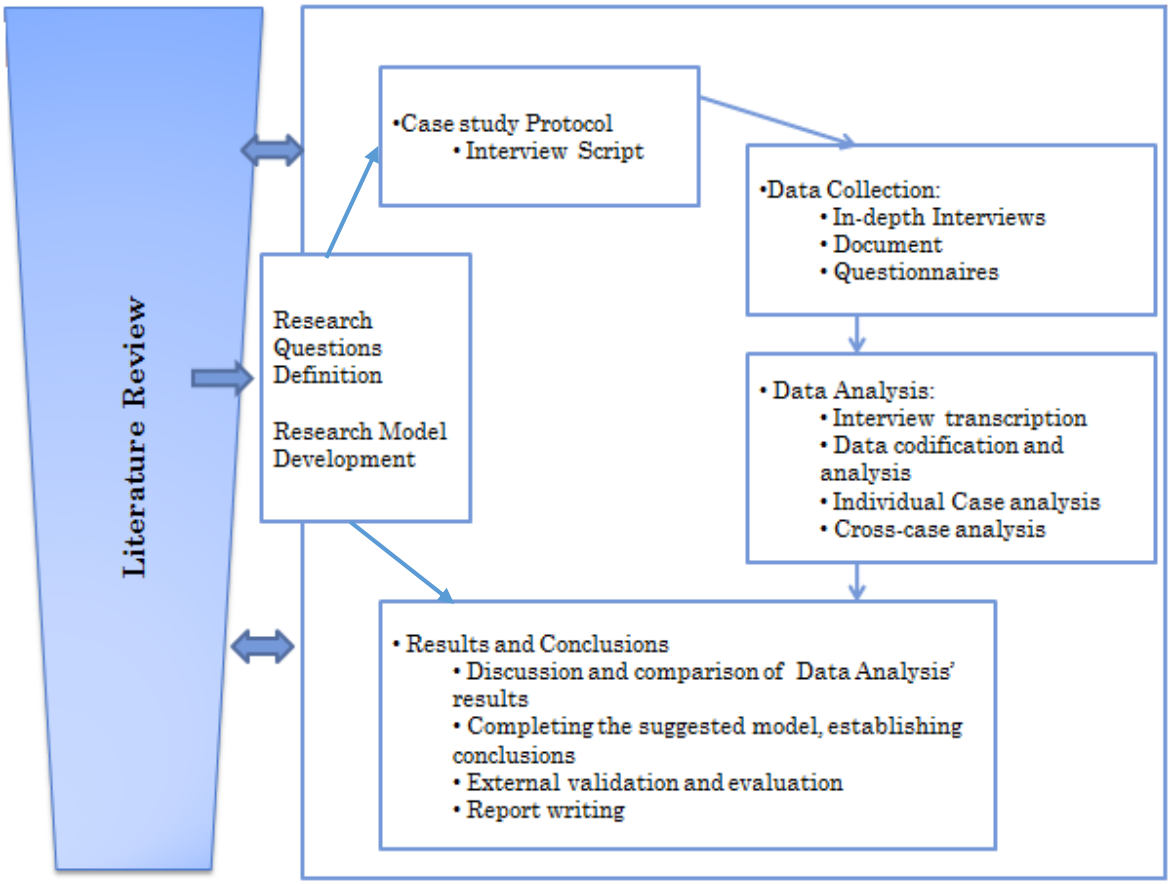
The purpose is to verify the suitability of these competencies, while exploring new ones that may be relevant and specific to the context under study. Furthermore, contingency factors are identified and explored through the data collection process. However, as suggested in the literature, the attributes that characterise projects are also analysed to understand whether different types of projects can lead to variations in the set of relevant leadership competencies.

In order to address these issues, an exploratory study was conducted. Exploratory studies should be undertaken when the aim is: (1) to better understand the nature of a specific problem for which few studies might have been conducted, or; (2) when some facts are known, but more information is needed for developing a viable theoretical framework (Sekaran and Bougie, 2013). In this context, multiple case studies are conducted with embedded units of analysis, as described by Yin (2013). This choice is consistent with several authors who argue that case studies should be performed when the research objective is to "investigate a contemporary phenomenon in depth and within its real-life context" (Yin, 2013, p. 18), where "the experiences of individuals and the context of actions are critical" (Darke et al., 1998, p. 279), and where the questions underlying the research take the form of "what", "how" or "why" (Darke et al., 1998; Yin, 2013).

Although mainly qualitative data were gathered, through document analysis and in-depth interviews, quantitative data was also collected. This multi-method approach contributes to the collection of richer and stronger evidence, and allows for the triangulation of methods, which may help increase the overall study quality (Yin, 2013).

The study will proceed using the following set of steps, as illustrated in Figure 1. The entire process is designed to follow the method proposed by Yin (2013), with necessary adjustments. The first step consists of reviewing the relevant literature, continuing on throughout the entire process, albeit with greater emphasis on the initial phase. This step helps to establish the research scope, and allows for the formulation of research questions and for the development of the research model.

Figure 1 - Research Process



Source: Adapted from (Henriques, 2006)

After defining the research scope and purpose, the research design is then conducted using the critical realisms stance. Decisions were taken and clearly justified, taking into account the various methodological possibilities. In addition, a case study protocol was developed to guide the process of data collection.

Within this study design, twelve companies from IS/IT industry sector were selected for analysis in this study. A total of thirty two interviews were held with professionals with different roles in the requirements phase of software development projects. Participants were chosen by convenience, rather than randomly, but always considering a set of established criteria.

The second of the main stages is data collection, where three techniques are employed: in-depth interviews; document collection, and; questionnaires to address some of the sub-

research questions. After the data have been collected, the data analysis phase can then proceed.

As prompted by the study protocol, data analysis began with the characterisation of the projects described in the interviews. However, the analysis of data brought new insights into the set of characterising features that were originally gathered from the literature review. Thus, an adapted dimensions chart was used to wholly, or partly instantiate thirty eight projects.

Surprisingly, the data analysis also revealed variations through the requirement phase of the described projects. No *a priori* directions were found in the literature review, and no initial assumptions were made regarding this topic. Therefore, as a result, issues on requirement phase characterisation were deeply explored, and a classification model was suggested.

The emergence of new topics in the course of data collection and analysis is accepted by the epistemology position that guides this research study. As society is produced and reproduced by its members through their set of perceptions, the knowledge from those acting directly on events cannot be ignored.

Therefore, the context of leadership analysis became richer than originally planned. From the semi-open questions of the interviews a set of leadership competencies emerged that were relevant for the requirements phase. These competencies were analysed and classified using the categories proposed in the literature. Although, apparently, no major differences are found in their nature, the relevance and explanations of their use, as mentioned by participants, can bring new insights to this topic.

The resulting set of competencies was then analysed, considering a list of factors that could somehow impact their relevance. This list was based on the project's characteristics, however additional contingency factors emerged from the interviews. The results found differences on the impact of some of these factors on each leadership competency. Factors related to project type and process were more frequently reported by participants, followed by project teams and client. The dimension that seems to have less impact is that of the leader.

Finally, the results of the questionnaire on the relevance of leadership competencies, proposed by (Dulewicz and Higgs, 2005b) through the requirement phase activities is presented. The analysis shows that differences exist in the set of competencies needed for each activity. Since these activities mostly differ in the nature of their tasks, it raises the question as to whether these competencies are more task dependent than any other variation factor.

Conclusions are drawn at the final chapter of this dissertation, as well as the main contributions, both theoretical and practical. As expected for exploratory research, this study presents new insights for further research. Although these topics are raised in the discussion of the results, the most relevant are then resumed again at the end of the study.

1.3 Document Structure

This research dissertation is structured in five chapters. In the first chapter, the background is presented and explained, as is the motivation for the research, leading to the choice of studied topics. Then an overview of the objectives and the overall research process is presented. Some insights on study results are also given at the end of the chapter.

Chapter Two reviews the literature for the topics of IS/IT and leadership, leading towards the formulation of the research questions and model development. The third chapter discusses the main philosophical and methodological choices for social research, and in particular for IS research. It also describes the methodological approaches of this research, explaining and justifying the choices made in the study design. This chapter concludes with a discussion of quality issues and strategies.

Chapter Four presents the analysis and discussion of the collected data. The analysis is presented into three main analysis sections, considering the sequence pre-established in the study protocol. It begins with the presentation and characterisation of the projects under study, using an adapted characterisation chart. The next section focusses on issues related to the requirements phase. Topics describe the issues of requirements nature and inherent process, namely volatility and success perception. This section also presents and discusses

the classification model put forward to characterise the requirements phase. Finally, the results found are revealed when assessing the relevance of studying this particular phase of the project life cycle, as perceived by the participants in the study.

Still within Chapter Four, the results of the analysis on leadership topics are also presented. Firstly, the set of leadership competencies enumerated by the participants is presented and compared, then a list of those factors that may impact on the set of competencies is explored. Finally, the questionnaire results of the relevant set of leadership competencies is presented and discussed, considering the main activities performed in this phase.

The main conclusions and contributions are described in Chapter Five. As a final remark, it should be added that all four research questions were addressed through the exploratory study performed. The main objectives were achieved and, as expected, they brought new insights for further research. These new recommendations for future research are presented at the end of this chapter.

2 Literature Review

2.1 IS/IT Projects and Phases

2.1.1 Projects and project management

The underlying purpose of this research is to study projects and project management. Pinto and Prescott (1988) argued that beyond projects themselves, project management has been one of the most researched and theorised topics in management, which is not surprising, as projects and project management are at the heart of implementing organisational objectives. Before further developing these topics, a clear definition should be provided, distinguishing these from other related concepts.

Many definitions of projects are proposed in the literature. Ng and Walker (2008) conceptualise projects as being singular events that may be part of a coherent set of discrete projects aimed at achieving a particular objective within the organisation. On the other hand, Turner and Muller (2003) describe projects as temporary organisations "to which resources are assigned to undertake a unique, novel and transient endeavour managing the inherent uncertainty and need for integration in order to deliver beneficial objectives of change" (p.7). Projects are considered to be temporary, as they have a definite start and end date, and they use temporary management structures that are formed specifically to carry out the project in question. They are also considered to be unique, as the product or service they provide is different from any other (PMI, 2000; Turner and Muller, 2003; Ng and Walker, 2008).

Additionally, PMI (2000) highlighted the process nature of projects, focussing on their progressive elaboration, where *progressive* means "proceeding in steps, continuing steadily by increments", and *elaboration* means "worked out with care and detail, developed thoroughly".

On the other hand, project management is the process of managing the activities and resources allocated to a project, while at the same time it focusses on achieving the system's contractual times and costs (Ward and Griffiths, 2000). PMI (2000) also defines project management as being "the application of knowledge, skills, tools, and techniques for project activities to meet project requirements (…) accomplished through the use of processes such

as: initiating, planning, executing, controlling and closing" (p. 6), which are usually referred to as the project life cycle.

Operations are also commonly related to projects. Operations and projects have some common characteristics, although they have a different nature. Both are planned, executed and controlled, and are performed by people, and are constrained by limited resources; however projects are temporary and unique, instead of being repetitive and ongoing, as is the case of operations (PMI, 2000).

Wateridge (1997) suggests that IS/IT projects frequently have a large number of stakeholders that have to be managed and satisfied, whilst at the same time they have to be implemented in order to deliver benefits to the client or organisation. Additionally, Thite (2000) and Eom (2006) argue that IS/IT projects differ from other projects, due to the characteristics of IT employees, who are frequently engaged in scientific or technical occupations, thus holding certain distinguishing personality-related and occupational-related characteristics. These authors, among others, defend IS/IT projects as a particular case of generic projects, because they have very specific characteristics which make them quite complex to manage. It is for this reason that this study chooses to focus on this specific type of project, rather than focusing just on generic projects.

Studying projects raises two other important aspects which need to be addressed: one is the general categorisation of projects, in order to consider different types of projects, and the other is the cycle of project activities, namely the project life cycle.

2.1.2 Project Categorisation

Project categorisation has been considered to be a useful tool, both for practitioners and researchers alike (Crawford et al., 2005; Crawford et al., 2006). Much progress has been made in this area in recent decades, which is not possible to summarise completely within the remit of this study (Crawford et al., 2006). Categorisation has also been considered by authors to help define best practices in management styles and competencies, to prioritise projects and for allocating resources, to balance the project portfolio in order to align with the organisation's strategy (Shenhar, 1998; Youker, 2002; Crawford et al., 2006; Muller and Turner, 2007), and also to improve and adjust risk management (Raz et al., 2002). Drawing on this, some of the more frequently highlighted trends in project categorisation are

enumerated below. A table is also provided to clearly organise a summary of project attributes found in the literature (Table 1).

Table 1. Summarised list of factors that address a project's categorisation.

ID[1]	Project Attribute	Typical Classification, Scale or Unit	Examples of an author applying the attribute
CF1	Size	Big; medium; small	(Chatzoglou and Macaulay, 1997; Crawford, 1999)
CF2	Problem, objectives and definition of methods	Well defined; moderately defined; poorly defined	(Chatzoglou and Macaulay, 1997; Wateridge, 1997; Turner, 1999)
CF3	Duration	Months	(Crawford, 1999)
CF4	Complexity	High, Medium, Low	(Crawford, 1999; Shenhar, 2001; Muller and Turner, 2007)
CF5	Applicability	Generic; bespoke	(Chatzoglou and Macaulay, 1997)
CF6	Technology uncertainty	High, Medium, Low	(Shenhar, 2001; Youker, 2002)
CF7	Urgency	High, Medium, Low	(Youker, 2002; Shenhar and Dvir, 2007)
CF8	Risk level	High, Medium, Low	(Youker, 2002)
CF9	Where (or by whom) it is developed	In-house; consultants; external. Software houses; industry; consultancies; academics.	(Chatzoglou and Macaulay, 1997) (Chatzoglou, 1997)
CF10	Organisational project management maturity		(Crawford, 1999)
CF11	Application area (industry)	Engineering and construction; Information systems; Organisation and business	(Crawford, 1999; Muller and Turner, 2007)
CF12	Contract type	Fixed price; alliance	(Muller and Turner, 2007)
CF13	Strategic Importance	High, Medium, Low	(Crawford et al., 2005)

(1) – CF stands for Contingency Factor

Source: the Author.

Generally, projects can be categorised into different types, considering several factors, in order that they can be better managed. Turner (1999), in his own research, and in collaboration with others (Turner, 1999; Turner and Muller, 2004; Muller and Turner, 2007) has suggested categorising projects according to how their objectives are defined and the methods for achieving them, the project industry sector, application area, and stages of the product life cycle. Later, the author also explored project categorisation by risk level. Similarly, Wateridge (1997) has grouped projects into: concrete, occasional and open, considering how well the objectives, outputs, skills and methods for each projects are defined.

Shenhar (2001) has also developed extensive study of the categorisation of technical and engineering-based projects. He argues that these projects should be typified in two dimensions: levels of technological uncertainty, and the levels of system complexity, according to a hierarchy of systems and subsystems.

In their recent book, Shenhar and Dvir (2007) added two new dimensions to project categorisation: novelty and pace. The first concerns the uncertainty of the project's goal and market to which it is intended, discussing how well the initial requirements should be described, as well as which marketing activities should be performed for each of the three proposed types of projects. The second dimension deals with the time urgency for project success, suggesting that projects which are time-critical may need different management structures and management styles to perform them.

Youker's work has also highlighted some of these project attributes to classify and justify why projects are different, and why one should consider different types of projects to address the appropriate management style. Indeed, to this end, Youker looked at the degree of uncertainty and risk, the level of sophistication of workers, the level of detail in plans, the degree of new technology involved, and the degree of time pressure (Youker, 2002). Similar to some of the studies described so far, many other authors have considered a project's own attributes for the purpose of categorisation, such as: dimension, complexity, duration, applicability and contract type (Chatzoglou and Macaulay, 1997; Crawford, 1999; Muller and Turner, 2007).

Despite the different ways of categorising and grouping projects, authors generally agree on the need and relevance of such activities. Crawford et al. (2006) justify that

organisations depend on the completion of their projects for realising their corporate strategies. One way to achieve this is to match the efforts and resources required for each specific project according to their needs and characteristics. This allocation is only possible if organisations can compare their projects. To do so, many organisations classify and describe their projects by attaching labels to them, which form the basis of the categorisation system.

2.1.3 Project life cycle

According to PMI (2000), a project can be perceived as being a process considered to be "a series of actions bringing about a result" (p. 4). These actions are usually grouped into several generic phases, each aimed at producing a set of clearly defined outcomes to be concluded (PMI, 2000).

> "Project phase is a collection of logically related project activities, usually culminating in the completion of a major deliverable" (PMI, 2000, p. 444).

PMI (2000) suggests that project activities can be organised into five groups (initiating; planning; executing; controlling; and closing processes, as described below) and that these can be linked to the general project phases that are shown in Figure 2, namely:

- Initiating processes: authorizing the project or phase;
- Planning processes: defining and refining objectives and selecting the best alternative course of action. Some of the processes found in this group are considered to be core processes (e.g. project plan and scope definition), while others are facilitating processes (e.g. such as quality planning);
- Executing processes: coordinating people and other resources required to carry out the plan;
- Controlling processes: ensuring that project objectives are met by monitoring and measuring progress regularly to identify deviations from the plan;
- Closing processes: formalising acceptance of the project or phase, through contract closeout and administrative closure processes.

Figure 2. Generic Project Life Cycle.

Source: Adapted from (PMI, 2000)

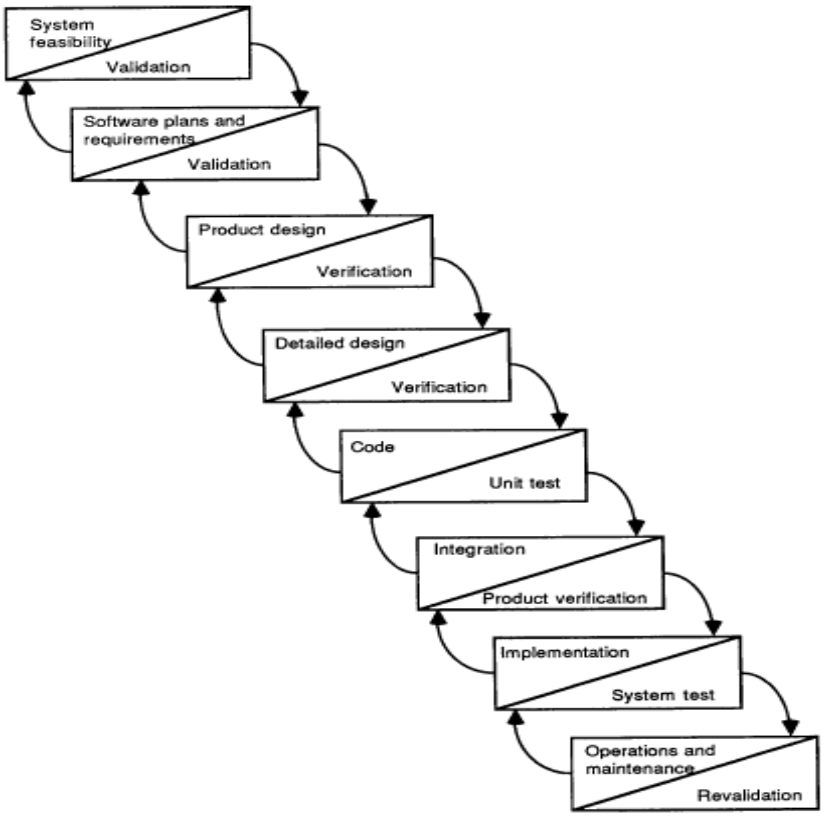
A project phase is part of a logical sequence that ultimately aims at the completion of the project objectives. The sequence of these phases is normally known as the project life cycle (PMI, 2000).

There are a diversity of project life cycles proposed in the literature and a large number of management studies involving this topic (Pinto and Prescott, 1988; Hartman and Ashrafi, 2002; Pressman, 2005; Ng and Walker, 2008; Chatzipetrou et al., 2015; Zhao and Chen, 2015). However, the appropriate project life cycle may depend on the project characteristics, such as type, dimension, complexity, and the organisational context, which may constrain the phase definition, or set of phases (PMI, 2000; Pressman, 2005). Although many project life cycles have similar phase names, they do not necessarily mean the same thing. The number of phases also differs among different project life cycles. While most have four or five phases, some may have nine, or more (PMI, 2000).

IS/IT projects, particularly the ones related to software development, have their own specific characteristics which determine the adoption of a specific life cycle. During the last decades many authors have proposed IT project life cycles (Boehm, 1988; Somers and Nelson, 2004; Pressman, 2005; Marasini et al., 2008; Ng and Walker, 2008), while those most commonly applied are the Waterfall Model, the Spiral Model and the Agile Model.

The Waterfall model was first proposed in the 1970's by Winston Royce, and is frequently called the classical life cycle (Pressman, 2005). This presents a stepwise, systematic and sequential approach to software development that starts with customer specification of requirements and continues through planning, modelling, construction, deployment and maintenance (Boehm, 1988) (Figure 3). Its stepwise and sequential approach received much criticism, and despite all the refinements, this model was considered inappropriate for most IS/IT project developments. Later, Barry Boehm (1988) proposed the evolutionary Spiral Model (Figure 4), which has evolved, based on experience with various refinements from the Waterfall model.

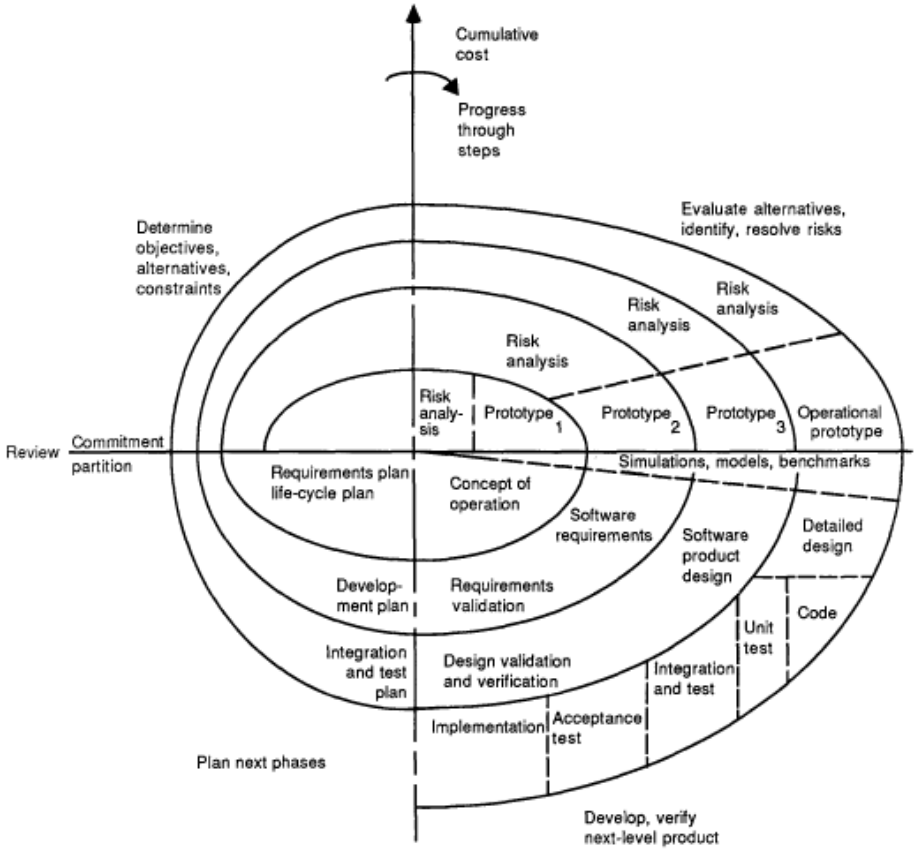
Figure 3. Waterfall Model of the software life cycle.



Source: (Boehm, 1988)

The Spiral model represents a cyclical approach to incrementally create a system definition and implementation. Each cycle involves a progression which addresses the same sequence of steps, from document to coding phase (Boehm, 1988). Nevertheless, some practitioners and researchers continued to argue that the existence of these models restricted the process of software development and did not allow the flexibility and adaptability that is needed for this type of system. As a consequence, in 2001, the Agile movement emerged which defined itself through the "Manifesto for Agile Software Development" (Alliance, 2001; Pressman, 2005). Agile approaches emphasise software development as being a dynamic process, evolving through organic, "rather than static, predefined, and mechanistic" iterations (Lee and Xia, 2010, p. 88), which represents a radical change from the traditional methodologies.

Figure 4. Spiral Model of the software life cycle.



Source: (Boehm, 1988)

Regardless of the model, each phase in the project life cycle aims to accomplish a set of deliverables that result from the combined tasks performed by the team members. The nature of these activities is very different, according to each phase and requires distinct skills. Russo et al. (2005) demonstrated that, given the diversity of activities involved, there is a need for a very versatile project manager in order to successfully execute the project tasks through all the phases, from start to finish. It is also important to point out that, according to this approach, the overall success of a project comes from achieving success in each and all of the phases. One of the phases that is often considered to be the most critical for achieving project success, is the requirements phase, due to the difficulty of understanding the requirements of a new system (Pressman, 2005). Considering this, we decided to focus this study on this particular phase.

2.1.4 Requirements phase

Although critical factors for projects success are not the main aim of this study, this literature was reviewed in order to understand the possible causes of high project failure rates (see Related Topics section for further discussion). One of the most commonly identified causes of IS/IT project failure is inadequate requirements (Bleistein et al., 2006; Nasir and Sahibuddin, 2011; Group., 2013).

A requirement is a condition or capability that must be met or possessed by a system or item of software (Nicolás and Toval, 2009). Requirements should mainly be identified and analysed during the requirements phase of the project's life cycle. This phase is commonly called *Requirements Engineering*, as it is considered to be a process where activities of problem analysis, product description, and recommendation of a solution are performed (Eman et al., 1996; Carrizo et al., 2014). In the same vein, Chatzoglou (1997) also named this phase *Requirements Capture and Analysis* (RCA). Regardless of the name, the activities of this phase are usually performed by software analysts and other project stakeholders, such as customers, end-users and managers.

With the purpose of understanding what the customer wants and needs, of assessing feasibility, and of negotiating and specifying a reasonable solution, whilst also understanding how end users will interact with the system and what will be the impact on the business, Pressman (2005) recommends seven well defined functions that need to be performed during the requirements engineering process, namely:

- Inception: where analysts and all the stakeholders establish the basic requirements of the problem, define constraints, and agree the key features that must be present in the system;
- Elicitation: where information from the first function will be refined and detailed, often making use of well-known techniques, such as structured meetings and descriptions of user scenarios, among others;
- Elaboration: where all information obtained will be used to develop a technical model, also called an analysis model, using a variety of modelling notations;
- Negotiation: as conflicting requirements are relatively common among different customers and stakeholders, this function intends to solve or minimise them;

- Specification: where, after the requirements negotiation, documents will be created (ideally combining natural language descriptions and graphical models) that present the results of previous phases in a consistent and understandable way;
- Validation: where the specification of requirements will be analysed to ensure that all requirements have been stated correctly and unambiguously;
- Management: where activities are performed to help the project team to identify, control and track requirements along the project life cycle.

On the other hand, Chatzoglou and Macaulay (1997) confirmed in their study that RCA is an iterative process. Each iteration has a process itself, divided in three steps, starting with information collection, which is then examined and subsequently checked. Whenever the information is insufficient, a new iteration is performed.

Furthermore, Chakraborty et al (2010) argue that the process of requirements elicitation can also be seen from the standpoint of social and behavioural processes. They describe it in terms of knowledge sharing, trust and the development of shared mental models. The authors consider the requirements phase as a dynamic and context-specific function of the collaborative interaction of all participants with their different points of views.

As with any of the other phases of the project life cycle, the requirements phase plays a critical role in achieving project success. This phase is often considered to be prerequisite for project success and crucial for the success of the whole development stage. In fact it bridges the design and the construction phases and involves communicating both with clients and system developers alike (Eman et al., 1996; Chatzoglou, 1997; Coughlan et al., 2003; Pressman, 2005; Nicolás and Toval, 2009). The criticality of this phase results from serving the needs of, and providing the basis for, the subsequent phases of the project life cycle, whilst helping to ensure that the project will be successfully completed (Eman et al., 1996).

Problems affecting the success of this phase are not only technical, but also managerial, organisational, economic and social (Chatzoglou, 1997). Some constraints identified by Chatzoglou (1997) include time, resources and access to information sources (which enable team members to obtain the best possible information), the lack of (the right) methodologies, and the attitude of the project team and users. Pressman (2005) affirmed that requirements elicitation is difficult, on account of problems of scope, understanding and

volatility. The boundary of the system is ill-defined, where customers and end users cannot clearly tell what their needs are, which leads to problems in communicating with the technical team.

Furthermore, requirements change over time. The changing nature of requirements is usually referred to as requirement volatility. According to Nurmuliani, N., Zowghi, D., and Fowell, S. (2004), requirements volatility is "the tendency of requirements to change over time, in response to the evolving needs of customers, stakeholders, organisation, and work environment." (p. 2). The authors state that this particularity of requirements, although quite common, can have a negative impact on the software development process and consequently on project success.

Eman et al. (1996) also stated that this is a problem of uncertainty, i.e. the activities and the context in which activities should be performed during requirements engineering are not stable or well understood. Taking into account requirements definition, Nicolás and Toval (2009) added that a requirement must be unambiguous, complete, consistent and verifiable, and so, writing a requirement specification can represent a meticulous and wearing task. The contributions of the described studies in identifying the problems of this phase are summarized in Table 2.

According to the literature, project managers and project teams play an important role in achieving success during the requirements phase (Chatzoglou, 1997). Almost all activities within a project are accomplished through teamwork. It is extremely important for an organisation to obtain the necessary resources to achieve that success, and therefore, many authors believe that the effective use of teams is a necessary ingredient for a project to be successful (Componation et al., 2008).

Table 2. Problems affecting the success of the requirement phase.

Problems Affecting the Success of the Requirement Phase	(Eman et al., 1996)	(Chatzoglou, 1997)	(Pressman, 2005)	(Mathiassen et al., 2007)	(Nicolás and Toval, 2009)
General Constrains • Time • Budget		✓			
Client and User behaviour • They cannot tell clearly what their needs are • They have a limited knowledge of the problem and possible solutions		✓	✓		
Project Management • Inexperience • Style • Lack of (the right) methodologies used		✓			
Project team • Attitude • Experience • Commitment • Motivation • Knowledge of problem domain and the purpose of the project development		✓	✓		
Communication • Between team members and users • Between customers and end users and the technical team		✓		✓	
Scope and Problem definition • The boundary of the system is ill-defined • The activities and the context of RCA are not stable or well understood	✓	✓	✓		
Requirements Nature • Writing a requirements specification can be a meticulous and wearing task • Requirements must be unambiguous, complete, consistent and verifiable • Requirements are volatile			✓	✓	✓

Source: The Author.

2.2 Leadership

2.2.1 Effective teams

Componation et al. (2008) affirmed that issues related to project teams involved in the IS/IT project are some of the most significant factors that influence productivity within the software development process. Often in IS/IT projects, several types of teams have to work in a coordinated manner (the technical team, the business team and cross-functional users (Peslak and Stanton, 2007)), which implies that different types of people are involved in developing the project, such as end users, systems analysts, programmers, project managers, functional area managers, and other stakeholders (Yang and Tang, 2004). Therefore, it is not hard to accept that team building is a critical task, in order to achieve project success (Kerzner, 2009).

Team building is the process of groups of individuals working with each other, the leader, external stakeholders and the organisation, in order to achieve a certain purpose and it is usually overseen by the project manager (PMI, 2008). PMI (2008) described developing project teams as being one of the primary responsibilities of the project. Those responsible should acquire a balance of technical, interpersonal and conceptual skills, which are all necessary to build, maintain, motivate, lead and inspire project teams to achieve high team performance and to meet the project's objectives, as well as to create an environment that facilitates teamwork (PMI, 2008). The leading pertinent question is: what makes a team effective?

Componation et al. (2008) defines a high performing team as being a group of people with complementary skills who have a common goal and working approach, who are committed to the same goal and each other, and who have respect for, and trust in each other. Additionally, Margerison (2001) pointed out that for a team to be effective, it should bring together competencies from nine different areas (advising, innovating, promoting, developing, organising, producing, inspecting, maintaining, and linking). Whereas it is unlikely that a single person can bring all these skills to a team, the author defends the importance of developing teams to ensure the combination of different elements to cover all areas.

According to Chatzoglou and Macaulay (1997), team members also play a key role in the RCA phase. These authors, among others, identified that the experience, knowledge, commitment and persistence of the team members, as well as user motivation, knowledge of the purpose of the project development, and communication with the project team members were all very important for the completion of the project development and also the RCA process (Chatzoglou and Macaulay, 1997; Xu and He, 2008; Kerzner, 2009).

Some of these factors are indeed frequently associated with leadership. According to PMI (2008), leaders are responsible for creating an environment that emphasises teamwork and team building, that fosters a spirit of cohesion, motivation and trust. They should also be able to establish and maintain the vision, strategy and communication, not only within the team, but also outside, influencing, guiding, monitoring and evaluating the performance of the team and the project, and inspiring the project team to achieve high performance. Thus, it is not surprising that leadership is considered to be one of the most important factors in team work, for both project and organisational effectiveness, and it is therefore regarded as being a vital factor in IS development group analysis (Yang and Tang, 2004).

2.2.2 Leadership and Management

Before further developing the theme of leadership, a clear distinction should be made between management and leadership. Kotter (1996) states that management relates to coping with complexity, while leadership is about coping with change. While managing is primarily concerned with consistently producing the key results that are expected by stakeholders, whereas leading involves establishing direction, aligning people, motivating and inspiring.

Likewise, Schein (1992) defends that "leadership creates and changes cultures, while management and administration act within a culture" (p.11). PMI (2008) adds that leadership is also the "ability to get things done through others" (p. 417), which involves the effort of a group of people working towards a common goal and enables them to work as a team. Additionally, leadership has also been defined in terms of individual traits, behaviours, influence over others, interaction patterns, role relationships, and hierarchical position, among others (Kuruppuarachchi, 2001).

The project manager is generally expected to be the project's leader (PMI, 2000). However leadership is not exclusive to project managers, and can be exercised by different

actors during the course of a project (Ng and Walker, 2008). Moreover, it is generally expected that several levels of leadership exist within a project, such as project leadership, technical leadership, and team leadership (PMI, 2000). Regardless of the existence of such different levels of leadership, the ultimate goal is to achieve leadership effectiveness as a way of improving overall performance. But what makes an effective leader?

2.2.3 Leadership effectiveness

According to Chen and Silverthorne (2005), leadership effectiveness is the use of the most appropriate leadership style, leading to a higher level of subordinate satisfaction and performance. Cicero et al. (2010) divided the concept of leadership effectiveness into three main indicators. The first indicator relates to the follower's perception of effectiveness, and, although this indicator may not be directly reflected in the subordinate's behaviour, the authors argue that it can still be considered to be a good predictor. The second indicator is subordinates' job satisfaction, given that one of the general objectives of leadership is to create a good job environment. Finally, the authors focussed on turnover intentions, as leadership should also be concerned with group maintenance.

However, analogous to team theories, team effectiveness is evaluated according to objective and subjective measures, such as the ability to meet team goals (Jiang et al., 1997). These authors additionally stress that these measurements also depend on the hierarchical level that assesses them. As it is regarded to be a subjective construct, leadership effectiveness is commonly assessed by considering the participants' opinion. For instance, Crawford (1999) measured project management effectiveness through superior assessment and self-rating of a number of dimensions, such as: value to the client and the organisation, the use of recognised project management methodologies, the effectiveness of relationships with peers in achieving project goals, the ability to inspire and encourage the performance of others, and the frequency with which projects are completed on time, within budget, and with achieving project goals. Similarly, Cicero et al. (2010) evaluated their three indicators of leadership effectiveness by considering a list of items to which participants had to respond according to their (likely to be subjective) perceptions.

2.2.4 Leadership styles

Over the last decades, practitioners and academics have developed a body of knowledge on leadership as a critical factor for success (Thite, 2000; Green, 2004; Turner and Muller, 2005). However, given that project leadership is essential for project success, it is necessary to question what makes a good project leader for an IS/IT project.

While there is no simple answer to this question, the authors have suggested leadership styles and characteristics that aim to characterise leaders and to enable a mapping between them and most appropriate situations (see for instance Turner and Muller (2005) and Kuruppuarachchi (2001)). Others have also tried to identify successful leadership styles for managers of IS/IT projects, under which IS/IT subordinates perform their best (Thite, 2000; Bennett, 2009).

However, appropriate leadership depends on the project itself, its type, dimensions and complexity (Dulewicz and Higgs, 2003b; Muller and Turner, 2007), on organisational culture and the organisational context (Hofstede, 1991), as well as the leader, subordinates and the situation (Kuruppuarachchi, 2001). Additionally, leadership style may depend on the organisational characteristics and context (internal and external), external forces, related tasks, and the management level, where it should change depending on the maturity of the employees, their job related experience, the willingness to accept job responsibility, and the desire to achieve (Kuruppuarachchi, 2001).

Over the last seventy years, different authors have given rise to six major schools of leadership. Table 3 summarises the main trends regarding this research topic, based on existing surveys (Turner and Muller, 2005; Muller and Turner, 2010).

Being the most contemporary trend of leadership, and with regards to the purpose of this study, the perspective of the *Competence School* of leadership is the most suitable, given its emphasis on skills and characteristics that a leader may possess or develop. Nevertheless, a brief description of each theory is given below.

Table 3. Leadership Schools Evolution.

	Leadership School	Main ideology
1930-1940s	Trait school	Focus on leaders' traits, such as their physical appearance, capacities and personalities.
1940s	Behaviour school	Emphasises the styles adopted by leaders for their particular leadership task. Leadership can be learned and is not a trait that people are born with.
1960s	Contingency school	Is concerned with the appropriateness of different leadership styles in different leadership situations, by matching the personal characteristics of a leader to the leadership situation.
1980s	Visionary and charismatic school	Focus on organisational change. Development of transformational and transactional leadership styles.
End of 1990s	Emotional intelligence school	Focus on self-management and interaction management. Emotional capacities are more important for leadership than intellectual capacities.
2000s	Competence school	Encompasses all the earlier schools Considers competencies as being a specific combination of knowledge, skills and personal characteristics.

Source: The author, based on (Turner and Muller, 2005; Muller and Turner, 2010).

Three early schools

The *Trait School* became popular in the 1940s, with the suggestion that effective leaders had common traits. These traits should come from birth, as an effective leader cannot be built or taught. The identified traits focus on three major areas, such as: abilities (hard management skills), personality (such as self-confidence and emotional variables), and physical appearance (Turner and Muller, 2005; Robbins and Coulter, 2007).

The later work of (Kirkpatrick and Locke (1991)) advocates six leadership traits that can dictate leadership success, namely: drive, the desire to lead, honesty and integrity, self-confidence, cognitive ability, and knowledge of the business. The authors believe that these traits can distinguish leaders from non-leaders.

Between the 1940s and the 1960s, the *Behavioural School* became popular. In contrast to the previous school, there is an assumption here that an effective leader can be built, featuring styles and behaviours that can be developed. Most of the theories associated with

this school characterise the leader according to some parameters, which include: concern for people or relationships, concern for production, the use of authority, involvement of the team in decision-making and decision-taking, and flexibility versus the application of rules (Turner and Muller, 2005).

In the 1960s and 1970s, the *Contingency School* was developed. This approach tries to apply leadership styles to specific situations, rather than trying to find universal theories of leadership. Within this school, leadership styles should be matched with a number of factors in order to find the best solution for creating an effective leader for that particular situation and context. Some of the contingency factors identified were environmental factors, such as the work force or a system of formal authority, subordinate factors, such as experience or perceived ability, team structures, and phases of the project life cycle, among others (Robbins and Coulter, 2007).

Visionary and Charismatic leadership

The *Visionary and Charismatic School* was popular during the 1980s and 1990s. The term charismatic leadership has been used to describe a subset of leaders who are capable of producing extraordinary effects on their followers, using their personal abilities (House and Baetz, 1979). Such leaders have the ability to influence their followers, and to support their vision through their own enthusiasm and excitement. In this sense, this leadership style and its effect on individual performance have been studied and have shown a positive relationship between charismatic leadership and performance, causing some to consider it as being a key determinant in achieving high levels of performance (Bass, 1990; Howell and Avolio, 1993; Flynn and Staw, 2004).

Furthermore, a number of studies were performed to identify personal characteristics of charismatic leaders. According to Robbins (2001), charismatic leaders have five main characteristics: vision and articulation, personal risk, environmental sensitivity, sensitivity to followers' needs, and unconventional behaviour. However, Flynn and Staw (2004) argue that it is a set of personal characteristics, such as confidence, dominance, sense of purpose, and communication skills, among others, that enable such leaders to articulate and communicate a vision for followers to follow.

Moreover, the visionary leadership school arose from the study of successful business leaders who had led their organisation through change (Turner and Muller, 2005). This was regarded as being the best way to manage complex organisations, by combining the concepts of strategy and leadership with the strategic vision (Wesley and Mintzberg, 1989).

Although related, visionary leadership goes beyond charisma (Robbins, 2001). The former author defined visionary leadership as being "the ability to create and articulate a realistic, credible, attractive vision of the future for an organisation, which grows out of, and improves upon the present". Westley and Mintzberg (1989) also argued that visionary leadership, instead of being considered a unidirectional flow process with specific steps [vision (idea) -> communication (word) -> empowerment (action)], should be considered as a dynamic model. A visionary leader appears to have three qualities that are related to the effectiveness of their visionary roles: leader communication skills and the ability to explain the vision to others through clear oral and written communication; the leader's behaviour and the ability to express the vision, not just verbally, but also through the leader's behaviour, and the ability to extend the vision to different leadership contexts (Robbins, 2001).

Transformational and Transactional leadership

Representative of the visionary and charismatic school is the distinction between transformational and transactional leadership, as developed by Bass (1990). Transactional leaders focus on doing things right, while the transformational leader focusses on doing the right things (Bennett, 2009).

Transactional leadership motivates subordinates by appealing to their personal desires (Bennett, 2009). It is concerned with coping with complexity, through planning and budgeting, organising and staffing, controlling and problem solving (Muller and Turner, 2010). It emphasises that follower rewards are contingent on meeting specified performance targets.

On the other hand, transformational leadership is concerned with coping with change through setting a direction, aligning people to a vision of an alternative future, and by empowering and motivating them to participate and take the initiative in changing the organisation (Bennett, 2009). Transformational leaders are also charismatic, who lead, inspire, and improve behaviour and productivity. As workers think beyond themselves, they

would provide extra effort to carry out their work, with greater job satisfaction, whilst being effective in getting the job done, and in increasing productivity (Bennett, 2009).

One further type of leadership that is derived from this school is that of Passive Leadership. Passive leaders avoid, or delay decision making, reject responsibilities, and prefer a "hands-off" management style (Bennett, 2009). Table 4 summarises the expanded dimensions for each leadership style.

Many researchers have been studying the impact of leadership styles on organisational performance. Thite (2000) and Bennett (2009) have studied successful leadership styles for managers of IS/IT, and both consider that the transformational leadership style is more appropriate and desirable by subordinates for achieving success. However, when examining the scales that were considered to be most relevant, it was found that important results exist for several different styles. In both cases, the subscale contingent awards from the transactional style achieved better results than some of the subscales of the transformational style, as was the case for the dimensions of technical leadership. From these differences, which cannot be ignored, it should eventually be appropriate to consider characteristics and skills inherent in leadership, instead of trying to adopt a certain style. Moreover, some evidence shows that leaders may possess both transactional and transformational behaviours. Further studies have suggested that transformational leadership builds on transactional leadership and, in particular, on contingent reward behaviour (Avolio et al., 1999).

Table 4. Dimensions for each of Bass's leadership styles

Leadership style	Dimensions
Transformational	Idealised influence (attributed)
	Idealised influence (behaviour)
	Inspirational motivation
	Intellectual stimulation
Transactional	Contingent reward leadership
	Management by exception (active)
Passive	Management by exception (passive)
	Laissez-Faire

Source: Adapted from (Turner and Muller, 2005)

Emotional Intelligence School

Just before the year 2000, the *Emotional Intelligence School* emerged. This school advocates that managers have different levels of intelligence and that their emotional response to situations is the distinguishing feature between leaders (Turner and Muller, 2005). The school suggests that emotional capabilities are more important for leadership than intellectual and technical capacities (Goleman, 1998).

Indeed, emotional intelligence and leadership style have been shown to be correlated with the performance of organisations (Dulewicz and Higgs, 2003b). Goleman et al. (2002) identified nineteen leadership competencies that they grouped into four dimensions (self-awareness, self-management, social awareness and relationship management). Through these competencies, the authors suggested six management styles, each appropriate for different situations. However, the authors did not covered any specific type of projects, namely IS/IT projects.

Leadership Competence School

The *Competence School* emerged in the 2000's and, according to the literature, this school's perspective provides the most advanced current understanding of leadership (Turner and Muller, 2005).

Initially, this approach seems to return to the original proposals made by the Traits School, whereby competencies can be developed, i.e. they do not only intrinsically exist at birth. In addition, different profiles of competencies can be used to create different leadership styles appropriate to different situations, reflecting the position held by the Contingency School (see for instance (House, 1971)). These different combinations of competencies can also create transactional leaders (Bass, 1990), are suitable for low complexity systems, as well as for transformational leaders (Bass, 1990), and are also suitable for high complexity systems, as suggested by the Visionary and Charismatic School (Turner and Muller, 2005). Although this school encompasses all the ideas of earlier schools, its main emphasis is on identifying the competencies needed to achieve leadership effectiveness.

Crawford (2003) briefly defined competence as being knowledge, skills and personal characteristics that all result in superior results or in meeting defined performance standards. Returning to previous work on competencies, in 1973 the psychologist David McClelland,

as cited in (Garman and Johnson, 2006), said that competencies are outcomes and relevant measures of knowledge, skills, abilities and traits, and motives. However, competency is a widely used concept that means different things to different people (Crawford, 1999). It has evolved as part of different research fields, such as corporate strategy (e.g. core competencies) and has been used to assess different professionals related to IS/IT projects (e.g. project managers and programmers) – see the Related Topics section for further discussion. Having recognised the disparate notions of competencies, the focus here remains on the study of leadership competencies, i.e. leadership attributes and skills used in the context of IS/IT projects. As such, in the context of the attribute-based inference of competence, the two main definitions are explored in Table 5.

Table 5. Competence Definitions.

Crawford (1997)	Turner and Muller (2005)
• Competence as a combination of input competencies; process competencies; output competencies • ***Input competencies***: the knowledge and understanding, skills and abilities that a person brings to a job; • ***Process competencies***: core personality characteristics underlying a person's capability to do a job; • ***Output competencies***: the ability to perform the activities with the expected levels of performance	• Competencies as knowledge, skills, and personal characteristics that deliver superior results • Can be technical, intellectual or emotional in nature, • Covering personal characteristics (including emotional intelligence) • Knowledge and skills (including intelligence and problem-solving ability, as well as management skills)

Source: the author, from (Crawford, 1997) and (Turner and Muller, 2005)

The first definition (Crawford, 1997) focusses on variation in competencies over the work process. The author suggests different types of competencies according to the task process stage: input, process, and output. In the second definition, Turner and Muller (2005) define competencies such as attributes that an actor may possess.

In this study, the latter definition will be adopted, as the skills and characteristics possessed by a leader are being considered, as illustrated in the Leadership Competencies Framework (Dulewicz and Higgs, 2003b).

From their review of the literature, and based on their own work, Dulewicz and Higgs (2003b), found that competencies are often categorised into four types: cognitive, emotional, behavioural and motivational. Additionally, they suggested that the cognitive type should be divided into intelligence- IQ and managerial skills (MQ), in order to better capture the main dimensions of effective leadership. Furthermore, the authors combined emotional, behavioural and motivational types into emotional competencies (EQ). With this competence framework, Dulewicz and Higgs (2003b) have shown that not only does EQ appear to be particularly important in explaining managerial success and top-management leadership, but IQ and MQ were also found to be important.

Within the three groups of competencies, the authors identified 15 dimensions that influence the performance of leadership (see Table 6). For the intellectual type they found: critical analysis and judgment, vision and imagination and strategic perspective. For the managerial type they considered: resource management, engaging communication, empowering, developing and achieving. The emotional type includes: self-awareness, emotional resilience, intuitiveness, interpersonal sensitivity, influence, motivation and conscientiousness. A brief description of each of these dimensions can be found in Appendix 1.

Different studies have suggested other frameworks for leadership competencies, that consider a different numbers of factors, as can be seen, for instance, in the work of Russo et al. (2005), which suggested 19 leadership competencies. However, these studies generally merge or split some of the competencies suggested by Dulewicz and Higgs (2003b), and there is general agreement regarding the list of 15 dimensions, which is presented in Table 6 (Turner and Muller, 2005).

Table 6. Leadership competencies framework

Competency Type	Competency
Intellectual - IQ	1. Critical analysis and judgment
	2. Vision and Imagination
	3. Strategic Perspective
Managerial (MQ)	4. Engaging Communication
	5. Managing Resources
	6. Empowering
	7. Developing
	8. Achieving
Emotional (EQ)	9. Self-awareness
	10. Emotional Resilience
	11. Motivation
	12. Sensitivity
	13. Influence
	14. Intuitiveness
	15. Conscientiousness

Source: (Dulewicz and Higgs, 2003b)

Combining different sets of these competencies, Dulewicz and Higgs (2003b) identified three leadership styles, namely:

- *Engaging leadership*: based on empowerment and involvement in a highly transformational context, with a focus on producing radical change through engagement and commitment;
- *Involving leadership*: based on transitional organisations which face significant, but not necessary radical changes;
- *Goal Leadership*: focussing on delivering clearly understood results in a relatively stable context.

They also found evidence that these leadership styles result better in different situations. For instance, they found that 31% of leaders had a predominantly goal-oriented style, 28% had an involving style, and 41% had an engaging style, which they subsequently show to provide perceived better results in low, medium and high complexity projects respectively (Dulewicz and Higgs, 2003b). These variations in the success of different styles according to different situations leads to the hypothesis that there potentially different leadership competencies are considered to be relevant during the various phases of a project's life cycle.

2.2.5 Leadership throughout project phases

Throughout the life cycle of a project very different activities are performed by the project team members (PMI, 2000). These different activities suggest that there is a need for different relevant professional skills (Russo et al., 2005). Ng and Walker (2008) suggest that during projects, the way that managers and leaders use their power and influence may vary according to the project phase and the team members' level of commitment.

Frame (1987), as cited in Turner and Muller (2005), was the first to suggest that different leadership styles are appropriate at different stages of the project life cycle. Also Turner (1999) suggested that different cultural styles lead to better performance at different stages of the project life cycle.

Competencies have also been considered along the project life cycle. According to Skulmoski (2005), in each of the project phases different competencies can be considered important. In the same way, Russo et al. (2005) have shown how leadership competencies can influence the project management phases. Indeed, PMI (2008) have also stated that leadership is important throughout all phases of the project life cycle, especially when it is important to communicate the vision and to inspire the project team in order to achieve project success.

Ng and Walter (2008), which also found this topic a relevant one, used an IS/IT project from a public Organisation in Hong Kong to illustrate how various types of power, and thus leadership styles, were used (by all participants) to influence team members across the identified project phases. To do so, they carried out a case study, directly observing and describing the progress of the project, drawing conclusions through their own (and possibly

subjective) analysis of actors and their behaviours, attempting to characterize them using the existing literature.

Recently Skulmoski and Hartman (2010) conducted an exploratory study to search for project participants' competencies that were relevant for each project's phases, by inviting the participants to rank and justify which competencies were considered important, from a list of seven competency categories (personal attributes, communication, leadership, negotiations, professionalism, social skills and project management competencies). Their study is not focussed on leadership competencies, as instead the authors consider this to be one of the required categories. However, the authors measured some of the competencies offered in the Leadership Framework of Dulewicz and Higgs (2003b), even when they are not directly related to leadership. For instance, they address negotiating and communications skills separately from leadership, whereas in the Leadership Framework they are both considered to be leadership competencies. Nevertheless, the results showed that different competencies are critical to the performance of each of the team members during the early stages of a project, such as the capability to deal with ambiguity, the ability to sell, persuasiveness, political awareness, or decisiveness.

Finally, Keil et al. (2013) conducted a Delphi study to explore and rank critical skills for IT project managers. Their top 5 skills placed leadership in first place, followed by verbal communication, scope management, listening and project planning. During their follow up interviews, panellists highlighted the relevance of the variations that can exist across the different project stages. However, the results did not show any variation in the importance of leadership and communication throughout the project life cycle (they were always ranked as being highly important). However, it is worth noticing that this topic was clearly less explored than the remaining body of the paper, and it was not even initially planned. Thus, the underlying contribution is valuable, as it highlights the importance of considering project life cycle phases to address the relevance of project managers' skills.

Table 7 summarises the studies that focus on the variation of leadership styles and competencies through the project life cycle.

Table 7. Summarised literature and corresponding results found.

Reference	Aim	Reference type and Research Methodology	Results
(Frame, 1987)	The provision of a practical approach to managing projects.	Book	The first study to suggest that different leadership styles are appropriate at different stages of the project life cycle.
(Turner, 1999)	To provide a guide for project management so as to achieve strategic organisational objectives.	Book	Different cultural styles lead to better performance at different stages of the project life cycle.
(Russo et al., 2005)	The evaluation of a set of leadership and influence skills, based on the existing literature, for use along the generic project life cycle as a critical factor for project success.	Qualitative and exploratory study based on the survey method.	Results are presented as relative weights of each competency for each phase and in terms of the level of overall project success; both sets of results seem to be positively related.
(PMI, 2008)	A guide to project management.	Book	Leadership is important throughout all phases of the project life cycle, especially when it is important to communicate the vision and to inspire the project team, in order to achieve project success.
(Ng and Walker, 2008)	To study an IS/IT project from a public organisation in Hong Kong with the objective of illustrating how power was used and distributed among project participants.	An ethnographic study mainly using participant-observation. Essentially qualitative data was collected.	The predominant leadership styles adopted varies throughout the project phases and between participants.

(Table continued)

Reference	Aim	Reference type and Research Methodology	Results
(Skulmoski and Hartman, 2010)	The study of project participants' competencies needed along the generic IS project life cycle (initiation, planning, implementing, close-out).	Two rounds of semi-structured interviews administered to IS specialists. Ranking surveys were also conducted.	Competencies are grouped into: personal attributes, communication, leadership, negotiations, professionalism, social skills and project management competencies. Different competencies were found to be more relevant depending on the different project phases and according to each project participant.
(Keil et al., 2013)	To identify and rank the most important IT project management skills, also considering their relative importance.	A Delphi study based on a three phase process: brainstorming, narrowing down and raking. A follow up phase to the interviews was also performed.	A total of 48 skills were obtain but only 19 were ranked as critical. The top five respectively include leadership and verbal communication in the first and second position. Follow up interviews suggested the relevance of considering the variations that may occur in the skills along the project life cycle. However, no variations were found to these two skills, as panellists always reported them to be highly important.

Source: the Author.

2.3 Literature Summary and Resulting Research Questions

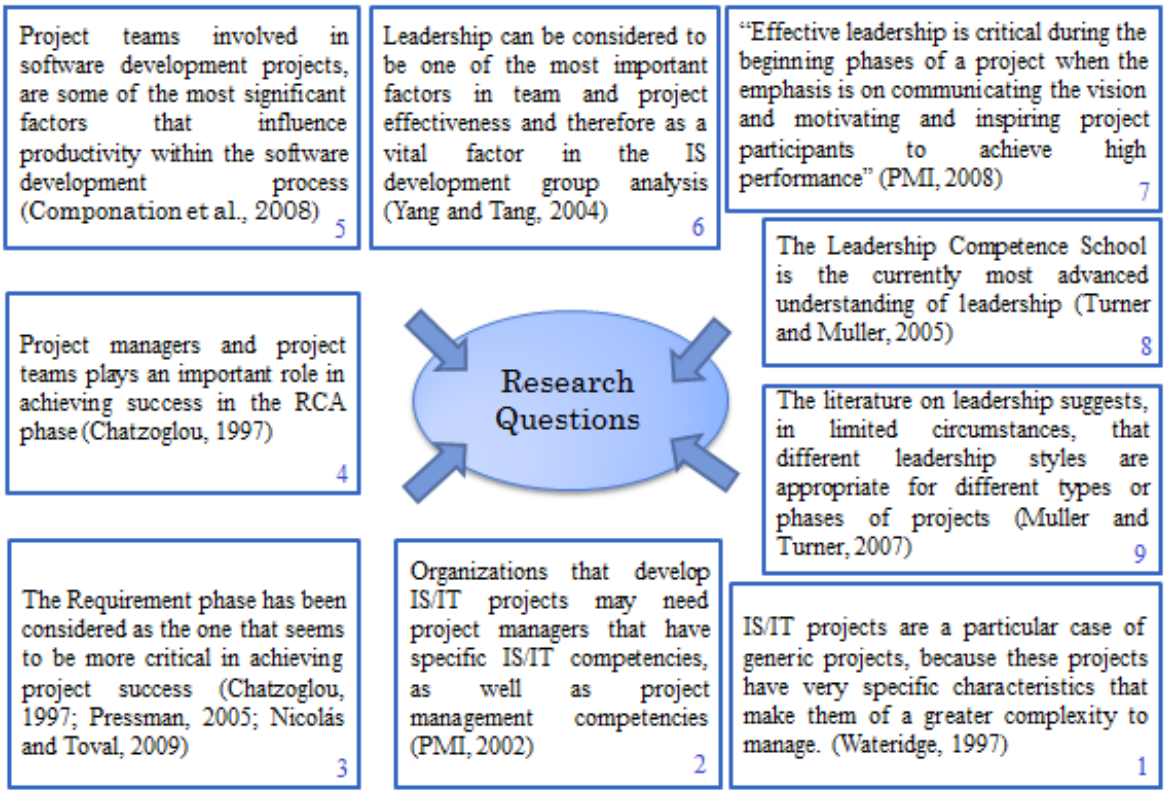
Throughout this chapter, two distinct fields from the literature review were presented. Although some of their topics are interconnected, few studies were found on both IS/IT projects life cycle phases and leadership. The logic that leads us to the research questions of this study is presented by the sequence of topics discussed. Some of these criteria are summarised in Figure 5.

An IS/IT project, particularly a software development one, can be considered to be of a particular and complex nature when compared to a generic project. Ng and Walter (2008) affirm that managing IS/IT projects is complex, not only because they involve delivering systems, but also because they involve a great deal of integration of skills and inputs from a diverse range of specialised talent and technical resources.

In addition, the literature suggests that leadership can be considered to be a critical factor for project success (see the Related Topics section for further discussion), and that different leadership styles are appropriate in different situations. Muller and Turner (2007) studied whether leadership styles influence project success, and how these leadership styles are appropriate for different project types. During their research one interviewee, who was working on IS/IT projects, said:

> "the feasibility and execution stages would be managed by somebody from the business, but the design stage by somebody from the information systems department. The reason is design requires technical knowledge, whereas other stages require business knowledge (…) during implementation the management of stakeholders is important" (Muller and Turner, 2007, p. 25)

Figure 5. Grounding of the Research Questions



Source: the author.

This statement reinforces that this is a relevant topic that needs to be studied in greater depth, but it also gives some clues on how competencies may vary along the software development project life cycle. Additionally, Eom (2006) suggests that new leadership studies should be conducted in the context of IS, due to the fact that IS personnel have unique characteristics, and that IS units are complex in nature. In fact, even those studies that consider leadership and the project life cycle together tend to explore the variations along the various phases (Russo et al., 2005), not considering any in particular depth. Alternatively, they tend to identify variations between the different elements involved in the projects (Skulmoski, 2005; Ng and Walker, 2008; Skulmoski and Hartman, 2010).

Furthermore, it has been well documented in the literature that out of all phases of the software project life cycle, the one that seems to be most critical in achieving success is the requirements phase (see for instance (Chatzoglou, 1997; Chakraborty et al., 2010)). However, few studies were found that focus on the impact that social and behavioural factors

can have on the outcome of the requirements phase. Of those who do so, some highlight the attitude and behaviour shown by developer teams and users during the course of actions (Chakraborty et al., 2010), while others suggest factors for increasing the quality of project and team management, as well as the techniques and tools used (Chatzoglou and Macaulay, 1997).

While the contributions of the existing body of knowledge are significant for the problems discussed, the literature review found no studies that explicitly integrated all these elements within a unifying model. No previous author was found who focussed their research on identifying which different set of leadership competencies are most appropriate for achieving success in IS/IT projects, particularly software development projects, by considering any of the project phase separately.

Therefore, this study aims to explore leadership competencies relevant to the requirements phase of the software development project life cycle. The study also considers some of the most relevant factors that can influence eventual variations in the set of leadership competencies. The following research questions can thus be formulated:

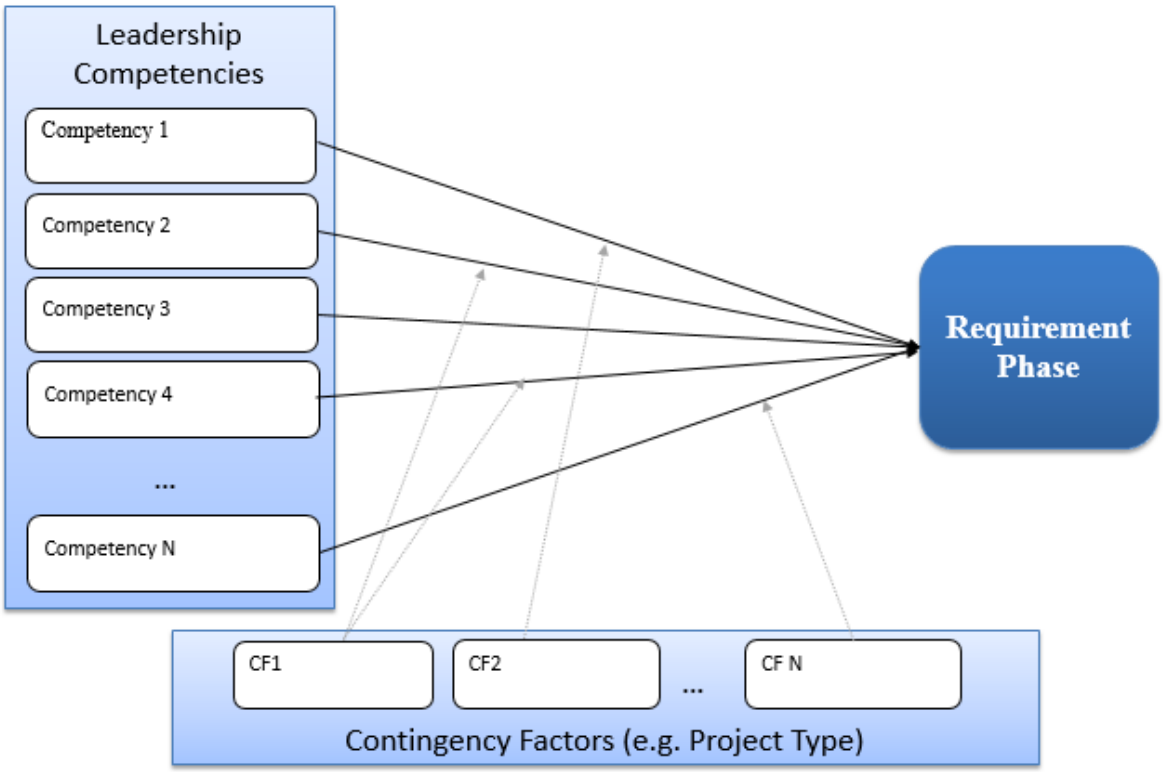
(1) Which leadership competencies are relevant for the requirements phase?
(2) How can leadership competencies help to achieve leadership effectiveness in the requirements phase?
(3) Which factors can influence the relevance of competencies during the requirements phase?
(4) How can these factors influence the relevance of competencies during the requirements phase?

The basis for the research questions together with the formalisation of the objectives for this study gave rise to the development of a theoretical model. This research model establishes the logical sense of the concepts for this study and presents the connection between the variables and factors that have been identified to be part of the environment that is considered to be important for the phenomena being investigated (Sekaran and Bougie, 2013).

In this research, the Leadership Competencies Framework proposed by Dulewicz and Higgs (2003b) was adopted as the basis for the model (see Figure 6). Although, this study

intends to check the relevance of these competencies for the context being studied, it also aims to identify new ones, whether they prove to be relevant, or not. To this end, the number of competencies given in the model are, at this time, just hypothetical examples, which will be completed during the data analysis chapter.

Figure 6. Research Model for leadership competencies in the requirements phase of the software development project life cycle



Source: the Author.

Apart from leadership competencies, contingency factors were also added to the research model. At this stage, these variables relate to the factors drawn from the literature on project categorisation (see Table 1). It is important to note that the organisational project management maturity attribute is not going to be considered, as it is beyond the scope of this study.

As suggested in the literature, these contingent variables are expected to somehow influence at least some of those competencies that are relevant for the requirements phase.

This is represented by the dotted arrows in the model which affect the relevance of the competencies for this phase.

It should also be noted that at this stage all the dimensions represented in the model constitute examples for future exploration. Meanwhile, a set of objectives and secondary questions were developed in order to understand the variables and the context of the phenomena being studied:

(RO1) – Understand how the requirements phase is undertaken.

(RO2) – Understand how leadership may influence the success of this phase.

(RO3) – Check the relevance of competencies proposed by Dulewicz and Higgs (2003b).

(RO4) – Identify any other leadership competencies that are relevant for the requirements phase of the software development project life cycle.

(RO5) – Identify the contingency factors of the project that influence the competencies during the requirement phase.

(RO6) – Assess how these factors lead to variations in the set of relevant competencies.

2.4 Related Research Topics

The topics mentioned here are tangential to this research study, and are not a central constituent, although they are at least indirectly related. The introduction of these topics in the principal literature review could deviate the reader's attention from the core research topics and could create confusion about the study's scope.

However, the literature review would not be completed without addressing them. So we decided to create this section to discuss these topics and to give a brief commentary explaining why they are not part of the main literature.

2.4.1 Project success

Project success is not directly studied in this research. Despite the large amount of existing literature that attempts to document the factors that lead projects to fail or succeed, there is no empirical evidence that demonstrates the link between leadership in the requirements phase and project success.

Before proceeding it is necessary to distinguish between project success and project management success. According to Cooke-Davies (2002) project success is measured against the overall objectives of the project, whereas project management success is measured by the widespread and traditional measures of performance against cost, time and quality. It is also important to distinguish the success criteria, which are the measures by which the success or failure of a project or business is judged, from success factors, which are those inputs to the management system that lead directly, or indirectly to the success of a project or business (Cooke-Davies, 2002).

However, success and failure are not always easy to define and measure (Thomas and Fernández, 2008). Many researchers have offered definitions, conceptual models and sets of critical factors for project success (Pinto and Prescott, 1988), but as in other research areas, there is no consensus in defining project success or failure (Cooke-Davies, 2002; Turner and Muller, 2005; Ng and Walker, 2008; Thomas and Fernández, 2008).

Early discussions considered that the success of a project was determined by focussing on "the iron triangle" of time, cost (on budget) and functional improvement (Ng and Walker, 2008), while ten to twenty years later the discussion was extended to include quality. Today, project success can be seen as being a combination of management success, technical success and business success (Thomas and Fernández, 2008), which uses as measurements: project stakeholder and participant's satisfaction, product success, system implementation, requirements met, system quality, business and organisational benefit, and team development (Muller and Turner, 2007; Ng and Walker, 2008; Thomas and Fernández, 2008; Zhang, 2009). In fact, it is widely accepted that success is a multi-dimensional construct (Thomas and Fernández, 2008), although there is no agreement about which dimensions best represents success. The dimensions suggested in the literature are summarised in Table 8, grouped by the type of measure.

For IS/IT projects, success can be measured by the extent to which a project team completes the project effectively and efficiently, together with teamwork satisfaction (Xu and He, 2008), or it can also be seen as being a combination of project implementation success and system success (Thomas and Fernández, 2008). Pinto and Prescott (1988) developed a framework with ten critical factors related to project implementation success, consisting of: project mission, top management support, project schedule/plan, client consultation, personnel, technical tasks, client acceptance, monitoring and feedback, communication and trouble-shooting. In turn, systems success can be divided into different dimensions, according to different authors. It can be represented by technical development, deployment to the user, and delivery of business benefits; and it can also be addressed through the success of the development process, success of the use process, quality of the product, and impact on the organisation; or it can consider six major dimensions of systems success, namely: system quality, information quality, service quality, system use, user satisfaction and net benefits (Thomas and Fernández, 2008).

Table 8. Summarised Measures of General Project Success

Measures of Project Success	Groups of measures
On-time	Project Management Success
On-budget	
Sponsor satisfaction	
Steering-group satisfaction	
Project-team satisfaction	
Stakeholder satisfaction	
Customer/user satisfaction	
Team development	
Product success	Technical Success
System implementation	
Met requirements	
System quality	
Business continuity	Business Success
Met business and organisational objectives	
Delivery of benefits	

Source: the author.

Besides the definitions above, Thomas and Fernández (2008) claimed that project success extends beyond the former dimensions, since it is a concept that means different things to different people. If so, the perception of success is influenced by individual expectations and a project might be perceived by their stakeholders as a partial failure that was in fact successful in achieving near-optimal results.

In line with this position, some authors have stressed that this perception along with success factors can be temporal, i.e., vary over time (Russo et al., 2005) and over stages of

the project life cycle (Somers and Nelson, 2004). Additionally, Hartman and Ashrafi (2002) state that if different stakeholders have different ideas of what success is and how success will be measured, it is likely that no one will be satisfied when the project is finished. They conclude that the definition of success among key stakeholders before the beginning of the project can contribute to achieving project success: "how success is defined, and who evaluates success therefore affects the final judgment of success and failure" (Thomas and Fernández, 2008, p.733).

It is noteworthy that while the success of the overall project should be a result of the conjunction of the successful phases that constitute it (PMI, 2000), even subjectively, this does not mean that the inverse is also true. In fact, considering that a particular phase was successfully performed does not necessarily mean that the project will be a success. Instead, it means that the project probably has an improved chance of success due to the complex factors that are related to project success. Thus, it is anticipated that by studying the requirements phase a contribution can be made to an improvement in the success level for that phase, and it can potentially positively influence the overall success of projects, although the success of projects per se is not considered to be part of the remit of this study.

2.4.2 Leadership as a critical factor for project success

Over the last decades, several authors have been discussing critical factors that contribute to project success (Thorp, 1999; Peled, 2000; Cooke-Davies, 2002; Thomas and Fernández, 2008). Some have focussed on the importance of the performance of project managers for project success, particularly when projects introduce new technology and/or processes, while others have shown that project management, including resources and tools used, as well as management styles accepted, was considered very important in achieving project success (Chatzoglou and Macaulay, 1997). Additionally, Green (2004) found that project coordination and communication, together with good project leaders were all well ranked as necessary factors for project success.

Such literature also focuses on the study of a manager's leadership style and competencies as an impact factor for overall project performance; successful projects require strong leadership skills (Kuruppuarachchi, 2001; Turner and Muller, 2005; PMI, 2008;

Bennett, 2009; Zhang, 2009). However, in line with the Turner and Muller (2005) survey in the area of project management, Thite (2000) identified that there was a shortage of empirical studies that focus on leadership as a critical factor for success.

Although the aim is not to study leadership as a critical success factor, the truth is that this topic is at least indirectly related to the objectives of the study. Concurrently, while the aim is to study leadership and its impact on the activities and objectives of the requirements phase, the underlying objective is to verify whether this phase is conducted with greater success. The ultimate concern is the potential for increased chances of overall project success, regardless of how success is measured.

2.4.3 Core competencies

The concept of competence is widely used through different areas and has evolved in recent decades. This diversification gave rise to different interpretations and meanings for the concept. One of such areas is corporate strategy, where one can easily find the concept of core competencies.

As proposed by Prahalad and Hamel (1990), the core competencies of the firm are the basis for a firm's competitive advantage. Core competencies in this sense are outside the scope of this research project, as the aim here is to explore individuals' competencies, in line with many project management theories (see for example (Crawford, 1997; PMI, 2002; Dulewicz and Higgs, 2003b; Garman and Johnson, 2006; Muller and Turner, 2010)).

2.4.4 Project Managers' competencies

Competent project managers and teams have long been related to successful projects (Crawford, 1997). While a successful project does not solely depend on the competencies of project management (PMI, 2002), extensive literature exists that aimed at finding, or developing the skills and knowledge that a competent professional should have. Posner (1987), as cited in (Skulmoski, 2005), found that a project managers' skills and characteristics should be composed of:

Interpersonal skills (84%)

Management skills (75%)

Team-building skills (72%)

Leadership skills (68%)

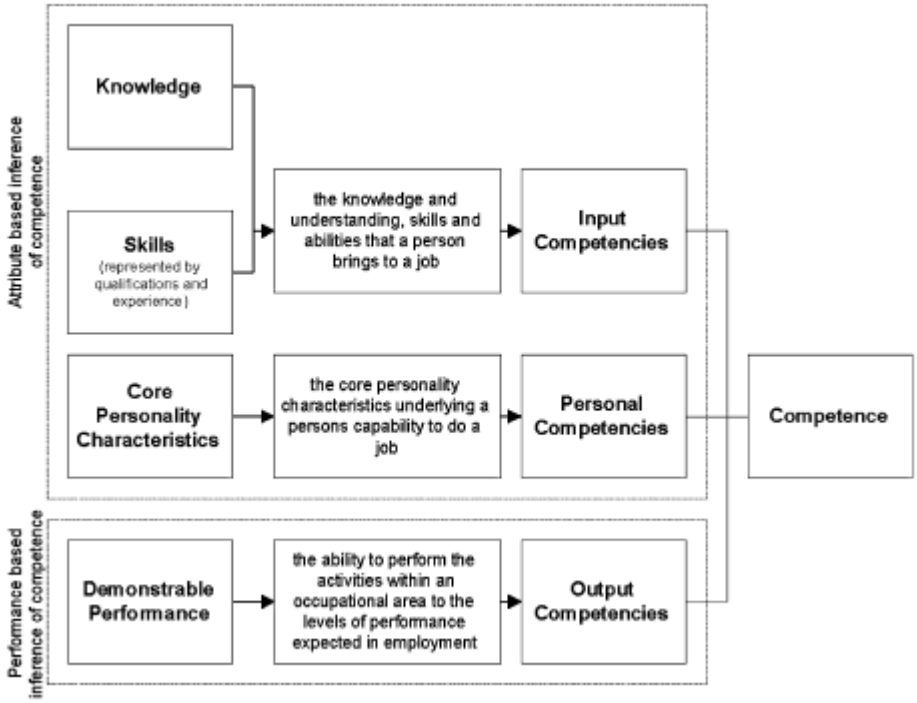
Coping skills such as flexibility and creativity (59%)

Technological skills (46%)

The author also concluded that the greatest effort should be on developing interpersonal skills rather than technical ones, due to their greater relevance. However, project managers' competencies are contingent upon the type of projects (Crawford et al., 2005; Muller and Turner, 2007), the project life cycle and the role they assume (Skulmoski and Hartman, 2010).

Skulmoski and Hartman (2010) recently posited that some competencies that play an important role in certain phases while being considered less relevant for others. They considered a four phase project life cycle (initiation, planning, implementing, close-out) and from a list of seven competency categories (personal attributes, communication, leadership, negotiations, professionalism, social skills and project management competencies), they invited the project participants to rank and justify which of the competencies, they found to be critical, due to the normal responsibilities and activities performed in each phase by project managers and other team members. Similarly, Crawford (2005) developed an integrated model for project management competence (Figure 7), which assesses knowledge, qualifications and experiences, environmental factors, performance and core personality characteristics, to provide a basis for identifying and measuring aspects of competence.

Figure 7. Integrated Model of Project Management Competence



Source: (Crawford, 2005)

The literature on the competencies of project managers gives perspective and understanding to the context that surrounds leadership. As observable from the contributing studies described above, leadership is often perceived and analysed as one skill, out of a group that a project manager should possess. However, the distinction between leadership and project management (Kotter, 1996) identifies these two concepts as being distinct, which leads to the belief that the competencies for an effective leader go beyond the competencies needed by project managers. Moreover, leadership is not restricted to project management, although expected, and can be pertinent for any other person/role who is not performing project management.

2.4.5 IS Project Managers' competencies

The Project Management Competency Development Framework (PMI, 2002) advocates that an organisation that develops IS/IT projects may need project managers that have specific IT competencies. These competencies should exist in coordination with general

project management competencies, which should be developed in order to achieve specific objectives. This argument strengths the relevance of studying software projects as a particular type of those projects that have characteristics that distinguish them from others projects.

Although, this study does not focus on specific IS professionals technical skills, there are research trends that aim to address the skills necessary for software development - see for instance The SWEEBOK® (Bourque and Dupuis, 2004). Instead, the present study focusses on soft skills, namely those leadership competencies that are relevant to the requirements phase of software development projects.

Under the topic of soft skills, recent studies have been conducted focussing on the need to address specific competencies for an IS Project Manager (Stevenson and Starkweather, 2010; Keil et al., 2013). Stevenson et al. (2010) explored the critical competencies that IT executives and managers expecting in an IT Project Manager. Their resulting set of competencies represents the criteria that these professionals value for hiring successful project managers. The results clearly support the importance of soft skills, rather than other technical expertise or certifications (namely PMI and similar). From their resulting list of 15 competencies, 6 were rated as being critical core competencies: leadership; ability to communicate at multiple levels, verbal skills, written skills, attitude and ability to deal with ambiguity and change.

The work of Keil et al. (2013) reached similar results for their set of critical project manager competencies. Leadership was placed in the first position and a great enhancement was given to communication skills. While the relevance on interpersonal skills and communication is evident in both studies, it is noteworthy the focus on the need to communicate not only with the team, but also with the remaining stakeholders of the first study.

Despite the outstanding contributions of these studies, their focus just remains parallel to this research. Since previous studies focus on the exploration of general management skills, they tend to consider leadership as a skill in itself. In contrast, in this study, the focus remains on project manager leadership, and we consider the leadership to be a category of skills

.

3 Research Methodology

3.1 Philosophical Perspective and Research Design Options

During the research process, authors should be able to convince others about the value and relevance of their studies, pointing clearly to the contributions made and the relevance of them (Remenyi et al., 2005). The research process can vary according to different factors. At least three factors can influence the appropriateness of the research process: area of interest; problem domain and research questions, and; resources and constraints (Remenyi et al., 2005; Yin, 2013).

The research area can determine which process is best suitable for the research study. According to Pedron (2008), research in Information Systems (IS) can be different from research in other areas. This can be justified, not only because IS is a relatively recent research field, but also because it usually involves different knowledge areas, including scientific, technical, organisational, societal and psychological issues. This diversity explains the different research approaches, methods and paradigms that can be found in IS research (Caldeira and Romão, 2002; Dubé and Paré, 2003; Chen and Hirschheim, 2004; Pedron, 2008).

Remenyi et al. (2005) and Yin (2013) claim that no research strategy can be adopted until the research question or problem is clearly defined. Authors argue that the research question is usually the most important factor that can influence the research strategy. However, the research strategy is also constrained by the resources available (Remenyi et al., 2005). Typically, time and money available for the study are the most compromising resources, which are even more relevant for a Doctoral or a Masters' study. Thus, research strategies must be carefully analysed and chosen, so as not to compromise the overall validity and contribution (Remenyi et al., 2005).

This chapter is organised into two main sections: the first one considers a theoretical approach and the other one instantiates the possible options of this particular study. It starts with an explanation of the different philosophy perspectives and resulting ontological and epistemological positions. Several research methods are described and discussed,

considering the appropriateness of each for specific situations. Complementary issues are also referred to that are due to research design options and particularities. Then, each topic of the first section is presented according to the decisions made for this study, always explaining the reasons that led to the final choices. Details of the study methodology are also given, including the data collection and analysis methods.

3.1.1 Philosophical Perspective

Ontology and epistemology perspectives

A research paradigm provides a guide for the overall research process as it can be defined in terms of the philosophical approach adopted by the researcher, considering their ontological and epistemological assumptions (Remenyi et al., 2005). The philosophical perspective is related to the major philosophical questions that should be addressed concerning why, what and how to research. The corresponding answers can delineate the researcher's ontological and epistemological position (Remenyi et al., 2005).

Philosophical issues can help to clarify research design, providing good insights to help answer the research questions and support the choice of the most appropriate design. It can also help the researcher to identify and even adapt research designs to deal with the constraints and limitations of the subject being studied.

In his book, Blaikie (1993, p.13) describes ontology as being the "branch of philosophy that is concerned with the nature of what exists". Furthermore, the literature also affirms that the ontology refers to the researcher's assumptions about the nature of reality - the nature of what exists, what is assumed to exist in the world, or the nature of the phenomena under investigation (Ilvari et al., 1998; Caldeira, 2000; Easterby-Smith et al., 2006). According to Mingers (2004), the ontological perspective varies depending on whether the researcher believes reality to exist independently from human beings. Under this assumption, Walsham (1995) affirmed that ontology can be distinguished between 'external realism' – where reality exists externally and independently; 'internal realism' – which considers that reality is constructed and depends on the shared human cognitive apparatus, and; 'subjective idealism'

– where there is no 'global' reality, as it is constructed by each person differently. These different views about reality are summarised in the left columns of Table 9.

Table 9. Alternative stances on reality and knowledge.

Ontology		Epistemology	
External Realism	Reality exists independently of our construction of it	**Positivism**	Facts and values are distinct and scientific knowledge consists only of facts
Internal Realism	Reality-for-us is an inter-subjective construction of the shared human cognitive apparatus	**Non-positivism**	Facts and values are intertwined; both are involved in scientific knowledge
Subjective Idealism	Each person constructs his or her own reality	**Normativism**	Scientific knowledge is ideological and inevitably conductive to particular sets of social ends

Source: Adapted from Walsham (1995, p.76).

Epistemology refers to the "general set of assumptions about the best ways of inquiring into the nature of the world" (Easterby-Smith et al., 2006), i.e., it is concerned with the nature of knowledge and with the procedures and methods used to obtain that knowledge (Ilvari et al., 1998). It can be synthesised as being the theory of knowledge (Blaikie, 1993). Guba and Lincoln (1994) describe epistemology through a question that describes the main concerns, focus and resulting position: "What is the nature of the relationship between the knower or would-be knower and what can be known?" (p.108). However, authors also affirm that the answer to these questions are constrained to the researcher's ontological position, since the way the 'real world' is perceived influences the way one can understand it. Epistemological perspectives can be mainly grouped into three different positions: positivism – that believes facts and values are two distinct issues and that scientific knowledge consists only in facts; non-positivism – where facts and values are intrinsically linked and are both involved in scientific knowledge, and; normativism – in which the scientific knowledge is ideological and "inevitably conducive to particular sets of social ends" (Walsham, 1995, p. 2). The right columns in Table 9 summarise these contrasting positions.

The assumptions that a researcher makes with respect to a particular ontological and epistemological perspective often lead to the adoption of particular methodologies and methods that are characteristic of that position (Easterby-Smith et al., 2006). Moreover, according to Caldeira (2000), the research methods are not self-valid, but depend on ontological and epistemological grounds.

Despite the existence of multiple research approaches for empirical studies, there are three philosophical perspectives that may be considered relevant: positivistic, critical realism and interpretivism (Caldeira, 2000; Mingers, 2004). These three philosophical perspectives differ mainly due to assumptions about the nature of physical and social reality, and also the sources and development of knowledge and the relationship between theory and practice.

Positivist research is essentially derived from the natural sciences (Remenyi et al., 2005). In this philosophical perspective, researchers believe that the study of society can be considered in a similar way to the study of natural sciences (Caldeira, 2000). Ilvary, et al (1998) explain that in the case of positivism, it is possible to separate facts from values in research. In fact, its main assumption is that the social world really exists independently of the observer, and that the research process should go through hypothesis and deductions in order to provide stable fundamental laws that can explain human behaviour (Easterby-Smith et al., 2006). Once the social world is believed to exist independently from humans, then the researcher assumes a passive role without participating or intervening in the phenomenon under study (Dubé and Paré, 2003).

According to this, one can recognise that the aim of positivism is to explain and predict what happens in the social world in terms of cause and effect relationships. It seeks to explain human behaviour by searching for regularities and fundamental laws "through observation, and by rejecting any scientific concepts that go beyond the domain of the observable" (Caldeira, 2000, p. 3). In this context, Easterby-Smith et al. (2006) add that any observable properties from the social world "should be measured through objective methods, rather than being inferred subjectively through sensation, reflection or intuition", i.e. mentally constructed (p.28).

Interpretivism is often regarded as the polar opposite of positivism due to the significant differences in terms of ontological and epistemological position (Easterby-Smith et al., 2006). In fact, an interpretative researcher usually claims one of the non-positivist or normativist positions from Table 9. Regardless, this is a research paradigm which is now commonly used in IS research. In this philosophical perspective, the phenomena are seen as objects of perception, rather than properties that exist independently of the observer (Caldeira, 2000). This viewpoint stems from the assumption that reality is no longer seen as external and objective, but it is assumed that the social world is essentially relativistic and subjective, constructed by human actors and researchers (Easterby-Smith et al., 2006).

The interpretive approaches adopt a philosophic position that the social world can only be understood through the interpretation of the activities that are actually being studied, in other words, it attempts to 'understand phenomena through accessing the meanings that participants assign to them' (Orlikowski and Baroudi, 1991, p. 5). Moreover, the aim of an interpretive study is to understand and explain the human experience, instead of discovering fundamental laws that are considered absolute truths and that can be replicated by others. Caldeira (2000) concludes that when studying a social phenomenon "an understanding of the social world that people produce and reproduce through their continuing activities" is required, and that "since people are constantly involved in interpreting their world (social situations and behaviour), they develop meanings for their activities and ideas about what is relevant for making sense of those activities" (p.3). For an interpretive researcher there is no value-free research, as he or she knows and accepts their own subjectivity during the process of deeply understanding the phenomena under study (Darke et al., 1998). The standpoint of the 'observer' is rejected, as the object under study and the researcher are usually inextricable connected (Ilvari et al., 1998).

Critical Realism is a more recent philosophical research paradigm which opens up a conscious combination of the two previous opposing positions (Easterby-Smith et al., 2006). For critical realists there is a real social world that is not produced by humans or the researcher. However, it is not possible to fully understand it in depth, neither to have a definitive knowledge of it. Nevertheless, it is possible to try to explain reality through a set

of observable events that form potential explanations about the social behaviour (Caldeira and Romão, 2002).

Ontologically, critical realism believes in the existence of things, structures and mechanisms at different levels of reality. These levels are classified into three interdependent domains: *the empirical*, that comes from experience of events that can be observed; *the actual* composed by all events (observable or not); and *the real*, made up of structures and mechanisms that produce the events and correspond to the whole reality (Caldeira, 2000; Mingers, 2004).

This approach believes that society is produced and reproduced by its members who may have different perceptions and interpretations of the same reality. Indeed, it assumes that people can "consciously act to change their social and economic conditions", however constrained by social, cultural and political issues (Klein and Myers, 1999, p.69). Epistemologically, critical realism refuses the adoption of a unique method. Rather it seeks to deploy the most appropriate methods to the problem under study (Caldeira, 2000).

The contrasting approaches for the discussed research paradigms are summarised in Table 10, considering their aim, the reality assumptions, the researcher's role during the research, the process of research, and the inherent perspective on social science.

Table 10. Summary of the distinctive attributes of the different philosophical approaches.

	Positivism	Critical Realism	Interpretivism
The Aim	To find regularities and causal relationships.	To find the causal relations that can explain the social world, through a set of observable events.	To discover and understand what people do and why they do it, exposing the intentions and rules that guide their actions.
The reality	The social world exists externally.	The social world exists and cannot be fully understood.	The reality is a social construction. The social world is essentially relativistic and subjective.
The researcher	Must be independent from the object of study and all self-interests should be irrelevant or should not influence the research.	Should be seen as an agent of patterns of events, generated under conditions of closure, through which he/she gains access with the aim of identifying causal laws.	Is part of what is being observed, since the world is a social construction. There is no "observer" researcher.
The research process	Should go through hypotheses and deductions. Science and its process are value-free.	To search for generative mechanisms instead of predictive theories.	Gathering rich data from which ideas are induced. There are no correct or incorrect theories but more or less interesting ways to understand the social reality.
Social Sciences	The aim is to study the social world as a scientific discipline. There is only one science – "the unity of the scientific method".	Social and natural phenomenon has fundamental differences. The social world is reproduced or transformed in daily life.	Significant differences exist between the research object of the natural science and the social science.

Source: Based and adapted from Caldeira (2000), Caldeira and Romão (2002) and Easterby-Smith et al. (2006)**.**

Quantitative versus qualitative

There are many ways to classify and characterise types of research, namely the dichotomy of quantitative versus qualitative.

Quantitative research has its origins in the natural sciences where the study of natural phenomena was developed. This approach emphasises numbers and numerical quantities, since quantitative researchers believe numbers "represent values and levels of theoretical

constructs and concepts" ((Straub et al., 2004) in (Myers, 2009) p. 7). The quantitative research progresses usually through a separation of the data collection stage, that must be equally treated and unbiased, to the data analysis stage, which is performed in a different time and place, often through statistical analysis of the data (Easterby-Smith et al., 2006). Indeed, this focus on numbers determines that the analysis is essentially performed through statistical tools and packages. Regardless of the data sources, researchers are motivated by numerical outputs and the possibility of deriving meaning from them, i.e. "the interpretation of the numbers is viewed as strong scientific evidence of how a phenomenon works" ((Straub et al., 2004) in (Myers, 2009) p. 7). Examples of quantitative methods include surveys, laboratory experiments, formal and numerical methods (see Table 11).

Table 11. Examples of qualitative and quantitative research.

Qualitative research **A focus on text**	**Quantitative research** **A focus on numbers**
Action research	Surveys
Case study research	Laboratory experiments
Ethnography	Simulation
Grounded theory	Mathematical modelling
Semiotics	Structured equation modelling
Discourse analysis	Statistical analysis
Hermeneutics	Econometrics
Narrative and metaphor	

Source: (Myers, 2009)

Qualitative research methods are usually undertaken when the aim is to understand social phenomena in their natural context (Darke et al., 1998). Qualitative research can indeed be defined as a set of techniques to interpret phenomena in the social world. These allow the researcher to describe, decode and acquire a deeper understanding of the social and cultural context in which people live (Easterby-Smith et al., 2006; Myers, 2009). The main motivation for qualitative research is that which distinguishes humans from the natural world: humans can talk. Thereby, talking to people and reading what they write is the best way to understand their motivations, know their thoughts, beliefs, perspectives and actions, in their actual context (Myers, 2009). Examples of qualitative research methods are action research, case studies and grounded theory, whereas common qualitative data sources include in-depth interviews, participant observation, documents and field notes (see Table 11).

Frequently, qualitative research has been used as a synonym for interpretive research, whereas quantitative research has been synonymous with positivism. However, according to Klein and Myers (1999) and Easterby-Smith et al. (2006), a qualitative study can be performed under diverse philosophical positions, such as positivism or interpretivism, as can quantitative research, which all depends on the researcher's own assumptions.

Myers (2009) argues that both quantitative and qualitative research are important for studying business organisations, and both can be rigorous and useful. However, each approach has advantages and disadvantages that make them best suited to different situations. Quantitative research is preferable when the aim is to study a particular topic through a large sample size, in order to generalise to a large population. However, it usually discards many social and cultural aspects related to the topic being studied, treating the context superficially as "noise, or something that gets in the way" (Myers, 2009, p. 9). On the other hand, qualitative research should be performed to study a particular topic in depth, namely the social, cultural and political aspects of people and organisations. This approach is also preferable for exploratory studies where the topic is new, or relatively unstudied, and when the aim is not to obtain a statistical generalisation.

Despite the clear distinction between the different research paradigms and the set of principles and guidelines that aim to help the researcher to choose the best research approach, in practice, researchers do not strictly follow a single approach (Easterby-Smith et al., 2006). In fact, more and more authors advocate the use of a combination of different methods, including qualitative and quantitative, in order to enrich their studies, since these allow different perspectives of the phenomena under study (Gable, 1994; Easterby-Smith et al., 2006; Yin, 2013). Moreover, the use of multiple methods can increase the robustness of the study results (Gable, 1994). It also enables triangulation of data sources, allowing comparisons and validations with the results obtained, and thus strengthens the findings, whether they are convergent or not (Gable, 1994). This topic is explored in greater detail below, together with the description of the research methods used.

Purpose of the study

Research studies can be further classified accordingly to their general purpose: exploratory, descriptive or hypothesis testing (Sekaran and Bougie, 2013). The nature of the study depends on the degree of existing knowledge about a particular subject. An

exploratory study tends to investigate new or poorly studied topics, whereas in descriptive or hypothesis-testing studies, the knowledge of the research area is greater and generally more mature. In addition, the design decisions tend to be more rigorous, as the knowledge base increases. Each of these research purposes is briefly described below.

Exploratory – An exploratory study is one that seeks to develop new ideas, constructs and/or theory (Dubé and Paré, 2003). They are conducted when there is little or no knowledge about a research topic and a deeper and more considered comprehension is needed. Presently, they are usually associated with studies whose research question takes the form of 'what' or 'why' (Yin, 2013). To conduct such a type of studies, extensive interviews are often undertaken with many people in order to explore the phenomenon in depth. Some authors also defend that exploratory studies are suitable to "develop pertinent hypothesis and propositions for further inquiry" (Sekaran and Bougie, 2013; Yin, 2013, p. 9).

Descriptive – A descriptive study is conducted when the aim is to describe or verify the characteristics of the subject under study, namely individuals, organisations or phenomena. This kind of research "helps to understand the characteristics of a group in a given situation, think systematically about aspects in a given situation, offer ideas for further probe, and research and/or help make certain simple decisions" (Sekaran and Bougie, 2013, p. 122).

Hypothesis Testing – The main purpose of hypothesis testing is to formally understand, explain and/or test the nature of relationships between variables. It can be used to establish cause-and-effect relationships, explain the differences among groups or to determine the independence of variables in a given situation. These studies help "to explain the variance in the dependent variables or predict organisational outcomes" (Sekaran and Bougie, 2013, p.124).

Yin (2013) and Dubé and Paré (2003) have additionally described another group of studies which they refer to as 'explanatory'. Explanatory studies are those that aim to test theories or explain phenomena. However, Benbasat et al. (1987) refers to explanatory studies in a different terminology for hypothesis testing.

Considering the theories described so far, we advance that this study falls in the assumptions of an exploratory study essentially qualitative. Although the reasons and the

reasoning will only be presented in Section 3.2, this methodology position will restrict and guide the following sub chapter's content.

Research Methods

In an exploratory study, many research methods can be used, such as experimental, survey and case study. In turn, qualitative research tends to favour methods such as action research, case study research, ethnography and grounded theory. Before addressing and justifying the choice of the method for this study, it is considered appropriate to briefly describe the concepts associated with common traditional methods in both qualitative and exploratory research.

Experimental - Experimental designs are commonly divided into laboratory experiments and field experiments. The first type of experiment is carried out in an artificial environment created for the purpose. This allows independent variables to be controlled and the random assignment of participants to various conditions. Field experiments are carried out in the natural environment of the phenomena. These involve the experimental manipulation of one or more variables for the context of the phenomenon and the subsequent measurement of its impact (Boudreau et al., 2001).

Survey - Surveys are a group of methods that emphasise quantitative analysis, which collect data from a large number of organisations through methods such as questionnaires, telephone interviews and published statistics, and whose data are analysed using statistical techniques. They are suitable for elucidating causal relationships and provide descriptive statistics, as their common aim is to discover relationships between variables and to provide generalised statements on the subject of study. Surveys are often cited as methods that contribute to a greater degree of reliability and generalisability of results, however to be successfully conducted, they must include *a priori* the right questions put in the right way. Another common disadvantage is the inflexibility facing the findings during the data collection phase (Gable, 1994).

Case Study - Case studies are derived from the desire to understand complex social phenomena in depth, particularly those related to individuals, groups and organisations, among others, in their natural context. While several definitions of a case study exist, that proposed by Yin (2013) is frequently cited: "A case study is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context,

especially when the boundaries between phenomenon and context are not clearly evident" (p.18). Its objectives include descriptions of phenomena, and the development and testing of theories. This research method usually combines several qualitative data collecting techniques, such as interviews, observation, documents, and may also include quantitative techniques (Darke et al., 1998; Yin, 2013).

Action Research - Action Research is a research method that combines the resolution of practical problems with the creation of scientific knowledge. This is achieved by changing the traditional role of the researcher, who becomes the generator of change in the organization, while simultaneously study the process. Therefore a close collaboration and synergy is established between the researcher and the subjects being studied. Such research is typically conducted through a two-phase iterative process: the first phase carries out a diagnosis and analysis of the current situation, followed by the formulation of theories, taking into account the nature of the investigation; and the second phase applies strategies of change within their context and studies their effects (Baskerville and Myers, 2004).

Ethnography - Ethnographic research originated in social anthropology, but nowadays it is also considered to be an important technique for study in the IS field, especially when the social and organisational context is of relevance. In ethnographic studies, the researcher spends much time in the field, immersed in the context of study, observing and experiencing the phenomena closely. This is appropriate when an in-depth understanding of the phenomena is needed, since the researcher is in the field for a long period, observing what people are doing, and how they are doing it, which is complementary to what they say they do (Myers, 1999). While some similarities exist with case studies, they differ due to the time and involvement that is needed for the researcher to perform their work (Yin, 2013).

Grounded Theory - Grounded theory (Componation et al.) has emerged essentially from the work of Glaser and Strauss (cited in (Danermark et al., 2002)), and having subsequently evolved considerably. GT is a research method that aims to generate concepts and theory that is simultaneously abstract and yet grounded in collected data. It has as a starting point the inductive generation of theory, and suggests various methodologies and procedures to improve the theory generation practice, in order to become more systematic and well-founded. The theory generation is an ongoing process

that consists of interaction between conceptualisation and analysis of new empirical data. This work is oriented towards the identification of properties and substantive relationships, rather than the statistical relationships between variables (Danermark et al., 2002).

All research methods are relevant and useful when applied to the appropriate situation. In fact, the appropriateness of each method depends mainly on three factors: the research questions (or research purpose), the extent to which the researcher is going to be involved in the research field, or is able to control the events, and the type of the phenomena that is going to be studied (Caldeira, 2000; Yin, 2013). For this particular research project, the case study research method was considered, as it was perceived to be the most appropriate for addressing the research objectives. Although the detailed explanation will only be given in Section 3.2, the following sections will reflect that decision.

A fundamental decision in case study research design is whether to conduct a single, or multiple case studies. Single case studies are useful in specific situations where there is a need to consider a unique, revelatory and/or critical case. Benbasat et al. (1987) explained that a single case study can also be performed for exploratory purposes, as a pilot test that can be followed by a multiple-case study. However, using multiple case studies is often considered more robust and compelling, while any analytical conclusions tend to be more powerful than those of a single study (Yin, 2013). This research design may increase the analytical benefits and conclusions when compared to a single-case study, as it permits case replication, allowing cross-case analysis and therefore producing stronger effects (Yin, 2013). In fact, single-case studies have been much criticised for their vulnerability and "the uniqueness or artefactual conditions surrounding the case" (Yin, 2013, p. 61), having raised many doubts about the ability to conduct empirical work with a single case study. Conducting multiple-case studies (even with a 'two-case' study) can mitigate some of these criticisms.

Due to the set of methodological principles and practices of rigor and relevance that have been developed to date [see for instance,(Walsham, 1995; Darke et al., 1998; Walsham, 2006; Yin, 2013)], case study research is now considered a valid research strategy in the IS research field (Klein and Myers, 1999). Nevertheless, this set of principles differs, depending on whether the case study is performed under the positivist

(Benbasat et al., 1987; Yin, 2013), the interpretive (Klein and Myers, 1999; Walsham, 2006) or any other perspective. The main practical differences are concerned with the case study purpose and process, the data analysis and the case study quality evaluation. Each of these topics is detailed in the next sub sections.

Research in the IS field

Research in the IS field has presented a wide variety of philosophical streams, which have been common to most social sciences (Mingers, 2004). Nevertheless the same three trends can be highlighted: positivism, interpretivism and critical realism. According to Klein and Myers (1999), research in IS can be classified into each of these philosophical perspectives, according to the research assumptions, evidence, process and stated objective (see Table 12 for details).

Table 12. Summary of the philosophical research positions in the IS research field.

Positivism	Critical Realism	Interpretive
Whenever there is an evidence of formal propositions, quantifiable measures of variables can be made using hypothesis testing and the drawing of inferences about a phenomenon from a representative sample to a stated population.	When the main task is to be a social critique, whereby the restrictive and alienating conditions of the status quo are brought to light.	Where it is assumed that the knowledge of reality is socially constructed, through language, consciousness, shared meanings, documents, tools, etc. It attempts to understand phenomena through the meanings that people assign to them.

Source: (Klein and Myers, 1999)

Historically, the positivist philosophy has covered the largest number of published IS research studies (Dubé and Paré, 2003; Mingers, 2003). However interpretive research has gained much relevance in IS research over the last decades, increasing the number of interpretive research studies published in well-known US and European-based journals (Walsham, 2006). In fact, from 1993 to 2000, 17% of the papers published in the main IS journals were interpretive (Mingers, 2003). Although most papers still follow a positivist paradigm, the number of interpretive papers increased when compared with the results of similar studies in previous periods of time. Figure 8 summarises some of Mingers' (2003)

findings, who reported the percentage of published papers per research paradigm, considering the six major US and European journals from 1993 to 2000, comparing the results with two other similar studies.

Figure 8. Distribution of research paradigms by IS Top Journals

	ISR (%)	ISJ (%)	MISQ (%)	EJIS (%)	AMIT (%)	JIT (%)	Mean (%)	N-J (%)	O-B (%)
Observation, Survey, Case	59	57	58	71	44	74	63	46	67
plus Experiment, Interview	92	80	89	87	68	85	85	93	97
Positivist	90	67	74	77	56	76	75	76	97
Interpretivist	8	23	18	12	35	18	17	18	1
Interventionist	1	9	5	9	6	4	5	6	1

ISR, *Information Systems Research*; ISJ, *Information Systems Journal*; MISQ, *MIS Quarterly*; EJIS, *European Journal of Information Systems*; AMIT, *Accounting, Management and Information Technologies*; JIT, *Journal of Information Technology*.
N-J, Nandhakumar & Jones (1997); O-B, Orlikowski & Baroudi (1991).

Source: (Mingers, 2003)

Positivist research in social-science tries to emulate how research is done in natural science. However, Lee (1999) argues that this is not appropriate for IS research, and that the research aim should not be to understand how the world is, but to produce knowledge about how one can contribute to change and meet the needs of the real world. Klein and Myers (1999) also put the case that interpretative research in IS is suitable for understanding and providing deep insights into phenomena such as human interaction in their context, management and development of IS.

While the positivist approach may not be seen as the most appropriate for the study of human behaviour in management and development of IS, it usually provides useful insights and strategies to shape the research process allowing increased accuracy and quality of the study. Thus, these recommendations should be used whenever this does not compromise or restrict the position and purpose of the study.

3.1.2 Research Design Options

Gable (1994, p. 6) stated that research design is the "arrangement of conditions for the collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure". He argues that it depends on some factors that will define the study, such as whether the study is exploratory or explanatory, if the goal is to describe a case or to establish causal relation, if it is a cross-sectional or

longitudinal study, and so on. For case study design, Yin (2013) has suggested five items to guide research design: (1) the research questions, (2) the propositions, (3) the unit of analysis, (4) the logic linking the data to the propositions, and (5) the criteria for interpreting the findings. Because of the interconnected nature of some of these topics, each of these is discussed below, although some just in an aggregate form. Additionally, some other topics are discussed to better clarify research strategies and design options.

Research questions and propositions

The starting point of any research study is defining the fundamental questions that motivates the research. A clear research question is the basis of the research design, as it establishes what the line of inquiry is, and also the anticipated results and contributions (Dubé and Paré, 2003).

Yin (2013) states that a case study research proposal should establish a set of propositions in order to define and guide what it is that is being sought. However, the author also considers that for some kinds of studies, such as exploratory studies, these propositions are not necessary. Instead, the purpose of the study should be well-stated, as should be the criteria that will judge the exploratory study.

Unit of analysis

Along with the definition of the research questions, the unit of analysis is critical to the case study design (Dubé and Paré, 2003). It defines what the 'case is' and, together with the research questions, defines what is going to be studied (Yin, 2013). Some authors claim that the selection of the appropriate unit of analysis comes from the definition of the study questions, as it will provide the means to appropriately respond to these questions (Darke et al., 1998). It should also be similar to previous studies, to allow comparisons between findings (Yin, 2013).

A unit of analysis can be defined in a more or less concrete way, although their boundaries should be well established (Yin, 2013). For exploratory studies it helps to establish the boundaries of the research and to define what extensions to the theory can be applied (Dubé and Paré, 2003). It may represent an individual, a small group, an organisation, an event, a relationship or some other phenomenon (Darke et al., 1998; Yin, 2013).

Data Analysis Methods

Generally, the main goal of a qualitative data analysis is to understand or interpret data, in order to answer the research questions (Kaplan and Maxwell, 2005). The former authors advocate that this is an iterative process, where an initial understanding is acquired and then reviewed, tested and modified as data collection and analysis proceed. Given this, they argue that "data analysis methods usually cannot be precisely specified in advance" (p. 12). However, Yin (2013) contrasts suggesting that considering data analysis techniques in advance can strengthen and guide the process of data collection and subsequent analysis.

Yin (2013) describes five techniques for data analysis: pattern matching, explanation building, time-series analysis, logic models, and cross-case synthesis; which are all summarised in Table 13.

Table 13. Analytical techniques for case study analysis.

Analytic Technique	Description
Pattern Matching	Allows the comparison of an empirical pattern with a predicted one, usually defined by the initial study propositions. If patterns match the results, they can strengthen the internal validity.
Explanation Building	Explanation building is a special case of the pattern matching technique. This allows the 'explanation' of a phenomenon, by predicting a set of causal links about how and why something happened. It is most commonly used in explanatory case studies, although it can also be used in exploratory studies to develop ideas for future work.
Time Series Analysis	Time series analysis is useful to assess a given phenomenon over time. It aims to consider relevant questions of 'how' and 'why' for the relationship of events over time, instead of only considering them at a given point in time.
Logic Model	The logical model is another special case of the pattern matching technique. A logical model provides a complex chain of events, through cause-effect patterns, over a period of time. This technique aims to match theoretically predicted events to empirically observed events.
Cross-case Synthesis	Cross-case synthesis can only be applied to multiple-case studies. It analyses each case individually, aggregating all the results at the end. The synthesis may combine a series of methods, both qualitative and quantitative, while one of the most common method is the use of word tables that group the data from all individual cases under a uniform framework. The analysis of the entire collection of these tables allows the drawing of cross-case conclusions.

Source: (Yin, 2013)

Although each technique has been described separately, they can, and in some cases should, be used in combination. The researcher must then identify which of the techniques is most applicable, in order to answer the research questions and thus develop a particular analysis strategy.

Researcher involvement and biases

The style of research involvement has been presented as one of the fundamental bases for setting up and carrying out of fieldwork (Walsham, 2006). The author describes the researcher as an outside or an involved researcher. In the first case, they act with no involvement in the field and give no feedback to participants. In the second case, an involved researcher acts more like a participant or an action researcher. There are advantages and disadvantages to both positions, however, the choice of the most appropriate approach depends on the preferences of the researcher, the aim of the study, the context, the internal and external conditions, and may even change over time (Walsham, 2006).

Darke et al (1998) further identified two types of bias introduced by the researcher: the impact on the behaviour of participants at the site, and the "researcher's own beliefs, values and prior assumptions" (p.286), which may influence the data analysis, and even prevent the consideration of possible contradictory explanations. The attitude facing this bias may have different approaches, depending on whether the researcher sees themselves as a positivist or an interpretivist. In an interpretive analysis, conclusions tend to be influenced by researcher bias, and thus is subjective. However, Darke et al (1998) suggest that data should be collected from multiple sources of evidence in order to enable data triangulation and to provide multiple information about the same issue from a variety of sources, in order to minimise the research bias and to strength the study findings.

Data collection methods

Several sources of evidence can be used in case study research. In fact, some authors argue that this is one of the main strengths of case studies (Yin, 2013). The use of multiple methods may establish convergent lines of inquiry, allowing triangulation and hence, stronger findings.

There are many methods and techniques suggested in the literature. For instance, Yin (2013) suggests six main data sources: documents, archival records, interviews, direct observation, participant observation, and physical artefacts. Apart from these, some authors have also suggested that quantitative methods, such as surveys, can also be included in case studies (Gable, 1994; Dubé and Paré, 2003; Walsham, 2006). The appropriateness of each technique may depend on the research purpose, the research constraints and the accessibility to the research field; in any case authors suggest the use of the largest number of data collection methods possible.

Each of the suggested data source methods is briefly described below:

Documents

Documents play a relevant role when carrying out case studies, in particular to corroborate and augment evidence from other sources (Yin, 2013). Documents can take a variety of formats, such as books, articles, meeting minutes, prospectuses, notes, emails, raw databases or any other administrative documents. Darke et al. (1998) also suggests internal magazines and organisational bulletins as useful sources of information.

Archival Records

Archival Records consist of one particular source of evidence, often taking the form of computer files or records. They present the same advantages as documents, but the usefulness of this source strongly depends from one case to another. As happens with documents, most records are produced for some specific purpose and audience, rather than just for the case study researcher. Thus, the document should be carefully analysed for its accuracy and usefulness (Yin, 2013).

Interviews

Interviews are one of the most important sources of evidence when carrying out case study research (Yin, 2013). This method consists of inquiring an individual, or a group of individuals, establishing a guided conversation, where information is provided. Interviews can be classified into Open-Ended or Unstructured, Focused or Semi-Structured, and Survey, depending on the structured level of the set of questions, and the flexibility for improvisation (Myers and Newman, 2007 Newman, 2006; Yin, 2013).

To perform interviews, there are two main issues that must be addressed, namely the interview style and the way data is recorded (Walsham, 1995). Following Walsham, the interview style dictates the researcher's attitude during the interview, whether they are too passive or over-directed. If the researcher overtly controls the responses of the interviewee, then they may lose some of the richness of the data. Otherwise, if they become too passive, then the interviewees may draw the wrong conclusions about the researcher's professionalism their interest of their views. Preferably, an intermediate position should be adopted, not only to avoid restricting the participant, which could have negative consequences for the data quality and richness, but also to ensure that that the path of the interview stays within the scope of the study. The interviewing style is also related to the extent to which questions should be tightly closed, or open ended.

When considering the approach for recording data, the investigator could simply take extensive notes along the interview. However, when doing so, it is almost impossible to report a full description of ideas and views, resulting only in partial notes. At the same time, the interviewer should establish social interactions with the interviewee, and taking notes makes this task even harder. As an alternative, interviews can be tape-recorded, or digitally-recorded. This approach addresses some of the disadvantages described above for taking notes, but there is still the concern of the inhibition of the respondent when the revelation of confidential or sensitive material is requested. The inability to capture non-verbal elements of the interview, as well as the time needed to transcribe all the recorded data are two other disadvantages commonly cited (Walsham, 1995; Walsham, 2006). Even so, Darke et al (1998) affirm that whenever research is undertaken as part of a higher education process, such as a thesis, then full transcriptions, and hence tape-recording should be carried out.

Direct observation

Direct participation occurs when the researcher has the opportunity to directly observe a particular phenomenon, or a related context. This observation can be formal, or casual, and may occur during a period of time. It includes observation of meetings, sidewalk activities, and factory work etc. Due to the potential lack of reliability of this method, data should be gathered by more than one observer (Yin, 2013).

Participant observation

Participant observation is a special case of direct observation, where the researcher may assume a set of roles and also participate in the phenomena under study, instead of just watching. Although this might have significant critics on account of the potential bias produced, it also provides uncommon opportunities, such as the observation of the phenomena from an insider point of view, rather than someone external (Yin, 2013).

Physical artefacts

Physical artefacts can take the form of technological devices, a tool, or some other physical evidence, that may be collected or observed in a field visit. For most typical case studies, this kind of data source is not as relevant as the remaining described so far (Yin, 2013).

Multiple Methods

The use of multiple methods consists of the combination of techniques and methods, both qualitative and quantitative, within the same case study research design (Yin, 2013). This strategy is very useful as it "can permit investigators to address more complicated research questions and collect a richer and stronger array of evidence than can be accomplished by any single method alone" (Yin, 2013, p. 63). Also, Kaplan and Maxwell (2005) argue that for different evaluation objectives, different methodological approaches should be required. This is inappropriate to adequately address many issues in IS research, however for verification purposes, it can be justified. Gable (1994) also suggests utilising several methods of data collection, in order to gather the richness of the phenomena under study. Indeed, for the same study, survey and case study approaches can be seen to be complementary, as the benefits of one method outweighs the weaknesses of the other. Nevertheless, the researcher should only perform these multiple methods when they find it appropriate and justifiable.

Considering data from multiple methods brings another advantage: the ability to perform triangulation of methods. Qualitative studies generally collect data by using several methods and techniques in order to give a wider range of coverage, as through the use of multiple methods, the results can be more accurate, more reinforced and more

robust (Gable, 1994). This is achieved by collecting different kinds of data from different sources and for the same phenomenon, allowing cross-validation (Jick, 1979).

Case Study Protocol

A case study protocol, as described by Yin (2013), is a major strategy for dealing with problems of case study reliability. It is part of the set of tasks that correspond to the preparation of the case study, and it is essential when conducting a multi-case study. This strategy aims to enable study replication, as well as to minimise eventual errors and biases (Yin, 2013). It keeps the researcher targeted on the topic of the case study and guides the data collection process for each single case. When producing a case study protocol, the researcher should have an explicit and well-planned field procedure which describes the main tasks for collecting and analysing the data, in order to constitute a research guide in the field. According to Yin (2013) a case study protocol should have:

- A brief description of the case study, including its main purpose and objectives
- The instrument, i.e. the case study questions, and also the procedures and general rules to be followed.
- A guide for the case study final report

The study protocol also ensures that each participant is informed beforehand of the conditions of participation, with respect to how the data will be obtained, recorded, analysed and reported; and also of issues regarding data protection, such as privacy and data confidentiality.

3.1.3 Quality Assessment Criteria

Regarding qualitative studies, there is no standard set of criteria to assess research quality. Indeed, quality standards vary with the assumptions of each philosophical position (Dubé and Paré, 2003). Since a case research can be conducted under several philosophical perspectives, strategies to address research quality may change. For instance, as a result of ideological assumptions of positivism, the case studies performed under this tradition follow quality criteria, including validity and reliability tests, which originated in natural sciences (Dubé and Paré, 2003). Notwithstanding, Yin (2013) claims that for any social research, four widely used tests exist to establish study quality: construct validity; internal validity; external validity; and reliability. As one kind of social

research, case studies can also be assessed through these tests, whilst the author also suggests a set of tactics to deal with each of them (see Table 14).

Table 14. Case study tactics for four design tests.

Tests	Case study tactics	Phase of research
Construct validity	Use of multiple sources of evidence Establish chain of evidence Have key informants review draft case study report	Data collection Data collection Composition
Internal validity	Use of pattern matching Use of explanation building Address rival explanations Use of logic models	Data analysis Data analysis Data analysis Data analysis
External validity	Use theory in single-case studies Use replication logic in multiple-case studies	Research design Research design
Reliability	Use case study protocol Develop case study database	Data collection Data collection

Source: Adapted from (Yin, 2013, p.41).

Dubé and Paré (2003) have also reported approaches to case study quality assessment. They made a list of attributes gathered from the literature to judge the quality of positivist case studies. These attributes are organised into three different areas, according to the research phase: design, data collection and data analysis. The first area aims to analyse the quality of research design in relation to the question formulation, the criteria for case selection and the underlying theory. The area of data collection regards the choice and application of the collection methods. In turn, the area of data analysis is concerned with the description of the method of analysis, as well as the use of preliminary techniques. Table 15 shows the summarised topics that should be considered for quality assessment, grouped into their respective areas.

Table 15: Issues to Case Study Assessment

Attribute	Issue to verify
Research Design	Clear research questions
	A priori specification of constructs
	Clean theoretical slate
	Multiple-case design
	Nature of single-case design
	Replication logic in multiple-case design
	Unit of analysis
	Pilot case
	Context of the study
	Team-based research
	Different roles for multiple investigators
Data Collection	Elucidation of the data collection process
	Multiple data collection methods
	Mix of qualitative and quantitative data
	Data triangulation
	Case study protocol
	Case study database
Data Analysis	Elucidation of the data analysis process
	Field Notes
	Coding and reliability check
	Data displays
	Flexible and opportunistic process
	Logical chain of evidence
	Explanation building
	Searching for cross-case patterns
	Quotes (evidence)
	Project reviews
	Comparison with the existent literature

Source: Adapted from (Dubé and Paré, 2003)

3.2 The Research Design

3.2.1 Philosophical Position

After introducing the main ontological trends presented in the literature, it is time to disclose the position underlying this study. The ontological position of the researcher can dictate not only their methodological choices, but also how the phenomenon is perceived at an early stage.

The author believes that there are distinctive differences between natural and social phenomena (Caldeira and Romão, 2002). The fundamental assumption of the existence of things and a real social world that can be changed or influenced by its members is also well accepted. Moreover, it is believed that such a social world cannot be fully understood, as it is composed by a set of perceptions and interpretations. A study like the one presented in this document intends to explain a set of phenomena and the causes that lead to such phenomena, rather than simply capture observations of the world, or create predictive theories. All these assumptions stand for the critical realism position. Caldeira (2000) explains that the aim of realism research is not to simply collect observations of the world, but to explain, through theoretical frameworks, the relationship between human activity and social structures. This paradigm is concerned with finding those causal relations that can explain the social world (Caldeira and Romão, 2002).

Epistemologically, the author also agrees that there is no single method for doing research. Rather there may just exist an optimal method for each research study that should be explored and justified, which thus can be performed considering the existing premises of rigor and quality. With such a vast nature of phenomena and realities, the idea of one path for research does not seem plausible.

Considering the decisions made for this particular study it should be noted that the research questions, methodology, methods and analysis were all designed and aligned to be coherent and to improve the likelihood of producing trustworthy research.

Methodology Selection

Sekaran and Bougie (2013) claim that the degree of scientific rigor in a research study depends on the careful exploration of several design alternatives, and the resulting choice of the most appropriate one, taking into account the specific study objectives.

Considering the topics described so far, the main objective of this study is to understand how leadership can affect the process of the requirements phase when developing a new software project. A deep understanding of this process can only be obtained by considering the social, cultural and political context in which it occurs, and thus the perceptions, motivations and actions of the people involved are crucial for achieving the research purpose. Since qualitative methods aim to investigate social phenomena in their natural context, favouring strategies that provide a profound understanding of people's motivations, perceptions, beliefs and actions, this study can be recognised as being essentially qualitative in nature.

When reviewing the literature, it seems that little research has been conducted to address behavioural issues related to the requirements process, in particular, as far as the author knows, no studies have directly observed leadership as a factor that impacts on the success of this phase. Thus, we believe that more information is needed to better understand the phenomena, and therefore an exploratory study will be conducted. This methodological choice is consistent with Sekaran and Bougie (2013), who state that an exploratory study should be undertaken when the aim is: (1) to better understand the nature of a specific problem for which few studies might have been conducted, or; (2) when some facts are known, but more information is needed for developing a viable theoretical framework. Moreover, some qualitative studies are exploratory in nature (Sekaran and Bougie, 2013), which is consistent with the research design here.

In Section 3.1.2, a set of possible research methods was presented that is consistent with exploratory studies that are essentially qualitative. However, according to Yin (2013), the case study method is preferable when research questions adopt a 'what' (in this case 'which'), or 'why' form, and the research objective is to "investigate a contemporary phenomenon in depth and within its real-life context" (p.16). Darke et al (1998) found that the case study has been the most widely used qualitative research method for IS research. The authors also state that this method should be appropriate when studying areas where there is a lack of understanding as to how and why phenomena

occur, or where "the experiences of individuals and the context of actions are critical" (p. 279). These include IS development, implementation and use within organisations (Darke et al., 1998).

Despite being reported for several decades, problems affecting overall project success and particularly the requirements phase are actually quite contemporary and are still very complex to solve[1]. Benbasat et al. (1987) reinforce that case research is well suited to understanding the nature and complexity of the phenomenon in its natural setting, whereas Dubé and Paré (2003) affirm that case studies can keep abreast of continued evolution in the IT field, since it studies and reports real-life experiences. Furthermore, these latter authors affirm that it allows access to and use of a variety of data collection methods that provide "richness and flexibility to the overall research process" making it particularly well suited to studying complex phenomena such as IT (p.598).

In this study, more than two case studies will be performed, which enables the research to be categorised as a multiple case study (Yin, 2013). Gable (1994) claims that this approach is preferable when the objective is description, theory building or theory testing. Some authors argue that whenever the researcher is afforded the choice and necessary resources, it may be preferable to conduct multiple-case studies, as this will probably increase the chances of the case study approach yielding substantive results (Darke et al., 1998; Yin, 2013).

3.2.2 Research Process

Before further development of the case study design is undertaken, it is appropriate to describe the several stages that comprised this research process. The entire process followed the method proposed by Yin (2013), with necessary adaptations. The whole process is illustrated in Figure 1.

The first step was the definition of the research questions and the development of the corresponding research model that establishes what is intended to be studied. These two issues are naturally derived from the literature review, and they give rise to the sub-

[1] The search for published papers considering the word "requirements" as a keyword and considering papers from January- 2010 until December-2014 resulted in 9 - MISQ; .4- EJIS, 225- International Journal of Information Management, 164 - Information & Management, 131 -Requirement Engineering Journal.

questions and research objectives. The definition of the objective for the study allowed for the design of the research and the decision about which were the best methodological choices to be made. Considering these, the case study protocol was developed and tested, which guided the process of data collection.

The cases were then selected, considering the pre-established criteria, and data collection was then performed. Three techniques were used to address all research questions: in-depth interviews, document collection, and questionnaires. After all the data has been collected and prepared, the analysis phase was performed. Firstly, considering individual case analysis, and then focussing on comparison and cross case analysis. These activities allowed for the development of conclusions that addressed the research main questions and that also permitted the completeness of the research framework. Each of these phases will be later described in greater detail.

Research Questions and Propositions

For this study, the broader topics of interest that emerged from two distinct research areas in the literature review were: the area of IS, particularly topics related to the requirements phase; and the behavioural area, represented by leadership topics. These were iteratively refined as the literature review progressed, eventually giving rise to the research questions shown and discussed in the previous chapter.

It should be noted that the resulting questions take the format of 'which' and 'how' and, as mentioned earlier, the form of the research question is instrumental in determining the most appropriate research method to be applied. These were one of the fundamental reasons that led to the case study design choice. Furthermore, no propositions were established, as suggested by Yin (2013), but a set of sub-questions and objectives were defined to clarify and clearly state the purpose of the research (presented in the previous chapter).

These main research questions and the set of sub questions not only serve as the basis for interpreting the findings in the phase of data analysis, but they also guide the construction of the data collection instruments. Thus, it is important to ensure that the sub-questions are aligned with the main questions and that they cover all the issues under study. Table 16 shows the relation between the main questions (MQ) of the study and all the sub-questions and objectives, in order to check the responses coverage. It should be

guaranteed that these sub-questions fully cover the main questions, i.e., that they give an answer to all main questions.

The first MQ (1) will be answered through SQ – R03 and SQ – R04, which aim to verify the relevance of the leadership competencies proposed by Dulewicz and Higgs (2005b) for this particular context, and to explore any new competencies that are context specific and thus not yet recognised in the literature. To answer the second MQ (2) the sub question, SQ – R02 aims to understand how leadership affects the success of this phase, by looking for empirical evidence and the presence of any critical leadership competencies. The third MQ (3) intends to identify factors that may vary the set of competencies found relevant, and therefore sub-question SQ – R05 will explore if any project characteristics result in such variation. However, this sub-question is not exclusive, i.e., factors that may lead to variations on the set of leadership competencies found critical can be identified beyond project categorisation whenever patterns exist in the contextualising variables. Similarly the fourth MQ (4) will be answered through sub question SQ – R06, looking for empirical evidence as to how factors may influence variations on the set of competencies.

Additionally some other questions exist to contextualise and better understand the phenomena under study, although these are not directly related to any main question. This is the case of question R01. As the study is about leadership in the requirement phase of the IS Project Management, it is critical to understand the context of phenomena, how this phase is undertaken, and how it is perceived by respondents. Knowledge as to how participants perceive requirements: their nature, definition, types, expected outputs, related activities and best practices, can not only help categorise the answers from all interviews, but it also helps understand participants' attitude to the stage.

This set of sub-questions and objectives is also relevant to guide the development of data collection instruments and the overall data collection and analysis process.

Table 16: Relationship between Main Questions (MQ) and Sub-questions (SQ)

Main Questions	Sub-questions and objectives (SQ)	Contextualizing Questions
(1) Which leadership competencies are relevant for the requirement's phase?	(R03) Check the relevance of competencies proposed by Dulewicz and Higgs (2003b). (R04) Identify any other leadership competencies relevant to the requirement phase of the software development projects life cycle.	(R01) Understand how the requirement phase is undertaken.
(2) How can leadership competencies help to achieve leadership effectiveness in the requirement's phase?	(R02) Understand how leadership may influence the success of this phase.	
(3) Which factors can influence the relevance of competencies during the requirement's phase?	(R05) Identify the contingency factors of the project that influence the competencies in the requirement phase.	
(4) How can these factors influence the relevance of competencies during the requirement's phase?	(R06) Assess how these factors lead to variations in the set of relevant competencies.	

Source: the Author

Unit of Analysis

This study has three elements which are combined in a very intrinsic way. The purpose is to study leadership during the requirements phase, taking into account the set of activities that have to be performed. More specifically, it is intended to explore leadership by considering projects with different characteristics, to assess whether different types of projects (or different instances of project characteristics) may vary the set of leadership competences relevant to the requirements phase.

Thus, the case definition can be put forward as follows:

We first consider N projects Pr_1 …, Pr_i and classify each, considering a set of characteristics drawn from the literature. The number of projects are directly related with those described in the interviews.

For each project Pr_i we analyse and classify the respective requirements phase Rph_i. There will be the same number of instances of Rph as the number of projects.

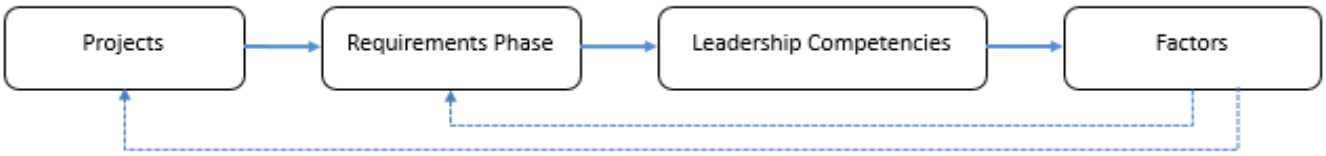
For each Rph_i we will identify the set of leadership competencies ($LSet_i$) found to be relevant.

Eventually, some similarities may exist and we could be able to draw conclusions about the resulting $LSet_i$ for the requirements phase.

Furthermore, we may want to understand whether different characteristics of projects lead to variations of the set of leadership competencies that are found to be relevant. We intend to understand how these characteristics affect the set of competencies. Additional factors can also emerge during the data collection and analysis.

Finally, it also seems relevant to understand whether different leadership competencies vary for different requirements phases.

Figure 9. Research Topics Logic of Analysis



Source: the Author

The logic that guide the analysis of the dimensions of this study is graphically represented in Figure 9. First, each case considers one project and their respective requirements phase characteristics and activities. Then, we explore the set of leadership competencies that are relevant for that particular case. Thus the project is characterised; the requirements phase is described and typified, following a process to address which

leadership competencies are relevant for the requirement phase of that particular project. However, it is important to note that it is not the intention to study projects individually. Rather the focus is on leadership during the requirements phase, and also the use of project is needed to contextualise the results. The last dimension to consider is those factors that may impact on the set of leadership competencies. The dashed arrows in the figure are aimed to illustrate an expected connection between these factors and the topics explored earlier on in projects and during the requirements phase.

From this discussion we can conclude that this study matches the Type 4 proposed by Yin (2013), i.e., a multiple case study with embedded units of analysis. The case would be considered to be the requirements phase, whereas the leadership and the project would be embedded units of analysis.

Data Analysis Methods

Although the data analysis process is discussed in detail in the next chapter, focussing on this issue in the design phase allows some reflection about the various types of data analysis techniques and which of them may be most appropriate for this study.

Pattern matching can be a possible strategy for data analysis in this study, as there may be patterns of leadership competencies sets that are relevant for different types of projects. If no pattern is evident, then a better explanation should be explored. In any case, it will be necessary to understand what does, if at all, vary the set of relevant competencies for the different projects analysed. Neither time series analysis, nor a logic model seems to be the most appropriate techniques for analysing this case study. The emphasis of this research is not to consider phenomena during an extended time period, and thus, such a technique may be ineffective. Likewise, the aim of an exploratory study is not to establish causal-effect patterns, thus the development of model with a complex chain of events is not the objective of the research. Cross-case synthesis shows itself to be a rational strategy for analysing multiple case studies and for drawing cross and linked conclusions.

In line with cross-case synthesis, each case must be individually analysed before any conclusions across cases can be drawn. Since the evidence in a case study tends to be quite extensive, their analysis usually begins as a description or as a narrative of the case. However, this should be guided by the case propositions and conceptual framework in

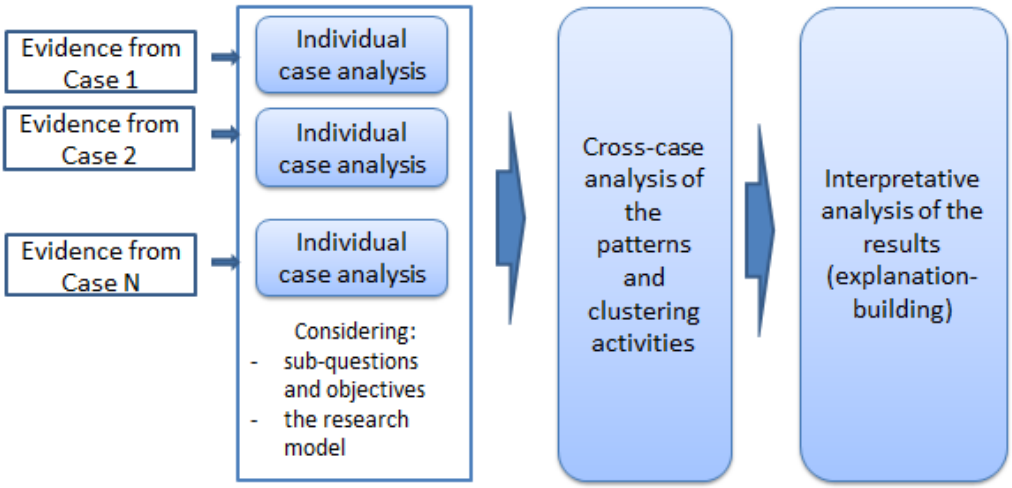
order that the evidence collected can be organised and incorporated under the topics of the study (Yin, 2013).

In this research, the propositions were replaced by the study sub-questions and objectives, and also by the research model. Therefore, all of them will provide the theoretical basis against which the empirical evidence will be analysed. This means that the evidence of each case will first be analysed, in order to address the research model and answer the sub-questions. Only after this can the results be compared, by considering each of the research topics, i.e. cross analyse the search for patterns.

Additionally, Yin (2013) argues that cross-case synthesis should also allow for the clustering of different groups of cases that apparently share similarities and may possibly be seen as a type of general case. This strategy will also be considered in this study, whenever it makes sense to group evidence.

As Yin (2013) suggests, this type of analysis is strongly based on the research interpretation of the findings. Kaplan and Maxwell (2005) also pointed out that "the product of any qualitative analysis is an interpretation, rather than a purely 'objective' account". Actually the completion of this phase considers an interpretative analysis of the conclusions reached so far, in order to draw general conclusions for the overall study. Figure 10 shows a flow chart of the several phases that will be followed during the analytic process of this study.

Figure 10. Analytical Process.



Source: Adapted from (Yin, 2013)

Research Involvement and Bias

In this study, the outsider attitude will be adopted, since the objective is to assess participants' opinions and ideas, and not to become an actor in the situation, neither to contribute to any direct change in the organisation. The underlying idea is to conduct the study in an unobtrusive way, helping to minimise the influence of the researcher on the data collected. However, this does not mean that the researcher does not bias the study at all. Walsham (2006) argues that a neutral researcher does not necessarily imply an unbiased one, as all researchers are naturally biased, due to their background and knowledge, which make them see phenomena in a particular way.

Case study protocol

A case study protocol was developed considering the guidelines proposed by Yin (2013). According to this author, a protocol is essential when carry out multiple case studies, in order to ensure that the same procedures and general rules are applied for all cases. This case protocol contains:

- Section A:
    - A brief description of the areas of interest of the study, containing the key readings for more information on the topics under study;
    - The main goals and objectives of the study, including the case study questions and sub-questions, as well as the respective logic model;
- Section B
    - The researcher's presentation;
    - A brief explanation of the importance of the study protocol and a discussion on ethical and confidentially issues;
    - The data collection plans, considering the data sources to be used, and the type of people to be interviewed;
    - The interview guide, containing the set of questions to guide the interview;
- Section C
    - A brief description of the format and outline of the final report, containing a plan of the organization of the chapters of the final report.

The resulting protocol was reviewed and discussed with a set of experts in the field, before being used for any site visit.

The Interview guide, being a critical part of the case study protocol, is discussed below in greater detail. The complete case study protocol can be found in the Appendix 3.

Interview Guide

The interview guide is the main element of the study protocol. It provides a set of questions that should guide the researcher during the data collection, as a reminder of which information needs to be collected. The questions on the guide should be drawn from the research questions, sub-questions and objectives, and should form the structure of inquiry, not necessary the literal questions to be asked (Yin, 2013).

While preparing the interview guide, reports from similar studies were analysed and thus some of the strategies and suggestions of these studies were carefully evaluated and incorporated. One of the main contributions was the Skulmoski (2005) study, in which the participants affirmed that they were unable to identify and discuss all the competencies that could exist, in order to perform a quality survey. Indeed, the author relates that some participants stated during the interviews: "In terms of soft skills, that's all that comes to mind. I'm sure there are others, but for now, that is all that comes to mind" (p.150). Respondents suggested the need for the supply of a competency list to help them to relate the concepts properly: "(…) it would be very useful to have a list of competencies in front of me (…)" (p.150). Considering the nature of this research, providing *a priori* this kind of material could restrict and biases the participants' responses and could thus hinder the provision of rich answers to some of the sub-questions of this study (e.g. RO3 and RO4 check the relevance of competencies proposed by Dulewicz and Higgs (2003) in this research context, and identify any other competencies that are relevant to IS/IT project management). However, after a set of open questions on these subjects, it seems appropriate to provide a list of competencies in order to foster discussion about the relevance of both sets of competencies.

The interview guide was firstly developed in English, due to the contributions and references of other similar studies. However, as it is expected that most participants are fluent in Portuguese, the guide was translated. Experts were asked to individually

translate the questions and then all the translations were discussed and aggregated. The resulting interview guide was then tested for comprehension. After these tests, modifications were made to some of the questions, for example, to open up the structure. A suggestion was incorporated to change the order of some of the questions, moving the interviewee's demographic characterisation to the end, helping to make participants more comfortable during the interview.

The interview guide is composed by twenty eight questions, grouped into seven parts:

- *Presentation of the research and the researcher*: this allows the participants to get to know the purpose and scope of the study, and what is expected from their participation. Confidentiality issues should also be reaffirmed and permission should be asked to digital-record the interview. This strategy allows the development of a relationship with the participant and also provides an opportunity to become comfortable with the situation so that she or he feel they can share their opinions openly (Walsham, 2006).
- *Questions to describe and characterise a recent software project*: each respondent are asked to describe a project that have recently finished or at least finished the requirements phase based on three questions and a table. The table contains project classification attributes, drawn from the literature, to be used to guide this assessment.
- *Questions to describe and characterise the requirements phase*: contains four questions to collect information about the activities performed, the people involved and the relevance of this phase for the overall success and also the methodologies and/or tools used to support this phase.
- *Questions to perceive the participants' opinion about the impact of leadership on software development projects, and especially during the requirements phase*: this part contains three questions to address the perception of leadership and how one can assess it.
- *Questions to explore leadership competences during the requirements phase:* contains seven questions to explore competence-related concepts, which includes a perceived competence definition and also the set of leadership competencies that participants believe to be relevant for the requirements phase, considering all the activities that should be performed. The respondents are also invited to reflect

about which factors may cause a variation in the previously identified set of relevant competencies. At the end, the Framework of Leadership Competencies (Dulewicz and Higgs, 2005b) is presented, along with a list of contingency factors taken from the literature, to encourage further discussion.

- *Questions to perceive the relevance of the study:* contains two questions to assess the relevance of conducting studies in the IS field and to survey the practical contributions that might arise from this study.
- *Questions to demographically characterise the respondent*: contains nine questions to understand the professional progression and background of the respondent.

Table 17: Relationship between Research Sub-questions and questions from the interview guide

Research Sub-Question	Questions from the Interview Guide
(RO1) – Understand how the requirement phase is undertaken.	D2) i)
	D2) ii)
(RO2) – Understand how leadership may influence the success of this phase.	D3) ii)
	D4) iii)
(RO3) - Check the relevance of the competencies proposed by Dulewicz and Higgs (2003b).	D4) ii)
	D4) iv)
(RO4) - Identify any other leadership competencies relevant to the requirements phase of the life cycle of software development projects.	D4) ii)
(RO5) - Identify the contingency factors of the project that influence the competencies for the requirements phase.	D4) v)
	D4) vi)

(Table continued)

Research Sub-Question	Questions from the Interview Guide
(RO6) - Assess how these factors lead to variations in the set of relevant competencies.	D4) v)
	D1) i)
	D1) ii)
	D1) iii)
	D2) i)
	D2) ii)

Source: the Author

The full interview guide is presented within the study protocol. Table 17 shows how each question from the interview guide is related to the sub-questions of this research. Additionally, Table 18 is presented with the remaining questions related to the transversal concepts which are described at the beginning of this chapter.

The remaining questions of the interview guide were chosen to contextualise the phenomena environment and to assess study relevance and practical contributions. Nine dimensions were created and are explained below. Additionally, Table 18 provides the relationship between each transversal dimensions and the questions from the interview guide:

- *Project categorisation (ProjCat):* contains questions to characterise projects which are presented during the interview. This characterisation is important to build a common framework for posterior comparison of results. Although questions made to describe projects are open structured, additional and more direct questions were made to a closer characterisation of the items presented in Table 1 (in the literature review chapter).
- *Participants demographic categorisation (ParCat):* consists of a set of questions that allow for the characterization of the respondents, according to their current position and professional experience, educational background and age range. This is important for contextualising the participants of this study.
- *Perceptions on requirements phase success (RPhSuc):* when reviewing the literature about the success of the requirements' phase, we note that definitions and assessment

can vary a lot, and therefore it is even more important to understand the points of view of each interviewee and to understand how a successful phase is perceived. This allows for the adjusting of expectations and responses.

- *Perceptions on competency definition (CompDef):* similar to many other concepts, competency now always means the same for all, especially for people with different professional backgrounds. To avoid misunderstandings, it was considered relevant to ask each participant what they means by competence. Alternatively, a definition could have been provided *a priori*, but this strategy was adopted in order to prevent biases in the answers.
- *Motivation to study: Requirements phase (MRPh); Leadership in IS projects (MLIS); Leadership in the Requirements phase (MLRPh); IS area specifically - Generability issues (MIS):* these four groups aim to assess the relevance of the research areas involved in the study and the leadership of IS projects, particularly during the requirements phase. Although the answers to these questions may not be considered to be accurate due to biases in the responses on account of possible sympathy with the researcher during the interview, they give an idea as to the participants' opinion. As a way of making the responses more truthful, justification and empirical evidence was asked whenever possible.
- *Main expected contributions and research relevance (Cont&Rel):* as a way of identifying potential practical contributions, it is interesting to consider participants' reflections about situations where results from this study could help resolve issues.

Table 18: Relationship between transversal dimensions and questions from the interview guide

Research Transversal Dimensions	Questions from the Interview Guide
ProjCat	D1) i)
	D1) ii)
	D1) iii)
MRPh	D2) iii)
MLIS	D3) i)
MLRPh	D4) vii)
MIS	D5) i)
Cont&Rel	D5) ii)

(Table continued)

Research Transversal Dimensions	Questions from the Interview Guide
ParCat	D6) i)
	D6) ii)
	D6) iii)
	D6) iv)
	D6) v)
	D6) vi)
	D6) vii)
	D6) viii)
	D6) ix)
RphSuc	D2) iv)
CompDef	D4) i)

Source: the author

After completion of the study protocol and interview guide, a pilot case was held to refine and validate the case instruments. Yin (2013) argues that this is a good strategy for validating the data collection instrument, and for becoming involved with the phenomena under study.

Case selection

As any research study, namely multiple case studies, it is important to establish the boundaries for data collection, i.e. the sample. This task can be straightforward if there is just a single, unique or specific case, but it may become more complex as the number of possible candidates increases (Yin, 2013). Therefore, Yin (2013) suggests that the selection of the cases in a multiple-case research can follow two main strategies: literal replication and theoretical replication. The first strategy considers cases as having similar conditions and thus they predict similar results, whereas theoretical replication selects cases with distinguishable conditions which may lead to contrasting results. In both strategies, there is no ideal number of cases to be performed. Instead, the researcher has to decide the number of replications that they need, or would like to have, considering,

for example, the certainty that the researcher wants to have in the results, or the importance of considering rival explanations to strengthen the results (Yin, 2013).

As described earlier, this study follows a multiple-case study research, with an embedded design, where the case is the requirements phase of software development projects. All cases follow a replication logic, and both strategies suggested by Yin are performed. It is important to consider cases with similar conditions, to see whether similar results can be obtained, however it is also interesting to select cases where certain conditions are purposely considered to be different, in order to see whether contrasting results are produced. Yin (2013) also suggests this approach to theoretical replication purposes, "to see whether the findings could still be duplicated" (p.54).

However, attention must be paid to the embedded units of analysis. The existence of leadership and the project as embedded units of analysis, along with the case definition, makes case sampling a process that has a degree of specificity. In fact, there is a close connection between each case and the main point of data collection, namely the interview. In each interview, one or more cases can be addressed if the respondent capably describes the different requirements phases from the different projects for which maybe different sets of competencies are needed. As such, the number of cases to be conducted is intrinsically connected to the number of conducted interviews, and there is no ideal defined number *a priori*. Instead, the interviews should be conducted until theoretical saturation occurs, which is a common strategy for this method (Skulmoski, 2005).

To assess whether or not a candidate is eligible for the study, a set of approaches and operational criteria was established to guide the selection process (Yin, 2013). The sample selection thus followed two main strategies:

1. Participants were chosen from large and medium-sized Portuguese companies which were present in the 2009 survey of the 200 biggest Portuguese Companies in the IS/IT industry (Sousa, 2010);
2. The snowball technique was used, where one respondent can recommend another participant whom they feel is qualified (Skulmoski et al., 2007).

However, all the cases had to respect the following criteria:

- Project leaders should belong to an IS/IT Portuguese software house which demonstrates diversity in project profiles in terms of type, size, development methods and applicability;
- Project leaders should have at least two years of experience in managing IS/IT projects;
- Project leaders should be available for face-to-face interviews;
- Projects should consist of software development projects and should be recent (recently finished or still in progress).

It should be noted that the main objective was to gain contact with those participants who could provide information about software projects, especially about the requirements phase. These participants are typically related to organisations and therefore it is prudent that the first selection and contact should be done at the organisational level. Considering this, more than thirty companies were contacted and a covering letter was sent to those organisations that would probably contain more potential case participants, presenting the researcher, the research project and its main objectives (see Appendix 2). This letter also explains the nature of the research and what form of collaboration would be expected. This practice is suggested by Darke et al. (1998), as a means to obtain access to organisations. Nevertheless, a considerable number of these companies never answered. One company directly refused to participate in the study, while the remaining requested additional contacts, such as email, telephone contacts and personal meetings, in order to establish access and details about the purpose and process of the study.

It was also agreed to provide some kind of feedback at the end of the study to those participating organisations who requested it as a condition for participating in the study. This can also be seen as a way of facilitating access, as it establishes a win-win relationship, whilst it is also an approach suggested by Walsham (2006). The Author believes that some feedback should be made available, be it a presentation or a report, to ensure that the organisation agrees to cooperate in the study. Darke et. al (1998) go further, claiming that organisations feel encouraged to participate if they perceive that the study topics are relevant and useful to them, with an expectation that the results might be available in a useful timeframe.

In the end, a total of twelve companies participated in the study. The list of those companies that agreed to participate in the study is provided in Table 19.

Table 19: Brief presentation of companies that participated in the study.

Company	Location	Brieft Description[2]	Corporate Website	Selection Strategy
IsAgile	Lisbon	IT Company, with expertise in consulting development of custom-made software	www.isagile.pt	(2)
CDP SI	Lisbon	Software House, owned by MSF SGPS, that offers Services of Consulting, Implementation and Development of Information Systems specifically for the Construction sector.	www.cdp-si.pt/CDP_pt	(1)
IBM (Portuguese office)	Lisbon	A globally integrated technology and consulting company with operations in more than 170 countries. The company develops and sells software and systems hardware and a broad range of infrastructure, cloud and consulting services.	www.ibm.com	(1)
EdiSoft	Almada	A defense & space information technology company, that offers its clientele the development of flexible solutions for software engineering and development, system integration and technology consultancy.	www.edisoft.pt/	(2)
Millennium Bcp	Porto Salvo	A Portuguese Bank open to public investment.	www.millenniumbcp.pt	(2)
OpenSoft	Lisbon	A Portuguese software house specialised in the development of technological solutions. Has extensive experience in developing solutions tailored to the client and in a web environment, particularly for governmental software products.	www.opensoft.pt/	(1)
Megasis	Lisbon	Software house owned by the TAP AIR Portugal Group, specialised in Systems and Information Technologies.	www.megasis.pt	(2)
Noesis	Porto Salvo	A consultancy company that provides solutions in the areas of Consultancy and Information Technologies. It is part of the group of the six largest information technology companies in Portugal.	www.noesis.pt	(2)
Critical Software	Coimbra	A Portuguese company, founded in 1998, specialising in the delivery of software reliable solutions, technologies and computer engineering services, for business-critical information systems.	www.criticalsoftware.com/	(1)
Novabase	Lisbon	One of the biggest Portuguese software-houses, specialized in customised development and consultancy IT services. Operates internationally, supplying products and services in several fields of IT.	www.novabase.pt/	(1)

[2] Information extracted from corporate portals.

(Table continued)

Company	Location	Brieft Description[3]	Corporate Website	Selection Strategy
Contactus	Lisbon	A Portuguese consultancy company of Information Systems, which operates in markets such as Public Administration, Telecommunications and Insurance.	www.contactus.pt/	(1)
Link	Lisbon	A Portuguese company in the area of IT that is part of the Aitec group. It provides solutions in various areas of information technology, such as: systems integration, IT consultancy, web portals, mobile solutions and quality audit. Customers are most of the large Portuguese companies, with particular emphasis on major telecom operators.	www.link.pt/	(1)

Legend: (1) – From the list of (Sousa, 2010); (2) – Snowball Technique.

Source: the Author

From this chapter onwards, all references to companies' names and research participants are coded, or omitted, to ensure their anonymity.

Data Gathering

The aim of this study is to collect leaders' perceptions about the set of leadership competencies they believe to be relevant regarding the actions and events that take place during the requirements phase of software development projects. It can be considered to be appropriate to conduct interviews with IS/IT leaders as the main source of evidence. Interviews are considered to be the most common method that is used for qualitative studies (Cassel and Symon, 2006). For interpretative case studies, where the researcher performs as an outsider, Walsham (1995) argues that interviews represent the primary data source, as "it is through this method that the researcher can best access the interpretations that the participants have regarding the actions and events which have, or are taking place, and the views and aspirations of themselves and other participants" (p.78).

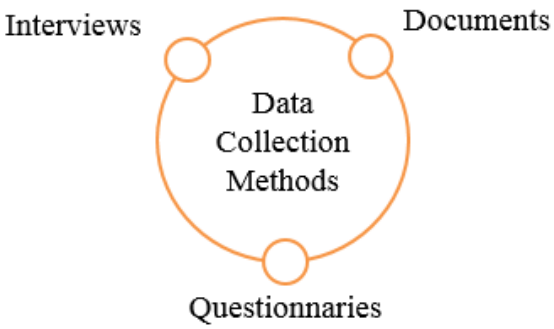
[3] Information extracted from corporate portals.

However, potential participants belong to the organisational group of employees who are most usually under great workload and pressure (Walsham, 2006). This gives rise to some constraints when considering the most appropriate methods to use, as these employees are not always available to participate in academic studies. Even when they do, they have major time constraints. Walsham (2006) argues that the researcher should be sensitive to these issues, not only when choosing the research method so as to ensure accessibility, but also during the scheduling of activities, as the participant should carefully consider the interview time and its appropriateness.

Taking all this into consideration, this research strategy involved conducting one hour semi-structured interviews with IS/IT project managers, who preferably had worked as leaders during the requirements phase. Whenever possible, interviews were supplemented with other sources of evidence, such as documents and quantitative data. Each of these techniques is briefly described below.

Data was gathered considering the three main sources of data: interviews, documentation and questionnaires (Figure 11). These three techniques were combined, in order to strengthen data collection and to provide a triangulation of evidences. It should be recalled that Yin (2013) (p.119) affirms that "a major strength of case study data collection is the opportunity to use many different sources of evidence" which will allow for the "development of converging line of inquiry" (p.120).

Figure 11. Data Collection Methods



Source: Adapted from (Henriques, 2006)

Thus, document collection was also performed, whenever possible, to diversify the sources of evidence and to allow data triangulation. These documents was searched prior

to field visits, in order to allow for preparation prior to first contact, or during the visit, to collect additional information for later analysis, along with the rest of the data.

The first data collection activity was the search of general information for each candidate company, through corporative web sites, organisational bulletins, whether digital or not, and brochures. This was important to understand internal organization, as well as products and target markets and also to assess each company, according to its adequacy for the study purpose.

Nevertheless, the main source of data was the personal interviews. Topics under study can be considered to be complex and intrinsic to people's knowledge, views, understanding, interpretations and experiences, which make interviews the most suitable method for data gathering (Mason, 1996).

Interviews

The inquiry process occurred between June and December 2011, and for some companies more than one day was needed to perform the interviews. All companies are located in Portugal, most in Lisbon or nearby, but some took place in Coimbra, forcing larger displacements.

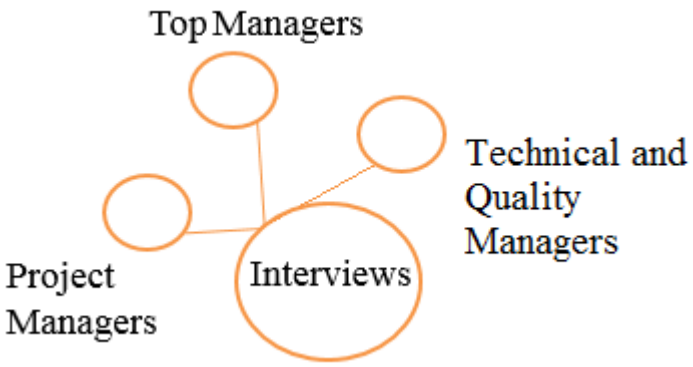
At least one participant was selected and interviewed per company. As described in the earlier section, participants were selected according to: (1) the criteria established; (2) their availability and interest in the study, and; (3) the recommendation of another participant or top manager. There was no concerns about the sample representability, given the nature and purpose of the study.

During the interviews, a respondent style was adopted by the researcher, which allowed them be in control of the enquiry process and the questions. The questions were made from the prepared list, and re-wording was only carried out when participants asked for clarification. However, in some cases, questions were regrouped or omitted whenever the participant's responses altered the way of conversation, or if they gave the answer in advance. This practice is well accepted by other researchers (Rubin and Rubin, 2012). The method used was the semi-structured interviews, which allow some flexibility due to

new emerging questions, needed to probe new and emerging ideas. This situation can happen and is desirable when carrying out an exploratory study.

Interviews were held personally and individually with the presence of the participant and the researcher in an isolated room. According to Creswell (1994), face-to-face, one-to-one interviews are useful when the research participants cannot be directly observed, which was the case in this study. Each participant was formally asked to voluntarily participate in the study, and no interviews were conducted without consent. As a result, it is assumed that the data collected consists essentially of self-reported data. This is frequently seen as a threat to data reliability and validity, due to over-modesty and self-aggrandisement concerns (Walsham, 1995). To minimise the impact of this issue, participants that are not directly involved in the project leadership were also interviewed, for example, those in top management and senior line management positions of (see Figure 12). This strategy is described as the triangulation of sources (Yin, 2013), and is part of the quality assurance approach for this study (which is further discussed in the Quality Assessment section).

Figure 12. Triangulation of sources



Source: Adapted from (Henriques, 2006)

A total of thirty-two interviews were performed. This number was not defined *a priori*. Instead, the interviews were carried out until no new information was being collected. Even when no more data was being collected, four more interviews were performed to reinforce the theoretical saturation. This technique is recommended by many authors, for instance (Eisenhardt, 1989).

Most sample respondents were generated through the snowball technique or "peer selection", which constitutes a purposive sampling, which also satisfies the same set of criteria. All participants were from the IS industry and work for Portuguese companies. Initially, only managerial role participants were considered, however, participants were also interviewed who had technical and top management roles, as they seemed to be able to provide additional information about the concepts being studied.

As this manuscript falls within the scope of a doctoral thesis, and considering that this study deals with relatively non-confidential material, tape recording or digital recording seem to be the most appropriate approach for data reporting (Walsham, 1995). Therefore, at the beginning of each interview, the researcher and the research were presented, and consent was asked to digitally record the interview. All participants agreed, except for two, who refused this procedure. In such cases, extensive notes were taken during the interview. Additional notes were also taken during the other interviews, whenever it seemed appropriated and needed.

Thus, the interviews were digitally recorded and backed up on several hard-discs, and kept off-site at my residence, to avoid file loss or corruption. Furthermore, data integrity was maintained by saving files with consecutive version numbers, so that early versions of all documents could be reviewed.

On average, each interview lasted for about an hour, but one clearly exceeded this, going on for more than three hours. Most interviews were performed in Portuguese, except for one, which was made in English. For this particular case, the English version of the interview guide was used (the original one).

The following table (Table 20) summarises the number of interviews made with each organisation, as well as the participant profile, i.e. job title.

It should be noted that some of the participants carry out their role in more than one professional profile at the same time, i.e., a Business Area Director can also carry out the activities of a Project Manager for a period of time, but only the most graduate professional position, was considered in the table - the one where the participant employs most of their time.

Table 20. Map of interviews from each company, considering job title.

Company	[Senior] Project Manager	Business Area Director	Commercial Department	Quality Manager	Technical Manager	Top Manager/ Company Director	**Total**
IsAgile						1	**1**
CDP SI	1						**1**
IBM	1						**1**
EdiSoft	1						**1**
MillenniumBcp		6					**6**
OpenSoft	1						**1**
Megasis						1	**1**
Noesis	2			1			**3**
Critical Software	1		1	1	1		**4**
Novabase	5			1			**6**
Contactus	2					1	**3**
Link	4						**4**
Total	**18**	**6**	**1**	**3**	**1**	**3**	**32**

Source: the Author

In summary, most of the interviews respondents were senior project managers, or the equivalent, but three Top Managers or Company Directors were also interviewed, as well as three Quality Managers, six Business Area Directors, one Commercial Manager and one Technical Manager.

Participants' profiles vary slightly from that which was initially expected, and thus the instrument of enquiry had to be adapted. Although the aim of the study remained the same for all interviews, participants with top-level functions (i.e. Top Managers and Company Directors) tend to be more distant from direct project management. Thus, some of the protocol questions, such as those related to the description of a project in progress, or recently completed, would not make sense. Furthermore, the second group of questions, which are related to requirement phase activities had to be adapted.

Therefore, without forcing any reference to particular cases, interviewees were asked to classify the typical company projects and to describe the normal activities, procedures and concerns related to the requirements phase. However, some of these respondents

made reference to specific cases to support their testimony and to illustrate exceptional situations. This strategy was also followed whenever the participant did not feel comfortable to describe a particular project (confidential issues).

It is worth noting that the opposite also happened as there were project managers who, in addition to the description of one or more specific projects, also mentioned general recommendations and concerns. This diversity of responses was managed by considering a strategy of grouping interviews, in order to consider the various situations separately (see Data Analysis Strategies for further discussion).

The participants included nine females and twenty-three males. Most participants came from the IS area and all had at least six years of professional experience. The most experienced participant had been working in IT for twenty-six years. Experience in their current position varies from one, to nineteen years, with an average value of five and a half years.

All participants were currently working for private sector companies, and there only three had had experience in working for the public sector. However, six participants had worked for client companies of the government.

All participants in the study had at least attended university, and seven of them had at least a Masters degree. Some had technical certifications (seven), but generally they gave special importance to certifications in the project management area (about one third have such a certificate from PMI, APOGEP, etc). Most participants reported a typical career progression (from programmer to their current position), but four related different professional paths as they came from other business areas, or from the academic field.

Considering the age group, participants are predominantly distributed in the age range of 30-40 years (eighteen), followed by the age group of 40-50 years (seven), the age group of 50-60 years (three), and the group of 20-30 years (two). Two participants did not indicate their age group, but from observation, we can guess that they should not deviate from the two most populated groups.

Documentation

Apart from an initial documentation analysis to contextualise companies and to prepare for the contact and the visit, other sources of documents were explored during the data collection process. Interviews were complemented, whenever possible, if available, with internal manuals and descriptions of project management practices and procedures, with focus on the requirement phase. This was important, not only to corroborate information gathered by interviewees, but also to collect additional information and to better understand internal processes and procedures.

Some examples of documentation include internal procedures and methodologies; the activities expected during the life cycle of the project, project classification frameworks and associated risk; and also guidelines for professional selection, taking into account the project type.

These documents were analysed together with the other data that had been collected, as described above, to augment the evidence and to corroborate the facts provided during the interviews.

Questionnaires

Although the nature of this research was qualitative exploration, one of the sub-questions and objectives was for verification purposes. As explained earlier, Gable (1994) argues that survey research is usually carried out for verification purposes, rather than discovery, and that the researcher should have a preliminary assumption of the answer before embarking on their survey. Therefore, in order to address RO3, questionnaires were given to the study participants to assess and verify how the Leadership Competencies Framework (Dulewicz and Higgs, 2005b) is relevant and applicable for the requirements phase. In such survey, participants were provided with a two entries table, with competencies and activities that they had to rank. They had to consider each of the competencies proposed by the authors, and had to assess whether or not it was relevant for performing each requirements phase activity. Additionally, participants were able to introduce new competencies, and to eliminate existing ones and also to discuss any relevant point.

Furthermore, a list of contingency factors (from the literature review) was provided, and discussions were held in order to identify which of these factors could contribute to ranking variants.

The Analytical Process

Data Analysis Strategies

The analytical process followed the insights proposed by Yin (2013). In first place, all interviews were fully transcribed and read in order to gain an overall understanding of the state of art and to identify any aspect that required further clarification. To guarantee that participants should not be identified, each interview was given an alphanumeric classification, based on the conjunction of six characters (XX_XX_XX). This classification is structured by first considering the month when the interview was performed, and then the second set of characters refers to the participant's organization, and the last set is the interview ordering number. An example of this codification is shown in the three first columns of Table 21.

Table 21. Interviews Classification Structure

XX	***XX***	***XX***	***#X***
JN – the interview was carried out in June	*O1 – the interview was carried out in the first organisation*	*I1 – the interview was the first performed at this organisation*	*#1 – refers to the first project described in the interview*

Source: the Author

Additionally, a set of two extra characters was included to identify each project described in the interview, or to identify the interview type. As mentioned earlier, as not all the interviews contain project descriptions, those that mentioned generic recommendations and concerns were identified by the "#G" characters (see the fourth column of Table 21).

Excerpts were extracted from the interviews in order to encode them into analysis dimensions. The technique of coding these extracts followed the recommendations proposed by Saldaña (2009). According to this author, coding activities are considered to be "the transition process between data collection and more extensive data analysis" (p.5).

At first, each analysis dimension was directly related to the sub-questions and the cross questions that were drawn from the literature. However, some dimensions were grouped and others were divided into sub-dimensions, in order to achieve a degree of homogeneity that allows the characterisation of the phenomena under study. This technique is described by Saldaña (2009) as "Lumping" and "Splitting" the data.

Figure 13. Interview Transcription and extracts (Example)

(…)

IR – Como é que caracteriza o projecto, por exemplo, ao nível de dimensão?

IE – Em termos de dimensão, em termos de equipa: portanto, como somos duas pessoas, portanto, eu tenho como funções gestão do projecto e responsável técnica e depois o meu colega faz de membro de equipa. Isto em termos de dimensionamento em termos de equipa. Em termos de duração, o projecto estava estimado à volta de 5 meses.

(…)

Source: from the interviews

The extracts obtained were coded and organised into files, one for each interview. Each file contains a set of tables corresponding to each analysis concept, and each table's cell contains an extract from the interview (see Figure 13 and Table 22).

The main concern of this phase was to fill the tables in the files, in order to ensure a basic understanding of each dimension, for each case study unit of analysis. Note that the extracts were analysed in the same language that were gathered, that is to say in Portuguese, which is also the mother tongue of the researcher. Transcriptions were only carried out in order to draw up the results for the final report, and were verified in pairs to ensure accuracy.

All excerpts were compared with the original text to ensure completeness and unbiasedness. These tables were further enriched with the data collected from other

sources: documents and questionnaires. With these set of files and tables we were able to create the case study database as proposed by Yin (2013), thus increasing the study's reliability (further discussion in next section). This concludes the first step of the analysis process: the analysis of each particular case.

Table 22: Example of extract's codification

Extracts	Interview Code	Dimension Code
"dimension, considering team size (...) two persons"	DZ12I1	LR - Dimension definition
"In terms of the length of time, the project was estimated to take about 5 months"	DZ12I1	LR - Duration

Source: the Author

This process led to modifications of the initial dimensions that were drawn from the literature: new sub-dimensions were created and some were eliminated or reorganised, as mentioned before (Saldana, 2009). However, such situations only occurred when they were considered to be appropriate in the context of the answers and after careful analysis. Additionally, discussion sessions were held with other researchers to ascertain their suitability and robustness.

After this instrumental phase, a set of frameworks for analysis was created, one for each concept of the study. These frameworks contain extracts from each case of analysis, to help the search for possible patterns. These excerpts were organised by projects, or by interview type. The creation of these frameworks also ensured that the information was well-organised, giving sense to them and allowing their interpretation and analysis. With this summary table, the researcher was able to compare and collate the results. Further analysis was performed when needed in order to compile the first answers to the research questions.

Additionally, the research study also included suggestions and recommendations from other researchers. These resulted from the presentation of the study, although still a conceptual version, at an international conference, and also at a public session of project approval.

Case study limitations

Despite case studies being currently well accepted as a valid research strategy, they have been always criticised. Case studies are in fact frequently cited as being unable to generate generalizable conclusions, especially in single-case studies (Dubé and Paré, 2003). By adopting a multiple-case research design, one can promote the comparison between different cases and therefore achieve more robust and general conclusions. However, in contrast with most quantitative studies, the aim of case research is not to obtain statistical generalisation. Indeed, the goal of this study is to expand the existing body of knowledge, instead of establishing statistical generalisation of the phenomena. However, analytical and theoretical generalisations may occur, especially when carrying out multiple case studies, by considering the phenomena through different conditions (Yin, 2013). Even so, Walsham (1995) argues that four types of generalisation are possible when carrying out interpretative case studies: the development of concepts, the generation of theory, the drawing of specific implications, and the contribution of rich insight. He also describes four published interpretative case studies to illustrate each type.

The second major weakness of case studies is the lack of rigor and subjectivity inherent to the process of data collection and analysis (Darke et al., 1998). According to Yin (2013), this may be true due for past instances in which researchers were careless in the use and description of techniques and when collecting and reporting evidence. However, the author argues that this problem can be overcome with the adoption of a different attitude by the researcher and with the production of methodological texts that provide support and guidance to conduct the process in a more systematic way.

3.2.3 Quality assessment

In this section, an auto-evaluation is made of the quality of this study. Firstly, and taking into account the recommendations of Yin (2013), a description is made of each of the tactics that was applied (see the third and fourth column of

Table 23). Secondly, the table of quality criteria suggested by Dubé and Paré (2003) was instantiated. An explanation was also given about each tactic that was applied in this research. Despite the different set of tests, some of the criteria have similarities, and thus some redundancy may exist.

Quality criteria by Yin (2013)

Table 23. Criteria for quality assessment by Yin (2013)

Tests	Case study tactics	Tactics applied in this research	Phase of research
Construct validity	• Use of multiple sources of evidence • Establish a chain of evidence • Have key informants review a draft case study report	√ √ √	Data collection Data collection Composition
Internal validity	• Use of pattern matching • Use of explanation building • Address rival explanations • Use of logic models	√ √ √ -	Data analysis Data analysis Data analysis Data analysis
External validity	• Use theory in single-case studies • Use replication logic in multiple-case studies	- √	Research design Research design
Reliability	• Use case study protocol • Develop case study database	√ √	Data collection Data collection

Source: Adapted from (Yin, 2013)

Construct validity

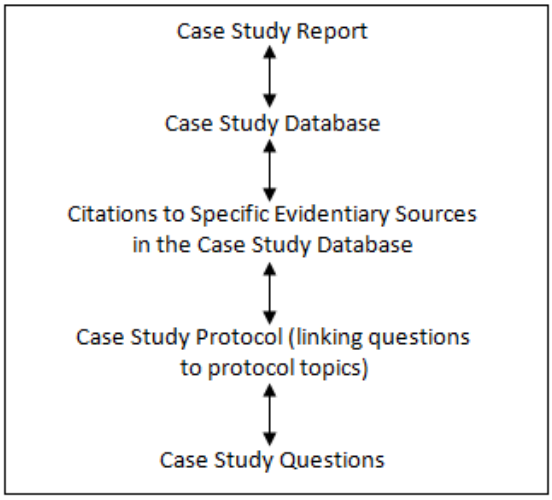
Construct validity is concerned with the identification of the correct operational measures for the constructs that are being studied. Case studies have been criticised due to this issue, considering that 'subjective' judgments are used to collect data (Yin, 2013).

To address this validation topic, three main strategies were implemented, following the tactics suggested by Yin (2013): the use of multiple sources of evidence, the establishment of chains of evidence, and the use of key informants to review the report.

According to Yin (2013), considering multiple sources of evidence when doing case study research can enable data triangulation, developing "converging lines of inquiry" and thus increasing the overall quality. In this study, two types of triangulation were used: data triangulation and methods triangulation. Data triangulation concerns the use of different sources of data, such as interviews and documents, or the consideration of different types of participants (for instance, top managers and project leaders). Methods triangulation can be the use of combined qualitative and quantitative techniques.

The establishment of the chain of evidence is achieved when it is possible to follow the case study questions to the case study results, and also from conclusions back to the initial case study questions (see Figure 14). In this study, this strategy was addressed through a set of steps. Firstly, the main case study questions gave rise to the six main objectives, which guided the protocol development. Therefore, questions presented in the case study protocol were linked to these main objectives in order to address the case study questions. Secondly, a case study database was created, with extracts and citations from the interviews and also from the documents collected. This database forms the basis for performing pattern matching and for drawing conclusions, and thus addresses the research questions.

Figure 14. Maintaining a Chain of Evidence.



Source: (Yin, 2013)

Internal validity

According to Yin (2013), internal validity is critical when establishing causal relations. For exploratory studies, such as the one described, this logic is not applicable,

as the aim is not to establish this kind of relationship. Nevertheless, some of the strategies proposed to address this test were at least partly addressed during the data analysis phase.

External Validity

External validity deals with the extent to which generalisations can be made from of the case study findings. Many critics have pointed out that external validity is one of the major barriers of case study validity (Yin, 2013). Yin claims that this happens mainly because these critics try to compare case study research to survey research. However, this might not be appropriate, as the aim of survey research is to achieve statistical generalisation, whereas case study research aims to achieve analytical generalisation. Analytical generalisation results from replication of the findings, conducted through a replication of logic in multiple case studies designs.

Reliability

Testing the reliability of a study will permit the minimisation of errors and biases (Yin, 2013). The idea is to ensure that a researcher who conducts the same case study, following the same steps and procedures, will achieve identical results. This requires that the entire process is described in detail, operationalising and validating the steps whenever possible.

As Yin (2013) suggests, a case study protocol was developed, not only to ensure the study reliability, but also to enable case study replication in a multiple case study approach. Also the case study database was developed and this served as the basis for data analysis and conclusions. However, the nature of the study does not ensure that exactly the same results will be obtained, even if another researcher conducts the same detailed steps.

Quality criteria by Dubé and Paré (2003)

The following table was developed by Dubé and Paré (2003), which summarises the proposed attributes to assess quality in exploratory studies (Table 24). A description is given for each attribute, describing how it was, if so addressed to this study.

Table 24. Table of attributes used to assess exploratory IS positivist case studies.

Attribute	Description
Research Design	
Clear research questions	Four 'which' and 'how' form questions were raised, followed by a set of research objectives. These questions and objectives were grounded in the literature review and are clearly presented in this document.
A priori specification of constructs	The underlying literature was presented and discussed, leading to a proposed research model for completion. It serves as a guide for the data collection and analysis. However, new insights are naturally expected from the field.
Clean theoretical slate	The theory of interest is presented in the Literature Review Section, in order to help shape the research. However, no hypotheses were formulated, which is consistent with the style of an exploratory study (Dubé and Paré, 2003).
Multiple-case design	More than two cases will be conducted, which follows the Multi Case Study Research design suggested by Yin (Yin).
Nature of single-case design	Not applicable.
Replication logic in multiple-case design	Both literal and theoretical replication logic. Cases were selected based on a set of *a priori* established criteria and the use of the snowball technique.
Unit of analysis	A unit of analysis is specified and discussed, whilst an embedded design is employed.
Pilot case	A pilot case was performed to validate the data collection instrument and to involve the researcher with the phenomena.
Context of the study	The sites were presented, as well as the case period and the time spent at each site. The data collected was both on-going and retrospective.
Team-based research	As the study is integrated into a doctoral thesis, the doctoral researcher is the central element, with support provided by the two supervisors.
Different roles for multiple investigators	The supervisors are responsible for the remit of guiding, discussing and reviewing the work.

(Table continued)

Data Collection	
Elucidation of the data collection process	The major concerns of the data collection process have been described so far. Additional details will be added in the next chapter.
Multiple data collection methods	Data was collected considering three different methods: interviews, documentation and questionnaires.
Mix of qualitative and quantitative data	The collection of both qualitative and quantitative data was also performed, due to the nature of some of the sub-research questions. However, no statistical analysis were performed, due to the research purpose.
Data triangulation	Multiple sources of evidence and the use of multiple methods of data collection support data triangulation.
Case study protocol	A case study protocol, including an interview guide, was developed and validated.
Case study database	A case study database was developed with extracts from all case evidences, for each research dimension.
Data Analysis	
Elucidation of the data analysis process	The data analysis plan was discussed in this chapter. Some of the phases were also described. Additionally, analysis activities, as well as the results are discussed in the next chapter.
Field Notes	Field notes were taken and interviews were recorded.
Coding and reliability check	Coding activities followed the recommendations of Saldaña (2009).
Data displays	Data were synthesised using a coding and a categorisation process, which is briefly described in this chapter. Resulting data are shown in the next chapters that consider recommendations and best practices.
Flexible and opportunistic process	Data collection was performed in stages, and did not rely on iterations.
Logical chain of evidence	The chain of evidence was achieved by linking the case study questions to case study results, and vice-versa. These questions guided the development of the data collection instrument and provided the basis for data analysis.

Data Analysis (continued)	
Explanation building	Explaining the phenomena is one of the objectives of the study which was presented earlier through the research questions format: "how" and "why"; and the research model presented at the end of the Literature Review Chapter. The way it leads to the study conclusions is presented in the next chapter of this document.
Searching for cross-case patterns	Only after the individual analysis of the cases can they be considered to verify the existence of patterns. According to Yin (2013), cross-case synthesis also allow for the clustering of different groups of cases that apparently share similarities. This strategy formed the basis for analysing data from all cases, and led to the results obtained, which represented in the next chapters of the document.
Quotes (evidence)	Quotes are presented whenever it is necessary, in order to provide evidence and to support the study conclusions.
Project reviews	Project reviews were performed, not only internally, but also externally. Internal reviews were carried out throughout the study process with the team and other specialists, with the aim of exploring and improving issues related to research design and overall quality. External reviews were also considered. The study was presented at an international conference and at a public session of project approval
Comparison with the existent literature	The results from the data collection and analysis were compared with the existing literature, in the relevant fields already employed for guiding the research design.

Source: Adapted from Dubé and Paré (2003)**.**

4 Analysis and Discussion

4.1 Introduction

The data analysis will be presented following a thematic rational. The sequence of concepts is in accordance with the sequence of questions that were put to the respondents, as has already been described in Figure 9. This strategy allows us to maintain the flow of data as it was collected, and it also allows us to establish a chain of evidence that scopes the detail of the study concepts.

Following the sequence shown in Figure 9, this chapter begins by presenting the projects described in the interviews. This is made through attribute orientation, rather than for each project individually. The aim is not to enter into detail for each project, but rather to identify the context in which the remaining topics were considered. Nevertheless, it is noteworthy that each project had been previously individually characterised into the proposed model for characterisation.

Although project-related issues may be referred to throughout the description of the analysis on the remaining topics, they will be revisited in the last sections of this chapter, and then the assessment of those factors that influence the relevance of leadership competencies will be discussed.

The analysis of the requirements phase follows the project characterisation. This section starts with an introductory discussion about the basic concepts inherent to the requirements phase. Topics regarding the requirements phase definition, nature and criteria for success are presented as they emerged during the interviews. This helps to establish an *a priori* understanding on how this phase is perceived.

Throughout the analysis of the interviews we felt the need to have a common basis for comparison and to contextualise the issues related to this phase. Thus we decided to create a classification model that aims to guide the analysis of all instances of the requirements phase. Following the same rationale of project characterisation, the requirements phases will be described according to their attributes, i.e. their results are presented in a comprehensive and concise form.

The third section of the analysis chapter focusses on topics related to leadership. We present the list of competencies described by the interviewees, and discuss each in

comparison with the literature. We then explore those key factors mentioned during the interviews that may impact on the resulting set of competencies. The discussion of these factors revisited the topics regarding the projects and requirements phase classification, but new factors were also included. The first attempt to instantiate the research model is also presented in this section.

Finally, the results of the questionnaire are posited to assess the relevance of competencies from Dulewicz and Higgs (2005b) for the activities performed in the requirements phase. New insights that emerged from these results are also discussed.

4.1.1 Interview Classification

Before going through the analysis of the data, it is necessary to clarify better the organization of the interviews. As explained in the methodology chapter, the triangulation of sources, i.e. the consideration of participants who carry out different roles and who allow different levels of abstraction of the phenomena under study, imply some decisions regarding the strategies for organising and analysing the interviews.

We made a separation of the interviews accordingly to their content. The content of each interview diverge regarding the description of particular projects and requirements phases, and also generic recommendations. Therefore, interviews were divided into two different types: generic or project-oriented.

Generic interviews do not describe any specific project. Instead they present more general and comprehensive content. Examples of this type are the interviews conducted with top managers and directors, but also those where the respondent did not feel comfortable to describe any particular project. In some cases a description was made of the average organisational project, which was also included in this type of interviews.

Nevertheless, the generic, comprehensive and global content nature of interviews allows for a different perspective of the phenomena and also a comparative analysis. Examples of interviews within this category are illustrated by the following excerpts.

Extracted from the interviews:

"With the procedures we have here (...) I do not see any added value in referring to a specific project, because we work, we work in the same strictly way for every project " [AG05I2]

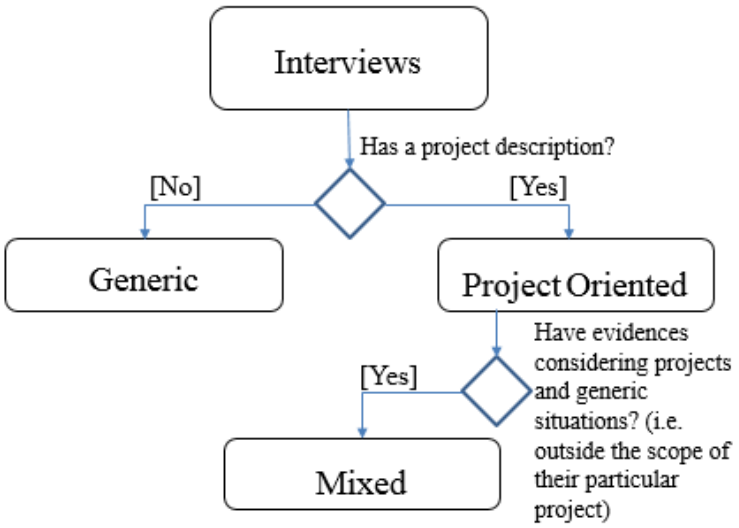
"We are able to control projects quite well (...) as projects are usually small. We usually manage to have modular divisions (...) we have a lot of projects with 4 or 5 people" [ST06I1]

"Oh, let's see ... as the director of this company, ah ... directly involved in information systems development projects, no! I sit on the usual steering committees, or I am involved at the level of business programme manager, but not directly in the project management itself. The last time I remember being the head of a project with the characteristics that you describe, I can say that was about twelve or thirteen years ago... indeed I do not remember which was actually the last one... however I can speak based on my experience on projects that I witnessed due to my job functions, although I was not directly involved in the project, right?" [ST07I1]

Project-oriented interviews may contain the description of at least one specific project. Whenever more than one project is described in each interview, their code is suffixed by the sequence number that describes the project (see Table 21 from the previous chapter).

There are also interviews that contain a description of a particular project, but also references to other projects or more general situations. This was carried out for comparative purposes or to enhance the evidence of a concept. However, as this is an illustrative intention, they do not get to be fully characterised (according to the list of attributes described in Figure 17). This kind of interview is treated as being a mixed interviews, as it may contain references of both types. To distinguish those projects which were totally or partially characterised, from the generic ones, we added an interview code with the "#G" label (G from Generic) to the former. The process and criteria for interviews classification are illustrated in Figure 15.

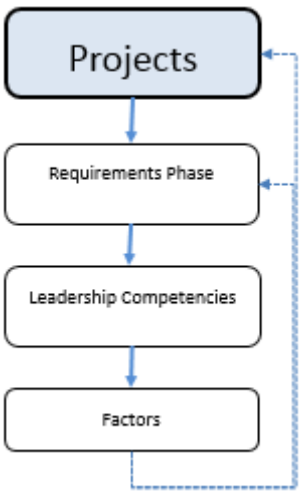
Figure 15. Rationale for interview classification



Source: the Author

In general, the analysis of the results is presented based on project-oriented interviews. However, the consideration of generic interviews allows a broader view of those concepts that can be better clarified. In fact, the analysis results form an interlinked relationship between these two kinds of perspectives, as one complements the other.

4.2 Project Characterisation Analysis



The analysis phase started with an assessment and characterisation of the projects described in the interviews. The interview guide begins with the questions where respondents describe one or more projects that have been recently completed, or that may be still in progress, but whose activities related to requirements phase have already been completed. The reason for this is the need to use the least possible data from events that occurred some time ago. This avoids distortions and keeps data collected as descriptions, rather than memories. The use of data obtained by memories is often seen as a threat to data reliability (Bernard et al., 1984).

The questions aimed for project characterisation are ordered according to their degree of detail (see Figure 16). The first question (d1) i)) is quite open, allowing the respondent

to report the aspects that they considered are the most relevant and characterising of the chosen project. The second and third questions (d1) ii) and d1) iii)) explore the characteristics presented in the framework derived from the literature review (Table 1). The decision to include an open question is to give freedom of response for project characterisation. Considering only those questions that directly characterise projects for the attributes of the framework could jeopardise some relevant aspect that are not sufficiently covered.

Figure 16. Questions for Project Characterisation from the Interview Guide.

D1)i)	How do you define the project?
D1)ii)	Classify (each) project with the attributes in the Table 1.
D1)iii)	With regards to the project's development, have you considered any specific development methodology? If so, which one?

Source: the Author

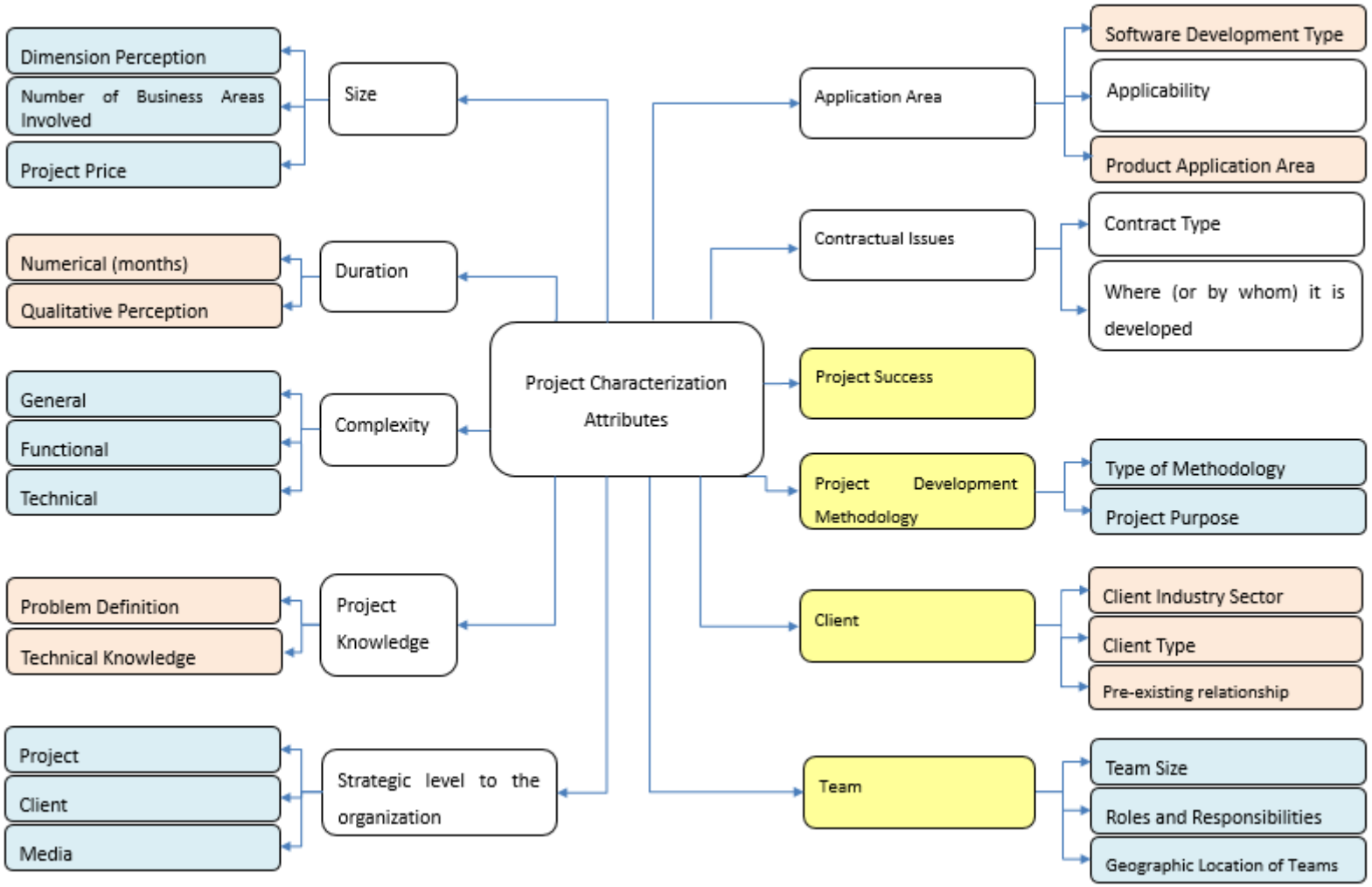
The description of the results will be ordered by the list of attributes, rather than by the order of the questions.

4.2.1 Project Characterisation Chart

The responses to the interview questions related to project characterisation were firstly address by considering the list of attributes derived from the literature (see Table 1). However, the application of some of these attributes proved not to be the most suitable for all the mentioned projects. Some of the difficulties felt in the process include aspects that were never referred to by participants, or new issues that were not adequately covered by this set of attributes.

As the analysis of projects progressed, it seemed appropriate to adapt this set of proposed attributes into a new one that could better represents the essence of the studied projects. Therefore, before going deeper in the analysis, the decisions made regarding the project characterisation system will be presented and justified. The suggested chart is shown in Figure 17, which summarises the resulting set of attributes that were used for the project analysis.

Figure 17. Project Categorisation Chart



Legend: The highlighted boxes represent those attributes that have been adapted or added. Source: the Author

Although the original set of attributes has been drawn from previous studies, in this case it did not show the same acceptance and alignment from study participants. An example is the variety of responses given to some of these attributes. Such variation had already been anticipated by Crawford et al. (2005), who suggested that the adequacy of a project categorisation system may depend on the context and nature to which it is applied.

The relevance of using the appropriate project categorisation system is the need to accurately represent the context of the study. Without this assessment, the effects of the type of project on the remaining topics of the study may be misunderstood or conditioned *a priori*. Thus, some adjustments had to be made to the attributes suggested in the literature, in order for the resulting chart for project characterisation to become specific to the problem under study. This chart also aimed to be more representative of the universe of the projects being studied and from this point forward, each attribute from the suggested chart will be discussed and used for projects analysis in a separate way.

Project Size

Project size was the first attribute from the original list that revealed some difficulties to assess. The nature of responses varied depending on participants' interpretation of the meaning of "size". Is was not clear what was intended with the characterisation of project size.

Two of the problems described in the literature about the individual misinterpretation and ambiguity of some project attributes did in fact occur with this attribute (Crawford et al., 2005). Participants characterised project size by considering the number of people involved, the number of business areas involved, the project duration, or the number of modules to implement, just to mention the most frequently cited. Examples extracted from the interviews are shown below.

Extracted from interviews:

"The system was huge, it involves sixty-eight modules, aaa .. sixty two modules" [ST09I1 #1]

"One year and a half, twenty two people, it is a big dimension" [ST09I1 #2]

Furthermore, the use of size was found to be considered in some cases as being a composite attribute while in other cases as an atomic one. In other words, some participants assessed size as being a single attribute, while others considered it to be a composite attribute. One such situation happened when a participant considered the project to be big and small at the same time and did so because he used two different dimensions to assess project size. Another example was a participant who assessed the project size by considering project value and also the number of people in the project team. Both situations are illustrated using extracts from the interviews.

Extracted from the interviews:

"Size was very significant" - physical/people dimension [OU10I2]

"The project itself was quite small" - temporal Dimension [OU10I2]

"The budget is around 500k ... (...) and in terms of the size of the team it was expected 12 people" [NV10I4 #1]

One possible strategy to overcome this issue is to pre-establish a set of metrics to measure size. However, pre-establishing metrics would probably restrict the exploration of those used in each company. In fact, despite the use of the size attribute to categorise projects is well accepted in the visited companies, the way that each one actually uses it may vary. The confirmation of this assumption came from the analysis of the collected corporate documents (see an example below). In one of the companies, a two entry grid is used to assess the project: one considering project complexity, and the other considering project dimension. However project dimension is assessed through eight sub attributes that the project manager should fill.

Extracted from internal documents of one of visited companies:

Project Dimension	*Average effort (FTE) in the project with subcontractors*
	Number of units from (our company) involved in the project
	Project developed in exclusive or in partnership
	Duration
	Longevity of billing cycles
	Financial guarantees
	Billing Service for the Project
	Billing Products for the Project
	The estimated profit margin for the project

However, in another company, a different strategy is used to measure project size. As could be observed from their internal documents on project management procedures, project dimension is related with the effort (man/days) needed for project development.

Extracted from Company's Internal Documents

"Projects may be classified into the following dimensions:

- *Small - where the effort of the project does not exceed 150 man days.*
- *Medium - where the effort of the project does not exceed 300 man days.*
- *Large - where the effort of the project is more than 300 man days.*
- *The classification of project size can be adjusted by additional qualitative criteria (e.g. risk and complexity)."*

Because some participants felt that this attribute is unclear, they probably found it useful to explain, during the interview, their own measurement criteria. Two examples are illustrated below, using excerpts from the interviews.

Extracted from interviews:

"… for me, small projects are below 1,500 hours, considering what is the normal scale (of our company), and considering the average project unit at this time, okay? If we are in a co-organisation structure, then maybe we can talk about 5,000 or 2,0000, it all depends" [ST08I3]

"Projects are classified (in our company) by levels on a scale of one to 5, where 5 means the most complex. Okay, this characterisation is assigned a bit based on the importance of the client, whether the project is core or not to the client" [NV10I4]

From the comparison of the responses, it can be concluded that project characterisation tends to be influenced by who is making it. Assessments may diverge in terms of experience, expectations and context. Usually, the project classification cannot be separated from their context (Crawford et al., 2005), that is to say, the project is given a particular classification as it is within a specific context. Out of this context, it could well change. Such an assumption is derived from statements like the one showed below, extracted from one of the interviews.

Extracted from interview:

"For our business area, this is a big project. I mean to say, it was one of the largest projects in (our) area that has existed in (our company), I even think that it was the largest.

Therefore it is a big project. However, if we compare it with the reality in (our company) with regards to other departments of (our company), then maybe it would be considered to be a medium-size project." [NV10I5]

Therefore, in order to cover the diversity given by participants, it was decided to consider the size attribute through three dimensions: the participant's perception of project size; the number of business areas involved in the project, and; the project price (see Table 25).

The first dimension classifies the perception that each respondent has about project size. This assessment has no concerns regarding the criteria used to classify the project size. The aim of this study is concerned with the behaviour of the leader during the activities of the project. What actually influences their practices and behaviour is more likely to be related to their perceptions, rather than real dimensions (in the sense of being standardised).

The size of the project when compared with other projects from different contexts, may not give any added value to those who have to perform it. As an example, a project which is considered to be big within one company's context, may be a small project in another company. By applying a standardised dimension, the results would probably be different. Thus, it is not expected that a standardised classification will shape special behaviours on project managers. Rather, they are more likely to behave guided by their own perception of project size. This practice could even dismiss the association of this classification to some behaviour issues of project managers. Thus, project size perception was classified through small, medium and large, which is in accordance with previous studies (Payne and Turner, 1999; Turner, 1999; Crawford et al., 2005).

The other two dimensions were referred fewer times than the previous one, namely: the number of business areas involved, and project price. Only eight respondents mentioned business areas involved in the project, and only six respondents considered the price of the project to be a relevant aspect.

Considering the number of business areas involved in a project, participants distinguish between several teams and units from the same organization, and several companies cooperating in a consortium. Nevertheless, all cases may need suitable

procedures whenever different teams have to work on a project. This might be especially true when the teams come from different contexts and cultures.

Regarding the responses about the amount involved in the project, these were made mainly to justify the classification of the general project size attribute. Sometimes a personal judgment was added regarding selling price, as participant considered it to be cheap or expensive. Both attributes can be used also to mark out those results obtained for the general size attribute.

The results obtained from the assessment of the size attributes is shown in Table 25. Seventeen projects were perceived as being large, seven as medium, and five as small. Note that seven projects were not classified according to their size, as they were described for comparative purposes, and for this reason they were only partially instantiated.

Table 25. Results from Project Size

Size Perception		Number of Business Areas		Project Price	
Large	17	More than one company	2	Numerical	3
Medium	7	More than one department	4	Appreciation	3
Small	5	More than one team	2		
Totals	29		8		6

Source: the Author

Project Duration

The attribute of project duration was maintained from the initial list of attributes. However, some changes were made as a result of the references made about project duration to classify project size.

Extract from Interview

"I can give you another example (…) that had a dimension of… a year's development" [JL02I1 #2]

We divided this attribute to include a numerical classification and a qualitative perception of time. In the first dimension the number of months that the project took to be finished was considered. The exception was projects that were not finished by the time the interview was conducted. For these projects, the estimated duration was considered.

No label was attach to any duration range. Such a procedure could erroneously classify a project due to its time duration. Similar to the size attribute, the duration classification may depend on the context of the project. Projects that last one month may be the norm for one organisation, while for another, a normal project may last six months. Nevertheless, grouping projects within a duration set of ranges may be advantageous for analysis purposes.

Two sets of ranges were applied, the first followed Cooke-Davies (2002), and the other Crawford et al. (2005 – www.pmcompetences.net). However, the first did not represented the duration of projects satisfactorily. It revealed an asymmetric distribution of projects through each range. The second set considers more granular time periods that reveal more evenly distributed projects. Thus it is more important to use the most representative criteria for the universe of projects under study (see Table 26).

Table 26. Results from Project Duration (month ranges)

Cooke-Davies, 2000		**(www.pmcompetences.com in) Crawford et al., 2005**	
< 1 year	18	**< 3 months**	**6**
1 to 3 years	11	**3 months to 1 year**	**17**
> 3 years	0	**> 1 year**	**6**

Source: the Author

Nine projects were not classified according to their duration: one was an evolutionary maintenance of an existent software system, and thus duration was not applicable, and the other eight were projects that were described for comparative purposes only.

Participants' qualitative assessment of project duration used short, medium and long criteria. However, it is worth noting that this dimension was less instantiated than the previous one. Only six participants referred this classification. However this can be useful to understand the standards that the respondents are used to. This became evident when

one participant reported a six month project as a short duration project, whether another participant referred, to a similar project a medium duration. Again, we strongly believe this kind of perception may influence behaviour on different project players, rather than the actual project length in months. The results obtained for this dimension are presented in Table 27.

Table 27. Results from Project Duration (perception)

Duration Perception	
Short	4
Medium	1
Long	1

Source: the author

Project Complexity

Project complexity attribute revealed some of the problems described to the size attribute. In the first place it also showed ambiguity in the way to be assessed. While some participants considered it as a simple attribute, others used several attributes to defined it. Previous studies have already mentioned the difficulty to assess this attribute (Skulmoski, 2005). Also, Crawford et al. (2005) affirmed "individual attributes as well as composites of attributes are used as the basis for characterisation of complexity" (p. 163).

The strategies that companies use to assess complexity also differ from each other. For one of the companies, project complexity is defined in terms of existing knowledge about the business area and technology, time critically, or the impact on client. On the other hand, a different company prefers to use attributes such as project dimension, team seniority and the number of other systems integrated in the project (examples are shown below).

Extract from company's internal documents

Project Complexity	Factors
	Requirements Definition
	Business knowledge in (our company)
	Knowledge of technology to be implemented
	Stability of technology to be implemented
	Media coverage of the Project
	Criticality in meeting deadlines
	Geographical dispersion
	Impact on Customer

Extract from company's internal documents:

Project Complexity:

A simple project:

- *Mature technology, project like a configuration, known client, experienced team, medium or smaller project size, with little or no business lack of knowledge, low number of integrations (e.g. 1 to 5 system integrations).*

A normal project:

- *Good knowledge about the technology, partly rotated team, business area with some or good knowledge, some integrations (e.g. up to 3 systems, and up to 20 integrations).*

A complex project:

- *Unknown technology, not an experienced team, unknown business, many different integrations.*

This is consistent with Muller and Turner (2007), who affirmed that complexity definition may be different from firm to firm. The authors described that respondents reported criteria such as: size of project; number of departments involved; number and type of stakeholders; location; form of contract to define complexity.

Additionally, complexity was described as being related to different perspectives of the project. According to some participants of this study, a project can be technically and/or functionally complex. Evidence from both types of complexity are shown from the interviews.

Extracted from the interviews:

"This is a new technology for us that is why we can consider this project as being a complex one" [ST09I1 #2]

"Technology-wise it would only be complex as it had several components and the technologies that we had to implement, for this client, were not the same… it was technologically complex (…), we had people who knew the business very well… eh… the business, so, regarding the functional part, this would not be considered a project functionally complex" [OU10I3]

Thus, we decided to consider the complexity assessment to include the functional and technical perspectives of the project. Table 28 shows how the results were distributed by considering the general assessment of complexity, functional and technical complexity. Altogether, thirty projects were ranked according to their degree of complexity. The remaining projects belong to the group projects used for comparative purposes. It should be noted that some answers in the table overlap, as in some cases participants felt the need to strengthen the different classification of complexity for each perspective of the system (general, functional or technical).

Table 28. Results for Project Complexity

	Complexity		
	General	**Functional**	**Technical**
High	6	11	6
Medium	2	1	2
Low	4	6	4
Total	12	18	12

Source: the Author

Project Knowledge

The Project Knowledge attribute is an adaptation of the original attribute of "The type of the problem" from the initial set. We decided to change the name and scope of this attribute to encompass all the perspectives described in the interviews. During the interviews, participants highlighted the importance of the existing knowledge of the problem, and also the technological knowledge that IT professionals should possess. These two dimensions of the critically of knowledge for a project are in line with the practices of other authors (Shenhar, 2001 2002; Raz et al., 2002 2002). For instance, Crawford et al., (2005) named an equivalent attribute as being "Uncertainty, Ambiguity, Familiarity", and detailed it considering general, technical and methods such as familiarity and ambiguity.

This kind of attribute has also been reported when assessing project complexity or risk (Crawford et al., 2005). The data analysis of both interviews and internal documents has also revealed some connection between this attribute and project complexity. For some companies, the assessment of project risk and complexity is made in terms of the uncertainty of the technological and business area/problem. For instance, one of these companies classified a simple complexity project (low complexity) as being a project were "*technology dominated (…) the client is well known (…) a business with little or no uncertainty*".

Considering this, we decided to include in the attribute Project Knowledge the references made to the existing knowledge considering the problem definition, i.e. functional part of the project, and the technological knowledge. Table 29 shows how projects were classified into this resulting composite attribute. The criteria for classification is defined through four categories: well-known - no ambiguity or uncertainty; moderately-known - there may exist some ambiguities; insufficient-knowledge - high degree of ambiguity and uncertainty; completely-unknown – a new business/client or technology.

Table 29. Results from Project Knowledge

	Project Knowledge	
	Problem definition	**Technological Knowledge**
Well known	10	2
Moderately known	9	2
Insufficient Knowledge	3	5
Completely unknown	6	1
Total	28	10

Source: the Author

Twenty nine projects were classified for at least one of this attribute's dimensions. The remaining ten referred projects that were used for comparative purposes. While functional knowledge remains the most referred dimension, technological knowledge should not be ignored.

Strategic Level for the organisation

The strategic importance of projects for the organisation has been previously mentioned as being a relevant dimension for assessing projects (Crawford, 2005). This author has shown a comparison between a list of the most common and another of the most important attributes for project categorisation. In both lists, strategic importance appears in the top ten (respectively the seventh and sixth position).

In line with the other attributes described so far, the assessment of the strategic importance of projects have also been shown to depend on several factors. During the interviews, respondents highlighted the importance of the strategic level of the project, and also mentioned the relevance of the strategic client. A strategic client was defined as:

- the client is a new customer or is from a new business (and strategic) area, "*the client is a new client and is not someone that we have previously done*

business with. (…) therefore, every new client, I guess, is highly important at the moment" [ST08I2]

- the client is strategic, according to the mission and vision of the company, "*there are other customers that, due to their business, or by the sight and mission of (our company) are much more strategic than this one*"[ST09I3] "*the customer is also strategic (...) at this moment the main objective of (our company) is to became international, so all big clients that, ah, that we can have some control of them will always be strategic "* [NV10I5]
- the client has other projects and/or there is a strong participation of other organisations in the same client. This aspect was reported as the media attention-level of the project, not only in the media, but also by reputation in the market. "*This specific client… ah, alone was not very strategic to us, but it was actually strategic for another reason: because this is not the only client that we have, where we develop projects in public administration and, considering that we are in a small country, everything becomes common knowledge: when things go well or when things go wrong, and it may have impact on other projects, even if they do not have anything to do with (this client), just because they are part of the public administration."* [ST09I3]

One of the respondents also reported the strategic level of the project to the client, i.e. "*whether the project is or not a core project for the client"* [NV10I4]. However, it was done in the context of project complexity assessment, and thus, we decided to consider it for the complexity attribute.

Another dimension mentioned by participants was the media-level of the project. A media project concentrates on it too much attention, including from the outside of the company. A failure in this kind of project may have a major impact on the company, particularly with regards to their reputation. This relationship has been documented in the literature (Crawford, 2005). As strategic position is also related to the impact of the project in the business market, it is not surprising to see this attribute as being one of those used to assess project risk.

To address all the dimensions mentioned in the interviews we considered the strategic level to include: strategic level of projects, the strategic level of the client and the media

level of attention. Table 30 shows the summary results for the classification of this attribute, according to the different kinds of strategic levels.

Looking at the results it can be observed that there are few references to low or medium strategic projects out of a large number of projects (a total of fifteen were classified). A possible reason could be that the respondents did not feel this attribute to be relevant for the project that they described. As the aim of project characterisation was to identify and assess the relevant aspects of each particular project, it is possible that the omission of this attribute means that it is not a relevant feature for that particular project. Moreover, since almost all classified projects has a high level, perhaps the rest of the "omitted" projects would be classified as medium or low.

Table 30. Results from Project Strategic Level

	Strategic level		
	Project	**Client**	**Media**
High	10	7	4
Medium	0	1	0
Low	0	1	0
Totals	10	9	4

Source: the Author

Application Area

There are a variety of forms proposed in the literature to classify the application area of a project. Crawford et al., (2005) identify some of them, but the areas to which they apply include a wide range of business areas. In fact, they are used to identify the different industry sectors to which a project can be applied, not focussing on any specific business area. However, one of this study's assumptions is to only consider software development projects. Therefore, the use of the referred classification system would be unproductive, as all studied projects would fall into the same criteria (e.g., Information and telecommunication (Crawford, 2001), or Computer Software Development (Youker, 2002)).

The original attribute only considered whether the project was generic or bespoke. A generic project refers to projects that are created to serve different users in a variety of situations. A bespoke project is a custom-built project, for a specific purpose and context. However this simplistic criteria may not represent the main similarities of projects that produce identical products. Thus, we decided to extend this attribute in order to reflect the universe of projects studied, namely in terms of the type of software development and/or area for which it was developed (the business area it is intended for).

To operationalise this composed attribute, three dimensions were used: the type of software development; the classification of projects according to their software degree of specificity, and; the domain area in which the project is produced. The first dimension was classified using the following set of criteria:

A1: Building a new system (from scratch);

A2: System replacement with development of new features or evolutionary maintenance;

A3: System replacement with no new feature or system migration;

A4: Existing product configuration.

For the second attribute two possible answers were used: generic scope software, including applications with common general characteristics and requirements, such as a CRM or ERP; and bespoke projects that represents specific scope software with unique features and functionalities derived from the business type, specific goals and context. The results of the application of these two dimensions are presented in Table 31.

Table 31. Results from Project Application Categorisation (the first two attributes)

	Application Categorisation		
	Software Development Type	**Applicability**	
A1	16	17	Generic
A2	4	16	Bespoke
A3	2		
A4	8		
Totals	30	33	

Source: the Author

The third dimension derived from the assumption that projects that deliver identical products could have similarities. Indeed, Youker said that "Each of these types of projects has more in common with other similar projects that produce the same type of product than with other types of projects" (Youker, 2002, p.2).

Although it may seem similar to the attribute of software development type, they are quite different. Whereas the software development type is concerned with the type of development that has to be carried out, this third dimension characterises the target area of the resulting product design, i.e. the destination area of the product. To sort these target areas the set of categories proposed by Crawford (2001) was adapted.

Note that this application area refers to the destination of the developed products and is not a way to characterise the client company sector. For example, a project may be implemented for a construction company, but the software developed may fall within the financial scope. Such a project would be classified as a producer of a software application for financial services, regardless of the company's sector. Table 32 shows how projects were classified into this dimension.

Table 32. Results from Project Application Categorisation (third attribute)

Project Product Application Area		
Services	Insurance	1
	Business Services	7
	Financial	9
	Health/Human/Social Services	5
	Total	25
Engineering and construction	Defence and Aerospace	2
	Total	2
Information and Telecommunications	Telecommunications	5
	Total	5
Total		32

Source: the Author

Contractual Items

Contractual Items is a new category created to classify aspects related to project contracts. In the initial list of attributes only one dimension was related to contract type and other dimension considers where (or by whom) the project was developed. However, during the interviews these two attributes were referred as being related to each other. Therefore we decided to join them in a new common category. Moreover, we notice that, for the set of projects described, whenever the project was said to be internally developed, there was no point in talking about the type of contract.

Extracted from interviews

"That was an internal development, by an internal team, which is why there was no acquisition contract" [JN01I0]

The contract type attribute was classified as being: fixed price contract, also known as closed project, to which is agreed a price and a deadline in the beginning of the project; time and materials contract, also known as incremental, that defines a pool of hours that are used as required.

Further analysis found that each of these types of contract are directly to the project type. Closed projects are the most referred contract type and it usually applies to a typical development of software. This contract type also includes the particular case of iterative projects, where payment is made in a phased manner according to agreed partial deliveries. Furthermore, there was one participant who argued that the type of project contract may be a cultural issue "*in Portugal, projects are always fixed price and we are not mature yet to adopt other models. There are some different experiences, but unfortunately still only a few*" [DZ12I2]. Therefore, it was not surprising to observe that the second type of contract was more commonly referred to maintenance projects, for instance.

The ‘where (or by whom) the projects are developed’ attribute was classified accordingly to the following criteria: externally, that is, at the client site or to an external client; or internally, referring internal developments. The initial set of criteria, obtained from the literature, also included projects developed by consultants. However, this criteria was not applied, as it falls outside the scope of the study.

Some exceptions were found of projects that did not fall within any of the given categories. Two projects were reported as special cases: internally developed ones, i.e. within the supply company's facilities, because the client sites were absence or unavailability. However, these projects are different from those classified as Internal, as their client continued to be an external client. On the other hand, they are also different from those classified as External, as, although these are for external clients, the project is developed without the client’ presence. To overcome these two cases, we created the criteria of "in house".

In summary, both original attributes were maintained, but they were grouped into the broader attribute of Contractual Items. In the classification, whenever a project was considered "internal", "not applicable" was written for the contract type attribute. It is worth mentioning that there was a project whose contract was initially established as fixed price, but due to a number of problems and setbacks, it was converted into a pool of an hour’s contract. Table 33 summarises the distribution of projects considering both ‘contract type’ and ‘where it was developed’.

Table 33. Results from Project Contractual Items

	Contractual Items		
	Contract Type	**Where it was developed**	
Fixed Price	26	2	External
Time and Materials	1	2	In-house
Not Applicable	7	7	Internal
Totals	34	11	

Source: the Author

Project Success

The project success cannot be considered to be an attribute to project characterisation. No questions were made to assess the success of the project, neither the factors that characterise the success of the project. However, some respondents felt the need to refer their perception of the project success. Three participants described more than one project considering their perception on project success "*the other [project] went well (…) but this one is not going so well*" [DZ12I3].

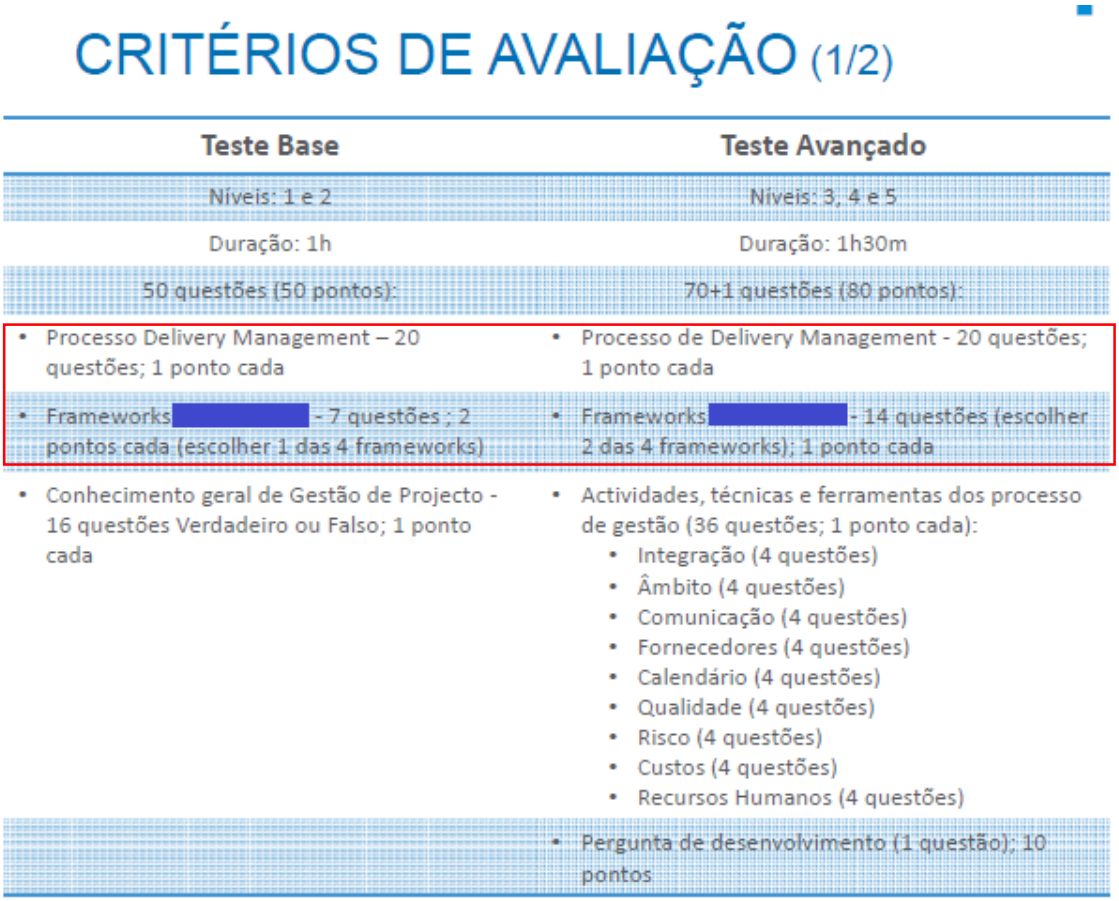
The reason for keeping this attribute is the expectation that it could allow a deeper understanding of some particularities of the projects, namely those aspects that may influence actions and behaviours of the project leader (at least for those who mentioned this issue). For instance, there was one participant who admitted to having delivered a project that was considered successful by external stakeholders, but when it came to considering the success in terms of the team and the achievement of internal targets it was a complete failure - *"We managed to meet the deadlines, but to do so we did damage our model"* [AG05I4]. The perception that someone has about the standards of project success, may eventually dictate actions in order to improve overall project performance and may impact on the type of leadership that is assumed.

Project Development Methodology

The Project Development Methodology classification aim to identify any formal or structured process used to guide the project development. Different project development methodologies are characterised essentially by variations in three main components: phases, procedures and deliverables that must be performed throughout the project, in order to better manage and guide the development. These variations are related with the sequence, control, and formality of the development process.

The use of a methodology can minimize the uncertainty regarding the process management and also allow to mark out project activities. Although this attribute has not been found in projects categorization literature, it may be indirectly related to other attributes, like uncertainty of processes, risk and complexity (see for example the reference to "process certain/uncertain" in the categorization system of Level of Certainty/Clarity proposed by Turner and Cochrane (1993).

The analysis of internal documents from some of the companies that participated in this study showed that the relationship between the methodology used and the project manager is often discrete. In companies that have a formalised methodology, the employees knowledge (and use) of that methodology is determinant for job promotion, namely to achieve the project manager position. See, for example, the following extract from an internal presentation on the individual evaluation criteria for job promotion, where more than 50% of the exam grade assigned to a manager candidate is directly linked to their knowledge and experience of the corporate methodology.



CRITÉRIOS DE AVALIAÇÃO (1/2)

Teste Base	Teste Avançado
Níveis: 1 e 2	Níveis: 3, 4 e 5
Duração: 1h	Duração: 1h30m
50 questões (50 pontos):	70+1 questões (80 pontos):
• Processo Delivery Management – 20 questões; 1 ponto cada	• Processo de Delivery Management - 20 questões; 1 ponto cada
• Frameworks [redacted] - 7 questões ; 2 pontos cada (escolher 1 das 4 frameworks)	• Frameworks [redacted] - 14 questões (escolher 2 das 4 frameworks); 1 ponto cada
• Conhecimento geral de Gestão de Projecto - 16 questões Verdadeiro ou Falso; 1 ponto cada	• Actividades, técnicas e ferramentas dos processo de gestão (36 questões; 1 ponto cada): • Integração (4 questões) • Âmbito (4 questões) • Comunicação (4 questões) • Fornecedores (4 questões) • Calendário (4 questões) • Qualidade (4 questões) • Risco (4 questões) • Custos (4 questões) • Recursos Humanos (4 questões)
	• Pergunta de desenvolvimento (1 questão): 10 pontos

"*The exam is eliminatory when the grade does not reach 50% overall, and 70% in the questions related to the process and the frameworks*"

However, the respondents' opinion about the relevance of the use of a methodology in the project was divergent. While some described the whole project process through a rigid and formal methodology, others gave them little relevance, particularly to certain types of projects. Those participants that reported methodology to be of little relevance also reported small projects, well-known business areas and situations where a close relationship exists between the client and the project manager (or the company). One of such cases is an IT company belonging to a major Corporate Group that works mainly for other companies within their group. Examples of both positions are illustrated in the following extracts.

Extracted from interviews:

"We have a defined methodology, and thus we apply it equally to all types of projects (...), we treat all projects in the same way, it is almost like a manufacturing line. No matter how different its characteristics or requirements are, or technology, technology platform, or business line" [AG05I3]

"For small projects, it does not make sense to have methodologies. You just need a Gant chart to control their development" [NV11I2]

Nevertheless, methodologies may influence the number and nature of activities that the project players must perform. This assumption was reinforce by respondents who reported that in certain circumstances, the methodology can give security to a project, minimising the risk that falls on the project manager.

Extracted from interviews:

"For larger projects it is necessary to have strong leadership and to be provided with all the existing methodologies (internal or external) needed to ensure the safety of the project." [NV11I3]

"That is why we have a set of structured processes to ensure that everyone executes them in the same way. (...). Organisations should not be relying on the specific characteristics of person x or y. Instead, they should employ people that are able to apply a methodology that has a proven success rates." [AG05I3]

The criteria to assess this attribute have emerged from the responses of the interviewees. Four types of methodologies were grouped. These types do not represent

any specific methodology, as suggested in the literature. Instead, they focus on the nature and sequence of the activities. Each criteria is described as follows:

1. Structured/Sequential: this criteria groups projects that had a sequential and structured methodology of development, with pre-established and rigid project life cycle phases. This includes projects that use the classical Waterfall Model, for example, or others with similar characteristics. "*from the prototyping phase towards (...) we finally took a bit of the Waterfall methodology*" [ST09I3], "*Yes, I mean, the traditional methodology: we carried out the requirements elicitation, we delivered it for client approval, ah, and then there is the functional analysis, is there not? And then, there are the development, testing, tests approval and production phases."* [NV11I3]
2. Structured by Iterations: whenever projects used a structured and sequential methodology, but considering several iterations of the process. Similar to that which has been described as the Revised Waterfall Model, or the Spiral Model -*"we will always have to carry out two or three iterations of the waterfall model."* [DZ12I2 #2]
3. Modular/Iterative/Incremental: this criteria includes projects that were developed using Agile or Modular methodologies. The project development was performed as time progresses and the previous modules are finalised and mature.*" the system is developed by modules "* [ST09I4]; *" we had to implement a very agile process here (...) we made a development and analysis that was also focussed in sprints, which is absolutely not normal "* [OU10I2]
4. None/Ad hoc: this criteria groups all projects that were developed without following any methodology. The work and activities were carried out as they emerge, and as it were found relevant. They are also named as ad-hoc, without any formality or predefined sequence. "*(Any methodology? Not specifically, no, no"* [ST08I2 #1]; *"Not all the steps are followed, ah, there are steps that are binned, for obvious cost reasons ..."* [JL02I1]

The summarised results of project distribution that consider the set of criteria described above are shown in Table 34 - the project classifications, considering the set of criteria described above. Eight projects were not classified according to their methodology, on account of their comparative purpose.

Table 34. Results from Project Development Methodology

Type of Methodology	
1 - Structured/Sequential	13
2 - Structured by Iterations	6
3 - Modular/Iterative/Incremental	5
4 - None/Ad-hoc	6
Total	30

Source: the Author

A final note mentions Project Purpose. This attribute contains a brief description (synthetized) of each project in terms of its objectives, main activities and limitations. Due to the uniqueness of each project, this attribute was not categorised. We do not intended to create groups of projects for this attribute. Instead, we intended to use it to eventually further explain the final results.

Clients

The attribute Client has emerged from the data analysis. Client characterisation was not part of the initial list of attributes. Only the application area of projects was slightly related to client issues. However, respondents have frequently cited client related aspects to define and characterise their projects. The main cited areas include: client industry sector, client type and the existence of a previous relationship with the client. These attributes are not new to the literature. Authors like Turner, J., Hobbs, J. and Crawford, L. previously included attributes related to clients in their project categorization systems: customer-supplier relationship (Crawford et al., 2005) and industry sector of organisation (Crawford, 2005).

The client industry sector defines the business sector to which the client company belongs. The criteria to classify projects into this dimension follows the set of categories proposed by Crawford (2001). However, an adjustment was made for public agencies, although these could be classified into the services category, due to their main activities, so we decided to create a new criterion. This decision emerged from the interviews' references to the specificities of projects of this type (see examples below). The first column of Table 35 shows the resulting classification of projects into this dimension.

Extracted from the interviews:

"*There is a difference between working for clients from public sector vs private sector*" [NV11I1].

"I have carried out many projects for public institutions, you know ... they have many differences" [ST08I3].

Client type refers to whether the client company belongs to the public or private sector. The results of this dimension may overlap those of the client industry sector. The reason for this is to highlight the relevance of this attribute, according to the respondents' references.

Furthermore, the literature suggests that there eventually may be differences in the final results of this study, due to this dimension. For instance, Muller and Turner (2007) have used a similar attribute, which is named the Industry Sector, as part of their independent variables for assessing project managers on project success by project types. On the other hand, Bourantas and Papalexandris (1993) conducted a study where they found differences between the leadership of public and private organisations. Both studies reinforce the existence of a separate dimension. The second column of Table 35 shows how projects were distributed according to client type.

Finally, the 'pre-existing relationship with the client' dimension identifies whether the client is a new one for the organisation/department, or whether there were/are other projects for the same client. The criteria for assessment could show dichotomy. However, we considered internal projects to be an exception, as they may have some specificities and thus we decided to distinguish them from the rest. The results of project classification into this dimension are shown in the last column of Table 35.

It is worth mentioning that only 16 projects were classified. No information was given for the remaining ones, maybe because this dimension was not perceived as being a relevant aspect of the project.

Extract from Interview

*"*Because it is even worse for an internal project, we also have the same problems…" [JL04I1]

Table 35. Results from Client Categorisation.

Client Industry Sector		Client Type		Pre-existing Relationship	
Services	14	Private	26	Internal	3
Information and Telecommunications	5	Public	6	Existing Relationship	8
Engineering and construction	9			No Existing Relationship	5
Public	6				
Totals	34		34		16

Source: the Author

Teams

During the interviews most of the respondents made at least one reference to classify the project team. Some of these were concerned with the project dimension attribute: "*it is a big project, I think it was a big project (…) it was big due to the number of people, or the number of units that we had to put in to it*" [OU10I3], "*In terms of dimension, in terms of the team (…) whilst considering the dimension of teams*" [DZ12I2]

Unlike most of the attributes described so far, the use of the team attribute to characterise projects has not been very common in the literature. The exception may be the geographic location of teams, which is also called: Number of sites (Evaristo and van

Fenema, 1999), Geographic distribution (Crawford, 2001), or Geographic location (Turner, 2000).

In contrast, the characterisation of teams is commonly found in studies about project management and leadership (Dvir et al., 1998; Burke et al., 2006; Scott-Young and Samson, 2008). For instance, the characteristics of teams has been used to clarify some behaviours when it comes to leadership (Burke et al., 2006). Mehra et al (2006) argued that teams may have different types of internal leadership due to their size, since, as "team size increases, interpersonal coordination becomes more difficult, and the likelihood that the team will fracture into coalitions tends to increase" (p. 242). Following the same reasoning, it would be expected that team size could explain further topics on leadership. Thus, we found it relevant to include attributes to characterise the projects teams.

References made by respondents also considered the participants' roles within the team: "*in the requirements there were two people, where I played the senior, as well as the project manager's role. Then, during the development phase, we had one full time person, two part time people, depending on the component that we were building (...) and then also in the tests and deployment phase, because there was a high workload, with three to four people carrying out the testing*" [ST08I3].

The literature suggests that team members' roles can define project team structure, which is related to teams' effectiveness, task productivity and thus, project success (Dvir et al., 1998; Zaccaro et al., 2002; Lui and Chan, 2008; Scott-Young and Samson, 2008; Patanakul et al., 2012). In the context of this study, knowing how the team is organised and what roles its leaders take may help us to understand some phenomena related to leadership, as was also suggested by other authors (Stewart and Barrick, 2000; Anantatmula, 2010; Patanakul et al., 2012).

Considering both theory and the evidence from the interviews, we decided to add an attribute which is related to teams in the project characterisation chart. The teams attribute includes three dimensions, following the rational described above: team size; team roles; and geographic location of teams. Each of these is summarised below:

- Team size: represents the number of people involved in the whole project. This dimension uses the classification criteria of www.pmcompetence.com

(Crawford, 2005), as this showed the representative and uniform distribution pattern of the described teams.

- Roles and Responsibilities: this dimension was qualitatively filled with excerpts from interviews. Each excerpt highlights the roles and responsibilities assumed in the projects, including the role of the leader who is being interviewed. No summary table is provided, due to the diversity and uniqueness of the results for each project case. Instead, this data is used for the topics of leadership, to help to clarify some possible behaviours or responses. Nevertheless, some examples are given in the second column of Table 36.
- Geographic Location: classify projects according to the geographic dispersion of teams. Dispersion refers to at least one team participant in a distinct site. The criteria for classification distinguishes between international and domestic projects (projects developed in the company's premises, in the original country). Furthermore, the former criterion also distinguishes from projects performed in one city, within the same city boundary (Crawford, 2001), and national, which represents projects carried out beyond the original city, but not outside the country.

Table 36 shows the summary results for the classification of projects into team size and the geographic location of teams. Additionally, some examples are given of the Roles and Responsibilities dimension.

Table 36. Results from Teams Classification

Team Size		**Roles and Responsibilities: Examples**	**Geographic location of teams**	
1-4	6	"My role here was essentially to organise, to know what had to be done, to schedule things with the client and also to ensure the availability of our team for those milestones (…) in all our projects, we have the role of Project Manager, who deals with the interaction with the client, the management and the organization. Basically, they are the maximum responsible for the project, before the sponsor, and then we have another role, which is that of technical manager."[DZ12I4 #1]	3	International
5-15	8		2	National
>15	5		33	One city

(Table continued)

	"there is myself, but I'm not involved full time (…) my position is actually to, ah, I head up the quality management pronounces services division" [ST08I2]	

Source: the Author

4.2.2 Project Types Inadequacy

One of the possible usages of project characterisation systems is to create typologies of projects to help identify and assign skills and practices to the appropriate type of project. For this research study, this would allow us to identify the leadership competencies necessary for each project type. However, throughout the literature review and data analysis we notice that the number of attributes that can be used in this characterisation can be large. Crawford et al. (2005) developed an extensive list of project attributes, which were grouped into fourteen main areas for synthesis. The authors realised that, despite their list of attributes, that they could not find a standard way to categorise projects. Thus, they suggested that researchers and practitioners use a subset of that list that better fits their own objective.

Furthermore, the literature on project categorisation systems tends to be very focussed on the nature of the research study and what works well for that particular purpose, which may not serve in a different context. Those typologies proposed tend to use a reduced number of attributes centring on just some of the project characteristics that are not necessarily the most determinant when explaining this phenomenon (Youker, 2002; Shenhar and Dvir, 2007). Indeed, some are chosen based on suppositions or personal guesses (Muller and Turner, 2007).

In this study, we arrived on a set of ten main attributes, defined through twenty five dimensions. The high number and diversity of characteristics emerged from the initial prerequisite to consider projects with different characteristics. Such diversity gives richness to the sample and context, although it naturally inhibits typologies. Creswell (2003) also suggests that this kind of sampling strategy augments case diversity, saying "I prefer to select unusual cases in collective case studies and to employ maximum

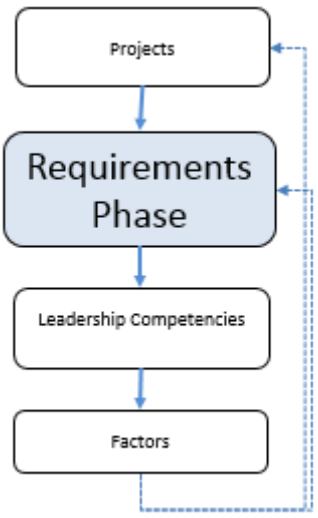
variations as a sampling strategy to represent diverse cases and to fully describe multiple perspectives" (p. 129).

The reduction of the set of attributes, or the consideration of certain attributes over the others can *a priori* restrict, or even hide, interesting learnings about the phenomenon. In the same way, only considering the attributes that are most commonly used in the literature can be useful for analysis, but does not allow for the portrayal of the diversity of projects involved.

Thus, we reject the project typologies at this stage of the analysis. This approach was also followed by Muller and Turner (2007), who selected a set of six project attributes to assess the significance of leadership skills through variations in each of these attributes. We expect that patterns, or any highlighted characteristic may emerged naturally from the analysis of leadership competencies. Furthermore, the topics related to factors influencing the set of leadership competencies may return to this topic, exploring the most relevant attributes of project characterisation.

Since we already have a deeper understanding of the projects under study, the next logical step follows the rational of Figure 9, which is to detail the project phase that we are actually interested in. Therefore, in the next section we are going to discuss topics related to the requirements phase, namely its nature, process and relevant characteristics. A model for the requirements phase classification is also suggested.

4.3 Requirements Phase Analysis



After the project characterisation, the next step of the analysis is the study of the requirements phase (see Figure 9). As discussed in the literature review, the requirements phase is one of the early phases of the project development life cycle. In this phase, activities are performed in order to identify and document the purpose of a software system (Nuseibeh and Easterbrook, 2000 2000; Rehman et al., 2013).

Guided by the literature, we were expecting a reasonably stable set of activities in this phase. At most, these activities would eventually differ in terms of the extension, order and depth with which each activity should be performed. Nuseibeh and Easterbrook (2000) have also suggested that some variations could exist regarding the methods and techniques used in this phase.

Surprisingly, during the data analysis we found the existence of some patterns for the way that respondents described their requirements phases. Most of the responses showed the use of several dimensions to assess and classify this phase, namely the activities and events that were performed.

When reviewing the literature, we found that much research has been carried out to identify the right methods and approaches to elicit, analyse, validate, document, communicate, reuse, and to trace requirements through the project life cycle (Ramesh, 1998; Martin et al., 2002; Hadar et al., 2014). However, scarce references were made to the requirements phase classification, and those who did so, did not follow any formalised framework (Melchisedech, 1998). To the best of our knowledge, no framework for requirements phase classification has yet been suggested in the literature.

Therefore, we collected the set of attributes reported by respondents during their descriptions. This set of attributes was compared with the existing literature and, as a result, a model for the requirements phase classification was suggested. The establishment of a standardised set of attributes can allow for the characterization of the

requirements phase of a project, as this has already been done in other areas, such as projects categorisation, to allow for comparisons.

However, going into the model's details without previously presenting some basic topics about requirements would be unproductive. Thus, in the first part of this section, we introduce some basic concepts related to requirements, through the eyes of the interviewees. We start with the requirements nature, which includes the perception of participants about the requirements definition, types and goals. We also explore the requirements phase as a process, which is made by a sequence of activities.

Next, we focus on two aspects of the requirements phase that received special attention during the interviews: volatility and critical success factors. These two topics represent most of the concerns that practitioners addressed about this phase of the project life cycle. Therefore, we took a little longer to discuss this issues and to analyse them along the existing literature. Although these might seem a little out of the scope of this study, we believe that exploring the main concerns of participants on this phase and their strategies to overcome them, may help to explain their attitude and behaviour.

4.3.1 Requirements Nature

There is plenty of literature defining requirements, describing the relevance and criticality of the requirements phase and activities within a software development project (see for instance (Chatzoglou, 1997; The Standish Group International, 2004; Aurum and Wohlin, 2005; Fernández et al., 2012b)). Although the main literature focusses on trends that have been continuing changing and evolving at least over the last three decades, topics on requirements are still regarded to be hot topics. However, knowledge of the extensive literature does not always explain what actually happens in practice. It is very important to understand how practitioners perceive requirements and how they feel about the activities and practices that they commonly perform. It is also interesting to identify the degree to which practitioners have knowledge about the best practices and tools currently suggested, and which they actually implement.

Empirical research is important for the requirements engineering (RE) field, as the results of such studies help to characterise the potential problems of this field (with regards to requirements at the business, product and project levels) and to evaluate new techniques within a relevant context. Empirical research provides valuable insight into

the aspects of requirements engineering. Furthermore, both academics and software practitioners need supporting evidence from case studies, field studies and experiments before adopting new technologies (Aurum and Wohlin, 2005).

Thus, understanding the nature, definition, types of requirements and what is expected at this stage from the participants' point of view, this can not only helps mark out the answers from all interviews, but also helps to understand their attitude to this stage. Often one person may perceive something as a difficulty, whereas another sees it just as an opportunity, or something that is normal. These different perceptions can justify different expectations, due to phase results and eventually lead to different behaviours and attitudes.

At first glance, it is useful to establish a common understanding about the requirement definition. Generally, participants seem to be quite aligned with each other according to their own requirements definition, and also the main definitions presented in the literature (see for instance (Aurum and Wohlin, 2005; Pressman, 2005; Fernández et al., 2012b)). Requirements were said to "*clearly define what the software must do*" [ST09I1 #1], and "*what the system should respond to users to meet those needs that are specified in the Specification Document*" [JL04I1 #G]. For a more complete explanation of what requirements are, one participant affirmed that they are something made by analysts. Clients do not have requirements, instead, they are always transmitting their needs, and therefore those responsible for the requirements' activities should be aware of it, and should convert those needs into system requirements [DZ12I2 #G]. The literature adds that requirements are the "real-world goals" that represent the "what" and "why" of the development of new software systems (Nuseibeh and Easterbrook, 2000).

It has been a common practice in both academy and industry, to address requirements issues by considering their type: functional and non-functional, for instance (Pressman, 2005). Many participants of this study referred to clear differences between the requirements types, describing different practices according to each type. Some of the mentioned types are company-specific, whilst others are more close to the general literature. For instance, one of the participants divided requirements into client requirements and features. The first type directly comes from clients and needs greater discussion and validity, whereas the second type is more technical and internal [ST09I1]. However, most of the references typically split requirements into non-functional and

functional types, and then into solution, domain, and architecture requirements, when more detail is needed.

The definition of requirements is most of the times associated with a process: the requirements process, which is also commonly known as requirements engineering (Aurum and Wohlin, 2005). The process itself represents the way a desired output can be achieved from the initial input. In this context, it describes the process of discovering the purpose of the new software system, by identifying stakeholder's needs, and then documents those needs into a specification that can be used to communicate, analyse, and implement the system (Nuseibeh and Easterbrook, 2000; Fernández et al., 2012b).

Most respondents also referred to requirements as being a process, including their main objectives. While some explicitly included the process in the definition, others made an implicit association, responding as if it was all the same *"[requirements] is where the project scope is established*" [AG05I1].

The requirements phase activities should have as their ultimate goal the alignment of stakeholders' expectations about what was sold. Frequently, different people have different perspectives about what is needed, and what the system will be. This may lead to diverging expectations about the new system that has to be managed, so that the final result can be approved. In line with this perception, participants reported that this phase should identify the real functional clients' needs, and that it should transform those needs into something implementable and manageable [ST09I3; ST09I4; NV10I4; DZ12I2].

From the data analysis, a list of sixteen main goals emerged. Respondents mentioned that this phase is especially important to clearly define and control what has to be implemented through the following phases of the project life cycle. They also stressed the importance to continue guaranteeing the alignment of stakeholders' needs with the final product, as a way to achieve project success. The extensive list of this phase's main goals is presented in Table 37. The table also provides the number of interviews that mentioned each goal, rather than the number of times each goal was mentioned, i.e. it does not reflect intensity. For each goal the table provides an example of the evidence extracted from one of the interviews that mentioned it.

It is worth mentioning that two other goals were eliminated from the list, because they did not really express goals, but rather the motivations and consequences of the

phase: “problem resolution becomes difficult/costly as a project progresses”, and “project rejection due to client dissatisfaction”. The first goal was mentioned in four interviews, and it actually highlights the need and importance of this phase. The second was described by two participants to justify that this phase is critical for identifying the real needs of the client. Both topics were considered to be better discussed during the requirements phase.

Table 37. List of Requirements Phase Main Goals

Phase Goal	Frequency	Example from Interviews
To form the basis for all the following project activities	16	“We should make a knowledge engineering process to extract information from the client, to be able to model this information in a structured way which will allow us to perform design phase activities, that will then support implementation activities” [ST09I3]
As a tool to define and control project scope	12	“There is a need for assessment to define the scope of the project [AG05I4 #1]”
To define what the system should do	12	“Is one of the most important phases, as it defines exactly what the software must do, and from that it also derives the whole traceability from testing and the implementation” [ST09I4]
As a way to ensure project success (or at least a large part of it)	12	"I think that the requirements phase is the most important [phase], because I think that is where you decide the success or failure of a project” [NV10I5]
To align stakeholders’ expectations	7	“Often we sell a product and the person who is selling has their own idea about the project, whilst who is buying the project has another idea, and then the requirements phase should consolidate it, if what was sold is aligned with that which has been though” [ST09I1 #1]
As a way to estimate the costs/efforts needed, and the viability and impact of the solution proposed to the client	4	“This phase is a critical one (...) As it allows the customer to have an estimation of what could be the effort, in terms of cost, of the activity that they want to be implemented, as well as how to know soon if it is viable, and the impact that it may have on the rest of the system” [AG05I2]
To identify/extract client needs	2	“We have to be, the project manager and their analysts team, if any, they have to be always prepared during any moment of contact with the client, as they may be letting us know their needs” [DZ12I2 #G]

(Table continued)

Phase Goal	Frequency	Example from Interviews
To control project budget and calendar	2	"It allows us to define how many people need to be involved, the price, what the customer wants, the schedule, etc. This is also very important in the case of client team rotation." [NV11I1]
To form the basis of project traceability	2	"Defines exactly what the software must do, and from that it also derives all project traceability" [ST09I4]
As a way to protect suppliers from requirement changes	2	"The requirements phase is very important, as well as the post proposal and the phase before the proposal. IT is the company's last safeguard" [NV11I1]
As a guide to talk to the client	2	"We have a meeting with them [the client] to talk about general terms, using the functional analysis as a guide to conduct the meeting. Then if they approve the job or that solution, then we have a free pass to start making the organic analysis and to start talking about the actual costs" [AG05I6]
As a way to reduce implementation problems	2	"Defines everything the system does, and is also a way to close the scope " [ST09I1]
To ensure that the project will satisfy client needs	2	"Initially we are interested in absorbing the client abstract functional requirements, because this is what will meet client needs." [ST09I3]
To document client information	1	"(Requirement elicitation) You know, you can document information for the client: "This is what you actually have, how it actually works, and this is what you are asking." [NV11I3]
As a way to learn about the business area of the client	1	"The requirements gathering where the business knowledge is little, the terms we do not know ... we should not be embarrassed to ask" [NV11I2]
Where we understand client nature and team nature, and establish a way to work	1	"To realise how far can I go with the team that were gave me, or that I requested, or that I chose, and finally, there is, versus the funds that have, as far as I can play, one thing after another" [DZ12 I2]

Source: the Author

Close to requirements definition comes requirements nature. Requirements nature stands for those aspects that prove to be intrinsic to the requirement activities. Most of them were initially found to be problems affecting the requirement phase, but they have evolved to be considered to be characteristics that are inherent to requirements activities.

In this context, two particular requirement characteristics were highlighted during the interviews: volatility and process progression. We ascertain from the literature review that volatility stands for the requirements change rate along the project process

(Nurmuliani et al., 2004). It seems that practitioners have understood that requirements naturally include these two characteristics (although they are not always desirable, for the most part). Requirements as a tight phase has become less accepted. Even when considering some outputs that are required at this stage (which will be discussed later on), the perception is that some of the requirements are going to change, evolve, or mature over the project, which seems to be, for the most, well accepted. Examples of such evidence are shown in Table 38.

Table 38. Evidence of Requirements Nature from the interviews

Interview Code	Evidence excerpt
DZ12I2 #G	The requirements elicitation activities never end in a project.
JL03I1 #1	The requirements phase is an ongoing process though all the project, because the requirements phase does not necessarily begin and end at the beginning of a project.
DZ12I2 #G	Requirements Elicitation is something that is intrinsic to the entire project.
ST09I1 #1	No matter how good the requirements are, they will never be closed, i.e. finished.

Source: the Author

The ideal project was reported to be one "*where we could identify all the requirements in the requirements phase, and where we could define with the client that "These requirements are out of scope, so we will make a change request for them". And all the project phases should be more sealed: "these are the requirements that we are going to be implement and then the tests will only be about these requirements that were initially defined*" [NV10I5]. Such a description is similar to which was discussed in the requirements literature some years ago about the requirements process and the best practices for performing requirements engineering (Pressman, 2005). However, nowadays, such a project is considered to be a utopia that may create unrealistic expectations for managers: "*it is impossible to satisfy all the requirements for a unique project (...) There is no project, there is no project in the world that will ever have 100% of the requirements correct at the beginning and that will be implemented at the end. It is just…it is a utopia project, I guess. In my opinion, I have been working in this industry for quite a while now, and that doesn't exist, utopias do not exist*" [ST08I2].

Requirements activities being an ongoing process through all the project life cycle is quite a recent concept. It was presented along with less-structured methodologies, such as Agile and RUP, which both consider revisiting requirements activities through all the project life cycle.

What has been discussed so far shows a different position regarding these issues from those that were earlier perceived to be problems. Their acceptance is something normal, which would make us expect that practitioners were more aware to be able to face and address these issues. However, problems affecting the success of this phase are continuing to be reported, and apparently no special practices are carried out to face them. These topics are going to be further discussed in the next subsection.

To conclude, we present a particular analogy which was described by one interviewee as not only being explicit to the requirement's phase nature when compared to a common state in everybody's life, but that it also summarises some of the difficulties expressed by practitioners and researchers:

"This phase is like a dating, isn't it? As in any relationship, there are times when everything seems easy and rosy, but then the first clash appears, and then the first issues, and then the first anger, OK? That's exactly the same. So this is the phase where I realise if this is a relationship that will endure, or whether it is just a sporadic relationship: it has come to pass that they adjudicated a project, but that they will certainly no longer award anymore" [DZ12I2 #G]

4.3.2 Requirements Volatility

Historically, requirements volatility has been identified as being one of the most troublesome characteristic of requirements. It often comes together with uncertainty and the need to handle contexts often too abstract (Nasir and Sahibuddin, 2011). However, this feature has also been referred to as a normal characteristic of requirements. Practitioners are now more awake to the issues related to volatility, but surprisingly they continue to report scope definition problems and a high level of requirement changes as being critical and as being a major obstacle to achieving success.

Extracted from the interviews:

> "All projects are usually sold for a closed price, which means that they have a requirements elicitation phase with a specific duration, where we account that the system will have more or less x screens, with x something else, and with x more of other things, that more or less agree ... and then we implement the systems, and then we execute the battery of tests. Ah, it was, of course, the ultimate goal to arrive at that requirements document, with the set of things to be done, and to perceive how wrong we were at the proposal stage" [DZ12I2].

The relevance of volatility to this particular study relates mainly to the implications that it can bring to a project. If the requirements change rate is high, it possibly increases the need for additional strategies and for further negotiation activities. On the other hand, the position each player assumes towards this phenomenon may influence the formality of the activities performed and the detail level of their outputs. Consequently, it may even influence the way that a project manager performs during this phase. Does it also affect the way leadership is carried out? This is a question that naturally arises. We cannot answer it yet, but we do think that it makes sense to try to better understand those aspects or circumstances that lead to such volatility classification and their possible implications.

During the interviews, respondents made several comments about their own position when facing volatility. The data were then analysed, and two different perceptions about volatility were raised:

A. Volatility as the natural process of requirements evolution
B. Volatility as a fault indicator of the requirements phase

Figure 18. Distribution of volatility positions by study participants

	A - Volatility as the natural process of requirement evolution	**B** - Volatility as a fault indicator of the requirements phase	**C** - Both
N	10	9	12

Source: the Author

Participants were then distributed according to their own perspective (see Figure 18). Note that this was not an exclusive classification, i.e. not all participants characterised their position facing volatility as only being of type A or B. Some participants also reported cases where volatility is normal (and desirable), and cases that changes to the requirements and scope can be seen as flaws in the process. This latter case was classified as C in Figure 18.

The analysis of data gathered from the interviews goes beyond the perception that each respondent has towards volatility. It was followed by an effort to find the reasons that support each perception and the strategies that are most commonly performed. Many participants believe that a requirement can mature, evolve and are to be improved over time. Twenty two interviews showed evidence corroborating this position, characterising volatility as part of the natural process of maturation and knowledge acquisition, i.e. as an inherent characteristic of the requirements. To illustrate this position, a respondent said that "*we never have closed requirements ... even if the requirements are very good, they will never be closed*." [ST09I1].

However, only three participants believe that changes to requirements never affect the success of this phase, all assuming the A volatility position. One of them said that when a client feels comfortable and sees in the requirements document that they really are demanding, then this phase can be considered to be successful. Even if they come to the conclusion that after all there are aspects of the system that they would like to change, and that this was caused by the natural maturation of the knowledge about the system and not by any restrictions of the phase, i.e., even if the phase had had more time to be performed, the results would probably have been the same [ST09I2]. Nevertheless, most of the participants held a mixed position, assuming that at least under certain conditions, changes can indeed affect the success of the requirement phase [for instance, ST09I1; ST09I3; ST09I4; NV10I5; DZ12I4]

One of the main differences found in the way volatility is perceived is the nature of requirements change. If the change is reported by a client as a "Change Request", this is because the client really understands that what they are asking for is a change from what was initially agreed, i.e. it is assumed to be different. Apparently, a client that is able to understand what they seek as a change, is a client that has understood what was initially

proposed and agreed. Thus, the initial activities of the requirements phase were deemed successful, since it was able to transmit to the client the system to be implemented.

Extracted from the interviews:

> "When there are failures in the analysis, they do not turn into change requests. A change request is something that is assumed to be new by both parties. When it happens, it cannot be considered to be a quality indicator of the success of this phase" [NV10I4]

A different situation is when change is seen to go beyond the content of the requirements' document, or when there is a divergence of understanding among the parties. These are often associated with omissions and errors that have elapsed from the requirements activities [JL04I1]. The required changes can affect the success of a project, as they often give rise to conflicts and costly situations which have a significant impact on the project [ST09I3].

Extracted from the interviews:

> "If the client is assuming that it is a change request, then what we described in the requirements phase regarding the requirements we gathered and discussed, and that which was written, was clear to the client, and later on they found that it was not what they really wanted and therefore it needed to be changed. (…) If there is not a change request (...), then we have to make a requirement change, but the client does not assume that as a change, then yes! Then yes, I think something failed during the requirements phase" [DZ12I4]

> "If we start to have change requests during the implementation, or during the testing phase, or if someone makes change requests during the testing phase, then one of the two things may be happening: either they are emerging needs and so far so good; or there were some flaws in the requirements phase. That is because whoever gathered the requirements did not detail them as they should have, and also because whoever was supposed to point out the requirements, did not remember to mention them" [NV10I5].

Further analysis found that the reasons that may be at the root of these problems can have originated from the client, the seller, or both. In fact, the reasons are diverse, and

can also be external (e.g. an amendment of the law), or internal (such as knowledge acquisition about the business context through the project activities). The list of the mentioned reasons was explored, classified and then organised into seven categories:

1 – Requirements Changes do not affect the phase success;

2 – The client felt comfortable with the requirements document;

3 – Requirements Changes affect the success of the phase;

4 – Requirements Changes were caused by errors/supplier failures;

5 – Requirements Changes were caused by inadequate outputs;

6 – Requirements Changes were caused by the lack of understanding of requirements activities outputs; lack of involvement by client and/or end-users;

7 – The client did not approve the requirements document.

The above categories are closely aligned with those presented in the literature. The literature provides evidence that incomplete or ambiguous requirements enhance the presence of deep changes later on in the project, or even raise new requirements. There are other influencing factors, such as the level of customers' and users' involvement in the process of knowledge acquisition; the use of the appropriate techniques and methodologies for the project, and the project manager's ability to efficiently perform requirements management. Furthermore, the type of project seems to influence the degree of requirement volatility (Verner et al., 2006).

Looking at the list of the causes of volatility, we would expect that the first two categories would be presented mainly (or exclusively) when position A was assumed, while the remaining five would prefer position B. This assumption was suggested by some of the interviews who argued that "*what can make the success or failure of a project has to do partly with the approach that we have to this particular issue, that is the possibility of the client transmitting new needs at any time*" [DZ12I2].

Therefore, we made a two entry table to cross the relationship of each of these causes, according to each volatility position. The results can be found in Table 39 (the output was modified from SPSS software, to simplify its appearance and to make it easier to analyse). Surprisingly, the variety and conditionality of responses did not show any relevant

presence in such categories with the expecting volatility positions. The possible exception might be the references to Category 1 and Category 3, with most answers falling in the expected volatility position (A and B, respectively).

Table 39. Categories to support each volatility position

	A – Volatility as the natural process of requirement evolution	**B** -Volatility as a fault indicator of the requirements phase	**C** - Both	**Total**
1 - Requirement Changes do not affect the phase success	3			3
2 - The customer felt comfortable with the requirements document	1	2	4	7
3 - Requirement Changes affect the phase success	1	9	11	21
4 - Requirement Changes were caused by errors / supplier failures	3	7	9	19
5 - Requirement Changes were caused by inadequate outputs	1	5	4	10
6 - Requirement Changes were caused by the lack of understanding of requirement activities outputs; lack in the involvement of client and/or end-users	7	7	10	24
7 - The client did not approve the requirements document	1	2	1	4

Source: Modified from the Output of SPSS

Commenting on the results, it was interesting to find that the most referred cause relates to problems that come from clients. Moreover, this category has a balance presence across different volatilities positions, which may indicate that this is a frequent problem that affects the activities of this phase, regardless of how one sees or manages it.

Client-side failures are mainly related to little client engagement during the activities of requirements gathering, which not only means the presence of a lack of willingness to participate in the activities, but also the omission of potential relevant information to build the system. One example that illustrates this category is shown below, as extracted from the interview:

"I think that it can be used as an indicator of the attention that the client paid to the requirements gathering, is it not? Why, why did they only remembered it afterwards? That is the question, is it not? Perhaps if they had given this sufficient importance, or if they had paid enough attention to these things at the right moment, then maybe they would have remembered that and would have had an answer about it." [NV10I6].

Additionally, problems of understanding, or even the ability to read the outputs of the requirements activities were also reported: *"The document was approved, but truly I believe that it was not ... that there were people who did not understand, or who did not dedicated sufficient time to realise what was being proposed"* [NV10I5].

Nevertheless, the reasons that affect requirements documents may also be caused by suppliers who were unable to produce the appropriate outputs, both in terms of quantity and quality: "*All that effort gets lost with the delivery of a 400-page document that no one will ever read*" [OU10I2].

The second most referred to category was requirements changes caused by suppliers. But does the difference between Category 4 and 6 represent an excessive blame to clients? Are the expectations for what is expected from the client and their own understanding of need to participate properly aligned -or are there any causes assigned to the clients that should be, at least partly, treated with caution by the supplier team?

The relative high number of references to inadequate outputs as a potential cause for changes to requirements could somehow justify the lack of their understanding by the clients. This could also discourage the involvement of clients in further activities, perhaps assuming that they might not have the necessary skills to accomplish them and to be useful in the process. However, such a causal relationship is not possible to ascertain with the kind of data collected in this study, neither is it the main objective. Nevertheless, such issues may be relevant for avenues of future research.

To conclude, another referred difficulty that may lead to changes in the requirements caused by the supplier team, is the lack of initial knowledge about the client's business rules. One of the consequences of this problem could be the establishment of inadequate estimations.

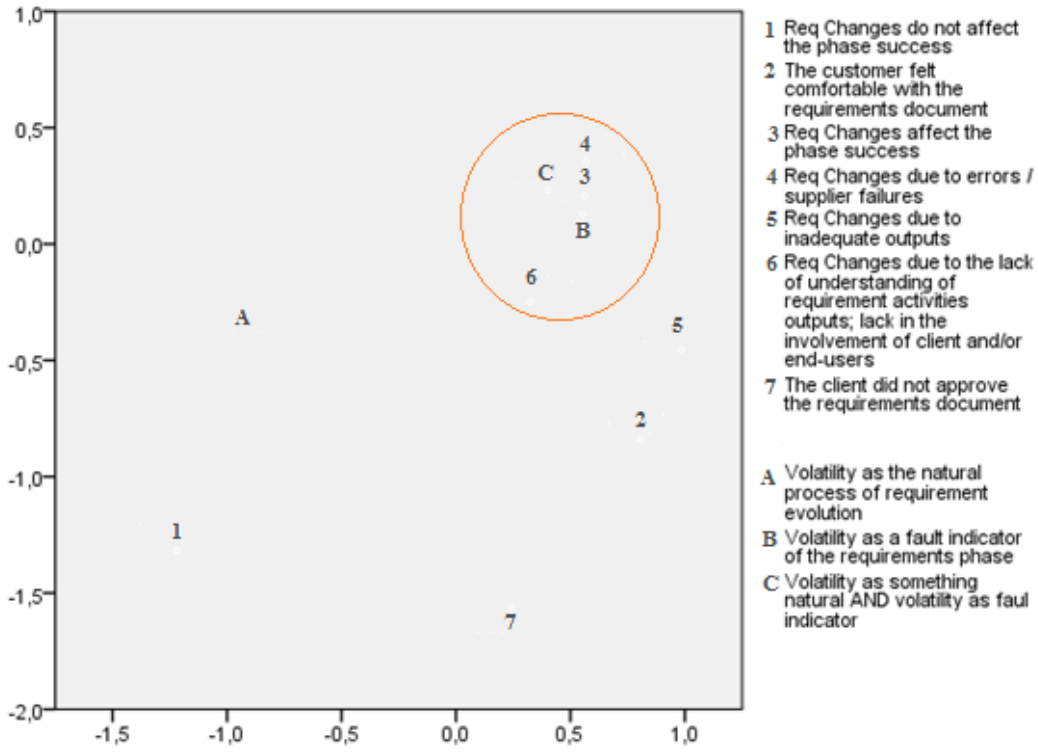
Extracted from the interviews:

> "It often happens, for example, when the team ... it often happens here - we have to go on consulting clients when sometimes we do not know their business and we go with an open heart and we have to go because that is how it works, quotation marks, and ... then after two or three months, we already know more and we also realise that if we had had the knowledge at the beginning, then we would have done better, for example. There are other situations where the fault lies with the client, but sometimes there are ... and ... it is very difficult to make a good analysis, that is the most difficult thing, from my point of view, the most difficult thing to do" [NV10I4].

Further to this analysis, we made a multiple correspondence analysis, which is represented in graphical form in Figure 19. This figure shows how the various categories can be related to volatility positions, through the graphical proximity.

The first observable conclusion is the distance between Category 1 and the A volatility position. This reinforces what has already been suggested, that no strong relationship can be concluded from this assumption and from the position assumed by the participants. Moreover, the graph shows a more filled spot near the volatility positions B and C. We found that Category 3 is near both the B and C stances, which makes sense, as these two positions assume that changes to requirements may indicate faults during this stage, at least under certain conditions, that probably may affect the classification of the phase's success.

Figure 19. Graphical Representation of Multiple Correspondents Analysis



Source: Output adapted from the SPSS

We also found that Category 6 is closer to the B position, whilst Category 4 is closer to the C position. This may suggest that individuals that assume the B position face volatility, have associated more often changes to errors from the client's side, whilst those with a C position tend to be more self-critical. The remaining categories had little compliance, which did not allow for drawing relevant conclusions.

Following this analysis, another interesting topic emerged during the interviews: participants found it relevant to report how they deal with volatility, i.e. the strategies that they apply. While some assumed volatility to be a project risk that requires the execution of a containment plan, others perceived this situation to be an opportunity to leverage continuing work and thus increase revenue from the project. However, the former case assumes that there is a common understanding from both parties to such an addition, which does not always happen in practice [ST08I1].

Reported strategies were organised into ten practices used to manage the volatility:

a- Apply incremental methodologies, with small releases

b - Leave some room in the project schedule to allow flexibility for requirements management

c - Consider the requirements document as a guide, and not as a contractual artefact

d - Consider the requirements document as a contractual safeguard

e - Generate Change Requests

f - Create contractual addenda

g - Generate new projects (future developments)

h – Use prioritisation techniques for requirements

i - Organise steering committees and frequent validation sessions

j - Absorb the impact of changes

Although some have been presented together, the aim is not to find any dependency or causal relationship between them. Instead, we want to understand whether any particular strategy (or group of strategies) is commonly-used under any volatility position. To do so, a cross relevance analysis was performed, using the SPSS software. The resulting output is presented in Table 40, which shows how strategies were related to each volatility position (again, the output was modified to simplify its appearance, and to facilitate the analysis).

Note that the strategies were not exclusively filled, i.e. some participants reported several strategies for the same project, and justified each due to the specific situation. One such examples is illustrated by two participants who assumed the use of Strategy (c) when working for governmental institutions, as the concept of time pressure was much less critical than in the case of other kinds of client companies [NV11I1; NV11I2]. Interestingly, both participants also took stance A when facing volatility. To justify such a position one of the participants affirmed that "We don't have the attitude of considering what was within the meeting minutes to be closed. And I believe that in governmental institutions these would not result. The meeting minutes serve as a guide" [NV11I1].

Table 40 - Strategies to face volatility, according to each volatility position

	A - Volatility as the natural process of requirement evolution	**B** - Volatility as a fault indicator of the requirements phase	**C** - Both	Total
a- Apply incremental methodologies, with small releases	4	3	3	10
b- Leave some room in the project schedule to allow for flexibility in requirements management	1	1	1	3
c- Consider the requirements document as a guide, and not as a contractual artefact	2			2
d- Consider the requirements document as a contractual safeguard	2	3	4	9
e- Generate Change Requests	1	2	5	8
f- Create contractual addenda		1	3	4
g- Generate new projects (future developments)		2	3	5
h- Use prioritisation techniques for requirements	5	2	1	8
i- Organise steering committees and frequent validation sessions	1	1		2
j- Absorb the impact of changes			3	3

Source: Modified from the output of SPSS

The above statements raised a consequent question of causality: is the stance taken by participants before volatility influenced by factors related to the project or business environment in which they operate? Further analysis showed that both participants came from the same company, but that the remaining participants from the same company took the C stance. We then searched the database looking for other participants that described projects in public institutions. However, they all assumed the C position. Therefore, based on the data collected in this study we could not ascertain the existence of any relationship between these three variables. We advocate that more research is needed on this topic.

Generally, the use of incremental methodologies, with small releases (a) was found to be one of the most used strategies to deal with requirements volatility. This seems to be true whether or not it involved a formal validation with the client (i). Although it was

not so frequently cited, strategy (i) was identified as being a good strategy for assessing requirements adequacy [ST06I1; ST08I2]. A possible explanation for its low adhesion is that it may be commonly viewed as an informal practice, somewhat outside the established methodology, and therefore is little referred to as a formal strategy. Another possible reason is that participants identified this strategy as being potentially beneficial, but that they did not always find availability from the clients and relevant stakeholders to perform the extra sessions that it could require.

Nine participants said that they used the requirements document as a contractual artefact safeguard. This means that the document, when approved, defines and guarantees what will have to be built and paid for. Although it may have advantages, namely during the negotiating activities to help defining the change requests, this strategy also receives some criticism.

Some participants rejected this practice on the grounds that it can lead to the production of alienated or misfit systems from those for the real needs of clients [NV10I4]. They also state that clients often sign the document due to external pressure, rather than the true understanding of the meaning of what they are signing [ST08I2; DZ12I3; JL01I1]. Furthermore, they argued that a system that does not satisfy the clients' needs is a system that does not achieve success, from the client's perspective. Moreover, a project without client acceptance is an unsuccessful project for the supplier: "if the project fails for the client, then it also fails for us. If it fails for us, then the project also fails for the client" [DZ12I2]. A middle ground exists when participants assume that this practice is useful, only when the client really validates what is being proposed [for instance in ST08I2].

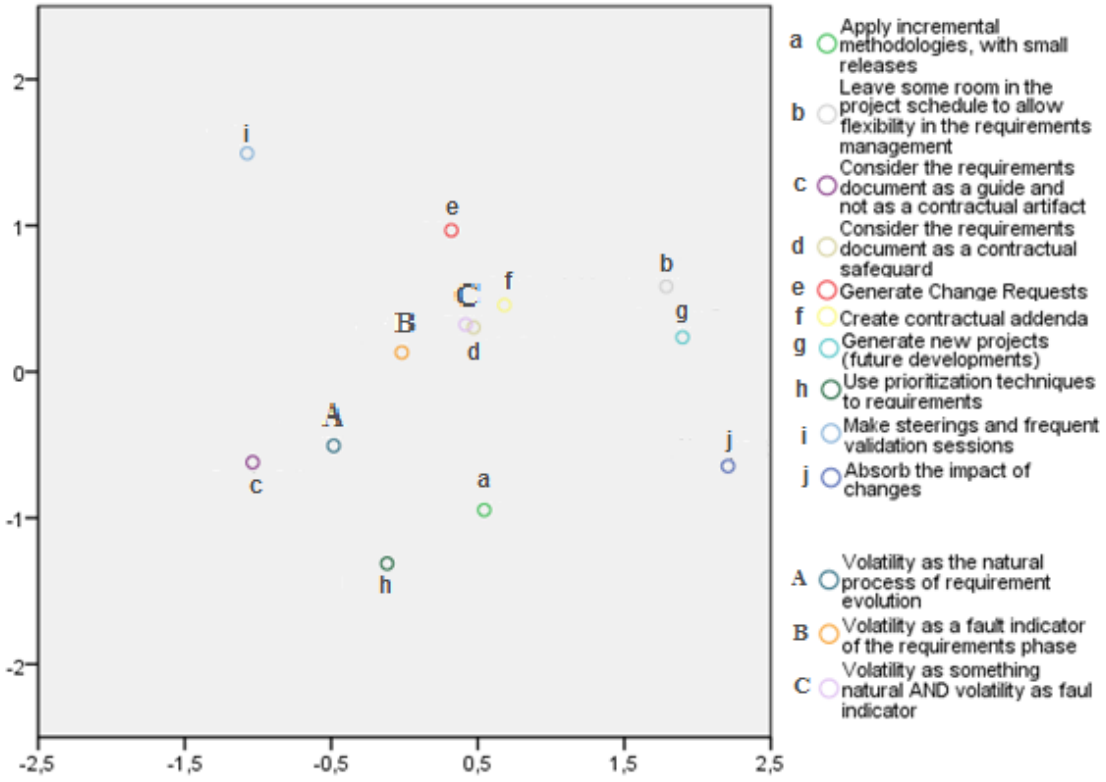
Moving to consider the strategies for each volatility position: the most used strategies reported by participants with the A stance were (a) and (h), namely the application of incremental methodologies with small releases and the prioritisation of requirements. Small releases allow for the minimisation of the amount of requirements to deal with in each iteration. This can minimise the requirement's complexity, and can make the client more comfortable and more aware of the requirement's document, or the requirement set [JL01I1].

Additionally, the practice of prioritising requirements is often performed in incremental methodologies, such as the Agile (Paetsch et al., 2003). Therefore it would

be expected that these strategies could be presented together. However, after analysing the graphical representation of the results (Figure 20), we found that the distance that separates these three variables only suggests a slightly tendency for the connection between them. We cannot therefore conclude the existence of a strong relationship between them, at least when considering the studied projects.

However, participants who took a B volatility position also showed a great coverage and diversity regarding the strategies they assumed, with a little differentiation amongst them. There is only a small difference in the use of the (a) and the (d) strategies, which corresponds to the application of more flexible methodologies, and the use of the requirements document as a contractual artefact. However, we did not find any strong presence of the use of these two strategies together in the graphic of Figure 20.

Figure 20. Graphical Representation of MCA of Volatility Stances with Volatility Strategies



Source: Adapted from the output of SPSS

Participants with a mixed position to volatility (C) revealed a greater use of strategies that alter or generate new contractual elements (e, f, g), along with the strategy of

considering the requirements document as a contractual element (d). Looking at the graphical representation of Figure 20, it is worth mentioning the proximity that exists between strategy (d) and the generation of additional contractual features (e, f, g). A possible reason for this is that, with the use of the requirements document as a contractual artefact, it may be easier to establish the scope of the project. Therefore, it may also be used later as an artefact to manage negotiation activities with clients. As clients are often required to sign such a document as a sign of commitment to what will be implemented, they may eventually be resigned to more frequent contractual changes.

Further analysis on this topic tried to understand whether there is any relationship between the reasons that justify the generation of contractual changes (strategies e, f, g), with the causes that explain the positions regarding volatility. To do so, a new graphical representation was produced, considering the causes of volatility and the assumptions and volatility strategies (see Figure 21). Once again, the relative distances between these variables was analysed. Assumptions 1 and 3 were omitted, as they represent a position of volatility.

The graph of Figure 21 seems to shows a set of close variables. These include the position towards the requirements document (2, 7), the origin of the errors that lead to requirements changes (4, 5, 6), and the strategies that generate contractual changes (e, f, g). Thus we may conclude that the strategies that generate contractual changes are the most applied ones, regardless of the type of the error that caused the change to the requirement, or even regardless of the client's attitude towards the document.

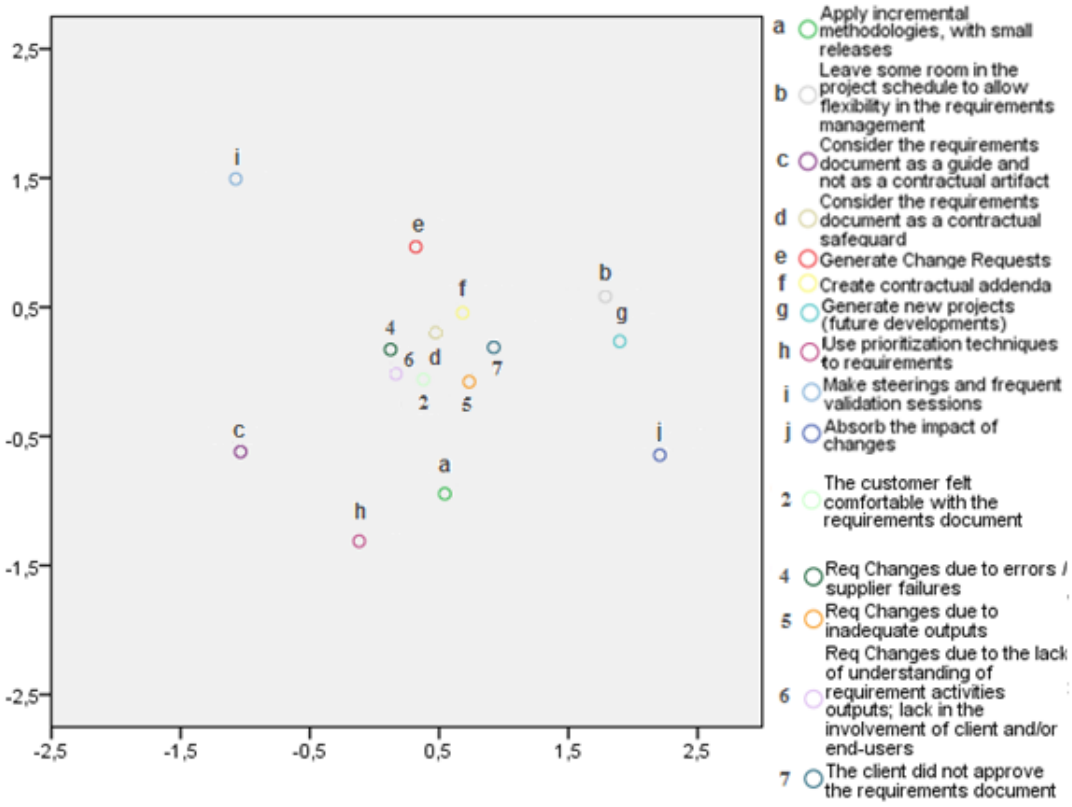
It was interesting to note that the use of the requirements document as a contractual element (d) seems to exist, whether it is properly understood by the client, or not (2, 7). Despite those who showed concerns about the client's understanding of the requirements document, there seems to be a common practice, at least considering the analysed data, of using the document content, regardless of its real accordance or suitability for the system purpose.

Looking at the graph, we see that strategies (b) and (j) have a relative proximity with the more compact set of variables. Commenting each separately, we recall that strategy (b) was equally ranked, due to its stance towards volatility. However, the flexible management of requirements in order to adjust subsequent changes could suggest that participants would be more approachable to deal with such changes. Surprisingly, Figure

21 shows that this strategy is close to position (C) and to those strategies that generate contractual changes (e, f, g). This seems to be contradictory, as it would be expected that in the case of requirements changes, such flexibility would lead to the implementation of other kind of strategies, such as the absorption of changes (j). A possible explanation for such contradiction might be the use of this strategy in situations where the project is earlier identified as having a high risk of requirements volatility. In these situations, and besides the effort to anticipate the onset of changes to requirements, it might also be necessary to use additional strategies, such as those that generate contractual changes.

Strategy (j) was mostly described in particular situations where the ability to negotiate was very low. Participants mentioned the strategic level of the project and/or the client to the company to justify their attitude [ST08I1], and even the difficult economic situation of their country (at the time of interview). They affirmed that it would not be beneficial for their companies to embark on a process of aggressive negotiation that may create conflict with clients, for fear of losing the customer to a competitor. This may be a situation which not all participants feels comfortable to describe, in part because it may highlight some weaknesses of the company. On the other hand, companies that participated in this study have diverse characteristics, namely their relative size in the market and their annual revenue. This could also impact on the way each company interacts with their environment and clients, influencing the strategies that the leader adopts. However, further conclusions about these topics were not possible, due to the reduced number of references and thus we advocate that more studies should be conducted.

Figure 21. Graphical Representation of MCA of Volatility Causes with Volatility Strategies



Source: Adapted from the output of SPSS

Despite the positions towards volatility, their possible causes and strategies to overcome the consequent problems, we found no systematic procedure to predict the risks associated with these changes, nor to resolve or improve the impact of the changes. However, the complexity of these topics makes them difficult to solve. Not all procedures can be systematised, especially those that depend on the nature of the problem and the people involved. Furthermore, it is not always easy to understand what kind of phenomena project managers are dealing with, or who is to be blamed. An example of such evidence is shown in the following excerpt taken from one interview.

Extracted from interviews:

"I mean requirements can be wrong, if you like to say, wrong I think, and this is for a number of reasons: one is that you haven't specified them correctly, and another is that you haven´t understood them correctly, but it could just be that the client does not understand what it is that they really want. Then they start to specify their own requirements. Therefore it is a bit difficult to, to say, really. Can it be related to the amount of changes that one experiences later on? Yes, maybe it can. Ah… was it a natural

progression through a project? Yes, it probably is as well. So, it's a bit difficult to confirm one, or the other" [ST08I2].

Additional questions may arise from these difficulties: was there any problem regarding the specification and documentation of the requirements that justify the change? Or is this just a result of the expected maturation of the knowledge about the project? Are the expectations from what to expect from each stakeholder aligned? These questions are not always easy to answer, but they may impact on the success of this phase.

In the next subsection we make a brief analysis of the perception that respondents have regarding requirements' success. The impact of the described issues will be discussed, among others, comparing them with the existing literature. To do so, we also present a set of tasks that are expected to be performed, in order that this phase can achieve the success.

4.3.3 Requirements Success

The requirements success was one of the major concerns mentioned during the interviews. Respondents stressed some of the topics of this study as being critical to achieving success in this phase, and eventually for the project itself. The main topics raised during the interviews included: the definition of the success of this phase, the main problems that usually affect the success achievement, and how one can measure the success. Thus, we decided to include a subsection on requirements success, as respondents marked it as the ultimate goal for the rest of the study.

The literature also found that the success of requirements engineering success has been associated with project success (The Standish Group International, 2004). In a global competitive market, where time-to-market and meeting stakeholders' requirements are key success factors, improving the requirements engineering process can significantly increase the likelihood of success of a software project (Aurum and Wohlin, 2005).

The requirements success definition proposed by Eman, K. and Madhavji, N. (1996) establishes the extent to which the outcomes of this phase serve as a basis for ensuring the overall success of the activities of the project life cycle. It is understood that failures in the outputs of this phase can result in failures in the subsequent project activities, and

can possibly jeopardise the final outcome. Accordingly, Standish Report (2004) revealed that some of the top ten reasons for failure late or changed projects deal with issues related to requirements outputs and activities. Additional surveys were conducted, which reported similar results (Beecham et al., 2005).

More recently, Nasir and Sahibuddin (2011) have also found that most practitioners consider the three most critical success factors for project success to be clear requirements and specifications; clear goals and objectives, and; a realistic schedule. Additional evidence of such relationship can be found in many published work, describing activities and outputs of the requirement process as part of the criteria for project success (Jugdev and Müller, 2005; Van Der Westhuizen and Fitzgerald, 2005; Verner et al., 2005; Kamata and Tamai, 2007; PMI, 2008; Prabhakar, 2008; Thomas and Fernández, 2008).

Table 41. Requirement Phase Success Definition Factors from Task Categories

Elicitation	Outputs from Modelling and Analysis	Validation, verification and acceptance	Management and traceability
Ensure that what was elicited really reflects client needs	Ensure that the planned documentation was built and maintained	Obtain stakeholders consensus approval	Meet all the specified requirements of the final product
Ensure that the supplier team understands exactly what the client wants	Obtain sufficient detail about the client's needs specification to support the following phases	Obtain the client's final product approval	Map what was described in the requirements documents with the outcome of the final implementation
Ensure that the level of detail and scale is suitable for meeting all client needs	Ensure that what was documented really reflects customer needs	Ensure that the client understood what they approved	
Minimise communication problems and misunderstandings			

Source: the Author

For our respondents, the definition of success at this phase is often made by contradiction, i.e. by denying the main problem domains. The data analysis revealed four major categories affecting this phase. These categories were organised using an adapted

version of the main requirements tasks proposed by Cheng and Atlee (2007): problems with the requirements elicitation; problems with the quality of outputs (i.e. the results of modelling and analysis activities); problems with the validation, verification and acceptance, and; problems in requirements management, namely requirements traceability throughout the project life cycle. Thus, the phase resolution is successful if there are no detected problems in any of the presented categories. Table 41 shows the factors mentioned in the interviews to define the success of the requirement phase, which is organised by task categories.

The success of the requirements phase was described as being the ability to understand and detail the client's needs in an efficient way [JL04I1]. This capacity is perceived as being a determinant factor for client satisfaction (for instance [ST08I1 #G]). However, situations were frequently reported where, after a considerable number of months of project development, the final system did not correspond to what were the real client needs. Such projects are frequently not approved without major changes [JL02I1].

For our participants, this can happen when the requirements elicitation was insufficiently carried out, and when the initial needs were not aligned with the subsequent implementation [ST09I1]. Moreover, communication problems may also affect this phenomena, as respondents reported that different views and understandings may exist among different project stakeholders, leading to irregularities or inconsistencies in the outputs produced [AG05I5].

Another problem mentioned was how requirements were documented. It seems that this is as important as the way that requirements were gathered at the beginning. Requirements documents must be completed, but not exhaustive or too boring [ST08I3 #G]. They must be updated and should transmit the real needs of the client [DZ12I2 #G]. Indeed, some respondents have focussed on the criticality of the client to guarantee that their needs are addressed in the requirements document. They further mentioned that sometimes the client signs a requirements document that they were not able to read or completely understand, and that this could dictate a low satisfaction level for the final product [NV10I5].

One interviewee summarised this problem in the following statement: "*If we deliver all of the requirements, then the project is deemed successful, but that is not necessarily the same as client satisfaction. Client satisfaction is something different, as you need to*

try to measure what are the requirements that the client actually thought they were requesting in the first place? Therefore, it is a lot different to say - "I implemented a project and I satisfied all of the requirements that we agreed and we had no change control and etc., etc.", as opposed to whether or not a client was happy with the end product" [ST08I2]. Frequently, participants focussed on the importance of the client's requirements validation, only after they fully understood what was documented [NV10I4 #1].

Moreover, requirements management, as a cross-phase in the project life cycle, seems to be critical for success. It should be ensured that the requirements are consistent from the time that they were gathered and documented through to final product delivery. It should also be guaranteed that implementation covers all the initially identified aspects. These two strategies were described as being the way to improve the traceability of requirements, and to increase the likelihood of the success of this phase. Additional success features were also reported, although less often, when relating to the success of this phase with the success of the final project: "I cannot separate it (the success of the requirements phase) from the success of the system as a whole" [JL02I1 #1].

To assess the requirements success, respondents mentioned two different metrics. The first was the degree of system usage. This was said to be the gauge of the ultimate success of the project, since no project can be considered a successful project, even if meeting the initial requirements, if not used in practice. The second metric was the general triple constraints: product quality and the cost and time of the project.

The main problems described by the participants have been addressed in the literature. Efforts have been made to overcome some of these difficulties, either by finding proven formalised practices to help to achieve the success or by the exploration and in-depth understanding of the phenomena associated with this phase. Extensive literature has been published suggesting definitions, methodologies, techniques, frameworks and tools to improve the results of this phase.

Regardless of the extensive literature and the augmented perception about requirements and its particularities, the respondents still report problems that affect the requirement phase, or the complete project success due to the requirements activities. It seems that the improved of understanding of the phenomena do not imply, in practice, the spread and sophisticated adoption of any methodologies or practices to resolve them. This

equates to better knowledge, but old problems. Accordingly, Simons et al. (2003) have found that some of the issues surrounding software engineering, namely those related to requirement activities, that were identified over 35 years ago, are still to resolve. Additionally, authors also focus on the misuse of the proposed techniques in practice, arguing that the real reasons cannot yet be fully understood, but there seems to be a clear difficulty in addressing the abstract nature of software.

We could hypothesise that the focus and critically given to this phase and outputs, and their relevance to the success would raise awareness among practitioners towards a greater knowledge and the use of the suggested best practices. This hypothesis was confirmed in some research studies, such as the one performed by Nasir and Sahibuddin (2011). These authors found that effective project management skills and methodologies were in the top five of the most critical factors for project success. However, what seems to be happening is that this support is not always used, either at all, or at least in the most convenient way (Aurum and Wohlin, 2005 2005).

In the next subsection we will explored the main strategies and methodologies used for the analysed projects, considering their impact and relevance. This will be done in parallel with the discussion of the proposed model for requirements classification.

4.3.4 The Requirements Classification Model

The RE research topic has been vastly explored. One of the literature trends has been to find and evaluate the best procedures and practices for achieving the best results for the overall project implementation. However, the references found to contextualise the requirements phase were sparse and not formalised. Each research study uses its own set of dimensions to characterise this phase. Thus, comparisons must be done carefully, as it is not completely known whether the results can be extended to different contexts.

Whereas the requirements phase is performed within the context of a project, several studies focussed on project categorisation to address the characterisation of the requirements phase. In the projects research area, several frameworks have been proposed to ensure a standardised form for addressing project characterisation. One of such studies was conducted by Crawford and her co-authors (2005), and this has been widely referenced to in later studies.

However, the set of attributes used in the previous studies did not follow any apparently standard criteria. Fernández et al. (2012b) argued that it is critical to ensure that when studying requirement, all projects must have in common at least the definition of requirements and the specification artefacts. While some researchers use project categorisation attributes, there are others who introduce some specific characteristics for the requirements phase.

Rodriguez and his co-authors (2012) used the International Software Benchmarking Standards Group (ISBSG) repository to address project characterisation in their assessment of tool usage. Such a repository provides 60 attributes to characterise projects. These attributes are grouped into project context (origin country; type of organisation; business area, and type of development); product characteristics (as application type user base); development characteristics (such as development platform; languages and tools); project size data (including different types of function points), and; some qualitative factors that assess the experience of the use of methodologies. No special relevance was made to specific characteristics of the requirement phase.

Furthermore, Eman, K. and Madhavji, N. (1996) characterised the RE process by considering four items: the main business of the organization; the functional area of information system; the number of IS personnel involved, and; the number of users involved in the process. Despite the relevance of these attributes, the focus remained on general project characterisation. Thus, it does not provide a deep understanding on the characteristics of the requirement's phase or how it was performed.

Additionally, Guinan et al. (1998b) described a common requirements phase contextualising the description and they made evident the focus on project characteristics: "The targeted development projects were "mid-sized," with each project expected to take from 12 to 15 months to complete. All projects had business application software as their design domain. Each participating team was surveyed at the end of the systems requirements phase of software development. Thus, all teams that worked on a similar class of problems, were studied at the same development phase, and they had comparable team size and project duration" (p.110).

Contradicting what already happens during project categorisation, examples of requirement phase categorisation are sparse and are not formalised. To the best of our knowledge, there is no standard model for requirement phase categorisation. The non-

existence of such a model fosters the *ad hoc* use of attributes among research studies and this may lead to the missing connection between the results of previous studies.

Thus, it is not surprising that no prior clues were found that suggested the need to consider a model to characterise the requirement phase, besides the characterisation of the project. However, the content analysis of the responses for the description of the requirement phase process revealed some interesting similarities. The results showed a pattern for the set of attributes used by participants to describe this phase. We then return to the literature to assess whether this pattern was also used in other studies.

Aurum and Wohlin (2005) focussed on stakeholder-related decisions that affect the decisions taken in the requirements phase. Maiden and Rugg (1996) presented a set of six factors to assess the most appropriate set of methods to support the RE phase: the objective of the requirements, which lies in the type of project (bespoken, package, etc.); the types of knowledge needed, which means the requirements modelling languages; the internal obstacles to knowledge acquisition, to represent situations where stakeholders omit, or do not transmit accurate information; the observable phenomena, including cases where the requirements are only obtainable through observation; the context of acquisition, which includes the organizational, political, financial and temporal context, and; finally, the interdependency between different methods.

The focus of the latter study is slightly different from those mentioned above. The description of aspects related with the conditions where the requirements take place is evident. However, the aim of this study is to address methods for the requirements phase, considering specific situations, which are commonly described as critical factors. Although it identifies major constrains for the requirement phase, it still misses the characterisation of this process.

This is already an improvement, when compared with other empirical studies about the factors affecting the requirement phase (Chatzoglou and Macaulay, 1997). The former study used mainly project related aspects, such as size, type, type of problem domain, applicability and developers, to characterise the requirement phase. It also included qualitative factors on the attitudes of team members and users towards the development of the specific system, its quality and the other characteristics of the methods and tools employed in this process, and also the management style and techniques adopted.

At most, it could be considered the assessment of the methodologies and techniques used to characterise the requirement phase. Although not directly linked, the information about the methodologies, methods and tools used in the project development process, may foresee some requirement process considerations.

Fernández et al. (2012a) have used project parameters to study their impact on requirements artefacts completeness. These parameters were grouped into three major categories: the costumer domain attribute, which includes the industrial sector; the general relationship with the customer, and; the characteristics of different stakeholders. Both industrial sector and the existing relationship with the client are included in the proposed project categorisation chart.

The last parameter, although not directly focussed on this study, remits stakeholder-related aspects. One of such aspects is stakeholder availability, which was mentioned during the interviews. The need to achieve system comprehension by clients was generally considered to be a critical factor, and not an attribute for characterising the requirements phase.

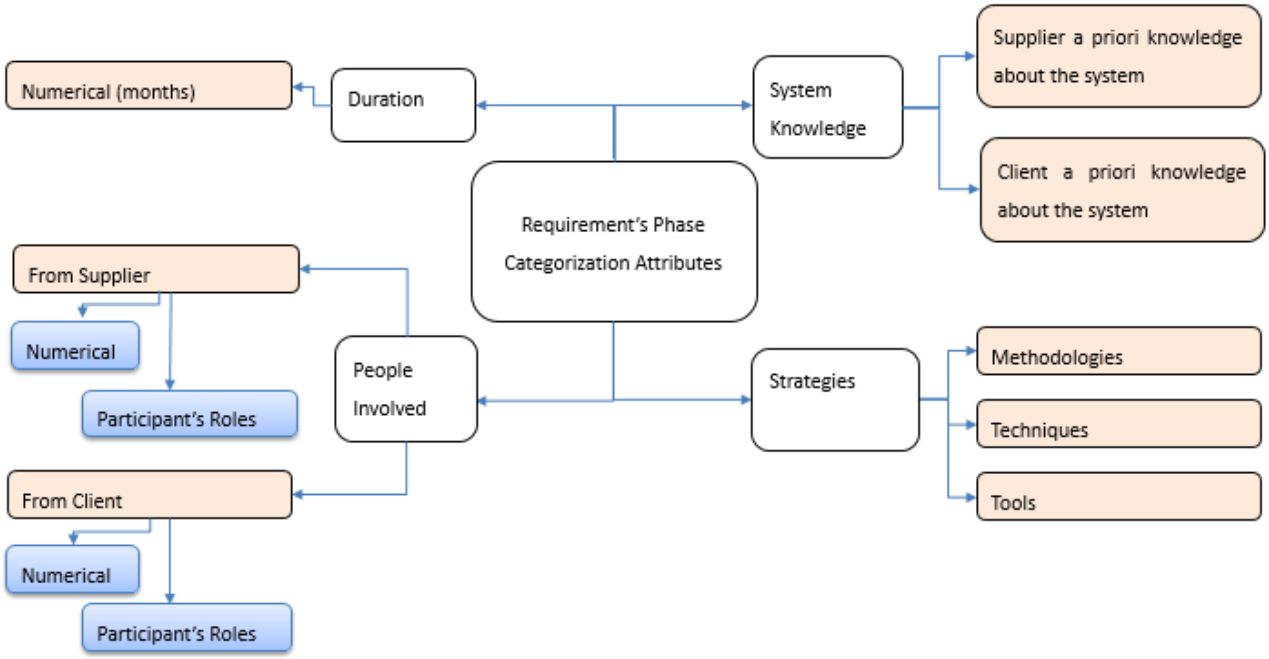
Another factor that was found to affect both the completeness and adequacy of requirement artefacts was the project type: whether the project is a database integration, or a content management system, for instance. The reason for this is the need for user-interaction (Fernández et al., 2012a). However, during our interviews, only a few references were made about the type of system development. Most of these cases were mentioned to justify complexity classification, both functional and technical. These dimensions are already addressed in the project classification chart.

The research of Chatzoglou (1997) is one of the exceptions to the common practice of requirements characterisation. The author stressed the importance to include specific information about the requirement process, in order to assess whether they influence the results of this phase. To this end, the author used such attributes as the number of people involved in the process; the percentage of the time spent in the process; the effort needed to perform the phase; the number and duration of the requirement's process iterations; the team members' experience; the problem of domain knowledge and the attitude towards this phase; the sources and major constrains about quantity and the quality of information gathered, and also; the management style adopted.

Furthermore, the follow up questionnaire also included the methodologies and tools that were used in this phase; the way resources were allocated through the iterations; the attitude of users, and; the critical factors of each iteration. The last category included issues related to project duration; team characterisation; time pressure constrains; external parties; strategies facing requirements; assessment of the amount of requirements, and; the standardised design process.

Based on this extensive list and on the patterns that emerged from the analysis of the interviews, a model for characterising the requirements phase was proposed (see Figure 22). The model is not intended to be exhaustive, but only to be representative of the descriptions made by interviewees. It includes four major attributes: phase duration; team size; system knowledge, and; strategies.

Figure 22. Requirements Phase Categorisation Model



Source: the Author

Project duration and team characterisation attributes are part of the project categorisation chart. However, results showed that a deeper understanding of the duration of this phase was needed. Thus, an attribute considering time related aspects was included in this model.

With regards to team characterisation, the interviews revealed that issues related to teams in the requirement phase vary from the rest of the project activities. Therefore, it

was considered relevant to include in the model some of the characteristics of the teams involved in this phase. The main attributes deals with the dimension and the main roles assumed by its members.

References were also made in the interviews about team members' experience and dispersion, however, due to their low numbers, we decided to use these results to justify or to strengthen further results, rather than to include them in the model. It is worth noting that several aspects listed from (Chatzoglou, 1997) were already addressed in the requirement's volatility discussion.

Despite the fact that the system knowledge attribute is already presented in the project categorisation chart, the results from the interviews make us consider it beneficial to overlap this attribute. The rationale was to follow the relevance showed by interviewees, which also reinforce this attribute during the phase description.

Each attribute included in the model of Figure 22 will be further discussed in more detail.

Duration

Duration has long been used to characterise the time needed to complete projects, although not considering any phase in particular (Crawford et al., 2005). However, this does not tell us anything about the time spent during the requirements activities, neither the time actually needed to perform it successfully. Some participants have claimed that frequently project managers compress the time needed to performed quality requirement gathering and specification [ST09I2]. They also argued that clients need time to reflect about what has been proposed, to think about the impacts and appropriateness of different solutions, and to raise relevant questions and improvements [OU10I1].

Fernández and his co-authors (2012a) argued that when time is compressed, it raises an additional risk to the project, and the appropriate detailed risk calculations should be performed. Time pressure leads to bad estimations for the project, which make the outcomes of this phase more prone to failures. On the other hand, the reduction of the time scheduled for this phase does not guarantee that the project will satisfy the global schedule. In fact, as the effort to correct an error exponentially increases as the project

progresses (Fernández et al., 2012a), it seems reasonable to suggest that this strategy will probably augment the time necessary for project completion and will reduce overall project quality. As the former authors states, by spending more effort on requirement process, it is expected that less change requests will exist further on in the project.

Similarly, some of the problems found in the Chatzoglou research (Chatzoglou, 1997) was partly caused by time compression in this phase, which overlapped quality issues. Time would restrict the number of the resources allocated to each iteration of the process, and would probably affect the final results.

At least six participants directly revealed a similar feeling towards this topic, arguing that reducing the time for performing this phase is not a good strategy for getting work well done:

Extracted from the interviews:

"When a requirements phase is very compressed in time, due to project issues, ah, that will certainly give trouble further on in the project." [JL05I1 #G]

“It should have taken more time to be performed.” [NV11I2 #2]

"Usually there is a very short time to do this phase" [ST09I2]

"This was done, it was done poorly, because hard time limits were imposed" [AG05I4 #1]

“But, we have to cut elsewhere. Because sometimes we have to cut in some phase. In the tests phase you cannot either, it is another phase that should not be cut. However, trying to cut in other… because sometimes this is impossible. We have these constraints imposed by clients, we have deadlines to fulfil for many reasons and ... but cutting in the specification phase sometimes make things go wrong” [DZ12I3 #2]

“There is a natural tendency for people to work like this, to shorten the requirements phase and to not give enough detail about its specifications. Then they faced problems during the developmental phase: things that are not sufficiently written, or with a high level of ambiguity. And someone takes technical decisions that were not taken in parallel or in line with the client. This makes all project schedules overrun, all of them” [ST08I3 #G]

Therefore, it was considered relevant to include the time spent to perform the requirement phase in the framework of requirement characterisation. Although some participants referred to the time they spent during these activities, those who were performing more flexible methodologies had some difficulties in separating this time from the rest. One said, the t requirements process to be an ongoing activity, which is performed throughout the whole project, thus justifying the difficulty in perceiving the time spent [DZ12I2]. On the other hand, we were not able to classify project total duration for projects that were not finished at the time of the interview. In these cases, no time classification was made.

Despite the relevance of the total time for performing these activities, the data analysis does not allow us to draw significant conclusions. In fact, when comparing a project that took two weeks to perform requirements activities with another that took five months, this give us little understanding about the relative magnitude of that time. Instead, this was compared with the relative time spent, when the data were available. We calculate the percentage of time spent in this phase, when considering the total duration of each project. We believe that this might give us a clue about the relevance and effort expended in these activities. Therefore, both dimensions were included in Table 42, which summarises the responses, according to a set of time and percentage intervals. Note that this classification only considered those interviews that referred to project classifications, i.e. it did not include those interviews where participants gave general recommendations.

Table 42. RE Duration Classification

Time Spent in RE (months)		**Time Spent in RE considering Project Duration**	
<1	4	**<20%**	4
>=3	3	**>=50%**	2
>=1 AND <3	8	**>=20% AND <50%**	8

Source: the Author

It is worth noticing that, apart from the results shown in the table, in six projects it was not possible to calculate time percentage, due to requirements or an unfinished

project. Additionally, it is also relevant to note that four participants directly complained they had less time than needed. The reasons for justifying this were mainly related to the following: client or stakeholders pressure [OU10I3]; aggressive deadlines for milestones [DZ12I3], or; internal procedures [AG05I1]. On the other hand, three participants said that their initial schedule had been exceeded. The problem of outgoing initial schedules has been discussed earlier, and the literature suggests that it may be caused by time compression (Fernández et al., 2012a), or the lack of the right methodologies that can help to calculate adequate estimations (further discussion on Requirement Methodologies subsection).

Extracted from interviews:

"This project is still waiting for the requirements closing phase (…) this part is taking a month more than what I had anticipated" [DZ12I3 #2]

Regardless of the data results, some participants had some concerns about the way time was allocate to each project phase. General recommendations were given, such as the one said by [ST08I3 #G] "*Typically this phase would take up 20 to 30%, or 30% of the time to make the requirements management, depending on the methods, and depending on the literature you are following; approximately 20% to 30% to do development, up to 40% maximum; and the rest of the time just doing tests, to deliver a quality product*"

It is our intention to further analyse the existence of any relationship with the time spent during the requirement phase and other project characteristics. This follows Chatzoglou's (1997) findings that the time needed to performed requirements, depicted in the number of iterations, depends on several factors. It may vary on the type of project, the degree of definition of the problem domain structure, for whom the project is developed, and by whom it is developed. The author concluded that the less structured the project is, the more time that is needed. In our interviews there were also some insights into this topic. As an example, one participant referred that "In public administration, this issue of duration is important, how to get there, but the customer is not so hard on these issues (not so sensitive to the days established for each phase)" [NV11I1]. This suggests that time issues might indeed depend on the organisation for whom the project is delivered.

However, time is always a limited resource for projects. Increasingly, the current aim is to perform better in less time, which is not always easy to achieve, as was referred in one of the interviews:

Extracted from the interviews:

"We have to evolve into a more agile paradigm. We have fewer and fewer projects where the clients lets us do things for several months - to do everything by the book. This is increasingly less time available - clients want everything for yesterday. Therefore we have to find a way to be more agile, (...) maybe during the preparation and specification phase - to make it shorter, or to begin to develop it earlier... to make partial approvals, to get our teams developing sooner. I just don't know, but there is a problem that we are facing here. It's just that every time we have more, such as, "implement a system in four months", that is to say, in four months we might not be able to make two months of specifications. How can we solve this problem? Ah, it is not easily to solve it, but we have to find a solution here..." [DZ12I3 #2].

Most researchers argue that this is a multifaceted problem. One possible way to improve these qualifications is by using the adequate methods and procedures, whilst another focusses on the human side of the process. Chatzoglou (1997) found that sometimes the amount of time and people allocated to the RCA phase in comparison with the rest of the project is not enough for completing this phase successfully. The author argues that the solution might be the adequate allocation of recourses at each requirement cycle, depending on several factors. However, this requires a higher awareness of these topics and existing recommendations (Chatzoglou, 1997). Some of these topics will be address below.

Team Size

Those who believe in the relevance of human factors for the requirement process advocate that teams issues impact the way that success can be obtained (Fernández et al., 2012a 2001). Within this topic, one of the most studied dimensions is team size, followed by team experience and expertise. The impact of team size has been identified as being a significant predictor of all aspects of team and group processes and also productivity

(Curral et al., 2001; Rodger et al., 2011; Portillo-Rodríguez et al., 2012). Thus, researchers have been discussing the best team size for performance.

The requirement phase activities and outputs rely mostly on teams, as happens with almost all group processes in a project. However, requirements' activities often deal with uncertainty and innovation, and a new system should be developed. Responsible teams have to extract information and deal with different stakeholders with diverse backgrounds and expectations in order to gain consensus amongst all.

Authors have been arguing that very small teams (2 or 3 people) may lack the diversity of viewpoints and perspectives to come up with suitable solutions in the innovative process (Curral et al., 2001). On the other hand, large teams may become too unwieldy to be effective, due mainly to communication, participation and information transfer and the ability to gain consensus (Curral et al., 2001). Poulton and West (1999) showed that larger team size (up to 12) is associated with less clear objectives, and also lower levels of participation, emphasis on quality, and support for innovation.

The aim is to achieve a team size that is capable of having a sufficient, but not too large number of members to perform the necessary task (Curral et al., 2001). According to Putnam (1978), there is an optimum team size, defined as being the one that allows the development team to achieve maximum productivity with the shortest schedule and lowest cost without affecting the final outcome. The author also concluded that productivity is higher for smaller teams, with an optimal size of 3-5, followed by 5-7 teams. Rodriguez et al. (2012) confirmed these results, by showing that projects with an average team size of 9 or more members are less productive than those with a smaller size.

Several studies (see for instance (Harman and Jones, 2001)) have tried to justify why this phenomenon is happening, and some have concluded that different communication overheads statistically affect duration time. In fact, these communication problems favour a larger number of smaller teams, rather than having a smaller number of larger teams. However, it also raises other problems that have also been associated with project team size. Rodriguez and his co-authors (2012) stressed the impact of project team size on schedule decisions, which is also an important factor for project success, as large teams need more time to communicate among team members.

Larger teams have been associated with poor team processes, low quality awareness, low levels of support for innovation when operating under greater pressure to innovate (Curral et al., 2001), high project elapsed time, and low levels of productivity. (Rodger et al., 2011). Authors argue that the larger the size of the team, the greater will be the difficulty in achieving agreement about shared objectives, achieving consensus on solutions and on quality issues, eliciting unanimous support for innovation and in ensuring appropriate participation in decision making. This may be caused by the variety of values, motives and experiences which can work as an inhibitor to obtain agreement. It also will increase the effort needed to foster interaction and to maintain ideal frequency, to share the information between team members, and to distribute influences in decision making (Curral et al., 2001).

However, ISBSG recently reported that projects' team size in their repository were distributed by 29% having up to 4 people, 30% having 5 to 9 people, 18% having 10 to 19 people, and 24% having 20 or more people. Although these results consider only the development team, the total of 42% of teams is substantially greater than what has been suggested in the literature. This is even more worrying when the same institute reported that: "The ISBSG data show that there are three main factors that impact software development productivity: programming language, development platform, and team size. The first two have the most significant effect, but it is also important to consider the impact of team size. The latest ISBSG Special Report reveals that teams of nine or more are significantly less productive than smaller teams" ((ISBSG, 2007) in (Portillo-Rodríguez et al., 2012)).

Following the same train of thought, several other authors argued that adding more people to a later project probably will not work, as it will make it even later (Brooks Jr, 1995), or at least more costly (Abdel-Hamid and Madnick, 1991). This is caused by the time needed for new programmers to learn about the system and it increases communication efforts. (Portillo-Rodríguez et al., 2012)

Studies conducted on the requirements phase have concluded similar results: smaller teams have a significant relationship with higher productivity. Boehm (1984) compared the effort that teams spent performing different activities and he concluded that smaller teams need proportionally less time for programming than larger teams do, need less time for meetings and have less communication problems and communication overheads than

larger teams. Additionally, large teams also increase the problems of coordination and communication between members of the team (Pendharkar and Rodger, 2007) and require a more than proportional increase in resources needed and higher communication and coordination costs (Pendharkar and Rodger, 2009). This happens even when considering that it would be expectable that when team size increases, both team expertise and the better distribution of skills would improve software quality (Pendharkar and Rodger, 2007; Pendharkar and Rodger, 2009).

However, team size revealed some dependency with other projects' characteristics, or even the project phase. According to Pendharkar, larger team size is shown to have a greater negative impact when a software project manager does not have sufficient information as to whether team members have sufficient prior experience in using tools or methodologies (Pendharkar and Rodger, 2007). This author also stressed that "most software quality professionals admit that team size should be larger in the beginning or middle of the project than at the end of the project. The higher team sizes in the beginning of the project allow for strict testing of the software product in early phases of Software Development Life Cycle" (Pendharkar, 2009, p. 142).

Despite the literature on this topic, the truth is that almost all our study participants pointed out team size when describing the requirement phase. However, the analysis of the interviews revealed some additional insights into this topic. The most relevant addition to the existing literature was the distinction made between the number of team members from the supplier and from the client company. It was stressed that, regardless of the size of the supplier team, the number of people that would be involved from the client company during the process of requirement gathering and decision making could be crucial to the successful development of this phase. Furthermore, emphasis was made about the involvement of the right people, rather than a high number of people. The lack of involving people with different views about the project, and sometimes they were the only ones with tacit information which could be identified as a critical factor for project success (see for instance [DZ12I3 #2]; [OU10I3]; [OU10I2 #1]). The impact of dysfunctional teams has been identified as a significant risk for project success. The two statements below are examples of what was said during the interviews.

Extracted from the interviews:

“In this project, there were no exaggerated number, because there are cases where clients bring the whole class. There is no possible understanding amongst each other... everybody goes to that meeting (...) because sometimes who is carrying out the requirements gathering or who is giving... I will give you an example that is happening to me right now in another project: the project is for the same group, but the group has several companies, so a representative from each company comes to the meetings. This it is pretty clear to me that this project will be one of those where, in the end, someone will show up, which is the guy who really uses it, and he will say: "But I don’t do it that way", and that person has never been involved in the requirements activities. So this is always a risk that we identify in a project: to involve the key people during the requirements phase” [DZ12I3]

“They had poorly defined the internal team to follow the requirements, why? There was the IT part, who was the project owner, but then this just involved one business area, the financial one, who had decided to accept the project. At the time, we warned that if there were more areas that would make sense to be involved in the requirements, namely: the definition, monitoring and project acceptance. Internally they decided that they were not, ah ... because this was caused by their attitude of the over-simplification of requirements: "Ah, but the reports are here, we said which ones are the reports, and then people from the financial department can assess whether each report is identical to the above and whether the data are consistent. So needless to involve other business areas". Ah ... and they did not. That’s why in these project there were not so many … we had few people, very few people involved. Oh ... and after what happened here, more needs for such additional requirements emerged after that, during the testing phase” [NV10I5].

Also present during the citations above, is the roles assumed by different members of a project team. The variety of these roles seems to be relevant, not only to gather different viewpoints about the project, but also to validate the project specifications. However, these role allocations were told to have variances according to a set of factors, namely the type of Client Company. The most cited factor was indeed the differences between public and private companies (Bourantas and Papalexandris, 1993). Private companies were identified as being less flexible in negotiation activities, as they would be more rigid and clear about the goals they want to achieve [NV11I1]. Participants also

mentioned that public companies have less structured processes and defined roles for dealing with requirement activities. The main reasons reported included that public companies were less oriented to goal achieving, and that the main motivation for new software projects would be political, rather than productive [ST06I1].

Extracted from the interviews:

"It was in the private sector that I started seeing the first… giving an example: the role of project manager does not exist in every client company. Nowadays it is beginning to exist everywhere, but it was in the private sector that I saw it for the first time. That is why they started to realise that they had to have someone on their side to lead the requirements process, for internal elicitation and project monitoring. They are much more focussed on objective achievement, and they do not bring 20 people for a meeting, as we see in public institutions ... they are improving, they will get there" [DZ12I3 #3].

Several concerns were stressed during the interviews about the number of people involved in the RE process and their impact on the effort of actually performing RE activities. A brief resume in presented in Table 43, which also contains one interview to illustrate where each impact was mentioned.

Table 43. Summarised consequences of large teams

Consequence of a large team	Example of an interview that mentioned it
The difficulty of the homogeneity of the proposed solutions	[DZ12I4]
The disparity of requirements from different interests, sometimes personal, which increase the effort to create a uniform and appropriate solution	[OU10I1 #1]
The difficulty in managing conflicts between participants	[DZ12I3 #3]
The difficulty in keeping the focus during meetings, which increases the effort required for productive meetings	[OU10I2]
The large amount of debited requirements that will have to be further analysed and discussed	[OU10I1 #1]
The difficulty in ensuring that someone takes the responsibility for decision making with regards to other people	[NV10I4]
The difficulty in managing the agendas of so many people	[ST06I1]

Source: the Author

Almost all the consequences presented in the table above suggest a tendency for a significant increase in the effort required to complete RE tasks successfully. Moreover, a large team from a supplier in this phase may represent a waste of resources, as usually the amount of requirement and work to be done does not need a lot of people in the team. In fact, several claims were made for the unused of resources whilst waiting for client responses to progress their work (see for instance [DZ12I2], [DZ12I3]). One of the mentioned strategies to deal with this was to carry out a longer phase with a smaller team, rather than a larger team with a shorter schedule [OU10I1 #1].

An excerpt is presented below from one of the interviews that summarises most of the topics mentioned so far:

"My opinion is: requirements gathering is not worthy of very large teams, okay? By committing very large teams, what will they do? They will charge a lot of information to the client, okay? In terms of requirements gathering, then they will have to validate during the meetings with them, and then feed the whole team. Typically, client teams are limited, ok? Therefore, the (X) company when implementing processes may have 30, 40, or 50 people to implement them, but one must take into account that the client's ability to charge requirements, and to be creative, does not cost anything, ok? (...) Therefore, it depends a lot from client to client. There are very democratic clients (this is confidential), as in public administration, where the whole organisation comes for a meeting - a meeting with 10 people, to gather requirements, where each one says whatever they feel like... and, that is all. When this happens, I think it brings serious dangers to the project, okay? Because each person asks one different thing, then there is no one... ah, who decides priorities. (…) In some cases it is necessary to say no to some situations, and that is not because of the development effort, as that kind of functionality does not make sense in the architecture, because it will only solve a problem from a person's belly button, any person. Of course one eventually gets there, raises requirements ... and then when there are 10 people at a meeting ... sometimes resulting in conflicts, as reaching consensus with 10 people is so hard! They soon begin to grumble, right at the beginning of the meeting. Therefore it is always better to have fewer people and to have people who know what they want regarding the topic that we are dealing with. Because elicitation with a pencil in hand, with 10 people?... if I make a requirements meeting I hope, indeed I pray for them to be focussed, but in meetings with 10? ... (...) ah, trying to run the least amount of people because then meetings are not so productive, as we are trying to identify the point

of view of each person. We are talking to a person about a subject, and then another person remembers something and interrupts the meeting with some completely different matter, and then... as suppliers are there too, it is rude to say "I am sorry, but now we are not talking about that, so let us close this point first." It is harder to hold requirements meeting with many people, with a lot of people, I definitely would raise a risk, ok? I realise that it is more complete, but I would raise a risk because of the difficulty of homogenisation. There are organisations where this is absolutely impossible to avoid, as they are flat structured organisations and everyone has to go, everyone has to give their opinion, and yet there is nothing that you can do about it. (...) Furthermore, the company is from the public administration and the more competitive the market is, typically one can find people who know what they want and... worse than a bad decision, is no decision...” [OU10I1 #1].

The relevance of team-related topics on the RE phase makes us consider it in the requirement model for categorisation. The results were organised by considering team size from both the supplier and the client side. Additionally, we also include the main roles of team members. In some cases, only the principal and generic roles were identified. Team size was found to be sometimes variable along the requirements process. Especially from the client side, where members can change according to their availability for meeting, or even the topic that is being discussed. This was also reported for supplier teams, but only when referring to big projects implemented by iterations or modules. When participants reported a great variance of this number, an average team size was requested. Table 44 shows the results mentioned during the interviews, and also how projects are classified according to team size.

Table 44. Results of team size during the Requirements Phase

Team Size from the Supplier		**Team Size of the Client Company**	
<3	16	**<3**	1
3-5	10	**3-5**	13
>5	4	**>5**	13

Source: the Author

The results in the table show a great difference in size distribution among different types of teams. Looking at the teams from the supplier companies, most have less than 3 members. Only four teams have more than five members (with none up to nine members), and the rest of teams reported three to five members. Regarding client size, the

distribution was quite different from supplier teams. Only one client team involved less than three members. There is an equal distribution of teams with three to five members, and with more than five members. However, the true is that some of the teams with more than five members included a high number of members: three of them have more than nine members.

When comparing the results with the literature recommendations, it was found that, when considered separately, both groups have a reasonable number of teams within the expected range - three to five members. However, most teams from suppliers are below this rule. The implications might be the lack of diversity and richness of perspectives, which may lead to more complete and effective solutions. Instead, client teams tend to be far superior to these recommendations. This may lead to the set of problems discussed above, affecting the successful implementation of the phase.

However, we do not believe that the assumption of looking teams separately is the best one. In practice these two teams should work together, and should pool their efforts together to produce the outputs necessary for the efficient execution of the project. Therefore, the size of the teams should be seen together as if they were just one team with different origins and tasks. But considering the number of members in the teams goes off considerably. Only four teams are within the optimum size, none has less than three people, and all the rest have more than five members altogether. The mean size is 8.5, which is below the reference value of nine, but some teams have more than twenty members. With the implications described in the literature, it is not surprising that participants are reporting so many difficulties in managing the RE process and client interaction.

An additional analysis was done in order to understand what percentage of team size was allocated to this phase, when compared to the overall project. The motivation for this analysis was to understand whether the number of team members during the requirements phase would have any relationship to the total size of the project team. Despite the size of the team being a good indicator for the phase, it does not allow us to understand its relation with the project itself. Thus, it was found that team size at this phase accounts for 40% of the team accompanying the overall project. As expected, for projects with very small teams, the percentage of the requirements team tends to be much greater, and in some cases even 100% (all members are present during requirements phase are in equal

number, and often are the same as during other phases of the project). Similarly, projects that have larger teams tend to allocate a lower percentage of members to this phase (5% minimum). Thus, we point out that, generally, the evidence referred by Pendharkar (2009) was not confirmed in the projects analysed, and thus further research on this topic should be performed.

The analysis of the roles assumed within the teams found that the most frequently cited one is that of project manager, followed by the programmer, and then the technical manager (see Figure 23). The role of project manager is expected to assist at this early phase of the project, and is indeed highly recommended (Guinan et al., 1998a). A set of tasks and responsibilities is established that should be performed at this stage. However, in some cases, the presence of the project manager is referred to as being conditional. One example is a study participant who said that there are two types of project managers: the ones that gets their hands dirty, and those that do not.

Extracted from the interviews:

"There are systems that, due to their size, effectively require a specific team for the analysis phase. It is not always possible for the project manager to focus all the responsibility and leadership on themselves, if this is that you are calling the requirements phase. That's because it may be someone other than the project manager. (...) What I am telling you is that you can have two, or at least two major ways to address this issue: one in which the project manager works hands on, if we can say it this way, and therefore they are part of the team for requirements elicitation, product specifications documents, production ... okay? They lead the meetings with the clients, but there will be other situations in which they are just one more member, and thus they coordinate the team, but it is a ... it is the analysis team that carries out this kind of relationship and therefore they produce deliverables just as the development team also produces deliverables and the project manager is responsible for these deliverables" [DZ12I2]

This may help to understand the situations where the project manager is not part of the team during the requirements phase. On the other hand, there are also cases where the project manager has not yet been allocated to this phase of the project. Instead, there are a number of other people who have the responsibility to conduct these activities until the project manager is assigned. There are other situations where the project manager is not allocated full-time to a project. From what has been described in the interviews, a more

or less intense project manager participation depends on several factors that relate to the project, such as size, complexity, and strategic level.

Not so expected was having a programmer as the second most-cited role. However, this can be explained by the ambiguity revealed in the roles that are assumed by programmers (Guinan et al., 1998a). Sometimes it is not clear what the responsibilities of the developer are and they may be in a large number within the organisation, and therefore more available. This may eventually cause them to support responsibilities that were not initially of their concern. Nevertheless, the third most cited role, that of the technical manager, is somehow related to programmers. There is clearly a concern about having a technical person to manage the technical complexity during this phase. However, in fact, the job title of technical manager does not exist in all organisations. Therefore, it is expected that in these cases, a programmer can perform similar functions when no one else is available.

The presence of roles that deal with functional complexity, namely functional managers, analysts and seniors, tends to be low when separately compared with the three most present ones. This could raise suspicions that the main concern at this phase might be technical complexity, rather than the functional one, despite the fact that the literature emphasises the opposite. Nevertheless, and assuming that these three roles have similarities that allow for comparison, when considered together, an equal presence was found than the one assumed by technical managers.

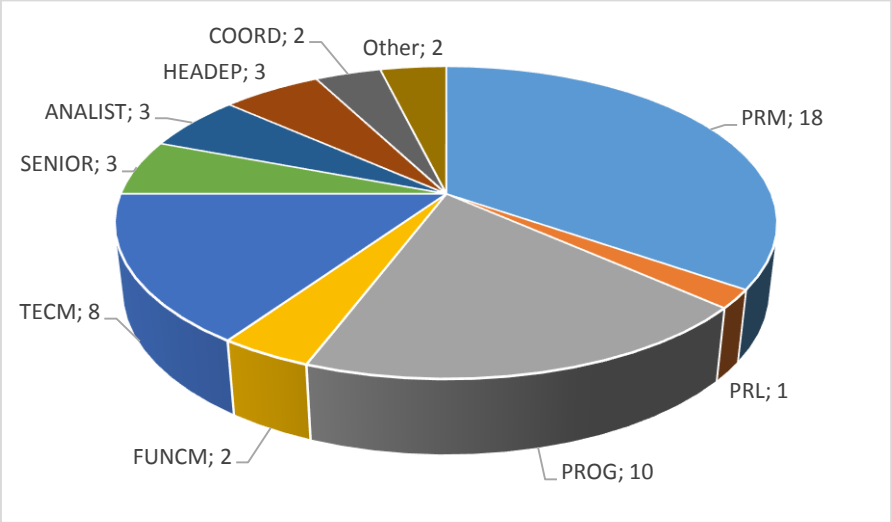
It is also worth noticing that in most cases where the presence of a programmer in the team was referenced, the presence of a project manager was also included. Then the question arises of whether the functional part of the problem may be assumed by the project manager themselves, leaving the technical issues for the programmer. The former can also provide a link between the team that will develop the system, and the project manager, facilitating communication between them all.

As a final conclusion on this topic, we stress that the allocation of roles to the requirements team seems to follow a trend within each organisation. We notice a degree of similarity in the roles mentioned in the interviews/projects from the same organisation. This finding brings new questions to the subject, particularly about the reasons that dictate the allocation of the members to the teams. Is this essentially a matter of organisational

culture? Does it consider specific characteristics of the project/customer involved? We suggest that further research is needed on these topics.

The implication of considering these dimensions in research can be several, both practical and theoretical. For practitioners, it could allow them to build a team that is more able to respond to the specific client team profile. This is already done to a certain extent, when project managers try to put senior members on a requirement team, but not only are they senior, but particularly those who carried out some former project for the same client company, or at least in the same business area. This can reduce the risks associated with system knowledge, and overcomes some client insufficiencies, but it does not fully improve the process, neither the relationship with the client. We wonder whether more suitable teams could indeed "educate" client teams better.

Figure 23. Role distribution in RE teams



Legend: PRM – Project Manager; PRL – Project leader; PROG – Programmer; FUNCM – Functional Manager; TECM – Technical Manager; SENIOR – Senior Manager; ANALIST – Analyst; HEADEP – Head Department; COORD - Coordinator

Source: the Author

From a theoretical point of view, the distinction between these two different teams which have to work in a coordinate manner to produce a desirable result can bring a new perspective when one examines these phenomena. Despite the huge amount of research on related topics, the tendency has been to focus only on supplier teams' issues, or on stakeholders' abilities and their characteristics. These two teams have been disjunctive when they perhaps should be seen as the two faces of the same coin. The literature focusses on identifying stakeholders, on involving the right stakeholders, on performing

techniques to negotiate with stakeholders, but not frequently whether they view stakeholders as being part of the requirement team. Maybe if they did that, then some existing theories from other areas, such as psychology and group process, would benefit the relationships and processes among these members, even when considering and restricting the whole team to best practices and recommendations, such as the size of the team, for instance.

This does not really show how key users are involved, neither does it explore the linkages between team roles and other practices and results obtained during the process. It would be interesting to better analyse the profile of the client team. Does it explain anything? Studies need to be done to identify whether differences exist with the same supplier team to different client teams with different profiles. Thus, this may raise new insights for future research.

System Knowledge

A number of studies have addressed the importance of system knowledge in software development projects in general, and in requirement activities in particular. Is has been mostly agreed that domain knowledge positively impacts requirement elicitation and analysis (Hadar et al., 2014). Domain knowledge is related to how the problem is structured, as it establishes how well the initial state is defined, as well as the goals, constrains and possible alternative solutions (Khatri et al., 2006).

The main advantages mentioned in the literature about analyst domain knowledge relate to elicitation activities. As a process based on intensive communication and interaction with the stakeholders, it seems that domain knowledge overcomes some of the barriers between these two different groups (Coughlan et al., 2003). The existence of a common vocabulary base, which can be derived from domain knowledge, is one valuable asset that may lead to a reduction in interaction delays and misunderstandings (Buchman and Ekadharmawan, 2009).

Domain knowledge can also assist the ability to focus on elicitation activities, deepening and refining issues that may have been forgotten or unexploited by stakeholders. Frequently, stakeholders omit tacit knowledge, as they are unware of their

importance, or actually do not even remember to mention it (Antón and Potts, 1998). These analysts are more aware of this kind of omission, due to their experience in the area. Guindon (1990) indicates that analyst domain knowledge can deduce inferred constrains that may reduce the completeness and ambiguity of the requirement specifications.

Domain knowledge can also guide requirement elicitation activities, such as interviews or meetings, to be more efficient, by asking questions that can manage the requirements to be gathered. Communication issues have also been shown to be positively affected by domain knowledge, as analysts have a greater ability to ask and to better understand the answers in a way that stakeholders fully understand (Hadar et al., 2014).

Often the importance of domain knowledge is implicit within several critical factors identified in the literature. Three example may be: (1) the suitability of schedules and plans for the project (Realistic Schedules and Realistic Budget); (2) the elicitation of clear and complete requirements (Clear requirements and specifications), and; (3) the establishment of good communication practices (Effective communication and feedback) (Nasir and Sahibuddin, 2011). Good communication practices, as discussed above, can be improved by the domain knowledge possessed by the analysts, since it provides a common language base (Hadar et al., 2014).

The establishment of realistic schedules is influenced by the knowledge that teams have *a priori* about the system domain and the project scope. According to Fernández et al. (2012a), a high level of domain knowledge allows for a greater awareness of the effort and time needed for the project, and thus improves schedule planning. These authors also found that some of the artefacts produced as outputs of requirement activities may vary in their completeness, depending on how much the client and domain are already known by the requirements team. They stress that for already-known clients (when a previous project has been carried out for that client), the Systems Limitations artefact were left incomplete. Furthermore, System Success Factors and Acceptance Criteria artefacts were showed to depend on an *a priori* knowledge about the client and its domain. The less familiarity there is with the domain, then the higher the chance of these artefacts being complete. The study concluded that when some of these artefacts are not produced or completed, then the specification of requirements cannot be considered as complete either.

However, this capability can also bring some disadvantages to the process. When an analyst becomes too confident, or when they faces major time constraints, they may fail in asking some questions that they considers to have an obvious answer for. In the worst scenario, they may even consider that the interaction with the client's team does not need to be so intense, as the analyst themselves already knows what the client needs are. The imposition of the analyst's own point of view over the client's opinion may be hazardous (Hadar et al., 2014).

Moreover, the high domain knowledge of analysts can lead to biases on the solution of a new project (Wiley, 1998). This can impact when they somehow constrain or force the new solution to be similar to a previous one. This can inhibit the emergence of new ideas, and can even decrease the suitability of the project to the specific situation. This phenomenon has been noted in the literature as being a barrier to obtain correct and complete requirements, as the analyst is biased in their assumptions, instead of trying to addresses the issues with the client (Hadar et al., 2014).

Thus, Berry (2006) argues that "intelligent ignorance" should be part of the requirement's team. According to the author, members of the team should have a low level of domain knowledge, or at least, these members should be added during the requirement's process. They are expected to bridge the gaps that experienced analysts may have left uncovered. The author further explains that tacit knowledge acquisition from the questions that someone ignorant in that domain may achieve, will allow them to get a better and more complete solution.

In conclusion, domain knowledge is critical during the requirements process, as it allows teams to address some of the most typical problems associated with this phase (Hadar et al., 2014). However, the ignorance domain can facilitate the generation of new ideas that are domain independent, can help to address issues left open by experienced analysts, and can even surpass their tacit assumptions (Berry, 2006; Niknafs and Berry, 2013). Additionally, this ignorance has also proved to be more efficient in activities such as requirements documents inspections (Mehrotra, 2011), and it also allows for the exploration of new alternative solutions, as on account of emerging new perspectives regarding the same problem (Niknafs and Berry, 2013).

So far, the focus of system domain knowledge has been on the supplier team side. However, the lack of understanding by the customer team should also be considered.

Problems in understanding the system can bring some disadvantages to the project. One such disadvantage is the clearance of users for project activities. Chatzoglou (1997) found that users' motivation decreases as their communication and project knowledge increases. The author argues that this might happen when users begin to understand the proposed solution and do not fully agree with it, or feel that their suggestions are not being considered by the supplier team. This may even be worse when considering some of the problems referred to above regarding the analysts' assumptions and information is thus taken for granted.

Another disadvantage might be the impact of domain knowledge on the process of decision-making. As the requirements process is essentially based on communication and the negotiation of possible solutions among clients and analysts, they should be able to decide what to do, when to do it, and which information should be needed to support these decisions. To do so, they require an accurate understanding of the system domain, and a detailed understanding of the software product that is going to be developed (Aurum and Wohlin, 2003). Without this clear understanding, the decision-making process could be prone to failures, since the decision (when made) would be based on uncertainty.

According to Fernández and his co-authors (2012a), stakeholder reliability can impact on the level of requirements specification completeness, and may also enhance future changes to the defined requirements. From above we could posit that the lack of knowledge of stakeholders may influence their level of reliability.

During the interviews, statements were collected concerning the client team's attitude and involvement in requirements activities. One of the most cited statement referred to how critical it is to have a client who is a decision-maker. According to respondents, someone has to assume the decision-making role in the process of requirements. Even when the system understanding of that person is not complete (neither the real impact of their decision), it was emphasised that "worse than a bad decision, is an indecision" [OU10I1].

Participants have also stressed concerns about two other issues related to stakeholder attitude, knowledge and behaviour. Once system knowledge and its implications seem to be relevant to the project scope definition, then the participants showed to be disappointed and concerned about the client's lack of involvement regarding the final outcome of this phase. According to what was mentioned, it is relatively common that a client has no idea

or feeling about those technological issues that can shape possible solutions (see for instance [ST08I1 #1]). Consistently, the existence of someone with this type of knowledge in the client's team was considered to be a critical success factor for the project [DZ12I1].

Extracted from the interviews:

"It partly depends on the kind of person that is carrying out the requirements elicitation: their knowledge of the business domain, or their approach to client business. Obviously, it also depends on the know-how that the client possesses, about their own business domain, which many times, sometimes is zero, and also about all the technological and application concepts" [NV11I3]

"It is important to master what is going to be computerised, as no one can computerise what is unknown. If you do not know anything, then you will have to learn it from the client team." [NV11I2]

"The tool for requirements analysis is experience, the experience that the team has in that business area, the knowledge that the team has about the solutions, and in analysing the requirements" [AG05I2]]

This need comes as a reverse to the advantages brought by analysts that possess domain knowledge. Apparently, there is some difficulty in establishing communication and negotiating activities when the client does not understand certain technological constraints that may exist. A participant mentioned that some of the problems that they were facing during the requirements phase were due to the limitation of the agreed tool that the customer could not understand [DZ12I3].

Perhaps as a result of such weakness, there were participants who complained about the inability or unwillingness of clients to carefully read and analyse requirement documents (see for instance [NV10I6] or [DZ12I2]). This was also reported even when these documents were mandatory by the client company. The interviews reported that this lack of analysis and perceived interest could at least partially discourages the supplier team from producing these outputs [OU10I3].

According to participants, clients do not read the documentation, on account of a lack of time [JN01I1] and lack of involvement [NV10I5], but also because they might feel that

this should not be their responsibility, or that they actually do not have the skills to evaluate them correctly [JL04I1 #G]. The latter brings us to domain knowledge again. Often clients have no idea of the solution they want or the real needs that they should have for their system [OU10I3]. In other cases, analysts feel that what the client is providing is just not enough for what is needed to define a software solution.

Extracted from the interviews:

“I can have a good customer who is telling me what they know, and everything they know, but what they know may not be enough for what they want” [AG05I5].

"Clients generally do not fit the job description, or often do not have much skill and may be watching and collaborating during the requirements phase of information systems. This is how top managers are, they are not oriented to the areas of information systems, at least most of them. But then, when we have to develop the system, we always have to talk with them to develop the system, and we have to explain it in a procedural way" [JL04I1]

This confers greater uncertainty and abstraction to the project solution. Thus, the supplier team has to assume the responsibility of devising a suitable solution, with even less knowledge and support than would be expected [ST09I3]. The Table 45 summarises the main problems mentioned during the interviews that are related to system knowledge. Additionally it gives an example extracted from one of the interviews.

The consequences of poor domain knowledge on the supplier team were also reported during the interviews. According to some participants, having a member on the team with extensive knowledge and experience in the client and the business area, can be a critical success factor for the project (see for instance [OU10I2 #1] or [JN01I1]).

Extracted from the interviews:

“Often the client does not know what they want, really… and here the problem was again made easier, due to the person who was working with me, who knew the business well. He often said, "Are you sure you did not mean this?", "Ah, so this is the requirement". So, you know, the requirements we collected have not been imposed by the client. We suggested them and then the client accepted, almost ... because the client, when we showed them something, they said "Oh, that’s it". Because the hardest part is the client

coming up with "I want this", and we have to manage turning it into requirements" [OU10I3]

Table 45. Problems affecting Client Effectiveness during the RE (mentioned during the interviews)

Problem found from client team	Example extracted from interviews
Lack of the time	"I've never seen a project, at least in my experience, where the user is taken from their daily work to work at 100% in an analysis project. I think it does not happen at all. They end up doing it in their free time, which typically is not much. And thus requirements gathering monitoring ends up being made very lightly." [JN01I1]
Lack of motivation	"Because after all, in the functional analysis there are many [clients] who do not have patience to fully read it. Many just give their OK and then "Oh, I did not even notice it was there"…" [NV11I3]
Lack of domain knowledge	"Nor even the client company, although it has done a similar application in the past, it had not mastered all the concepts" [NV10I4 #1]
Lack on the clear understanding of the wanted solution	"With my experience on previous projects where things did not go well, I find it important that the client side is aware of what they want" [DZ12I1]
Lack of technological knowledge	"The capacity of the client side to have a person with computer skills and good knowledge of the existing application ah, this reduces this ambiguity, OK? In other projects where there is no such person in the client-company, the ambiguity rises considerably, yes" [NV11I3]

Source: the Author

Nevertheless, some evidences was found in line with the literature which argues that much knowledge can also bring some obstacles when carrying out requirement activities. Participants working in the same domain and for the same client for a long period of time argued that they should not go through all the stages of the requirements phase in order to improve efficiency [JL02I1 #1]. Another participant, with project management role, revealed a lack of knowledge of the business domain and the project client. He told us that he was assigned to that project in an attempt to unlock a behaviour that was entrenched between the client team and the supplier team. This behaviour included mutual disinterest on the project, as it was not consider appealing any more, almost like a routine task, and as a consequence, projects performed with those teams working together were lacking rigour and quality. This manager also reported a set of situations in which he

revealed the difficulties he had in breaking the cycle: the team believed that no documentation was needed; the mute knowledge, i.e. not explicitly documented anywhere; and the set of *a priori* background assumptions by the analysts [OU10I3].

Extracted from the interviews:

"The company's team knew the client. We had team members who were with that client for six years. This was not my case, as a manager, because I only went to this client now for this project, and therefore the reason why the project manager was changed was to try to fix this question of "Yes, that's OK, that's OK...", in order to impose some boundaries with the client, because there was a history where this did not happen like this. They thought it would be good, "Let us change the person who is in charge to try to stop this behaviour and to organise the team to think as it is important to elicit requirements to be able to make good quality tests." (...) So we were able to show, we... the client could see what we wanted for the solution and from there on we could easily draw up the requirements. Therefore I feel happy, I feel ... ah ... I gave a lot of emphasis [on requirements], to the team, even to the person who was the analyst, because they had been doing that for some time and knew everything quite well. They even came to be upset with me because that was not a requirement. Of course we learned many lessons in this project that I would do similarly in the next project. But it would also have some improvements, such as for instance, the way people write the requirements" [OU10I3]

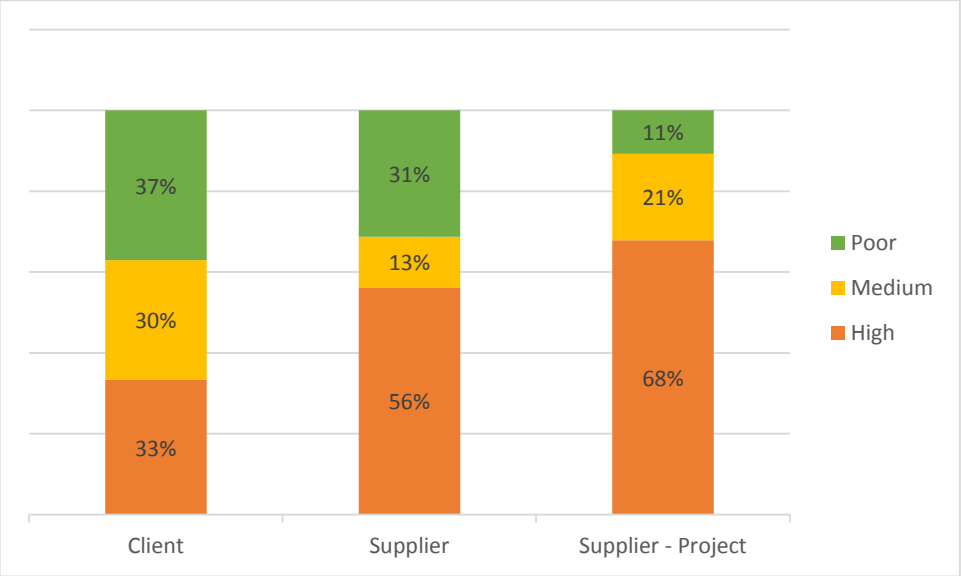
Considering both the literature and evidences collected during the interviews, it was decided to include this dimension in the Requirements Framework for Categorisation. In fact, this dimension was previously included in the project categorisation framework, but the emphasis made again in the context of the requirements phase made us consider its inclusion in this framework also, even when considering the risk of repeating ourselves. But, comparing the results obtained in this dimension in the project characterisation context and in the context of requirement activities, some different, although small, were found.

The second and third column of Figure 24 show that, although the proportions remain similar through the different levels of knowledge, the percentage values change a little among them. One reason for this might be that the knowledge that someone needs for project execution could be more general, i.e. less detailed, than the one needed to perform requirement activities. Or it could also be that who actually assessed the project's existing

knowledge may not be the same person who was involved during the requirements phase activities. Therefore, their evaluation might be based on, or perceived by others. Regardless of the reasons, we expect that revisiting this construct in the context of requirements can bring new insights into the discussion.

The first and second columns of Figure 24 show the differences in knowledge level between clients and supplier teams. Domain knowledge was addressed considering three categories: poor knowledge, medium, and high knowledge. Each evidence reported in the interviews were classified into one of these categories. The results show that clients were almost equally told to have different kinds of knowledge. However, when compared with the same knowledge level of the supplier, clients were mentioned less times to have a high knowledge, and were frequently classified as slightly or moderately knowledgeable.

Figure 24. Domain Knowledge distribution considering Client Team, Supplier Team and Project Categorisation.



Source: the Author

It is worth noting that the results presume the client to be the one who really operates in the given domain. It seems contradictory that they are regarded as the less knowledgeable of their own context. Although the context of a software system may be different from what the client is used to, it might be assumed that the decision about the system development is a client's initiative. Thus, it should be expected that previous to such decision, a careful and detail analysis was performed to support the need for the

system construction and to identify to what extent it should operate. If so, then at least part of the supplier teams' complaints would already be addressed. This raises a question about what the real motivations are for building a new system, and what is the regular analysis to support such decision.

Strategies

Frequently, the study of the requirements has involved how this process has been executed. The literature has shown that the quality of a software product is largely determined by the development practices that were used (Aurum and Wohlin, 2005; Nasir and Sahibuddin, 2011). Previous studies found that besides these practices, other problems have emerged and hampered the execution of this phase. Among them, the lack of well-defined procedures and guidelines for the use of the most appropriate methods and tools can be pointed out, and also the poor use of the existing modelling techniques (Iivari et al., 2000; Mathiassen et al., 2007; Svahnberg et al., 2015a).

On this basis, several empirical studies have been presented that look for the best techniques, methods, tools and principles to reduce the problems related to systems development (Iivari et al., 2000; Svahnberg et al., 2015a). In fact, the amount of suggested practices has been so high, that some authors have been calling it the "methodology jungle" (Avison and Fitzgerald, 1995). This also yielded the suggestion of contingency models that link the proposed techniques to their operating context (Mathiassen et al., 2007).

Simultaneously, frameworks have emerged with the aim of guiding the development of projects in a standardised way. Such frameworks include CMMI (Team, 2006), and others from ISO Organisation, such as SPICE (El Emam, 1997) (see (Schneider and Berencach, 2013) for an assessment on frameworks for development process). However, they usually only cover partially, or slightly the requirements phase, due to their broader scope (Svahnberg et al., 2015b).

Further, specific frameworks were also developed to address the best practices to apply to this phase, such as the Good Practice Guide (Sommerville and Sawyer, 1997), R-CMM (Beecham et al., 2005), or the Requirements Engineering Process Maturity

Model (REPM) (Gorschek et al., 2003). Still, Svahnberg and his co-authors (2015a) stressed that within the requirements phase, a range of activities can be highlighted, that are not always fully covered by these frameworks. Even considering those created to be applied in this stage, only a few include all its activities. These authors noted that most of the suggested practices tend to focus on requirements management activities, followed by the analysis phase, planning, elicitation and validation. In the former case, only 25% of the number of practices from the requirement management were applicable (Svahnberg et al., 2015a).

Despite the relevance of this topic, as demonstrated in several empirical studies, some authors have shown that what happens in practice is far below these concerns and recommendations (Guinan et al., 1998a). According to Chatzoglou (1997), and more recently Niazi and his co-authors (2006), many of the projects they analysed do not use any methodology, or fail to use best practices during their development or during the requirements process. But even for those that do use them, they did not always choose the most appropriate techniques to the context in which it was to be inserted (Derakhshanmanesh et al., 2014).

The adoption of practices should not be considered outside their context. This includes the type of project, the team involved, or the level of the organisation's management capabilities (Iivari et al., 2000; Derakhshanmanesh et al., 2014). Existing recommendations reinforce the need to make a decision based on careful analysis of factors to determine the appropriateness of the practice. Only then it is possible to improve the overall system performance and also the organisation’s performance (see for instance (Niazi, 2006; Carrizo, 2014)).

Chatzoglou (1997), for example, found that projects developed for internal use must perform less iterations through the appropriate use of methodologies that focus on the team members’ attitude and the project management activities. On the other hand, projects with a moderate level of problem structuring should pay special attention to the use of methodologies, to user-involvement, and to the general attitude towards the project (Chatzoglou, 1997).

The author also stresses that the incorrect or non-existent use of methodologies and tools in the requirements process may explain some of the problems found in the literature that impact the planning activities. Although the requirements process is not always

planned, when it does, it tends to be modified or diverted from what was originally thought. That happens on account of the lack of initial information, poor analysts' experience, the lack of stakeholders involvement, and the scope changing, among others (Chatzoglou, 1997).

During the interviews, participants highlighted topics about the use of strategies and practices for each project. All references were analysed and organised into three concepts: methodologies, techniques and tools. Before proceeding each concept should be clarified.

Using the layering approach suggested by Iivari et al. (2000), we assume that an approach can be instantiated by methodologies, which in turn uses techniques. Additionally we believe that these techniques can still be supported by tools. An approach is "a class of specific methodologies que share a number of common features" (p.186). A methodology is "an organised collection of concepts, methods (or techniques), beliefs, values, and normative principles supported by resources material" (p. 186). Finally, a technique "consists of a well-defined sequence of elementary operations que more or less guarantee the achievement of certain outcomes if executed correctly" (p.186). To better clarify each concept an example is given. For more information, refer to (Iivari et al., 2000). An approach is, for example, OO (Object-Oriented) or SSM (Soft System Methodologies). OOSE (Object Oriented Software Engineering) or SADT (Structure Analysis and Design Technique) are methodological examples, whereas techniques can be Use Cases, or OD (Object Diagram) (Iivari et al., 2000).

From this point forward, each concept is discussed separately. Whenever possible, a brief explanation is included of the extent of use of each practice (Niazi et al., 2006; Svahnberg et al., 2015a). Considering the categorisation proposed by Pressman (2005), it is intended to understand whether participants take decisions on which techniques to use giving the nature of the activities that should be performed.

Methodologies

A content analysis of the interviews revealed that the participants not always mentioned methodologies in a consistent way. While some clearly refer to a known methodology from the literature [DZ12I2], others mentioned as methodological options what are commonly known as techniques [DZ12I3]. Still, there were some who needed further clarification about the meaning of "methodology" [ST09I1]. The confusion

between these concepts may suggest some lack of awareness about its importance in the system development process, and for the requirements process as well.

Without a clear understanding of what methodologies are, and how they can help in system development, it is unlikely that their choice is made based on issues to ensure that they are the most appropriate for a specific project (Carrizo et al., 2014). Moreover, considering that the methodology guide the choice and the use of techniques and tools (Iivari et al., 2000), we suspect that they may has not been chosen in a systematic or formalised manner. If so, the choice probably has been done subjectively, i.e. without considerations of suitability (Chatzoglou, 1997). In compliance with this, many participants reported that the choice of methods or techniques to be used are made accordingly to "*those used here in the company*" [ST09I2], or "*what the client wants*" [OU10I3], without any reference of preliminary evaluation of their suitability.

Examples from the interviews revealing criteria for methodology choice:

"The team was aware of the methodology to be adopted and the customer team had total coverage of the business area. The methodology was strictly followed, with complete knowledge, because the customer team knew how to teach it" [NV11I2 #1]

"When we go to a client we always ask "Do you want us to follow your [Methodology], or do you want that we follow ours?" [ST08I1 #G]

This situation is enhanced by participants' statements about the suitability of some of these practices compared to the reality of projects and companies [JL02I1]. There were also some complaints about the suitability of some of these techniques when considering the average level of knowledge and involvement of clients in the projects. As a result, some of these techniques acted more as obstacles to communication than facilitators [ST08I3; OU10I2]. The question is the level of formalisation of these techniques. When the client perception of a technique is that they have no skills to properly understand their outputs, then they assume that it is not adequate (see excerpt below). This may even foster one of the most often mentioned problems of client involvement: the ability to read/understand the requirements documentation (for example [ST08I3; DZ12I3; ST09I2; NV11I3; JN01I1]).

Extracted from the interviews:

“Yesterday I received an email from a client who told me "Oh [participant’s name], the document is very well done, but we do not have the technical capacity to analyse it! So, we are going to just keep the requirements matrix, because that is the only thing we can understand. You know, the use cases seems to be cool, and they seem good, but we are unable to know if they are OK, or not." [ST08I3]

The lack of standardisation knowledge about methodologies becomes an obstacle in the global perception of what are those methodologies that are actually used. However, assuming that methodologies are structured methods that emphasise the use of a set of consistent rules and procedures (Guinan et al., 1998a), it was decided to classify the methodology through its procedural nature, usually termed a model (Martin et al, 2002, Boehm, 1988). Thus, the focus is mainly on the sequence and structure of the proposed activities, to assess the type of model used.

This is a common procedure in the characterisation of methodologies due to their sequence of proposed activities. For example, the original Waterfall model predicts various activities that should be performed in an iterative and sequential manner. Therefore, it is regarded as a linear model (Pressman, 2005). In turn, Agile methodologies provide a more flexible and incremental development, which make them iterative or incremental models (Larman and Basili, 2003).

Following this rational, we considered four categories of models: Linear; Linear with Iterations; Iterative; and None/Ad hoc. Each one was completed with the descriptions of project activities. A summary table is presented in Table 46, which presents and explains the categories, shows examples of methodologies found in each category, and also some illustrative descriptions from the interviews.

The following step was to calculate the number of references made within each model. Note that during the same interview, several different models can be referred to, which are associated or not to different projects. As explained by Martin and his co-authors (2002), a model can be combined with the principles of another model. We may have, for example, a linear model and perform it through several iterations. The result is a linear model with interactions.

Table 46. Development Models Criteria

Model	Explanation	Examples of Methodologies	Examples from the interviews
Linear	Include methodologies with a sequential and rigid structure of activities	SSADM; Original Waterfall Model	"There was an early requirements phase, right? We closed the requirements, then, we started the development phase. We finished it, then we started with the testing phase and so on. So here we performed these well-defined phases" [ST09I2]
Linear with Iterations	Include combinations of linear structured methodologies with iterative and modular activities.	Waterfall Model Revised; Spiral Model	"At every stage, we implement one Waterfall model, as I was telling you earlier. It means that we close the requirements specification document that is followed by its implementation, typically when we got... so we already had four iterations or large iterations, and we are starting now the fourth iteration of requirements review, where we apply the Waterfall model for each case" [DZ12I2 #2]
Iterative or Incremental	Include methodologies that are performed through incremental activities. More flexible and iterative.	Agile methodologies: Scrum; eXtreme Programing (XP)	"Although at that time we did not use any agile methodology, in fact no one talked about it at that time, we ended up empirically using what today is known as Agile methodologies. This means progressing the project through iterations. We were making the progressions in the project by iterations, and in each iteration we put things into production, and we gave things to users. Therefore, it is very important, more important than doing a very long period of analysis with a very long documentation which then is delivered to the users to read" [JN01I1]
None or Ah hoc	When no methodology or structured procedures are used	-	"Nothing, nothing. (...) although we had training in business requirements and functional analysis recently. But here we found everything against the good practices; It was ping-pong technology" [AG05I4 #1]

Source: the Author.

Most of the projects that were studied were classified as being linear - twenty three (see Figure 25). This result is in line with what has been found in previous studies

(Petersen et al., 2009). According to the ISBSG report (2013), 74% of projects that actually gave information on the use of methodologies were said to use the Waterfall Model. As mentioned earlier, this model is classified as Linear, so the results are supported. The conclusion might be that this model remains very up-to-date, although it was proposed in the 1970s, and despite all the criticism (Petersen et al., 2009).

Nevertheless, there is a growing concern about the use of more flexible and modular methodologies to "get the teams to develop some things earlier" [DZ12I3] and to better tailor the requirements to real customer needs [JN01I1]. Adaptations to the linear model are in greater number. The most common cited practice is to consider several project life cycle iterations, also called modular approach. In this model, the project is divided into several modules of development, and for each, a linear model is applied. This modular division can occur in parallel (with several teams developing simultaneously), or sequentially (the delivery of a module origin the start of the following one). Each model is illustrated by excerpts from the interviews:

Extracted from the interviews:

"When projects are small, this is how it works [document approval and following implementation]. However, this project is planned to be eighteen months long, so it will be divided into four stages, i.e., the architecture phase, where we are at this point, which defines the architecture requirements and then implements the architecture. Then there will be four phases for a set of functionalities and... the first three will be performed sequentially, i.e. when the first ends, we put the system in production and begin the second phase, then put it in production, and then the third stage begins, etc. Each of the phases, each of these four phases, will have requirements analysis "[ST09I1 # 2]

"We started the development with the requirements analysis, after we specify the architecture design, then, based on that, comes the implementation phase and then the validation. Validation means various unit tests, integration tests, system tests and so forth. We implement this life cycle for each module, and then these various life cycles may overlap" [ST09I4]

It is also worth mentioning that only four projects were said to use iterative models (see Figure 25). Although some participants have indicated the use of some of the basic principles of such methodologies [JN01I1; JL03I1], it was also noted that in the cultural

context in which the study was performed, there is not yet enough maturation to satisfactorily perform such methodologies.

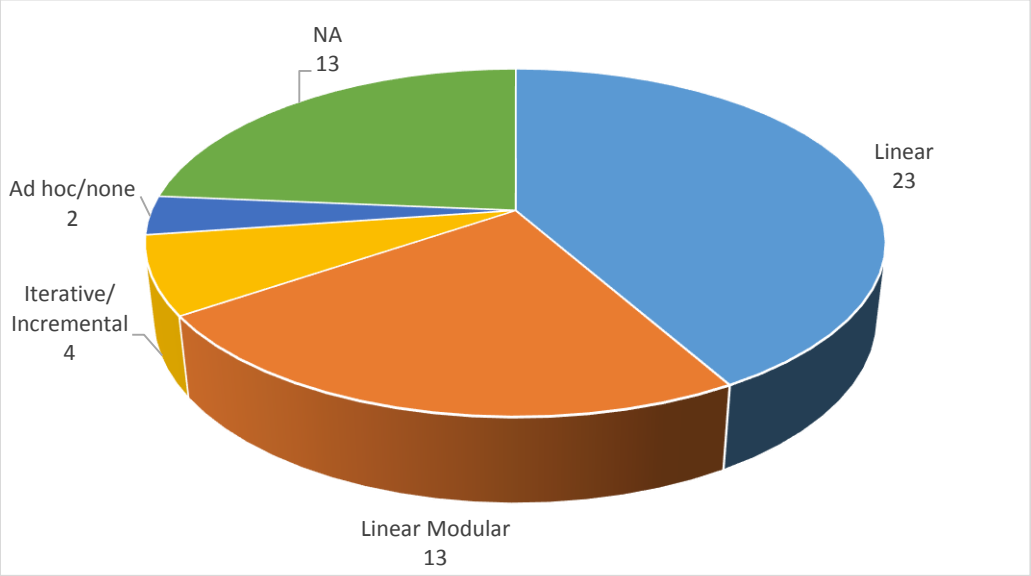
Extracted from the interviews:

"The point is that throughout my experience, and even when considering that projects are sold typically in a Waterfall model, as in Portugal, projects are always for a fixed price, yet we are not mature enough to use other models. There are some experiences, but unfortunately few. Oh, actually the strictly Waterfall model that is sold on paper, in practice is very difficult to perform. We are always doing… at least, we will always have to do two or three iterations of the waterfall model" [DZ12I2].

Moreover, with the emergence of standards for project development, companies felt the need to incorporate some of their recommendations in their management practices. Nine participants, from four different companies, refer to being accredited for at least one standardisation, CMMI being reported in all cases. Again, these results confirm those mentioned by the ISBSG report (2013) in 22% of projects that have at least one certification, CMMI being the most common one.

The relevance of these topics comes from their benefits as demonstrated in previous studies (Guinan et al., 1998a). According to the former authors, the use of structured methods will allow the establishment of communication channels between the external stakeholders and the project teams, which will aim to increase the involvement and commitment of users in the development process, as well as foster the teams' understanding of the users points of view (Guinan et al., 1998a). Pressman (2005) also notes that structure methods are import to help the team deal with the complexity and ambiguity inherent to the development process.

Figure 25. Distribution of projects considering their development models



Source: the author

Apart from these findings, it should be reinforced that the methodologies presented above act as guides for the development system as a whole. Although generally all give some recommendations regarding the requirements activities, not all cover its entire process (Chatzoglou, 1997; Svahnberg et al., 2015b).

During the interviews, some participants refer to what extend the methodologies were used support the requirements phase. One such example is shown in the following excerpt.

Extracted from the interviews:

"Well, we use an internal methodology based on CMMI, for the management of requirements. The templates, quite honestly, I don't know whether they follow any concrete methodology. Does it suit for what I need? Yes, it suits, considering what I know about it. But my focus is more on project management and not on requirements. (…) Because in terms of project management, I use PMI, which supports the activities, and then the methodology for development, or the internal organisation of the project, depending on the project. Now, I have been adopting some particularities of Agile methodologies for some projects, as it gives me another kind of possibility. This enables a kind of requirements monitoring which is easier in some circumstances." [ST08I3]

The analysis of the interviews found that fourteen participants reported the use of a specific methodology for the requirements phase. However we could not address how they are actually used in practice, or even whether they are the most suitable ones. The general references on this subject described a set of pre-defined procedure within the company, some supported by standard and other development methodologies. In most cases (Dermeval et al., 2015), the order of the procedures was described as being linear, establishing a set of activities to be performed within a rigid sequence, producing a set of outputs supported by the use of techniques and tools. In Table 47 we give some examples of such descriptions made during the interviews.

Table 47. Examples extracted from the interviews on the use of requirements process models

Type of Model	Excerpts from the interviews
Iterative Model	"The requirements gathering phase was divided into several functional areas within this project. We divided it into different modules. There were several iterations and reviews about the requirements document details, which we were building iteratively, according to the meeting results. The document then goes to validation, through several review iterations and ... and that's it, we come to the final one. Then, there is a phase of requirement management during the implementation, or the management of the scope of the project. From the prototyping phase, which is a slightly different methodology from the Waterfall one, and as it is actually completely different, we ended up performing the Waterfall methodology and that was how the development process unfolded" [ST09I3]
	"It would have been impossible if we had to close all the requirements phase and only then start the development. Therefore what we have done, was to close requirements packages and then we began to develop each one. We divided them into requirements packages, even though this was the first phase and: OK, this package is closed, we have the *requirement document* (DER), we have the *requirement technical document* (DET), and thus let us implement it, let us deliver it for testing" [DZ12I4 #2]
	"If I build that initial set of all features? This requires some requirement gathering at the beginning. I don't say that it doesn't exist, it does exist! However, I won't go so deeply into the design of all screens that will be developed. I make a light elicitation at the beginning. Then I prioritise the requirements and then, yes, as I need to implement, I do the analysis of what I will implement. But only for that small part that I am implementing." [JN01I1]

(Table continued)

Type of Model	Excerpts from the interviews
Linear Model	"We had several meetings with the client. We submitted the document for approval, then I did, I scheduled a meeting with the client where we reviewed the document. From that revision, some changes resulted, such as requests for, or etc...And then we produced a new version of the document which was approved by the customer." [DZ12I1]
	"We made the requirement manual, and then the client signed the document" [NV11I2 #1]

Source: the Author

According to Chatzoglou (1997), only half of projects used a methodology for project development. Almost all also covered the requirements phase, but only a small part of these used a specific methodology for this phase. Whenever no methodology is used, it seems that the process is supported by different, and non-related, techniques and tools.

The results from our interviews, although not addressing specific methodologies, are not far from the results obtained by Chatzoglou (1997). However, this number is shown to vary according to a set of factors, namely the project type, the existing knowledge of the problem domain, the target user, or the developing organisation (Chatzoglou, 1997).

In this study conditional factors on the use of methodologies were also reported: "we know the business very well. So, there are some phases that we do not need to get through" [JL02I1]. Thus, it would be expected that our results also vary according to project characteristics. Such an analysis, although beyond this study scope, would support or contradict the relationship between methodologies and some project-related topics. That would probably augment the existing knowledge as to what to expect from each type of project and even prevent some of their related issues. Therefore, we consider this topic to be relevant for future research.

Techniques

As it also happens with methodologies, the techniques used during the activities of requirements may dictate at least part of requirement phase success (Neill and Laplante, 2003; Fernández et al., 2012a). The techniques that support the requirements activities

aim to help with the completeness and clarity of specifications (Fernández et al., 2012a) to create effective communication channels; to establishes commitment by stakeholders (Guinan et al., 1998b), to the share of the proposed solutions, to foster an agreement in the negotiation process, to share and deepen the existing knowledge (Nuseibeh and Easterbrook, 2000); to raise different perspectives regarding the problem analysis, and to support the requirement evolution (Dermeval et al., 2015).

In order to deliver high quality software systems on time and on budget, it is essential to have properly structured and controlled requirement specifications that are understandable, comprehensive and consistent (Aurum and Wohlin, 2005). In fact, the completeness of requirements specifications has been discussed as being an important aspect of requirement quality, namely for reducing scope changes (Fernández et al., 2012a).

Although a rich set of methods for RE is available, not all the methods are fully integrated into the development process (Fernández et al., 2012a). Additionally, the use and suitability of the existing techniques is not always the most appropriate (Chatzoglou, 1997). One reason might be the high variety of RE methods that makes it difficult for the practitioner to assess which method and techniques are appropriate for their project (Fernández et al., 2012a). Thus, it is not surprising that Carrizo (2014) found that the choice of the technique is often made considering subjective criteria. He also stressed that this choice may decrease the quality of requirements results and can impact on the final software product.

Thus, the available RE techniques should be tailored to the context where it should be applied. Such a context may include different project parameters such as: time, budget, or the availability of end users, and also the clients' capabilities and the development process models that are used (Fernández et al., 2012a). The choice of techniques should also regard the type of knowledge or information that needs to be elicited (Davis, 2006).

The diversity of techniques and its appropriateness to specific projects was also highlighted during interviews. One participant affirmed about the use of a technique, "*I think it doesn't work well in all types of project. It depends. In some cases, a session is enough to communicate what the project will be. But for some other projects it is not enough.*" [DZ12I3 #1].

Generally, participants described a standard set of practices which are supplemented (or reduced) according to specific project issues. However, no major explanations were given about the reason that dictate the choice of such techniques. In [ST08I3 #G] the client profile was mentioned to justify the use of UML Uses Cases; in [ST08I3 #2] the functional complexity of the project to justify the broader use of techniques was mentioned, just to illustrate some typical responses. However, the criteria for choosing techniques did not prove to be carried out in a systematic way. Instead, it seemed to depend on the specific team's (or the manager's) perceptions of the project.

Extracted from the interviews:

"When the requirements are, as in this case, sufficiently clear, when they have a base platform, we usually only do the requirements matrix with a technical description. Then this description is converted into more technical language, at the level of a technical descriptive document solution. In other projects, when they are more complex, or have higher ambiguity, we usually use UML to support the requirements descriptions (…) the notation tool that we most frequently use internally is the use cases (...) and some activities diagrams also, which support the above; sequence diagrams, which have not been necessary. There was only one project to date where we needed to do so, but typically we make, the use cases are used. However, usually only if we have a player with a large IT background in the project, which is not usual." [ST08I3 #G]

Considering what has been described so far, it is not surprising that in some cases, the participants reported the use of techniques (in an ad hoc basis), with a poor result.

Extracted from the interviews:

"For this project in particular, the requirements component is super important. Then yes, we are using use case diagrams, domain diagrams, class diagrams, and then we have to extend everything and anything to make thinks understandable: concept views, requirements matrix to support ... it has everything! And even so, no one is nearing consensus. So you can see: not always can methods solve all issues, these issues." [ST08I3 #2].

Apart from the reported problems about the use of techniques, it is time to organise and discuss the list of techniques mentioned during the interviews. Several authors have suggested categories for classifying requirement techniques. Mathiassen et al. (2007) split

the techniques found in their literature review into four categories that focus risks on related issues.

Nuseiberh and Easterbrook (2000) used a methods classification based on the needs of the project. For this goal, the authors suggested six groups: 1) traditional techniques, 2) group elicitation techniques, 3) prototyping, 4) model-driven techniques, 5) cognitive techniques, and 6) contextual techniques. Based on this, Tun (2009) extended these categories with the “communication” and the "reach" dimensions. Each of these categories encompass a distinct type of techniques. A brief summary of each original group, as well as examples of techniques, are shown in Table 48.

Table 48. Groups of techniques, explanation and examples

Group	Explanation	Example of Techniques	Adaptations
Traditional techniques	Generic data gathering techniques	Questionnaires, surveys, interviews and analysis of existing documentation	Considers all the common and generic techniques to the requirement phase
Group elicitation techniques	To achieve a better understanding and agreement on requirements through the involvement of stakeholders and teams	Brainstorming; Focus Groups, RAD/JAD workshops	Considers the proposed techniques not only to elicitation purposes but also to the remaining activities
Prototyping	To elicitation when there is a need for urgent stakeholder feedback or the uncertainty level is high	GUI interface prototyping (mookups), Evolutionary prototype	Considers the prototyping not only as an elicitation technique but also as a guide to validation and negotiation activities

(Table continued

Group	Explanation	Example of Techniques	Adaptations
Model-driven techniques	Use an existing model to drive the requirement process	KAOS, Goal-Oriented, Scenario-based Methods	-
Cognitive techniques	Use techniques for knowledge acquisition	Card Sorting, Repertory grids, protocol analysis	Considers these techniques, not only for knowledge acquisition, but also for knowledge transfer, and consensus achievement
Contextual techniques	Use as an alternative of the above techniques focusing the social interaction and context analysis	Ethnography, conversation analysis and social observations	-

Source: Adapted from (Nuseibeh and Easterbrook, 2000)

Most previous studies focus primarily on techniques for the elicitation phase of the RE process. However, their usefulness goes far beyond. Although each of these models represents a good basis for techniques classification, they have significant differences in the way that they are applied, and regarding the purpose that they are covering.

The focus of this study is different from the above, because we are addressing the whole process of requirements, and not just a particular set of activities. The techniques mentioned by participants covered various activities of the requirements phase. Therefore, we decided to adapt the groups proposed by Nuseibeh et al. (2000) in order to include techniques for all the requirement phases. The right-hand column of Table 48 presents the changes made to those originally suggested. Thus, the analysis of the techniques discussed by the participants will be guided regarding the adapted set of groups.

The list of techniques mentioned during the interviews is shown in Table 49. The resulting table shows the frequency of each technique that was mentioned, grouped into each group of techniques. Then, each group is illustrated through excerpts from one of the interviews.

Although many presented techniques are referred to be used during the elicitation phase of RE, the truth is that they are transversal to many other phases. As Nuseibeh et al. (2000) highlighted, approaches explored to modelling activities are often used as elicitation tools to drive further discussion and requirement gathering. Furthermore, these models and consequent analysis can be part of the requirement specification, and they act as a tool to achieve agreement or communicate requirements among stakeholders.

Considering the results obtained, we found that the most frequently used technique is meetings (forty-one). As a meeting, we mean a schedule reunion of a group of people, somehow related to the project, from different origins (Supplier Company, Client Company or external) in a pre-agreed place and date, to discuss and reach consensus in project related issues.

The basic nature of these meetings are not far from those that guide brainstorming and focus groups, although procedures may be different. If we consider both as being a different kind of meeting, then the frequency number became even higher. However, each of these techniques, when explicitly mentioned, did not found many adherence (3 times each). Additionally we found that those who mentioned the use of this technique performed six meetings on average during a project.

An additional note goes for interviews. Carrizo (2014) found interviews to be the most frequently used elicitation technique. The author also found that it is often the only technique used, which contradicts the results obtain in this study. Participants only mentioned interviews for six projects.

The contradiction may be due to the interpretation of what is considered as being an interview. Unfortunately, the study did not provided any explanation of the scope of the interview technique. Does the author also considers meetings as one kind of interview? If he does, then the results are confirmed. If not, maybe the results of his study could be extended in order to assess their completeness due to meeting technique. Regardless of this, Carrizo (2014) found that the reasons for it spread of use are far from suitable for the application context. In fact, the choice may be simply on the grounds of history or familiarity.

Besides, some participants criticised solely using the meeting technique. According to [OU10I2], “The problem of a formal meeting is that they come to speak about the

evidences, you know? I mean, sometimes they do not speak about the problem". This is in line with other empirical studies that conclude that not just one single technique can be considered to be the best to use in all cases. Instead, all techniques have their pros and cons, and their suitability depends on the particular application domain. Thus, several authors have suggested the use of mixture of several techniques, in order to achieve the best purpose coverage (Nuseibeh and Easterbrook, 2000; Rehman et al., 2013).

Table 49. Techniques analysis results, considering each technique group.

Group	Techniques	Freq	Example from interviews
Traditional techniques	Interviews	6	"Interviews were made with the project sponsor, in this case also the project owner. Then interviews were conducted with the key users. The methodology we follow is the creation of a document with the requirements, with the result of requirements elicitation, where we identified, ah, the development that we are going to do, we try to specify all the rules that were identified at the time of the requirements gathering, and all the developments we will have to do, in a way that is readable for the user, and for the final customer " [JL02I1 #1]
	Document Creation	39	
	Analyse Existing Systems or manuals	8	
	Informal contacts	9	
	Risk Analysis	6	
	Informal Notes; meeting minutes	5	
	Total	**73**	
Group elicitation techniques	Focus Groups	3	"We had a focus group at the beginning, to whom we presented the solution we were going to develop. In the focus group we had people from the bank offices and also people from the central buildings. The solution was very different. The whole team was also there" [JL03I1 #2]
	Brainstorming's	3	
	Internal Validation	9	
	Meetings	41	
	Validation Sessions	15	
	Total	**71**	
Prototyping	Prototyping Evolutionary	3	"We could have to go through the development automatically, but due to the risks of not enough detail in the specification, we ended up doing a little prototype phase.(...) We developed some key screens, we only design the screens" [ST09I3]
	Prototyping Mookups	16	
	Total	**19**	

(Table continued)

Group	Techniques	Freq	Example from interviews
Model-driven techniques	User stories	1	"For this project in particular, the requirements component is super-important. Then yes, we are using use case diagrams, domain diagrams, class diagrams, then we have to extend everything and anything to make things understandable: concept views, requirements matrix to support" [ST08I3 #2]
	Domain Modelling	2	
	UML use cases	11	
	UML activity diagram	3	
	UML sequence diagram	2	
	UML State Diagram	1	
	UML Components diagram	1	
	UML Class Diagram	2	
	Data Modelling	1	
	Entities Diagram	1	
	Business Strategic Analysis	4	
	Total	**29**	
Cognitive techniques	Priotization	9	"We use a requirement matrix. That was the basis for the negotiating activities " [ST08I3 #1]
	Requirement Matrix - Traceability	7	
	Functional Mapping	1	
	Formal representation	2	
	Concept views	1	
	Total	**20**	
Contextual techniques	Technical Description	6	"In this project, for example, we adopted a new, a new structure based on contextualising. (...) We go to the ground testing with the workers, i.e., with the key user "So show me how it works. Pretend I am not here. Sometimes I may ask you a question, but keep going"(...) and the person will gather all kinds of processes, in an inherently way (...) and sometimes we gather requirements that were not presented yet. " [OU10I2 #2]
	Ethnography	3	
	Financial/benefits analysis	5	
	Total	**14**	

Source: the Author

The second most referred technique was document creation. Document creation relates to the set of artefacts that together represent the requirement specification. This document is often used to mark out the scope of the project, and sometimes to establish a contractual commitment. This technique was considered in the group of traditional techniques, due to their popularity. The creation of a requirement document is a common output of the requirement phase (Fernández et al., 2012b). Informal notes and additional documents creation were maintained separately as they are not so common practices.

Despite the relevance of this technique, Fernández et al (2012b) found that it were less needed for stable and well known project domains, and small projects.

The third technique that was most mentioned was the prototyping technique. The advantages of its use are several, namely the involvement and commitment of stakeholder to the project; the establishment of a more accurate project scope [DZ12I2]; and to encourage discussion [OU10I3]. These have been also stated from previous studies, however special care must be given with their widespread use. Fernández et al. (2012b) have shown that in some cases, this technique may inhibit flexible and adjustable specifications. This is specially truth to large projects, where this technique should always be followed by a requirement specification.

Considering the group frequency (shown in Figure 26), it is not surprising to observe that the most referred to groups are traditional and group elicitation techniques. What deserves a careful look is the result for model-driven techniques. These type of techniques were said to be used when the projects are complex and large, but also when the client comes from an IT company sector. However, some participants mentioned some difficulties when using these type of techniques, namely the UML models, as illustrated in the extracts below.

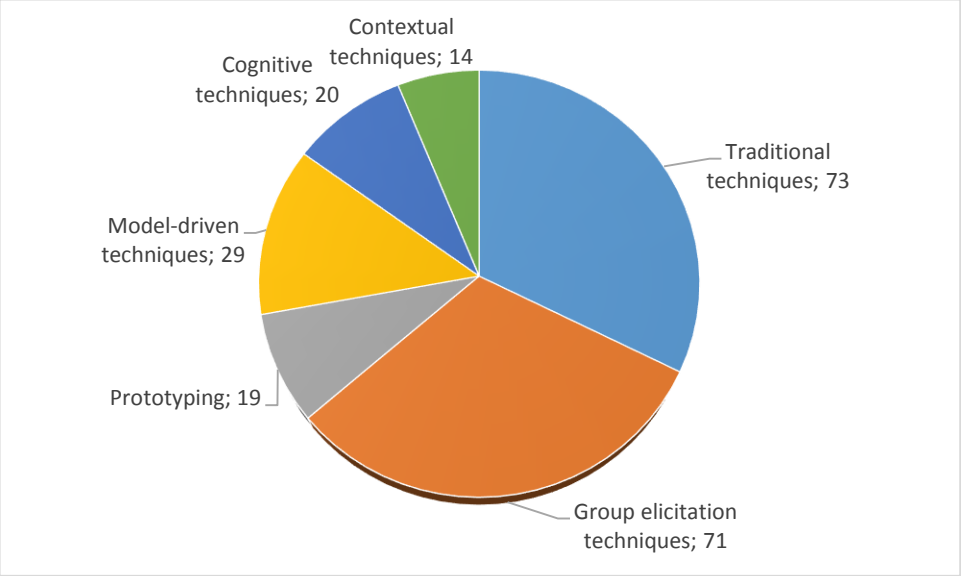
Extracted from the interviews:

"I have had many problems with clients because of the UML notation. I have had clients who told me "I need a special training to figure this out" [OU10I2 # 2]

"They [the client] actually want something like: requirement one, ah…that will be integrated with the system xpto. Pay careful attention to this aspect, and this and this. There is an identified risk that relates to that and that, link with that. The priority is x… cool. I agree with the requirement. That is what they want… it also depends on the client" [ST08I3 #2]

As was illustrated in one of these interview excerpts, clients tend to reject techniques that they do not understand. Instead they focus on those artefacts that seem to be more intuitive and easier to analyse.

Figure 26. Techniques results grouped into major classification dimensions



Source: the author

Comparing the results with those published in the ISBSG report (2013), we found that the widespread use of the techniques is not yet well established. The techniques involved in the requirements phase account for less than 40% of the projects that mentioned the use of any technique during project development. And often, the applied techniques raise some distance and discomfort among clients, which shows that the choice should also consider those people who are involved from the client side. Situations such as that of the previous excerpt may restrict the use of more structured techniques, as they became more difficult to understand.

Furthermore, when comparing the general outputs mentioned in this study with those described in Fernández et al. (2012b), we conclude that they are far from the complete list suggested in the Requirement Engineering Reference Model. Major considerations should be performed to improve the choice and the use of the requirement techniques.

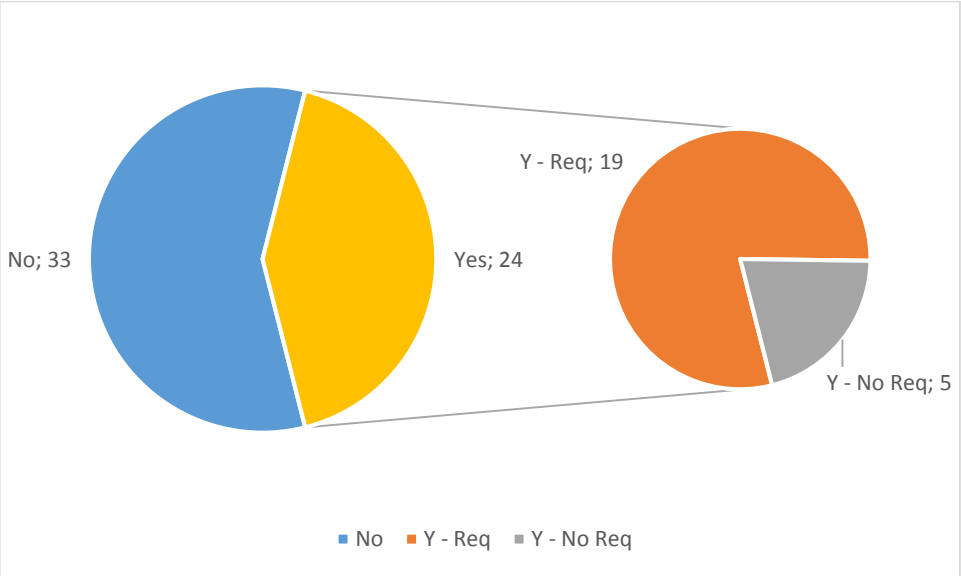
Tools

The impact of the use of tools in the development of software projects has not achieved consensus amongst researchers. Prendahkar (2007) found that the use of ICASE tools reduces the cost of development of large systems. However, Rodger (2011) contradicted the previous findings, saying that no significant impact was found for the use of tools in development's time and productivity. However, the author stressed that at

least in part, the results could be explained by the lack of developers' experience in the use of these tools. Also Guinan and his co-authors (1998a) stated that the use of these tools can help developers spread their message across the team.

Analysing the descriptions made by the study participants, we found that twenty-four projects used tools to support the development process (see Figure 27). Moreover, nineteen of these also cover requirements activities. These results showed better results when compared with those obtained by Rodriguez et al. (2012). The former authors found that the use of tools that support requirement activities was 5.2%.

Figure 27. Results on the usage of tools during project development, and particularly for RE



Source: the author

Most tools were based on internal procedures and standards. Only a few were designed to explicitly support the requirements activities. It seems that the awareness of requirement issues come from the standard processes. As this is a relatively new procedure in the studied companies, this may explain a lack of maturity about the use of tools, their features and their benefits. The following excerpt illustrates what was referred to as immaturity of the process.

Extracted from the interviews:

“Obviously where we worked faster, and obviously with my entry, was at the level of project management: monitoring, documentation and organisation of the project management. And of course, I had to extend it to the technical areas, you know? At this point we are still exploring which were the supporting tools for the project development. We were obviously leaning towards Microsoft tools as our partners, such as the TFS tool. For requirements management, there are tools and also for the quality department, which we are trying to standardise. However licensing issues influence the decisions, but we are trying to internally standardise this type of process. That’s why CMMI is not only, obviously, for my unit, but it is transversal. It does not have to be this way, but we are trying to make an extra effort to include areas such as SAP, QA, Infrastructure and Projects, which is where I belong, where I have my responsibilities." [ST08I3]

These results, although encouraging, remained below the expectations. With the high number of tools proposed both by industry and academia, widespread use would be expected. Additionally, many of these tools address some of most referred to problems which affect the phase.

As an example, one of the critical success factors for RE is the use of repositories to maintain requirements information accessible and updated (Cheng and Atlee, 2007). Thus, the use of tools that provide such repositories are critical for requirements. Surprisingly, only one participant slightly mentioned the use of such a technique, highlighting the benefits of their use.

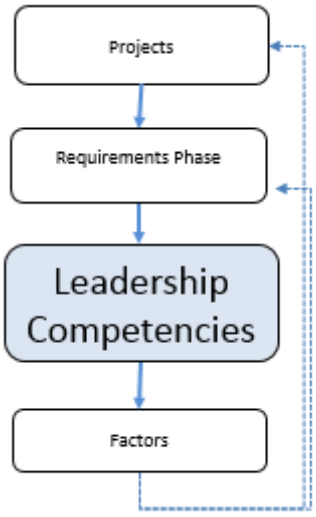
Extracted from the interviews:

“Oh, we used a free tool that was called PangoScrum. It allows me to have a record of my colleagues who ended in the units, puts the units as closed and tested, and we quickly saw the progression. (...) As the client did not have access to our infrastructure, we only have this type of online tool. If they wanted to, we could also follow through our reports of progression. That is, in terms of project management, I continued to do the reports as requested, I do it weekly. We also held the same steering meetings, but the difference here was that the client was able to daily monitor the development of sprints” [OU10I2]

With the end of the presentation of the attributes from the requirements model we may conclude that major considerations should be perform to improve the overall requirement process, in order to standardize their procedures to best practices proposed in the literature. Still, new insights emerged from this discussion. Some of those questions include: How does the level of knowledge from both parties about the business rules that define the project scope impact on the progress and success of the phase? Is the number of people involved in the phase' activities a positive factor for completeness of the collected information? How is it related the way the phase and its activities are performed and the phase characteristics? Does it impact the success of the phase?

This set of questions is far from being exhaustive. However, despite the relevance of these topics on the successful implementation of projects, the continuity of the exploration of these topics here deviates the attention of the main objectives of this study. Therefore, we agree that these topics are very interesting for future research and we move to the second phase of the analysis on the relevant leadership competencies within the context described above.

4.4 Leadership Analysis



The presentation and discussion of the leadership topics is the next step in the logic of analysis our research. So far, we have known and characterised the projects under study and also discussed topics related to the requirements phase. Now it is time to address the leadership and how this relates to the context described below.

The organisation of this subsection follows the order of the questions posed in the interview in order to maintain the guideline of the results. The first subsection presents how leadership is applicable and relevant to the requirements phase. Then we present the resulting list of the leadership competencies explored by the participants. This list is also reviewed in the light of the previous studies found in the literature.

We follow with the summarised list of the contingency factors mentioned in the interviews. Each of these factors is analysed among the leadership competencies and a preliminary model instantiation is shown.

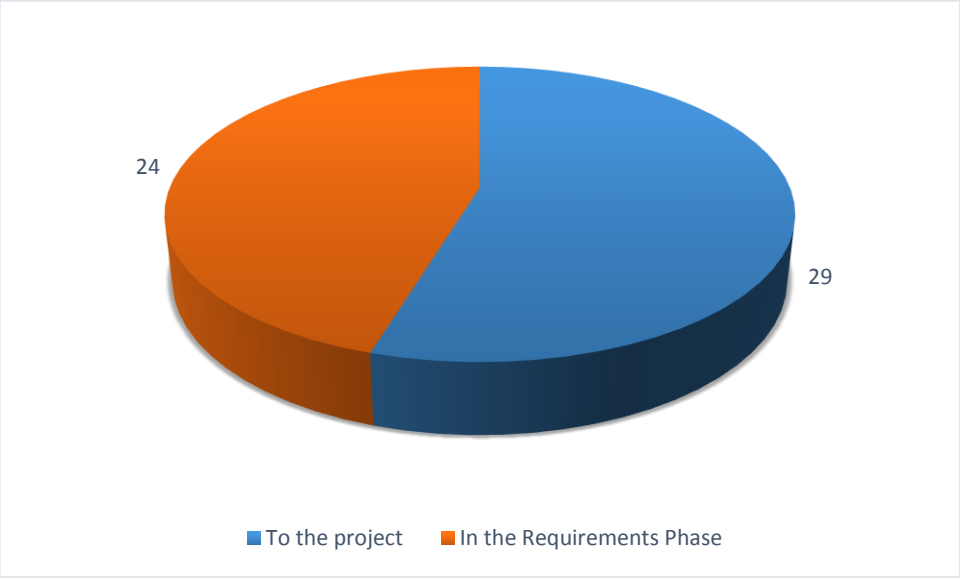
Finally, we discuss the results of the assessment of the leadership competences, proposed by Dulewicz and Higgs (2003b), considering the activities carried out in this phase. This chapter ends with a final summary of the results of this study.

4.4.1 Leadership in the Requirements Phase

Generally, leadership has been stressed as being a critical factor on project. However, sometimes the literature also shows contradictory results. To assess the relevance of leadership in the requirements phase, we asked participants to discuss how these topics would be related.

The responses were unanimous in affirming that leadership is an important factor for projects. However, not all participants agreed that leadership may vary through the project phases. While some consider leadership to have no major variations through the project life cycle phases, others saw leadership as being specifically critical for this phase (see Figure 28). To illustrate each position, we show excerpts from the interviews below.

Figure 28. Assessment of leadership relevance in the RE



Source: the author

Extracted from the interviews

“I think it is important throughout all the project lifecycle phases, especially if it is an iterative development” [JN01I1]

“That is, the analysis may need the particularity of focussing people and guiding them, and it forces them to take decisions and to be focussed on the solution design” [NV10I4]

“If the team is well developed, or in other words, if the team knows how to work: if they are good programmers; if there are no problems with the programming languages; if there are no problems in the databases; if there are no problems in the team's operation… For example, people who usually start working always at the same time, or people who like to work more at night, and others who like to work more during the day. Because we give people that kind of flexibility here to combine their schedules. But you have to guarantee that at least for six hours they have to work together, right? One might like to work at night, but the other loves to work in the morning. So, at least for six or seven hours they have to see each other. Because people are working as a team, right? So, apart from this, if the project has these people, but in a controlled way, then it almost doesn’t need a leader, right?” [JL04I1]

Nevertheless, one of the respondents claimed that different types of leadership must exist along the life of the project. For instance, during the development phase, the leader should essentially focus the team to meet the established plans and deadlines. There were also participants who argued that the developing phase needs to be managed rather than led, in the sense that the phase should be monitored. These assumptions are in line with some of the previous studies (see for instance (Frame, 1987; Turner, 1999; Russo et al., 2005; Muller and Turner, 2007)).

Surprisingly, references were also made during the interviews that stressed that the impact and relevance of the leadership does not necessarily dependent on the project or phase, but rather on the type of activity that has to be performed [ST06I1]. Therefore, at first glance, the results of this study differ from those theories of leadership, where different leadership styles should be assigned to different project’s nature and types (Dulewicz and Higgs, 2003b; Muller and Turner, 2007).

Furthermore, we found a greater emphasis on the need of the leadership skills in all interactions with the client throughout the development of the project. The need for an effective leadership was mentioned to be higher.

Extracted from the interviews

“I think in all contacts with the client, throughout the project phases, [the leadership] is always crucial. Because otherwise one could say "Ah, you just have to put a leader there and everything will be OK. Then he can go away and from this point forward the project runs alone.” But this is not true. I think that all contacts with the client end up being literally negotiation activities” [ST06I1]

Moreover, the analysis of the interviews showed that the participants who stressed the relevance of the leadership in this phase also tend to distinguish the skills needed to deal with the client and with the team. Even those participants who did not, also stressed the need to be able to handle these different types of situations.

To further clarify these positions, we asked participants to assess how leadership could be relevant in this phase, i.e., participants were asked to explain why they think leadership is important in this phase. The responses analysis resulted in a set of leadership goals that represent the main tasks that a leader should be able to accomplish (see Table 50). These tasks were mentioned to be critical to the success of this phase and were assigned to the leadership role. To each goal of Table 50 we provide an illustrative excerpt from the interviews.

Table 50. Summarised results on Leadership goals for the requirements phase

Goals	Excerpts from the interviews
To conduct the meetings	"We need someone who can almost reduce the room to silence and follow an idea, because otherwise [the meeting] can take six hours to discuss everything" [ST06I1]
To give the strategy	"I think that it is important to have someone, someone from the team, who can gives the strategy to the project, right?" [DZ12I1]
To manage the project	"The leader should be able to manage the project" [JL02I1]
To guide the project to the results achieving	"[The leader must] know how to guide and motivate the team to the project conclusion" [JL02I1]
To mitigate client pressures on team due to scope negotiation	"The leader has to protect and mitigate the negative impact that may exist between the client and the, and the development team" [JL02I1]
To take strategic decisions	"It has to be the leader of the project who makes the decision on whether the project should progress" [JL02I1]
To manage and negotiate the project scope	"[The leadership should] manage the project scope. I usually take on the scope management" [NV10I4]
To foster team formation	"From the team's point of view: [the requirements phase] it is also when the team has to be built. Therefore, it also requires attention and ... Because in the other phases of the project, then, the team is already known, i.e. team members know each other"
To manage the human side of the project	"For example, I would not say success... I would say that a project can achieve its goals [without the leadership], but cannot be successful. That's it, I know cases were they sniff out the team, quotation marks. I know projects that were finished on time, and that even delivered what the client asked for, thus, the project from this point of view was a success. But in the meantime half of the team have separated, or half the team left the company. So, he achieved the objectives of the project, but for me, the project was not successfully executed. Because clearly the management of the human component was poorly done. Maybe he exaggerated in the work overload for the evenings or at weekends."
To foster a controlled discussion among the team	"Everyone should give their opinion and should be involved, but when no consensus is possible or when ..., who has to decide is the manager. And then it is the manager who decides and it is that decision that has to be followed"
To monitor the project	"A leader is someone who is worried if we are progressing on schedules, if we are doing what it's supposed to, if we are all properly working "[OU10I3]
To Win the trust and client closeness	"The way he got the client intimacy and the way he understands the client is crucial during this phase"
To be a proxy between the client and the team	"[the leader should] filter what the customer is asking for. The team must be focussed, must be working to meet its deadlines, regardless of whether there will be a phase two, a phase three, or a phase four. Because we work a lot, and sometimes the client… Sometimes it's difficult to make a fence for the client, because if not, then the client would possibly come saying that all the requirements have changed and the team would probably be in shock"

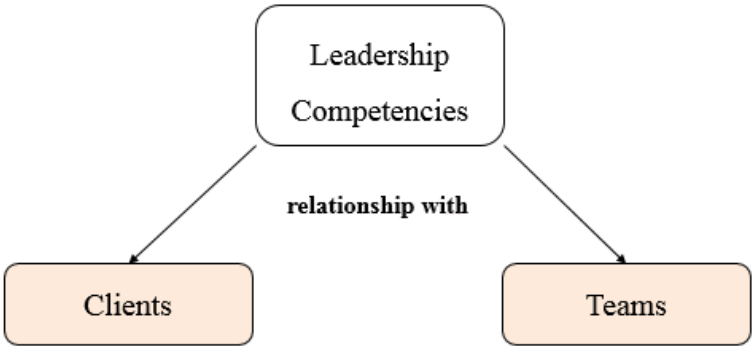
Source: the Author

Following the results so far, we noted that the goals of the leadership can generally be split into two categories: goals oriented to the team, and goals oriented to the relationship with the client. Indeed, almost half of the goals from the table are directly related to the relationship with the client. However the focus of the literature has not been the relationship with the client. Instead, it focusses on the dyad leader-subordinate or the leader-team (Robbins and Coulter, 2007).

The need to consider different leadership skills or styles to address different situations has already been targeted in earlier studies, but the focus remained on the different stages of the project life cycle or the chronologic sequence of activities (Prabhakar, 2005; Russo et al., 2005), the different position of power and task structure (Fiedler, 1967), the degree of change or innovation of the project we are dealing with (Dulewicz and Higgs, 2005b), among others. However, no literature was found addressing the need to adapt the leadership skills to the target audience of each activity.

Furthermore, the most effective project leaders were said to be those who can identify the critical moments to apply their specific skills (Ramo, 2002). Upon this assumption, the results of this study suggests that the leadership competencies in this phase may depend on the target of their goals. Figure 29 schematises these two different dimensions: the leadership competencies needed in the relationship with the client and the leadership competencies needed in the relationship with the team.

Figure 29. Distinguished Leadership



Source: the author

The attitude and behaviour that the leader assumes towards each target was also referred to in the interviews as the leader's role. Therefore, there were people who

performed more than one role, depending on the situation, even considering the need to use a different set of competencies [ST06I1].

Extracted from the interviews

"There are two roles: the team leader, who has to build the team, and coordinate the project development performed by the team to meet the deadlines and to meet the requirements; and the project leader, who is concerned with the project-related issues, namely the completion of the project within the schedules. In this case, the leadership will act a bit differently, the team leader is concerned with the team, and the project manager is concerned with the relationship with the client." [JL02I1]

A deeper analysis of these results tried to clarify the differences of the leadership behaviour according to each target. In a simplistic approach, one could though the elements from the client company as being part of the team's members. However, the underlying relationship with each target seems to be quite different. It should not be forgotten that the client is also a leader that usually has a higher power position.

Leading on to further conclusions, we must look at the type of the goals assigned to the leader. In fact, they do not seem to differ much from the common activities of the leader described in other studies (Robbins and Coulter, 2007). Yet, the emphasis on the activities to be performed with the client is quite clear.

Extracted from the interviews

"[The leader] must be able to speak the user's language, to understand the users' needs and difficulties. He has to, as they say, "put on the user's shoes"" [JN01I1]

The client is seen as someone the leader should conquer and they should gain their trust [NV10I4], empathy and closeness [ST06I1]. And since the client may be the owner of the project, their political position in the process is expected to be different from the context of a regular team: "*Clients need to feel that the solution has suggested by them, even if it doesn't*" [ST06I1].

On the other hand, participants also highlighted the need to manage the project scope [OU10I3] or to negotiate solutions [ST06I1] without raising any conflict, which could be critical to the project success [JL02I1]. Such claims help to understand the relationship

and interaction that must be established with the client, but also suggest that the main differences may exist on account of the client characteristics [DZ12I2].

The great emphasis given to the situations where there is a need to interact with the client suggests that, at least, part of the leadership relevance in this phase is focussed on these situations. The client recognition; the establishment of a relationship with them; the need to negotiation and client persuasion; the need to conduct meetings effectively and efficiently to achieve the desired results - all focus directly or indirectly on these moments of client interaction.

The remaining leadership goals considered project management and monitoring; team management, and; the ability to transpose into the requirements specification documents the envisaged solution. Also challenging is the nature of these activities which may need the ability of the project leader to address ambiguity and ill-defined goals (Byrne and Barling, 2015). However, these goals also frequently assigned to managers, rather than to leaders (Plakhotnik et al., 2010). In fact, the differences between expected leader's behaviours and manager's behaviours are not always clear, as the literature has been used to them being quite interchangeable (Byrne and Barling, 2015).

On the other hand, the leader is expected to have a team to manage. As the context of a new system is usually of great complexity and ambiguity, the leader should orient the team towards the development of a suitable solution. However, we found that the team may vary considerably in the requirements phase. In some projects this phase can be performed by the leader alone, whereas in other projects the team could be very large.

Hardly a team could be defined with one single element. According to Byrne and Barling (2015), a project team is a group of "*people with varied knowledge, experience, and experience who, within the life span of the project but over long work cycles, must acquire and pool vast amounts of information in order to define or clarify their purpose, adapt or create the means to progressively elaborate an incrementally or radically new concept, service, product, activity, or more generally, to generate change"* (p. 138). Thus, it would be expected that no leadership could be applied in this case. However, our respondents mentioned that the leadership applied in the requirements phase should be defined in terms of the skills needed for both targets (when they exist). Furthermore, the concept of team in this phase should go beyond the team from the supplier company. It appears that the team in the requirements phase may also be composed of elements from

the client side, as long as the above definition remains valid. This may be probably one of the major differences found when comparing with the previous literature.

Regardless of the type and composition of the team in this phase, participants highlighted that the context, culture and profile of the team members may present major variations. Sometimes different departments area, or even different companies have to work together to find a common solution. One of such examples is a project developed by a business company's consortium, i.e. more than one company collaborating together. Moreover, if the team includes members from the client side then the variety of contexts, cultures and motivations may increase even more and probably make the task harder. But the literature found that the team diversity can also be an advantage for the project, as it can increase overall creativity and innovation (Gassman, 2001).

A final note briefly compares the leadership goals, described here, with the critical success factors for this phase (Chatzoglou and Macaulay, 1997). We found that they both overlap in many goals. An example is the need to manage the scope of the project. This leadership goal is also considered to be a critical factor, as it reduces schedule overruns, reduces failures in the solution, maximizes the suitability of the solution, and also maximizes client satisfaction. Thus, we could conclude that leadership can indeed be relevant to the successful execution of this phase.

In the next subsection, we present the competencies drawn from the interviews. We discuss each competency among the literature and a final resulting set is explored. Next we present the factors mentioned that influence these competencies. As a result, a preliminary model instantiation is made.

4.4.2 Leadership Competencies

During the interviews, participants has sparsely showed evidence of the competencies needed to perform certain tasks of the requirements phase. However, most of the competencies were mentioned to answer the question d4) ii): which are the relevant leadership competencies to execute the requirements phase?

From the transcripts we identified a list of 54 leadership competencies (see Table 51). To improve results comprehension, we organized the list of competencies into

categories. Additionally, we included the frequency of the amount of times each competency was mentioned.

Table 51. List of Leadership Competencies mentioned in the interviews

Personal Attributes	**Freq**
Emotional Intelligence	3
Creativity/ Innovator	3
Ability to learn (fast)	6
Reliable/ trustful	15
Stress control	8
Persistency	3
Empathy	7
Self confidence	6
Personal preferences	1
Guided to achieve the results / Focus	22
Political Profile	7
Critical Analysis	14
Be an example	5
Facilitator	9
Availability	3
Enthusiastic	3
Transversal Vision	2
Self-motivation	4
Flexible	5
Analytical capacity/ Ability to create a suitable solution	5
Future Vision/Impact Perception	12
Disciplined	9
Renowned as the leader	14
Communication	
Good communication skills/common communication language	25
Influence people	4
Listening skills	10
Technical to client translator	7
Assertiveness	12
Negotiation Skills	
Conflict management	10
Negotiation Skills	10
Client persuasiveness	7

Social Skills	**Freq**
Interpersonal Sensitivity	20
Polite	3
Respectful / Ethic	3
Ability to adapt to customer profile	6
Take the client to assume their responsibilities	2
Give visibility to the client	6
Job Relevant Knowledge	**6**
Technical knowledge	17
Management expertise	5
To know the domain business area	16
Experienced	17
To know how to drive the meetings	13
Common sense	8
General Management Skills	
Decision Maker/ Power to decide	12
Rigorous/organized	5
Change Management/ Expectations	9
Professional behaviour	2
Sales Skills	4
Team Management Skills	
Guide the team/give the vision	21
Motivate the team	18
Rigidity with the team	4
Empowerment/Scale	12
Foster Team Creativity and Involvement	10
Develop the team	6

Source: The Author

Despite the extensive size of the list, some participants stressed that it may probably not be exhaustive, as only the most relevant competencies were highlighted [NV10I4]. Some of these competencies were described as general leadership competencies [NV11I2], whilst others described those competencies needed in specific situations [JL02I1]. It is noteworthy that the main competencies required for the leadership critical goals were the most referred to ones.

The most frequently cited competency was communication. Communication was highlighted as being a critical baseline for other competencies. It was referred to as being critical for understanding client needs, for explaining solutions to the client, for negotiating with stakeholders, for documenting and formalizing the agreed solution, for being able to transmit the solution to the team and for establishing a good relationship with both the client and the internal team. Some examples are illustrated bellow.

Extracted from the interviews:

"It is also very important the communication between the client team and the team from our company. A leader who cannot hear, who is not assertive, if they cannot interpret the message that has been given to them, then they will have problems in the future, they will come. (...) Communication is the key, the language." [NV11I2]

"Oh, they will have to understand the business. They will have to be able to speak the client's language. Ah, communication is very important, as if the person is a very technical person, then they will hardly be able to transmit the ideas to the client or even understand what the client is trying to transmit" [JL02I1]

The enhancement of communication skills was expected. The literature has documented well the relevance of communication to leadership (Muller and Turner, 2007; Stevenson and Starkweather, 2010). Furthermore, Muller and Turner (2010) showed that communication was highly ranked amongst information and telecommunications projects. Skulmoski (2010) also found that communication was critical during the initial phases of project life cycle. In this phase, one should be able to gather information and understand the business problem in order to suggest a suitable solution. However, the solution must be sold and approved for the project to proceed. To do so, additional skills are needed, namely writing, selling and presentation skills [JL03I1].

The second most cited competency was focus on achieving results. This competency is related to the focus on the solution and problem solving. As this phase needs to come up with a solution that satisfies all stakeholders, it might be relevant to be focussed on allowing the project progression [AG05I1; JL04I1; JL03I1]. Participants are also expecting changes to the initial requirements throughout the project, so they should be aware of the impact of the solution on the organisation. Management scope is also related with this competency, as it helps to maintain the project viable [AG05I1].

The next competency is the ability to give vision to the team. According to Skulmoski and Hartman (2010), the initial phases of the project is also when the team is being formed. Therefore, establishing clear goals and objectives, fostering group cohesion and commitment are critical to team effectiveness (Byrne and Barling, 2015). To accomplish these tasks, other competencies were also said to be needed, such as the ability to motivate the team (for instance [ST06I1, JL02I1; NV10I4; OU10I3; DZ12I1; ST08I2]) and the ability to foster team creativity and involvement (for instance [NV10I6; OU10I2; NV11I3]).

Extracted from the interviews:

"Then there is a topic that I think is more relevant, and that is the ability of the project leader to transmit the vision of what the project is, is more than the normal management of a project. They are the person who is able to transmit some enthusiasm, some vision of what you are doing. This cannot be the case in all projects, right? There are projects that are much more technical (…) but I mean, this aspect of the ability to mobilize people towards a goal is something very relevant from the point of view of people management." [AG05I1]

The knowledge that the leader should have to perform their activities were also frequently mentioned. This number is even higher if we aggregate all the competencies related to this knowledge: job-relevant knowledge from the table above. Although some referred knowledge should be generic, such as common sense, some specific knowledge was also mentioned.

Extracted from the interviews:

"I think it is very important that any leader, at any stage, has the knowledge to perform it. What does it mean? To be a leader in the requirements phase you have to know

what to lead. I must know what a requirement is, I have to know what is required in this phase, and what is its aim." [OU10I3]

In contrast with previous studies (Chatzoglou and Macaulay, 1997), technical knowledge were highly mentioned comparing with the management expertise. However, respondents have mentioned that although it is important, it is less critical than the remaining knowledge needed during this phase [JN01I1; JL03I1, ST08I2; AG05I2; NV11I1; AG05I3; AG05I6; AG05I4].

Extracted from the interviews:

"More than technical skills. Technical skills are very important for software engineers, as obviously when they create software architecture, they create the software itself. However, with regards to requirements gathering, during the phase of defining what you will have to do, you have to have a lot of so-called emotional intelligence. It is much more management than engineering, it is much more management than engineering." [JN01I1]

"I have always said, and continue to say, that a manager of information technology projects must know about information technology. He doesn't need to be an expert, or a specialist, but he has to know about information systems, as he has to be perceived as, in the technical team, he has to be perceived as a technician. They have to recognize him as being someone who "I know more than him" for example, the technician can say, "I know more than him in my specific area, but he knows what I'm talking about and he also knows other things" [JL03I1]

On the other hand, leader expertise was highly reinforced. By expertise, one means that the leader has the capacity to manage, technically, but can also take advantage of their knowledge and experience of previous work in the same business area.

Extracted from the interviews:

"Who is coordinating the project has the responsibility to have a critical view on the project: a view based on their experience of tons of other projects and based on the culture of the organisation to which he belongs" [AG05I5]

The topic of leader's integrity and honesty was also mentioned quite a lot. An honest and trustful leader can transmit greater security to the team, and foster a stronger

relationship between them [JL02I1; JL03I1]. However, the leader's integrity and honesty were also said to be critical in the relationship with the client. To establish a strong relationship with the client, the leader should be perceived as someone who is trustful, reliable [ST06I1; JL04I1; ST08I1], and highly professional [ST09I4].

Extracted from the interviews:

"From my point of view, [we have to win the client by doing] things are as simple as: when going to a validation meeting, we should prepare the meeting; we should conduct the meeting very well; we should take decisions that give visibility to the client, and such decisions should be incorporated in the analysis, for example. If we combine certain things, certain actions, to win credibility and give confidence to the client... Because, after this initial barrier, the client is more relaxed and is really worried about building the system. If they detect any lack of professionalism, then the client starts to… they start questioning everything we say. It's a little of the credibility we create." [NV10I4]

Some respondents stressed one major problem for leadership: the recognition of the leadership role by their followers. Although it may be dependent on other competencies, such as trustfulness [OU10I1], experience [AG05I4], or the knowledge that the leader possesses [ST09I1; OU10I3], a leader who is not recognized by his team is more likely to have problems in the project [AG05I4; OU10I1]. Obviously, we could wonder what the reasons are that may lead to such problem: is the team new to the leader? Is the leader someone who was imposed, rather than being a natural leader? Both situations are common in organisations and deserve a careful look in future research studies.

Extracted from interviews:

"So, there is always the problem of someone who assumes the leader's role and the others who do not recognize them as the leader. It also happened to me here in this project, as I said, the people who were in the project had a lot of knowledge and we had a technical architect, or someone who was drawing the solution, and I had team members who did not recognize her as the leader... and so on... and then the above leader in the hierarchy has to resolve these conflicts" [OU10I3]

The political profile and the ability to make decisions were also mentioned to be important, because this phase is critical to getting the approval of others (both the client and internally) for the project to proceed [AG05I1; AG05I3; AG05I4; AG05I6; ST08I1].

Moreover, we found that these two competencies may be related to the concept of reputation [OU10I1].

Although the causal dependency of competences is out of the scope of this study, we also found that a leader with good business or technical knowledge can be more easily recognized as the team leader, and that the leadership capacity of the leader who is known and respected within the project context, and within the organisation, is more likely to be recognized by their team members. This is in line with previous studies that stressed that trust, accountability and political profile are interlinked with leadership reputation (Hall et al., 2004). On the other hand, leadership reputation was showed to impact on the leadership performance and effectiveness.

Extracted from the interviews:

"Typically, in terms of sub-areas, there are people who we perfectly realize have some upward on the others. And that ... ah ... and this is important because, someone to be recognized as a leader is not only because they are the "boss", they have to... and people have to recognize them, and I think that if everyone in the team were able to identify the same person as the leader and identify their leadership skills, although for different reasons, I find it is very important. And that's a very important factor for the rest of the project to run better, as it means that the team is cohesive" [NV10I5]

Finally, it might be surprising to see that negotiation and conflict management have been distant from the most cited competencies. The need to get the solution approved, the need to obtain consensus among stakeholders, the need to manage change requests and also the need to manage the team are some of the situations were these two competencies were said to be more critical [JL04I1; AG05I5; ST08I3; ST08I1; ST09I2].

However, based on the interviews transcriptions, we found that negotiation and conflict resolution may be built upon the most cited competencies. Accordingly, negotiation is more likely to succeed if the leader has good communication, selling and persuasiveness skills (Skulmoski and Hartman, 2010). Apparently, the scope control and focus on the results may also impact on the ability to negotiate [JL03I1; AG05I1]. Finally, other competencies like reputation, trust and soft skills (e.g. interpersonal sensitivity and stress control) may influence on conflict resolution (Jordan and Troth, 2004; Kadefors, 2004).

Extracted from the interviews:

"The capacity of persuasion and getting justified approval within the client. Because then some conflicts may arise, couldn't they? And one must be able to manage this conflict without creating a rupture, because if we break with the client, the whole course of the project may be in question" [JL02I1]

To resume this subsection, the list of leadership competencies achieved one of the purposes of this study. However, the comparison of this list among the ones suggested in the literature is still missing. Thus, in the next subsection, we present the critical analysis of the results obtained with those of the previous studies.

Compared Leadership Competencies

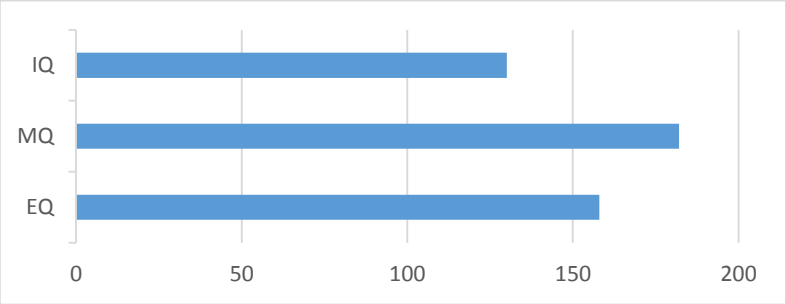
Although question d4) ii) is an open question, with no baselines or scope limits, we decided to assess their results in comparison with the main literature of this study. To do this, we used the competency framework proposed by Dulewicz and Higgs (2003b). We analysed each competency mentioned in the interviews against the referred framework.

Some competencies easily fit into the framework, such as Critical Analysis to IQ-1(Critical Analysis and Judgment), or the Interpersonal Sensitivity to EQ – 12 (Sensitivity). Others were not as straightforward. The first attempted to fill the framework, in comparison with the results of other researchers, showed great divergence. The comprehensiveness of some of the skills have made their classification difficult. Therefore, we adopted a broader and iterative strategy to make the classification clearer.

The first step of this analysis was to broaden the scope of each leadership competency category. To each category we assigned a verb that should represent its main aim: Intellectual Competencies -> To know; Managerial Competencies -> To manage; Emotional Competencies -> To feel. Following these intensions, we next classified each competency under one of these categories, regardless of the competency list of the framework. For instance, the competencies "conflict management" and "guided to achieve the results" are needed "To manage"; the competencies "to know the domain business area" and "Ability to learn (fast)" belong to the category "To know"; and the competencies "Disciplined" and "Self-confidence" to the category "To feel".

Two research partners were asked to classify each competency according to these broaden categories. The results were compared and discussed. No further analysis was performed until a consensus were established. After all, the competencies were fitted in the categories, we made an analysis of the relevance of each category (number of citations to any competency included in each category), according to our respondents. The results are shown in the Figure 30.

Figure 30. Results of the relevance of each Competency Type



Source: The Author

Surprisingly, the results showed some divergences from the main literature (Dulewicz and Higgs, 2003a; Muller and Turner, 2007; Geoghegan and Dulewicz, 2008). Accordingly, we were expecting the EQ (Emotional Intelligence) category to be the most ranked. Facing these results, one possible justification could be that respondents were not so aware of the EQ competencies, as they were of MQ or IQ ones. Responses to these competencies were more disperse than in the other two categories. It might be difficult to explored emotions and personal characteristics, rather than more tangible issues, such as procedures and practices. On the other hand, respondents could still be under the context of the main problems of the requirements phase. Thus, the focus on practical competencies to solve them would be understandable. However, we cannot exclude that our participants may be lacking the perception of the relevance of such competencies. Throughout the extensive literature, they might be still focussed on managerial issues, rather than emotional ones. However, we could also wonder whether participants were actually referring to the project manager, rather than the project leader. These two roles are frequently interlinked, but a separation is needed, in order to understand the relevance and impact of leadership.

Only when the later analysis was concluded, did we progress though the comparison of each competency mentioned in the interviews with the competencies from the

framework. The results of this analysis are shown in Table 52. This table presents the relationship between each competency found in the interviews and the competencies of the framework. For each case, we give an excerpt from one of the interviews that mentioned the competency, to contextualize the classification made.

Table 52. Comparison between competencies proposed in the literature and those mentioned during the interviews

Competency Type	Competency	Identified in the interviews	Extracted from the interviews
Intellectual (IQ)	1. Critical analysis and judgment	Critical Analysis	"So, for me, the leader's role is: to hear, the solutions proposed and all the client has to say, and understand what the problem is and what is the best solution for the client (…) I think they need a great analytical capacity to be able to see the solution among all the problems the client gives" [ST06I1]
		Analytical capacity/ Ability to create a suitable solution	"Because, basically, in this phase, people are asking for many things and then there's a big job of trying to realize that in a concrete solution. And then we should guide the people to go on one side, or another, to do things in one way, or another. I mean, basically we have to transform an idea into a concrete project, right?" [AG05I1]
		Technical to client translator	"But it is very critical when we, when the project leader cannot put it on paper, then obviously in communication with the clients. They cannot put on paper a closed solution, neither can they write a document that is clear of what is going to be done. And when the client approves that document, then they never accept a solution, and we can say that will have no change until the end" [AG05I6]
		Technical knowledge	"I have always said: a manager of information technology projects have to know about information technology. They do not need to be an expert, but they have to know about information systems. However, they have to be perceived as, in relation to the technical team, it has to be perceived as a technician."[JL03I1]
		To know the domain business area	"The best analyst is someone who, besides their experience, is someone who knows the business very well" [JL01I1

IQ - (continued)		Listening Skills	"You have to hear, always, ok? That's a basic rule, always hear people until the end. You have to hear all the complaints and, you know, people always have much complains of what is going wrong, and so on. You have to hear all these things, and try to give solutions." [JL04I1]
		Ability to learn (fast)	"It is important that when you go for a project, that you know nothing about the business, ah, the key is during the first interactions with the client, in order to try to understand their business" [JL02I1]
	2. Vision and Imagination	Guide the team/ Give the vision	"The project leader should transmit the vision of what the project is, in other words, it is more than the normal management of the project. Is the person is to be able to transmit some, some enthusiasm, some vision of what you are doing, and that's the most important part, that sometimes we can achieve it (…) This aspect of the ability to mobilize people towards a goal is something very relevant from the point of view of people management." [AG05I1]
		Future vision/ Impact perception	"I am not saying that it only depends on the lead, but she has a very important role, even to anticipation possible problems in the future (…) the scope management and eye for details, and consequently the ability to foresight failure in the specification, is some of the metrics you could use to assess the project manager, okay?" [AG05I5]
		Creativity/Innovator	"You have to have ideas, basically. They have to be a person who is creative, leading ideas for the team. They have to make things to be relatively fun and innovating, so that people begin to realize" [JL03I1]
	3. Strategic Perspective	Give visibility to the client	"So that's how I use to say, here I always perform like the devil's lawyer, because I'm always, regardless of my position, I'm always performing the other side. Because when I'm with the client, I'm always concerned about our team, and when I'm here, I represent the client, and I want the client to be served in the best possible way. So, it's the ability to put the right shoes on, right? As we use to say, shoes from both ways." [DZ12I2]

IQ - (continued)		Transversal vision	"Transversal vision. You have to realize a business process, which begins in a point and ends in another, all that it goes through and all that it entails." [AG05I3]
		Change Management /Expectations	"The foreknowledge and expectations management of a project, the communication... the anticipation of the risks and the expectations management on a project are, for me, fundamental to the project to proceed." [ST08I3]
		Take the client to assume their responsibilities	"You have to know how to accept what the client is saying, but you have to insist with him, so that he can feel that the responsibility is his, not ours, i.e. you have to tell him that if something goes wrong in the requirements analysis, then the application also goes wrong, because we cannot implement such thing" [JL04I1]
Managerial (MQ)	4. Engaging Communication	Good communication skills	"95% of my daily work is to communicate, I don't do anything else but to talk all day, you know? You have to talk with the team, talk with the client, with the stakeholders that may be involved, anticipate risks (…) the basis is always to communicate" [ST08I3]
		Client Persuasiveness	"And also to be able to persuade the client to follow the way that best suits for us and that we proposed. We have to regard the budget because there is the money, it is not." [DZ12I3]
		Assertiveness	"We have to be assertive" [DZ12I2]
		Polite	"It has to be someone who is, commonly knows, a polite person" [ST08I1]
		Sale Skills	"And then it is a very commercial part, where you have to sell it, sell the idea, sell what we've understood, sell and the client must accept this as it was his own idea" [ST06I1]
	5. Managing Resources	Rigidity with the team	"With the team, I think you have to have a very steady hand, steady hand does not mean a dictatorship, it can be a democratic style," [NV10I4]

MQ - (continued)		Organized/ Rigorous	"Communication and organisation as well. Because you have to organize all the work. There might be parallel meetings, that you have to join all the work and standardize work" [ST09I1]
		Availability	"The ability he has to meet with people on a regular basis" [AG05I1]
		A lot of management expertise	"Most of our project managers, also because they had specific training: they got certifications such as PMP; they have the perfect training. They know the most appropriate practices and methods for managing projects: the combination of standards and internal rules and therefore these are the baselines with which they have to work. "[AG05I5]
		Professional Behaviour	"It has to be someone who has, as we often say, is a politically correct person" [ST08I1]
	6. Empowering	Empowerment/ Scale	"[The leader] should know how to scale when needed, and that's another issue that concerns me often in projects: that is that the project leader who thinks they can solve some problems and therefore, they don't scale it. Then it continues and will delay the project, when they could have scaled it, and by now the problem would be already solved, as they could not solve it, he needed other stakeholders to do so, right?" [AG05I4]
		Foster team Creativity and Involvement	"I work in a kind of leadership that doesn't try to impose definitions or situations on the team, but to talk with them and together achieve the best thing to do. I'm not the best, and I don't know everything, so, for this reason, I always try to reach consensus and a dialogue with the people who are working to find the best solution" [NV11I3]
	7. Developing	Develop the team	"It is to maintain and build a team, right? Because I think if the team is built, and is a cohesive team, united, things are able to progress" [NV10I6]

MQ - (continued)		Facilitator	"You need to go with to try to facilitate, if we complicate the requirements, the requirements are things… That's like everything in life, the problems that people's lives, can be very complicated or just a little bit. We can, when we see that the problem is very, very complicated, we can divide it into small pieces, right?" [JL04I1]
		Motivate the team	"The first thing that comes to my mind, is motivation. I think a motivated team makes all the difference." [DZ12I4]
	8. Achieving	Conflict Management	"You need leadership skills that allow to have a relationship as well as possible with the "stakeholders" of the project, as the client and the relationship manager, for situation when there is a need to clarify something. Because sometimes there are some "stresses" due to the differences between the requirements we are receiving, their understanding from the Business Area and the Development Area that may say they are not viable, ok?" [AG05I2]
		Guided to achieve the results/Focus	"I think that's a matter of focus. The person must ensure that they do not lose focus of the project and that everything that is said to be a requirement and a project need is really what matters to our client" [JL03I1]
		To know how to drive the meetings	"We need to have someone who can almost put a silence in the room and follow an idea, because otherwise it [the meeting] can take six hours to discuss everything..." [ST06I1]
		Decision Maker/ Power to decide	"The leader should has some power to decide and he has to hit the table if necessary, because if not then things will go badly for all" [ST09I3]
Emotional (EQ)	9. Self-awareness	Disciplined	"I think we must have a good baseline, a good methodological basis in order to support the this activity" [ST08I3]
		Self-confidence	"if you are not confident that you are doing the right thing, then things are probably going to go wrong" [DZ12I4]
		Flexible	"I think that here, in this company, we are all, at least in this area, we are all very flexible." [ST09I1]

EQ - (continued)		Emotional Intelligence	"A leader must have a lot of social skills, or emotional intelligence." [JN01I1]
	10. Emotional Resilience	Stress control	"First, because our work is based on stress and if there is a panic, the panic generalizes quickly. If there are people who know or who are able to influence the moral, we can achieve the objectives faster" [OU10I2]
		Persistency	"But in this case, my role is, perhaps, to be very persistence and patient, to try to get people ... In this case and elsewhere, to try to get people to understand what is needed without making any scandals or confusion." [JL03I1]
	11. Motivation	Self-motivation	"And motivation, obviously. We all must have the ability, in my personal opinion, we must have the ability to self-motivate, even when sometimes you don't want to, ok ?," [DZ12I4]
		Enthusiastic	"To be there he must be in a good mood, with a good sense of humour, to listen to them carefully, to give them much visibility, because they like to feel important" [NV10I6]
		Personal preferences	"We also classify projects as "interesting", that is something that is not here. I think the interest of the project is something that tremendously motivates the leader, as there are leaders who prefer simple projects, while others may prefer complex projects." [ST06I1]
	12. Sensitivity	Negotiation Skills	"I think he needs to be a good negotiator. I think as a leader you should be a good negotiator" [ST08I2]
		Interpersonal Sensitivity	"She has to empathize, she has to be able to perceive the person who is in front of her, and has to understand if she should be more aggressive, less aggressive, just to name one example, ok?" [OU10I1]
		Empathy	
		Ability to adapt to client profile	"things have to adapt also to customer reality" [NV10I5]

EQ - (continued)	13. Influence	Renowned as the leader	"If the relationship manager does not have a specific background and the recognition in their functions, then the client does not give them attention, right? And the same is also true for the internal side of the project." [AG05I6]
		Influence people	"The leadership we are talking about is the influence we have on the people who are around us" [JL02I1]
		Be an example	"If someone did a bad job, ok, perhaps instead of being rude, I'll show him how it's done, I'm going to help him to do a better job and you will notice, and people will naturally start giving more relevance to their work and she will eventually follow the example" [OU10I2]
		Political Profile	"He has to be a person, I think, with ease to articulate, i.e. that has some political capacity "slash" moderator" [ST08I3]
	14. Intuitiveness	Experienced	"To have a project manager who has had experience in this area, that already has knowledge in this area is an added value" [AG05I5]
		Common sense	"[The leader] to achieve must, must have all the common sense, which is extremely important in these situations (with all common sense)" [AG05I2]
	15. Conscientiousness	Reliable	"In terms of the relationship with the client, well, I think it is essential, why? Because when we start a new project, we have to transmit confidence to the client, ok? As we also do with the team in the implementation phase." [DZ12I4]
		Respectful/Ethic	"If you have respect and if you are a honest person, I think a person can have the respect and admiration of colleagues" [ST08I1]

Source: Adapted from Dulewicz and Higgs (2003b)

As mentioned before, the competencies from the list focus on the two main relationships in this phase. While some competencies have been reported to act for the team, others are used for the relationship with the client (and/or client's team).

However, we realized that the framework does not give special emphasis to this duality. Furthermore, it does not distinguish the personal competencies very clearly,

between internal competencies that make up the personality of the leader, with those used in the relationship with others. While all the competencies were fitted in the framework, we recognize that the task was not easy for some of these competencies.

Returning to the old theories of leadership, the traits model (Kirkpatrick and Locke, 1991) seems to address some of these topics more clearly, at least taking into account the reports made by the study participants. For instance, this old model distinguishes the competencies related to the characteristics of the person, not only in terms of his personal characteristics, but also their professional experience, and the competencies that depend on others to be achieved.

An additional note needs to be added regarding the nature of the competencies. While the most recent theories of leadership advocate that all competencies may be learned, most of the respondents did not agreed with this assumption. Personal characteristics where generally told to be inborn traits, that can eventually be highlighted with the right professional education. The remaining competencies should be acquired through the professional experience, or through academic education. An example is illustrated below.

Extracted from the interviews:

"In my opinion, I don't know if people are born with these capacities, I have no training to say that, and I don't know if someone can say it, but really, I think our life experiences, throughout our lives, since we were babies and then when we are children, adolescents and adults … our life experiences shape our personality and also shape characteristics such as leadership, among them. I believe that our life experience makes us what we are and also transforms our capabilities, such as leadership. I think leadership can be improved with training, because we realize, and now talking about the emotional intelligence, we also manage to realize what it is emotional intelligence, or what is leadership, in this case. We realize that if what we are doing, whether we are doing it the best way, or not... but I think it depends on the personality of each person, and then on the experiences that have been built up over time." [DZ12I4]

Although it is not in the scope of this study, we cannot ignore the comparison of the results with the literature on project management competencies. While there was considerable consistency between the results that we obtained and those reported in past studies, some differences did emerge (PMI, 2002; Crawford, 2003; Cheng et al., 2005;

Sumner et al., 2006; Skulmoski and Hartman, 2010; Stevenson and Starkweather, 2010; Fisher, 2011; Keil et al., 2013). The first and most relevant one is the different study focus. All of these studies consider the skills needed for a project manager to be effective, and leadership is perceived as being one those. However, the focus of this study is on leadership's role and on the set of competencies needed for a leader to be effective.

Stevenson (2010) explored the most critical competencies for hiring IT project managers. His resulting set of most relevant competencies includes leadership, ability to communicate at multi-levels; verbal and writing skills; attitude, and; the ability to deal with ambiguity and change. Although the study considers leadership to be a competency, rather than a group of competencies, as in this study, his results showed a great relevance of the topic. Furthermore, the authors found that communication to multi levels was almost as equally ranked as leadership. This need to consider both team members and top levels in the organisation hierarchy, and external stakeholders in the communication process supports our assumption to consider different competencies for different targets. It also supports the relevance that participants gave to the communication and interpersonal competencies.

In addition, Sumner et al. (2006) found that competencies such as communication and interpersonal skills may improve the involvement, collaboration and cooperation of the stakeholders in the project. This was done taking into consideration the external perceptions, i.e. observer assessments of leadership practices as a good predictor of project success. Nevertheless, the study reported contrasting results regarding the ability to inspire a share vision. Despite this, it has been reported in this study as being the third most important competency for a leader during the requirements phase, and Sumner and her co-authors found it to be the last relevant practice. One possible explanations might be the focus of our study on a specific phase of the project life cycle that may vary the relevance of some competencies, and another could be a lack of clarity regarding the competencies needed for project managers and those needed for project leaders. At the author's own admission, there may be a gap between the competencies that project managers value, and those that external observers prefer. Therefore, this study includes a final recommendation for IT project managers to improve their recognition of the importance of leadership skills, beyond management ones.

Keil et al. (2013) conducted a Delphi study to explore the most critical skills for managing IT projects. Their resulting list ranked leadership as the "the most important contribution a project manager can bring to a project" (p. 404). Verbal communication was the second most ranked skill, which supports our findings on the relevance of good communication skills. The remaining competencies from the list are generally consistent with the competencies found in this study, with one exception. Keil's results show a relative relevance for management competencies, such as project planning, time, risk and cost management, which were not explored in our study. However, the focus on project managers rather than project leaders justifies this difference. Moreover, the relative position each competency assumes in the list may also vary accordingly due to the same reason.

In line with the former studies, Skulmoski and Hartman (2010), Cheng et al (2005) and Fisher (2011) have also shown lists of critical competencies for project managers. Their resulting lists did not vary much from those described so far. The main results of this study are considerably consistent with these previous ones. However, direct comparisons are hard to perform. To start with, the studies' different approaches raise some natural uncovered competencies amongst them. The relative ranking of these competencies has also showed some variations among the studies. The focus on different roles in the project, even though they may overlap, satisfactorily justify these differences.

Furthermore, we also found differences in the granularity of the skills used and the way skills were categorized. For instance, Skulmoski and Hartman (2010) considered *leadership* as a set of skills, whereas Fisher (2011) only considers more granular skills which are often associated with leadership. In addition, the synthetize conclusions made by categories of skills may lead to possibly erroneous comparisons, as the same competency may be organized into different categories among the studies. While *business domain knowledge* is a category in (Keil et al., 2013), in this study, we categorize this competency as a Critical Analysis and Judgement competency, under the Intelligent competency type. Therefore, careful attention must be paid when drawing conclusions.

A final remark is due concerning the interchanging use of constructs and terms among the project management and leadership research areas. As mentioned before, these two roles often overlap in a project, however we should not forget what distinguishes them. A project manager is usually expected to be the project leader, and the exploration

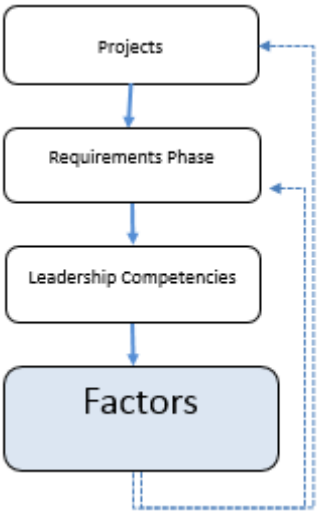
and assessment of leadership competencies of project managers would be convenient for top managers, but these might not be appropriate. Results have shown that differences exist in both groups, and therefore a separation of concepts is needed.

On the other hand, the literature has shown concerns regarding the misunderstanding of each role. Often practitioners undervalue the relevance of leadership skills when compared to project management, or they mistake both. This may be a result of a lack of clarity of each concept, and eventually may led to inappropriate behaviour which may inhibit a project's success.

In the next subsection, we discuss those major factors described during the interviews which may cause variations to the relevance of each leadership competency. As a result of this analysis, we carry out an instantiation of the research model.

4.4.3 Leadership Contingency Factors

The literature has shown that the relevance of leadership is not an incontestable truth, but depends on different factors and situations (Fiedler, 1967). Moreover, it has been advocated that no leadership profile can be the best for all situations, but rather different profiles should address different situations. (Dulewicz and Higgs, 2005a; Muller and Turner, 2007). The results of this study were consistent with these former authors. Respondents have stressed the impact of different factors on the relevance of leadership in projects, specifically during the requirements phase. Consequently, the relevance of leadership competencies was also said to vary among different factors (see excerpts below).



Extracted from the interviews:

"There are different types of leadership, but a certain type may result in one case and not result in another one" [ST06I1]

"When someone talks about leadership, I always think about leadership styles, right? The most democratic styles, the most managerial styles, the styles more... there are four or five styles, or six styles of leadership. They are all good, depending on the context to

be applied. This is the case for the project manager also, as there are styles that sometimes are best suited to some type of projects, while other styles are the best for other types of project managers ...” [OU10I1]

The second part of the analysis on leadership sought to explore the factors that may vary the leadership competencies relevant for the requirements phase. To do so, the transcripts were analysed and a resulting list of 22 factors emerged. These factors were then organized into five dimensions: client; project team; project type, project process and leader profile. Furthermore, we also cross-analysed the impact of each factor on each leadership competency. Each of these dimensions is discussed below.

Client Dimension

As indicated in Table 53, client dimension includes the personal profile of the project owner, and their commitment and involvement in the project, but also the industry sector, context and culture where he comes from. The most cited factor of this dimension was client profile. Although the literature has not given emphasis to the leader's relationship with the client, concerns have been reported to the need of the leader to establishes effective communicate ways among different stakeholders (Sumner et al., 2006). Furthermore, it has been reported that conflicts may arise due to the combination, not always smooth, of contrasting stakeholder interests (Skulmoski and Hartman, 2010).

Table 53. General Contingency Factors: Client Dimension

Client Factors	**Code**	**Frequency**
Client characteristics; personality	CTY	47
Client Company Industry Sector	CIS	26
Client motivation and commitment	CMI	9
Client Company Context and Culture	CCC	9
Application Industry Sector	AIS	3

Source: the Author

Moreover, one of the skills reported as being most critical in this, and other studies (Stevenson and Starkweather, 2010), was interpersonal sensitivity. Thus, it may not be surprising that clients with different personalities and profiles require different

approaches to be treated. Participants described evidences where different types of clients would need different kinds of leadership styles, or set of competencies.

Extracted from the interviews:

“The characteristics that the leader must have, must always suit the client. That’s why, for each project, I almost have an indicator to say "[The client] It's very nice, it's very collaborative... Has this…" things like these. In one case it might work, for another it might not. We have clients whose leadership profile they prefer is someone to be very direct, whereas others like leaders to use a lots of soft words to say something. There are some clients to whom we can say "The order is clearly wrong" and they don’t get offended, but this is something unthinkable to say to other clients” [ST06I1]

From the interviews’ analysis we found that the way clients like to be treated, their awareness of project related issues, including their motivation and commitment all seem to influence the way the leadership becomes effective [OU10I2]. As one participant explained, in this phase it is critical to establish a relationship with the client, and the impact of client issues may be tremendous:

Extracted from the interviews:

“What I find funny is that I think it depends not only on the leader role of our side. I think it depends a lot on who is leading on the other side, too. This was what I was saying, I think that the success of the projects, for me, depends on this dyad, these two persons who are in the project. First, because there are profiles that match and others that don’t. Therefore the role is relative, because what goes well in one project may not be replicable in another. I think it all has to do with the client and... and I think, yes, that the leader's role has tremendous impact, because at this requirements phase, as I say, the client was supposed to give problems and not solutions, and when it gives solutions, the project usually ends badly” [ST06I1]

On the other hand, the context and culture of the client’s company were also reported to influence leadership effectiveness. Organisational culture has been vastly studied in the fields of management and also leadership (see for instance (Ogbonna, 2000; Dulewicz and Higgs, 2005b)). However, the focus has been on the appropriate style of leadership for addressing internal organisational culture. Instead, our results focus on the impact that

organisation culture may have on client attitude and procedures, which apparently also impact on the leadership competencies needed to establish an effective relationship.

Extracted from the interviews:

“There are tougher clients than others, right? Tougher clients are due to the organisation they belong to, organisational culture; clients are tougher, because they are more demanding; they are tougher clients because they have had bad experiences in the past and therefore they came to us with less capability to trust in us” [DZ12I4]

The capability (or maturity) of the client company's management procedures and their business industry sector were also related with the former factor. Both factors have been frequently included in previous studies to assess suitability of different leadership profiles (Anantatmula, 2010; Yang et al., 2011). One again, the focus has been to consider the internal style of leadership needed to overcome the specificities of each industry sector, rather than the differences in stakeholders from these different industry sectors that apparently may lead to an impact on the leader’s behaviour.

According to [NV10I4] "*For example, I notice that the bank sector is a very, very formal business. I've worked on public organisations, in the pharmaceutical sector and in the banking sector, and what I think, for example, is that I clearly prefer the pharmaceutical sector. Why? Because decision-making in this sector is much more agile, and is much more pragmatic than banking or the public sector... ah... I don’t know if that’s because traditionally they don’t have money problems, i.e. in a public organisation being in a two-hour meeting or five hours meeting is the same for who pays. I do not have to allocate costs anywhere. In the banking sector, on the other hand, because in the past they had much money, people are not so pragmatic when making decisions (...). Because, for example, the pharmaceutical sector focusses on deliveries and on quality and agility. For example, in the banking sector or in a public organisation there’s a lot of resistance. We must take a deep breath and then go to the ground and keep the team busy, because things do not happen as fast as they were supposed to*".

The analysis of the influence of this dimension among the 15 leadership competencies is shown in Figure 31. To perform this analysis, we used the list of competencies that emerged during the interviews, grouped as presented in Table 52. We then reviewed all transcriptions to look for any evidence of the impact of each factor on

the relevance of each competency. Finally, we present the results using a radar chart. This type of graph is suitable to visually display a set of multivariate observations considering a set of variables (the axes in the chart). These observations when aligned with the axes form polygons that represent the magnitude of the variables (Chang et al., 2012). In this case, each axis is one of the competencies from the framework, and the coloured polygons represent the influence of each factor mentioned for each competency.

Figure 31. Client Dimension impact among Leadership Competencies

Legend: C1 - Critical analysis and judgment; C2 - Vision and Imagination; C3 - Strategic Perspective; C4 - Engaging Communication; C5 - Managing Resources, C6 – Empowering; C7 – Developing; C8 – Achieving; C9 - Self-awareness; C10 - Emotional Resilience; C11 – Motivation; C12 – Sensitivity; C13 – Influence; C14 – Intuitiveness; C15 – Conscientiousness.
Source: the Author

As can be seen from the graph, the two factors that showed to have the greatest impact on leadership competencies were client characteristics; personality (CTY) and client industry sector (CIS). The impact of the first factor seems to be more evident for competencies C1 - Critical analysis and judgment, C4 - Engaging Communication, and C12 – Sensitivity. This is consistent with the results discussed above, as different client profiles may need a greater use of competencies that allow one to establish a good relationship and effective communication path with each client. To be successful, a leader should exhibit adequate behaviour reflecting sensitivity in the relationship with different clients. Only then can the leader critically analyse the problem in order to suggest a suitable solution. The enhancement of this competency also reflects situations where the

client is “a more difficult one”, and to balance this, the leader must provide greater use of analytical ability to solve the problem.

On the other hand, the client industry sector (CIS) was showed to mostly impact on the C5 - Managing Resources competency. This result was already evidenced with an excerpt from one interview. The urgency and procedures from different industry sectors need to be managed, especially in relation to team activities and motivation.

Team Dimension

The second dimension of factors that were said to impact on leadership competencies refers to team issues. Respondents highlighted that teams influence the way leadership must be applied. The topic of teams has been well covered in the leadership literature, therefore it was not surprising to find contingency factors related to teams (see for instance, Byrne, (2015).

From the analysis of the interviews transcripts a list emerged of 6 factors that were included in the team dimension: geographic location of teams; team size; existing domain knowledge; team seniority; team members’ profiles, and; team members’ rotation. The results can be seen in Table 54, which also shows the frequency that each factor was cited.

Table 54. General Contingency Factors: Project Team dimension

Team Factors	**Code**	**Frequency**
Geographic location of teams	GLT	33
Team size	TSZ	25
Existing domain knowledge	DKN	13
Team seniority	TSN	10
Team members	TEP	9
Team members turnover	TRV	8

Source: the Author

As indicated in Table 54, the most cited factor was the geographic location of the team members. Participants referred that when teams have to work in disperse locations, leadership efficiency meets some additional challenges. Virtual teams are difficult to

address, but it can be especially hard when teams do not know each other or/and include members from different cultures.

Extracted from the interviews:

"In my last project I didn't know the team. There were three Israelis, one Spanish, two Argentinians and one of our colleagues from Portugal. I only knew the one from Portugal. I have never seen the others. And I was the project manager of that team for a year, you know. But I never saw them (…) I needed a lots of patience. Virtual teams are very, very complicated, and people from each country have very different ways and cultures." [JL03I1]

The establishment of a spirit of cohesion and collaboration towards a common goal can be hard to accomplish, as there is no physical presence of the leader. Additionally, problems may arise due to the lack of efficient communication mechanisms and the inability to monitor team performance and alignment towards the implementation of the solution. One of the participants reported a situation where it was impossible to verify the completeness of the objectives throughout the project, and he later discovered that none had been completely finalized [JL03I1]. Still, other kind of problems were also reported, such as the difficulty in scheduling a meeting, or the reputation and recognition of the leader [AG05I4; JL03I1].

Extracted from the interviews:

"Especially in a team of this kind, where they didn't know me, so they didn't know... because it helps a lot when you have a name in the organisation. I've done a lot of projects, and people know me "Ah, that's the [name of participant] that was in that project". When you are working with teams you don't know, who don't know you, the ability for you to demonstrate that you are a value added to the team is very important (…) people are not aware that you are not only the person who is responsible for the most bureaucratic issues, but you also give an added value to the project and they can take advantage of this to help them" [JL03I1]

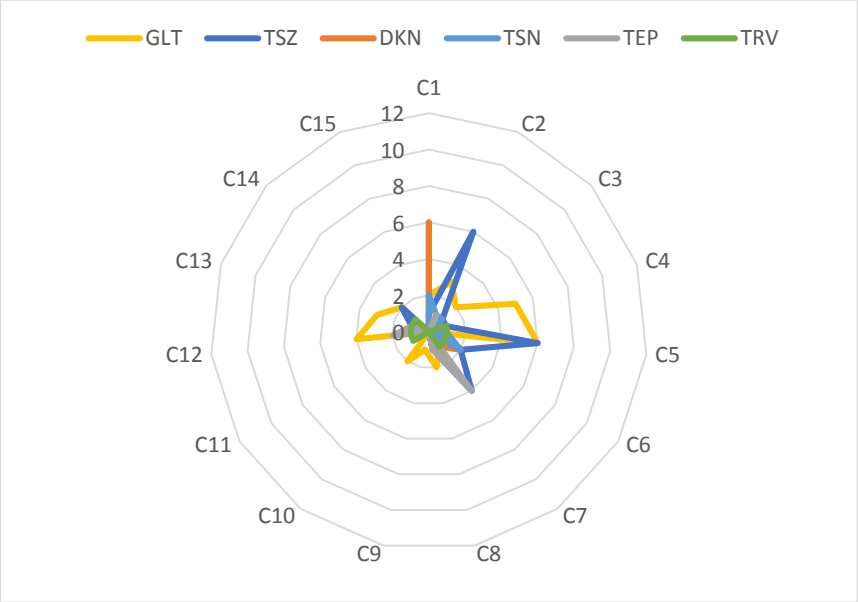
The main concerns described in the interviews support previous studies on virtual teams, in that leadership faces augmented challenges to establish effective communication channels (Andres, 2002; Hertel et al., 2005), and to perform management

and team development functions (Bell and Kozlowski, 2002; Kayworth and Leidner, 2002).

Thus, the literature suggests the need of communication mechanisms that may eventually substitute the lack of emotional cues and others provided by face-to-face communications; the establishment of clear roles among team members, the careful assessment of the team members to be included in this kind of teams, and an attitude of comprehension towards schedules and team members' opinions as a way to accomplish leadership effectiveness (Kayworth and Leidner, 2002).

Accordingly, Figure 32 shows that respondents have highlighted the resource management competency to be the most influenced by the physical distance of teams. Surprisingly, communication competencies did not have special enhancement, as was to be expected from the literature review. One possible explanation might be the small number of projects studied under this condition. Although participants may cite this factor from their previous experiences, the results may vary from a study that is focussed on this topic.

Figure 32. Team Dimension impact among Leadership Competencies



Legend: C1 - Critical analysis and judgment; C2 - Vision and Imagination; C3 - Strategic Perspective; C4 - Engaging Communication; C5 - Managing Resources, C6 – Empowering; C7 – Developing; C8 – Achieving; C9 - Self-awareness; C10 - Emotional Resilience; C11 – Motivation; C12 – Sensitivity; C13 – Influence; C14 – Intuitiveness; C15 – Conscientiousness.
Source: the Author

The factor of *team rotation* was found to have some similarities to team dispersion, namely regarding problems of leader recognition and the establishment of a spirit of cohesion among the team [JL03I1]. Previous research has found that team composition is often a given fact, rather than a choice, which may impact on the relationships among team members (Zander and Butler, 2010).

Moreover, team composition was already found to impact on team performance (Morgeson et al., 2010). The former authors suggested that a leader should compose their team by selecting individuals who would "provide the requisite mix of knowledge, skills, abilities, and prior experiences that enable task accomplishment as well as the values, interpersonal skills, and motivations that enable the team to work effectively together" (p.12). These studies support the team factors found, namely *team members profiles* and *team rotation*. Although none of these factors have been mentioned frequently, those who did so have only slightly focussed on the need to strengthen interpersonal and communication competencies.

Extracted from the interviews:

"Project managers now have a very serious problem, which is to never know their teams. I've worked six years with the same team, on various projects. I knew the people, and the people already knew me. People had a lot of freedom to speak. We had brainstormings every week. (…) Nowadays it is much more complicated, because people ... I don't have the same team twice." [JL03I1]

"There are certain things that dependent on the type of project, on the group, on the person, and on the team that is already working" [ST06I1]

Team members' seniority and *existing domain knowledge* can be considered as special cases of the *team members' profile*. As stated by Mongeson et al. (2010), team members can be characterized by their knowledge and past experiences, which can also define seniority. During the interviews, the existence of senior elements in the teams were both said to influence leadership positively [NV10I4] and negatively [AG05I4]. Senior members are expected to be more experienced and knowledgeable, which may reduce complexity and project risk. However, the position in the team that these elements assume make them resist to external leadership, namely to the new procedures and methods that the leader wants to implement. Examples are illustrated below.

Extracted from the interviews:

"For instance, team seniority: If I'm in a team of senior analysts, people who already know the business, my involvement will tend to be much smaller. In this case, maybe my role has to be more focussed on the client, monitoring the team, but on the other side rather than functionally" [NV10I4]

“There are many seniors. We have many cases like these, because this is a [company] that is already 30 years old, or nearly 30 years, so there are a lot of people that, after a certain age, because they have a certain level of seniority, they may not easily accept another person, sometime younger, to be the project leader. And they start to do what they think they should do, on their own initiative. Then if the project leader is not a good leader, i.e., if he could not be able to clearly define the function to each one within the project, and be very specific about it and monitor it, then it sucks. I’ve been also living such situations” [AG05I4]

Team members’ domain knowledge was said to be critical for this phase, as it forms the basis to understand the client needs, the whole problem context, and therefore to suggest a suitable solution [ST09I1; NV10I4; DZ12I1]. Whether or not related with seniority, the knowledge of the domain can foster communication with the client, and eventually the likelihood to produce a suitable solution. Furthermore, the existence of domain knowledge dictates the complexity level of some of the activities of this phase. In particular, when knowledge is low, activities of scope management and negotiation were said to be most critical [ST09I2; DZ12I3]. To overcome this issue, respondents stressed the need for greater analytical skills.

Extracted from the interviews:

“It affects the degree of attention on a project. Because, when the team already has the know-how, it's all well-defined, the risks don’t normally come from the level of definition, they come from the other strands. Whereas when it is not well defined, the project risk increases substantially” [NV10I4]

“In medium or poorly defined projects we will have to have even better negotiation skills …. ah, especially in the activities of negotiation and maintenance activities, right? Because, if a project is set incorrectly, it is more likely that many changes will emerge” [ST09I2]

On the other hand, when the domain knowledge is higher among team members, participants highlighted empowerment competency, as they feel more likely to delegate activities to their team members [ST09I1; DZ12I1]. Surprisingly, we would expect an enhancement of communication competency and the ability to deal with ambiguity. We though that in ill-defined projects, with low domain knowledge, it would be more likely that the leader had to deal with greater ambiguity and uncertainty, and that this would depend more on knowledge transfer from the client. To do so, an effective communication would be critical.

However, respondents did not give special relevance to either competency, at least during this phase of analysis. In fact, this may have happened due to the few citations regarding these factor, but it could also represent an obvious relationship and thus participants did not feel it worth mentioning. Yet, participants might think that the communication with the client would eventually not be the primary solution for improving domain knowledge. Instead, a deeper analysis needs to be undertaken. Regardless, further insights may be needed to understand these results.

Finally, team size was the second most referred to factor that was said to affect leadership competencies. Apparently, as the size of the team increases, it also becomes more challenging to lead. Participants mentioned that big teams are more prone to conflict emergence [ST08I1], are more challenging to develop as a team [NV10I5; NV11I3], i.e. to establish a spirit of cohesion and collaboration towards a common goal [AG05I5], and to monitor and manage all recourses [ST09I2]. These obstacles also can impact on the leader, especially on their capacity to resist stress and to control emotions, since they are more likely to handle more complicated situations [ST08I1]. Additionally, the larger the size of the team, the greater need for interpersonal sensitivity [NV11I3].

Extracted from the interviews:

“A delay of one month on a project with a team of twenty people is financially much more painful than a delay of one month for a small project with one person, for example. In terms of... it requires a much more proactive management to get ahead." [NV10I4]

Nevertheless, large teams were also said to have some advantages: respondents highlighted the empowering capability when teams are bigger, since it is not possible to concentrate all responsibilities in one person [NV10I5; OU10I3; NV11I3; AG05I5]. This

phenomenon has been referred to in the literature as the establishment of a collective self-regulation process and the spread of the leadership role among team members to foster team performance (Zaccaro and Klimoski, 2002).

Extracted from the interviews:

"For example empowering. This depends on team size and depends on the complexity of the various areas you may have. (…) I think it depends on the size of the teams we're dealing with. That is to say, no one can directly manage twenty people, therefore if we are talking about a project where twenty people are involved in the requirements phase, ah, it's guaranteed that some responsibilities will have to be delegated through several people" [NV10I5]

Previous studies have also discussed team size in relation to team effectiveness and performance (Pendharkar and Rodger, 2009; Rodger et al., 2011; Rodríguez et al., 2011) and leadership (O'Connell et al., 2002; Lee-Kelley and Loong, 2003; West et al., 2003). The results obtained are in line with the main concern stressed by our participants. For instance, as team size increases, cooperation and communication becomes harder between team members, which may foster conflict emergence (Amason and Sapienza, 1997). On the other hand, larger teams also showed to be related to lack of leadership clarity, as leadership objectives and power may be dispersed among team members, which may be hard to be clearly perceived (West et al., 2003). The literature also found that team performance and innovation has a negative correlation with team size (Curral et al., 2001; O'Connell et al., 2002; Puck and Pregerning, 2014).

To overcome these difficulties, participants highlighted two main competencies: vision and imagination, and managing resources (see Figure 32). Recall that we included the competency guide the team/ give the vision in vision and imagination, which was said to be especially hard for large-sized teams. On the other hand, as the number of team members increases, it also increases the number of resources to manage. Once again, we were expecting an enhancement of communication and conflict management competencies, but no special relevance was given to either. Participants may have emphasized aspects related to the management of teams and eventually may have indirectly include these two aspects both of the competence of resource management and the establishment of project vision. However, further analysis of these topics should be conducted to clarify these results.

Project Type Dimension

From the analysis of the interviews transcripts emerge 7 attributes that were included in the dimension of Project Type. Project Type is a frequently used moderating variable for leadership research, but its meaning varies among research studies (see for instance (Muller and Turner, 2007; Muller and Turner, 2010)). Regarding the responses of this study, we define this dimension through project duration, project complexity, project size, project strategic level, project application type, project contract type, and where (or by whom) it was developed.

Table 55. General Contingency Factors: Project Type

Project Type Factors	**Code**	**Frequency**
Project Duration	PRD	33
Project Complexity	PCY	32
Project Size	PSZ	26
Project Strategic Level	PSL	19
Project Application Type	PAT	19
Project Contract Type	PCT	10
Where (or by whom) it was developed	WDV	10

Source: the Author

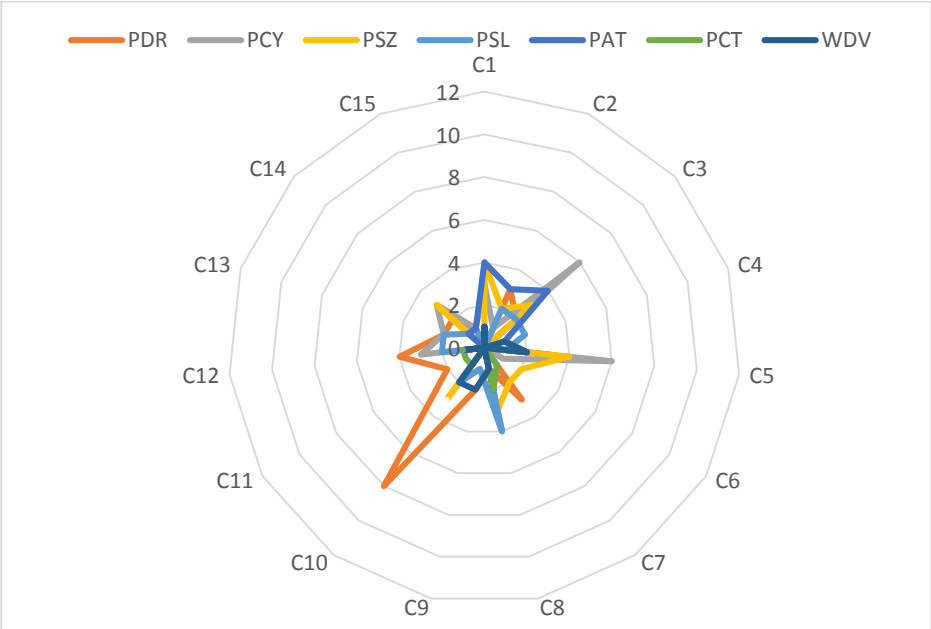
As can be seen from Table 55, project duration was the most cited factor that was said to impact on leadership competencies. Apparently, project duration influences team motivation [NV10I4; ST09I1; JL03I1], and also the self-motivation of the leader [AG05I5]. Long projects were also mentioned as affecting the capacity to maintain a good relationship with the client. As time goes on, the relationship between the leader and the client may suffer from misunderstanding and attrition. Consequently, it may lead to situations of conflict and disruption [NV10I4; ST09I1].

Extracted from the interviews:

"Project duration is related to the motivation level of the team, for instance. This is to say that if I had to identify what are the changes between a half a year project and a two years' project, if I had to sum it up, given my experience, the motivation of the team

and the spoiling of the relationship with the client, I think that's where the focus should be, on the relationship." [NV10I4]

Figure 33. Project Type Dimension impact among Leadership Competencies



Legend: C1 - Critical analysis and judgment; C2 - Vision and Imagination; C3 - Strategic Perspective; C4 - Engaging Communication; C5 - Managing Resources, C6 – Empowering; C7 – Developing; C8 – Achieving; C9 - Self-awareness; C10 - Emotional Resilience; C11 – Motivation; C12 – Sensitivity; C13 – Influence; C14 – Intuitiveness; C15 – Conscientiousness.
Source: the Author

However, the largest focus of the project duration was on the leader's ability for emotional resilience and stress control [JL02I1; AG05I3; AG05I4]. This result can be observed in Figure 33, by the most outstanding dash regarding C 10. An illustrative example is shown below.

Extracted from the interviews:

"If the project is a long one, then it needs a lot of patience. Not all persons have the stomach to be in projects for more than one year, as we get tired, worn out, because we never see the end coming. (…) A lot of patience is needed for a long-term project, and then, when the project gets complicated for a number of reasons, even during the requirements gathering phase, such as the lack of time to do it properly, there are more personal factors, such as the capacity to deal with stress which becomes relevant. This is one of the factors, for me, which pushes people down in projects." [AG05I4]

Previous studies have also included the project duration in their research. For instance, Lee-Kelley and Loong (2003) studied the variations of project structure and leadership style according to the project duration. Although the establishment of a discerning relationship was not possible, the authors found that managers that are task-motivated tend to successfully manage medium-term projects, whereas socio-independent managers were usually assigned to short, or long-term projects. According to Fiedler, "socio-independent" leaders are more detached and are less susceptible to situational and personality distractions. On the other hand, "task-oriented" and autocratic leaders are best suited to extremely favourable or unfavourable contexts, whereas in-between situations would favour a 'relationship-oriented' leader, which are self-esteem and motivated, with good inter-personal skills (Fiedler, 1967). These posits support our results that variations exist in leadership due to project duration. Moreover, we could hypothesize, from the results obtained, whether those leaders best suited for long projects show minor variations in their behaviour due to their ability to be emotionally resilient and to be able to focus on the results.

Project complexity had almost the same report frequency as project duration. In fact, both factors were often referred together with project size [AG05I4; NV11I1; AG05I6; JL03I1].

Extracted from the interviews:

"If [the project is] complex, I think the leader has to have the ability to orchestrate a series of events that usually coexist in a large and complex project. Therefore, a person's ability to get mentally organized and to be a tidy person is very important. A person who gets easily dispersed cannot lead a complex or large project. And for me, a project leader must be a person with very neat ideas, a very organized person" [AG05I4]

As mentioned above, the project complexity was said to impact mainly on the ability to manage a large number of events in order to produce the expected results. The leader's ability to organize, track, and monitor all tasks and resources was enhanced in cases of more complex projects, or large projects [AG05I4; ST09I3; NV10I6]. To do so, respondents highlighted the need to assign more experienced leaders to this kind of project, as their last experiences could support them in decision making, and to accomplish the task.

Extracted from the interviews:

"For project complexity, I think it requires a lot of experience. To a project with great complexity we would need... I think most of all we need someone with experience, to go out to the ground and to make the best decisions" [NV10I4]

This is in line with the suggestion of Lee-Kelly and Loong (2003) to assign experienced managers to complex projects, since their inner confidence and self-belief in their abilities and experience may help to deliver successful projects. However, related with this, one respondent described that the assignment of managers to projects are especially dependent on project complexity and size. This respondent referred to this kind of projects as being "best projects", and stressed that the best managers are often assigned to the best projects, which creates a vicious cycle of competency distribution [AG05I1].

Respondents also enhanced the need for the leader to be an organized person [AG05I4; ST09I3], and to have high negotiation skills [JL02I1]. The ability to be organized (both mentally and externally) and to develop effective plans seems to have special importance in complex projects. This is consistent with the results described above, as it is expected that to properly manage and monitor events, a leader should be an organized person, with strong planning capabilities.

Additionally, looking at the graph of Figure 33, we found that the main focus was given to Strategic Perspective (C3 from IQ) and Resource Management (C5 from MQ) competencies. Clearly, respondents gave special relevance to intellectual and managerial competencies, rather than emotional ones. However, these results contrast with the main literature found in this topic (Dulewicz and Higgs, 2005a; Muller and Turner, 2007; Muller and Turner, 2010). The former authors advocated that complex projects need greater (or in equal manner) emotional competencies than the remaining competencies. As stated in Muller and Turner (2010, p. 446), "with increasing project requirements, however measured (complexity, project type, duration, etc.), there is an increasing need for emotional competencies in the manager". Moreover, the literature posits the following conclusions:

- Medium complexity projects need emotional resilience (EQ) and communication (MQ), whereas highly complex projects require great sensitivity (EQ) (Muller and Turner, 2007).

- Successful managers of medium complexity projects have strong critical thinking IQ , and managing resources, empowering, and developing (three MQ competencies), as well as self-awareness, sensitivity, influence, and conscientiousness (four EQ competencies). However, no variations were found for high complexity projects, as all competencies were equally ranked as being needed more (Muller and Turner, 2010).
- Transactional leaders are more suitable for less complex projects, whereas transformational leaders are preferable to medium and highly complex situations (Geoghegan and Dulewicz, 2008).

These findings join the premise of Dulewicz and Higgs (2005a) that leadership has everything to do with emotional skills, and make us question whether the focus of our participants did indeed remain on leadership functions, rather than the project manager role.

As mentioned before, project size was frequently cited, along with project complexity and duration. However, participants described particular concerns about project size during the requirements phase: "in a large project, the requirements elicitation becomes a little harder to accomplish. You need additional skills to be able to identify what are the essential requirements" [JL02I1]. Among these competencies, we can highlight the experience [AG05I3; ST08I3], the existing domain knowledge [ST09I2], and the capacity to critically analyse the problem and to create a suitable solution [AG05I1; DZ12I1]. Other problems were also reported regarding outstanding team motivation and commitment [NV10I4], and the assignment of clear goals and responsibilities [AG05I4], but we found it to be related with large teams (as discussed above). The graph of Figure 33 summarizes these results.

Furthermore, large-sized projects were also said to have some advantages. One participant affirmed that this kind of project allows for experimenting different techniques that may improve the practices of other projects [NV10I4]. Some of these experiences are related to the empowering and distribution of tasks and responsibilities among team members [AG05I4]. As the leader is unable to control everything in a large project, they naturally adopt a different attitude toward the team members.

Extracted from the interviews:

“Depending on the project and its size, I would say that the project manager has to be able to distribute the work and put everyone to do what they think is the best thing to do. Therefore, they need skills to distribute, delegate and distribute very clear and specific functions.” [AG05I4]

“Large projects give the chance to try other techniques of delegation and leadership that small projects don’t allow, such as delegation and the decentralization of decision-making” [NV10I4]

The literature review does not show special relevance for empowering issues determined by project characteristics, especially project size. Tuuli and Rowlinson (2010) affirmed that few studies were conducted that consider the context of projects to study the empowering process. Thus, we advocate that our results may raise the need for further clarification on these topics.

The remaining four factors from Table 55 were less cited than the above ones. The strategic level of the project was mentioned to keep greater attention on the project’s outputs. Any problems that may arise will be more visible to the outside of the project and may cause dissatisfaction among internal and external stakeholders. As a result, greater pressure may exist which demands additional competencies, such as stress control [NV10I6; ST09I2] and communication [NV10I4; NV10I5].

Extracted from the interviews:

“If it is a media project, then everything that happens in the project will be known by the administrator. So, you must have very ... Because strategic projects also require something else: the relationship with the client has to be much more carefully managed. Why? Because If anything goes wrong, not only will the client be unhappy, but also our administrator” [NV10I4]

“I was going to say that in terms of the strategic level of the project for the client, we might need more or less in terms of internal communication. But it is also true, it is also valid for projects that are strategic for our company. Therefore, if a project is more strategic, then there will be more people asking about the project.” [NV10I5]

However, the visibility of such projects was also said to be beneficial. Respondents highlighted that it may help people to be more aware and committed to the project

[AG05I1], but it also facilitates the provision and allocation of the best resources to the project [ST06I1; ST09I3].

Extracted from the interviews:

"The strategic level for the organisation, yes! This is usually very important for one issue: it can usually get the best strategic resources for the project. Ah, it's very easy to negotiate recourses, because since the project is a strategic one, we have to guarantee that the team is suitable" [ST06I1]

Previous studies have also stressed this contingency factor on leadership style, but the results did not show significant variations on leadership among this factor (Muller and Turner, 2010). This is in line with the graph of Figure 33, where we cannot strongly highlight any particular competency. One possible reason for this is given by Muller and Turner (2007), that advocates that "often projects of higher strategic importance were considered more complex". Thus, competencies may have been deployed to complex projects.

Similarly, project contract type was not shown to impact on any prominent competency (see Figure 33). However, these results contradict those of previous studies. Muller and Turner (2007) found that fixed price projects revealed critical thinking, strategic perspective, empowering and developing to all be significantly higher than in other contract type's projects. Nevertheless, our respondents mentioned that project contract type may influence the overall attitude of the leader, as it directly involves financial resources. The emphasis was given to the need to keep the team motivated and oriented on achieving the results.

Extracted from the interviews:

"A closed contract requires a much closer management style and a greater control than Time and Materials contracts, for example" [NV10I4]

One of the explanations given during the interviews was the criticality of negotiation activities that were seen to be more important in fixed price projects [OU10I1]. In this type of project, both parties are negotiating scope, budget and time, usually with divergent interests [JL02I1]. One of the consequences was said to be the stress and emotional control needed for such negotiation moments [NV11I3; ST09I2]. On the other hand, for

projects with time and materials contracts, these issues were not so relevant, as generally it pre-establishes a pool of hours with no a priori targets, or flexible ones [OU10I1].

Extracted from the interviews:

“In Time and Materials contracts, i.e. a pool of hours one, I think that it may be so, I'm not doing this based on any known rational, but I see that people who usually work on a pool of hours basis feel more despised and feel like they were least part of the company.” [OU10I2]

Regarding the Project Application type, respondents mentioned differences between bespoke and generic projects. The main difference is based on the degree of uncertainty or ambiguity: a tailored project usually deals with more ambiguity and uncertainty [JL04I1]. But also, the ability to gather all the information needed from the client side to build up a suitable solution. In this situation, communication skills, creativity and critical analysis were all said to be particular relevant [ST06I1]. On the other hand, generic projects may have to meet and satisfy a greater number of requirements, in order that they can be attractive to a larger number of potential buyers [OU10I3]. Thus, skills such as vision and strategic thinking were more emphasized by the participants in this type of application [ST09I2].

Extracted from the interviews:

“Oh, maybe a project that involves a specific development may be much more demanding during the phase of requirements elicitation in the analysis phase. Why? Because nothing is set, you have to go to the client, the client has to systematize their ideas, which is not always easy to assess” [NV10I4]

Additionally, participants reported differences for technical projects versus projects that need tacit and explicit knowledge, a.k.a. business projects [AG05I1; JL04I1]. These differences relate to the difficulty of dealing with ambiguity. Technical projects are more likely to be successfully specified, as their degree of uncertainty and ambiguity tends to be low [JL04I1; ST09I4; AG05I3]. On the other hand, business projects deal with different types of processes and information which may be spread across different departments and stakeholders [ST06I1]. Therefore, the elicitation of information may not be properly available or it can be hard to assess [NV10I4; ST06I1; JL04I1].

Extracted from the interviews:

“If we have to implement an application, for example, to test engines, they are all technical things, that is to say, all engineering stuff. The models are given to us, "Look, I want you to meet the equation this, this and this, these are the rules x, y, z". It is much easier to elicit requirements in such a system, isn’t it? Comparing to a system that involves tacit knowledge and explicit knowledge, such as the corporate culture (…) It requires very different skills. Why? Because any programmer or analyst can make the requirements analysis for an engine system. That are equations, the equations are there, he writes the equations, and then he has to do the algorithms to solve those equations. A different thing is for example, when we have to identify, for example, a company’s sales strategy, its logistics strategy, its production strategy, that's what we have, that's where the greatest difficulty is.” [JL04I1]

In the former case, respondents stressed leader’s ability to deal with ambiguity and the need to critically analyse the information to come up with a suitable solution. In summary, the graph of Figure 33 shows that this factor was said to mainly affect the competencies of critical analysis and judgment (C1), vision and imagination (C2), and also strategic perspective (C3), all from IQ. These results at least partly contradict the literature review. Despite the relevance of clear goals and methods are well documented in the literature, the results from previous studies show that the leader should tailored their style accordingly to the degree of uncertainty (Byrne and Barling, 2015).

We were expecting a greater variance of competencies from EQ and MQ, as has been said earlier, they significantly demonstrate project success, especially in poorly-defined contexts (Geoghegan and Dulewicz, 2008; Turner et al., 2009). Analysing our results regarding leadership styles, as proposed by Dulewicz and Higgs (2005b), we conclude that the style with the highest rating of competencies C1, C2 and C3, is the Goal Oriented one. However, the researchers suggested that this style would be more appropriate in stable contexts with clearly-defined goals. For information system projects, several authors have found that an Engaging and Involving style is preferable (Dulewicz and Higgs, 2005a; Turner et al., 2009; Muller and Turner, 2010). However, the results obtained here partly support the relevance of skills found in other studies. For example, Muller and Turner (2010) stressed that the competency of Critical Analysis and Judgment (C1) showed to be one of the most relevant for information systems projects.

Finally, the last factor of this dimension is where (or by whom) the project was developed. Although not so frequently-cited as the remaining factors, two streamlines were stressed: projects developed within the client headquarters and internal projects. When the project has to be developed in the client facilities, respondents said that the leader should keep the team protected from pressures, conflicts and deviant orders from the client [ST06I1]. Communication paths, together with teams' attitude should also be tailored to the client company culture and context, in order to prevent misunderstanding situations. As one participant said, "If we are on the client site, we should take it easy, ok? You have to pay attention to people and to make them see that they should be careful with what they say, beware of the emails they send and be beware of that sort of thing, isn't it?" [NV10I6].

Extracted from the interviews:

"From the team side, I think that what a team prizes most is that the leader knows what will be the solution, which features it will bring, but also that they act like a filter in the relationship with the client, namely their requests, i .e. the team must be focussed and it must be concerned about meeting deadlines, regardless of an eventual phase two, phase three or phase four. Regardless, if the client was to enter the room, as we work a lot in the client's facilities, and sometimes it's difficult to lock out the client, and thus they do not go into the room saying that all the requirements have changed and make our team all go into shock" [ST06I1]

Regarding internal projects, the respondents stressed that they are critical and tend to be more stressful and demotivating. They usually take longer [NV10I4], receive less (and not optimum) resources, and tend to have lower priority when compared to external projects [ST06I1; AG05I4]. Participants enhance the need for specific competencies to deal with such projects, namely to manage and motivate the team, and to communicate [ST09I2].

Extracted from interviews:

"In an internal project, who will we complain to? To us? To our director? When there is a client, people are already prepared, OK. It's the client! You have scope management issues, you know? Because when you says internally, "Look, I cannot do this, because I don't have the resources", perhaps it won't be well accepted, because ... and then things

do not proceed so fast, because there are different priorities, projects tend to get late, and cause the people in the project to be worn-out" [NV10I4]

However, respondents also identified some advantages of this type of projects. As team members are expected to be colleagues, the posture and confidence of all those involved in the project can be more comfortable and effective. An example was given by a participant, who reported the way that a leader communicates with the team and even their assertiveness used in these projects, which would be unthinkable for projects developed for external clients [ST08I1]. One possible explanation might be the cohesion that exists in the team, as its members are probably already known, and the initial process of recognition and establishment of a relationship might be less complex.

Project Process

The dimension of Project Process concerns the use of methodologies during the project. This dimension was the most cited, revealing to critically impact on several competencies (see Table 56). The use of methodologies was one of the features addressed to characterize the project and the requirements phase, and this may have been one of the reasons that highlighted this factor.

Table 56. General Contingency Factors: Project Process

Project Process Factor	Code	Frequency
Methodology	MTD	55

Source: the Author

We decided to consider this factor separately from the remaining of the project type, as it is the only one that describes how the project was conducted. Moreover, its large frequency of citations could lead to some misunderstanding about the results, as it enhances the impact of the project type, instead of the design process (see next subsection for details).

During the interviews, methodology was mentioned to:

1. discuss the relevance of the leadership among the various methodology models and to distribute leadership relevance among the phases of the chosen model [JN01I1; JL04I1; ST09I4; OU10I4];
2. give credibility, security [NV11I2] and stability to the project process [NV10I4];
3. guide project execution and guarantee their success [ST06I1; JL03I1; ST08I1; AG05I2; ST09I3]
4. reduce the effort and complexity of the project [AG05I3], which may also blur the leader's competencies [AG05I4]

Several models were mentioned during the interviews, however, discussion remains regarding only two of them: the traditional linear (e.g. Waterfall model) and iterative/incremental (e.g. Agile) models. Nevertheless, the opinions regarding the relevance of leadership diverge among models. Some participants described that for traditional methodologies, leadership would be more relevant during the initial phases, but not as relevant as in any iterative model [JL01I1]. The Agile methodology was said to be much more concerned with the people involved in the project, rather than formalizing procedures [JL03I1]. Thus, the leader should focus "on the ability to work, on putting people working together, and in establishing personal relationship between them", which is not the main focus of the linear methodologies [JL03I1].

In contrast, other participants highlighted that one of the purpose of the use of a methodology is to reduce the complexity and uncertainty of a project [ST06I1]. Therefore, iterative methodologies do not always achieve this goal, which may represent additional challenges for teams [JL04I1]. Additionally, the tight phases of more formalized methodologies can foster greater tension and discussion among stakeholders, as the solution must be well defined a priori. In this case, leadership competencies of conflict management, negotiation, communication and influence were highlighted.

Extracted from interviews:

"Ah ... Yes, clearly, clearly. If the process is a rolling wave, then the leadership characteristics do not have to be as strong as is the case in a classic waterfall process, isn't it? Therefore, the methodology used requires different leadership skills (...). When you

walk into a waterfall, you must have these skills: negotiation, conflict management and negotiation. It's a good, it's a good topic. Ah ... but we need these capabilities, as we have told: conflict management, pragmatism. In a rolling wave there is, they are not so intense, because the client or who is asking for the project knows that they have a second chance, okay? Therefore, projects are less demanding in this sense." [OU10I1]

"If we think of a more traditional model, a waterfall model, where I do the analysis, then the implementation, and then the testing... If we use such a model, then the leader is more important during the analysis phase, in the requirements definition phase. Because then, during the implementation phase, their role is less active. In the more iterative or agile models, the leader's role becomes even more important, because they have to manage all, they have to guarantee that things will be integrated with each other in the end. I would say that in these models, leadership is more important." [JN01I1]

"When we are talking about agile methodologies, every month we agree with the client streams of work, for example. If it goes… where the customer can easily see the results, then it may become more relaxed politically, and the negotiation attrition will also be greatly reduced" [NV10I4]

The second listed concern regards the relationship with the client. As mentioned before, one of the main tasks of this phase is to establish a relationship with the client that may be based on several cornerstones. Two participants directly mentioned that the methodology could help the leader foster this relationship, as it can be perceived as being professionalism and a way to give safety to the project [NV11I2; NV10I4].

Participants have also argued that the methodology could support some of the leadership activities, decreasing their complexity [AG05I3]. By giving a proven set of activities, the process of the project development is expected to be supported by the best practices and thus to be more successful [ST06I1; AG05I6].

Extracted from interviews:

"For those that don't use any methodology, I think it should be chaotic. I think it makes a crazy difference, because when you follow a methodology that has had good results, and it is known that it will eventually work, then you don't need to make experiments. Performing the requirements phases without any methodology to the person based on, I really don't know how it will be. Without having a

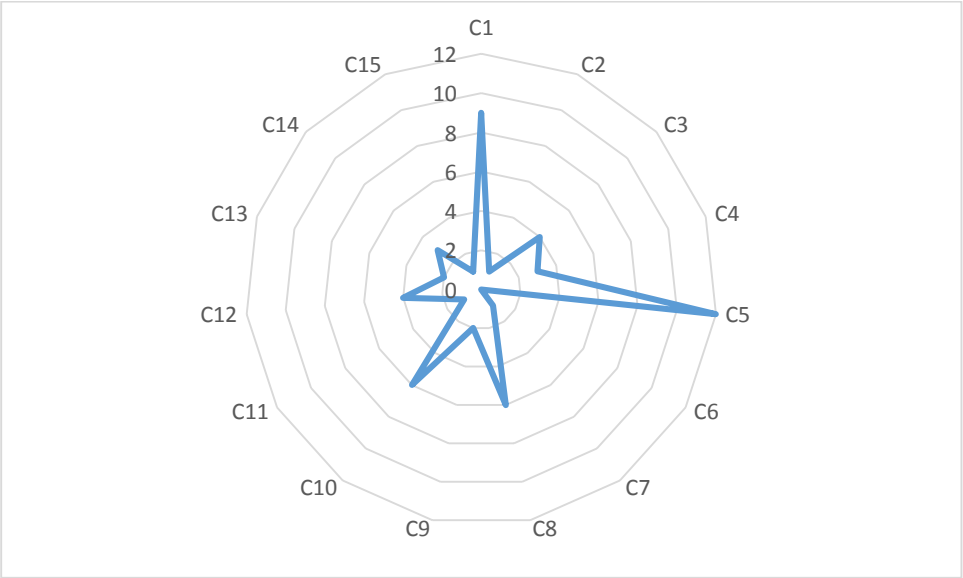
document to write the requirements, I think it should lead very quickly to the failure of the project" [ST06I1]

In extreme, methodologies were considered to be more important than leadership by transforming all project activities in routine and stable tasks [AG05I3; AG05I2; AG05I6]. The need to blur leadership competencies was mentioned by participants from an organisation with a strong structured and formalized methodology. For these participants, an organisation cannot be held hostage to heroes, as it was called by one of them [AG05I3]. Thus, the methodology should act as a replacement for the leader's functions. By ensuring that all processes are structured, clear, and routine, participants believe that the projects can be performed like "in an assembly line" [AG05I3]. Although some coordination is always needed, leadership skills tend to be more irrelevant.

Even so, three of these participants eventually revealed that even with the imposed methodology, a leader can make a difference, not only in exceptional situations, but also in manage people: motivation, empowering, communication and the establishment of a common vision and commitment [AG05I6; AG05I4; AG05I5]. Nevertheless, this position was not assumed by the vast majority of participants, but it helps to shows its impact on the leadership.

In contrast with the latter position, one participant noted that when the methodologies are taken to the extreme, they might lose track of common sense [OU10I2]. One of the associated problems is that managers begin to miss seeing people as people, but see them only as resources, or parts of processes. From their point of view, "there are methodologies, practices, or whatever you want to call them, all of these ways of working, which sometimes take hold of a person", and they may get limitative [OU10I2]. The same opinion was shared by other respondents. According to [JL03I1], a computer project is a project of people, so the methodology cannot be used to overly-formalize people.

Figure 34. Project Process Dimension impact among Leadership Competencies



Legend: C1 - Critical analysis and judgment; C2 - Vision and Imagination; C3 - Strategic Perspective; C4 - Engaging Communication; C5 - Managing Resources, C6 – Empowering; C7 – Developing; C8 – Achieving; C9 - Self-awareness; C10 - Emotional Resilience; C11 – Motivation; C12 – Sensitivity; C13 – Influence; C14 – Intuitiveness; C15 – Conscientiousness.
Source: the Author

In summary, the graph on Figure 34 shows that the methodology impacts mainly on competencies C1, C5, C8 and C10 (considering the average point for highlighting effects). Critical analysis and judgement (C1) has been ranked as having a critical impact on several factors. In this case, the need to build a suitable solution to the problem may be affected by the (or set of) procedures that exist. The different approaches for building the project was said to vary the ability to critically analyse the problem. In linear models, the analysis should be performed during a one-time phase, at the beginning of the project, regardless of the existing knowledge and maturity. Rather, in iterative models, the solution may be built by steps, and may change with the improved knowledge of the relevant needs (Nerur et al., 2005).

Although linear models allow a better control of the process and deliveries, they may also be more time consuming, as all activities must to finished and approved before proceeding to the next phase (Chiocchio et al., 2005). The management of the resources in these models may also be challenging. For instance, the team members may have to wait for a document approval, or may have to rework changed requirements. Both situations may delay the project plans, so they can also exercise a higher pressure to

accomplish the defined goals on schedule, and in budget. Therefore, it is not surprising that Managing Resources (C5) was the highest competency said to vary with methodologies.

On the other hand, since flexibility is not one of the major characteristics of linear models, the need to maintain the initial decisions through the project development may cause disagreement and conflicts with stakeholders (Chiocchio et al., 2005). On the other hand, iterative models bring flexibility to the project, but may also lead to problems of chaos and augmented stress, due to the uncertainly involved (Augustine et al., 2005). The need to remain focussed on the final project outcome and to manage conflicts in linear models can explain the enhancement of the Achieving (C8) competency.

Finally, according to Byrne and Barling (2015), high levels of goal and methods uncertainty can lead to employee stress. Additionally, contexts where there are multiple stakeholders tend to be even more uncertain, which is the case of the requirements phase of a project life cycle (Chiocchio et al., 2005). We argue that eventually it may also lead to stress for the leader, which would explain why the competency of Emotional Resilience (C10) was said to be highly needed.

Leader Profile

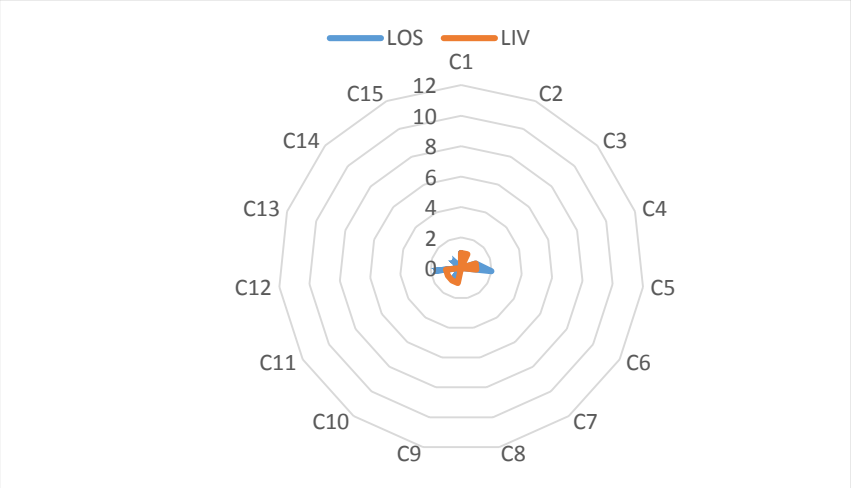
The last dimension is the Leader Profile. This dimension includes the leader's own personal style, and the involvement of the leader in the execution of activities. Table 57 shown the frequency of each factor being cited during the interviews. Although none has been frequently cited (see Figure 35 to emphasis), their inclusion allows discussion with the relevant literature.

Table 57. General Contingency Factors: Project Type

Leader Profile Factors	**Code**	**Frequency**
The Leader's own style	LOS	8
Leader Involvement	LIV	8

Source: the Author

Figure 35. Project Process Dimension impact among Leadership Competencies



Legend: C1 - Critical analysis and judgment; C2 - Vision and Imagination; C3 - Strategic Perspective; C4 - Engaging Communication; C5 - Managing Resources, C6 – Empowering; C7 – Developing; C8 – Achieving; C9 - Self-awareness; C10 - Emotional Resilience; C11 – Motivation; C12 – Sensitivity; C13 – Influence; C14 – Intuitiveness; C15 – Conscientiousness.
Source: the Author

The leader's own characteristics and personality have been addressed greatly in the literature (see for instance (Judge et al., 2002; Turner and Muller, 2005; Aronson et al., 2006)). The suitability of these characteristics has been said to depend upon several factors, such as the project and company context, namely when dealing with uncertainly (Aronson et al., 2006; Byrne and Barling, 2015). So, we would not suppose the context of this study to be an exception, especially when considering the expected uncertainty during the requirements phase.

Our respondents have mentioned that certain profiles would probably not be the most suitable for the context under study. For instance, a person with a marked technical profile would probably not be able to succeed during this phase [ST06I1]. It was also remarked that a certain style would be appropriate, depending on the group and context where the leader should act. And that, despite all the procedures and methodologies that might exist, each different leader would perform differently [OU10I3].

Additionally, conditions were also mentioned that may vary over time and may affect the remaining leadership competencies [ST06I1; ST09I3; DZ12I1]. One of such conditions is the mood of the leader. According to [ST06I1], "depending on, I think the mood or the personal condition of the person, their skills may be highlighted or become faded". But other conditions were also referred to, such as external conditions: political,

social, economic, among others, that may affect the effectiveness of the leadership competencies.

Extracted from interviews:

"External [conditions] there are many things that surround our personal life, socially, economic, politically, etc., which ultimately influence us. No wonder that during the last year, it completely increases the number of cases of people facing psychological problems, as we live in a social and political and economic context today, completely different from that which we experienced five or six years ago, and this ultimately impacts the productivity of the people themselves and the motivation of people in their work. This is not related to their day-to-day life, their responsibility in particular, is relative to the human being, as there are external conditions that exercise an influence, and this has to be noticed, you have to try to, somehow mitigate or resolve these conflicts, but they exist, and they will always exist. This is the human condition, isn't it? It would be good if we were able to step into our office and leave the world outside, but that's not possible." [ST09I3]

So far, the results described are in line with previous studies, in that the personal context has a significant influence on leadership style and effectiveness. For instance, according to Kelley and Loong (2003), the personal context has a significant influence on the leadership style. The former authors focussed on the leader's type of past experience as a predictor of the leadership style assumed. Moreover, the work of Byrne and co-authors (2014) showed that, under certain diminished psychological resources (anxiety, depression and alcohol consuming), leadership effectiveness decreased.

The other factor of this dimension is probably related with the results of the latter study. One participant claimed that leadership competencies and practices are affected with the degree of the leader's involvement in the execution of the project activities [DZ12I1]. She stressed that "it depends if I'm hands-on, or just coordinating the team. Obviously to keep things calm, temper and rational, it is much easier when I'm not entangled in describing requirements until exhaustion, right?"

Therefore, it seems that personality may in fact influence the assumed leadership style and it effectiveness. However, this seen to have been neglected in the recent

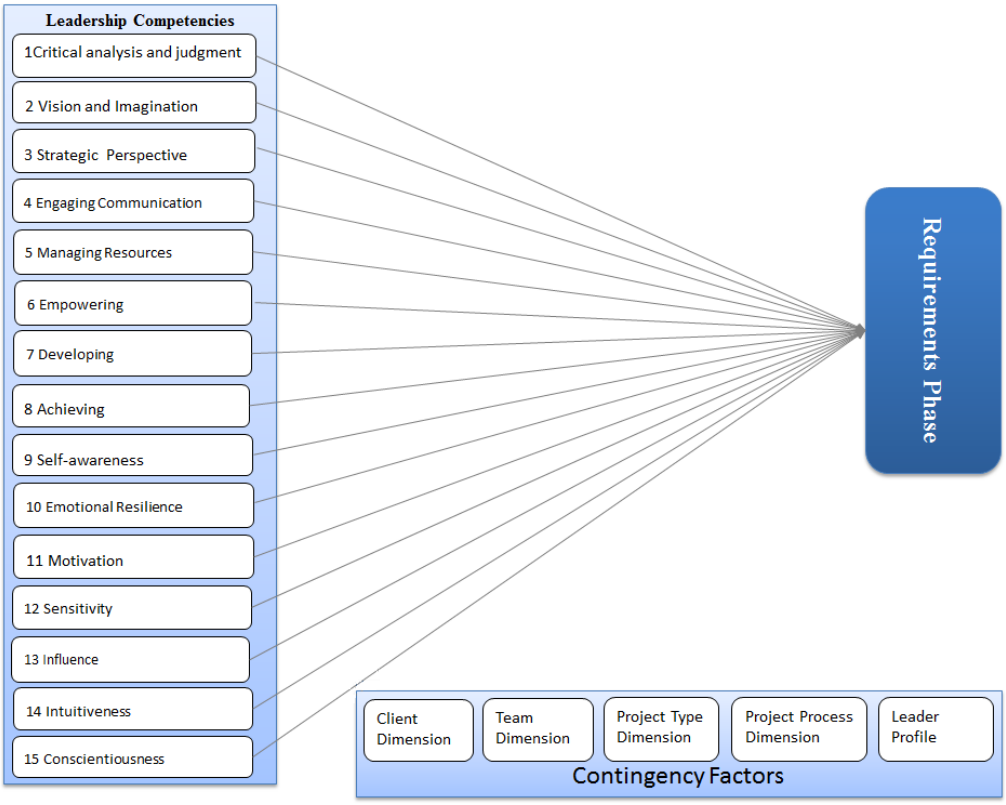
literature on leadership and job performance (Kelley and Loong, 2003; Byrne et al., 2014), and therefore, further research is suggested.

In the next subsection, a final review is presented, summarizing the results discussed so far. We also perform a first instantiation of the proposed research model for this study.

Research Model Instantiation

In the former subsections we presented leadership competencies and the contingency factors explored by the study participants. The list of competencies was aggregated and classified using the Dulewicz and Higgs (2005b) framework. Next, contingency factors were grouped into five dimensions, focussing on issues related to clients, teams, project characteristics and process, and the leader's profile. Therefore, we are now able to draw the first conclusions from these results. To do so, we use the research model proposed for this study (see Figure 6), even though it may not be fully completed at this time.

Figure 36. The first results of the Research Model for leadership competencies in the RE phase of the software development project life cycle

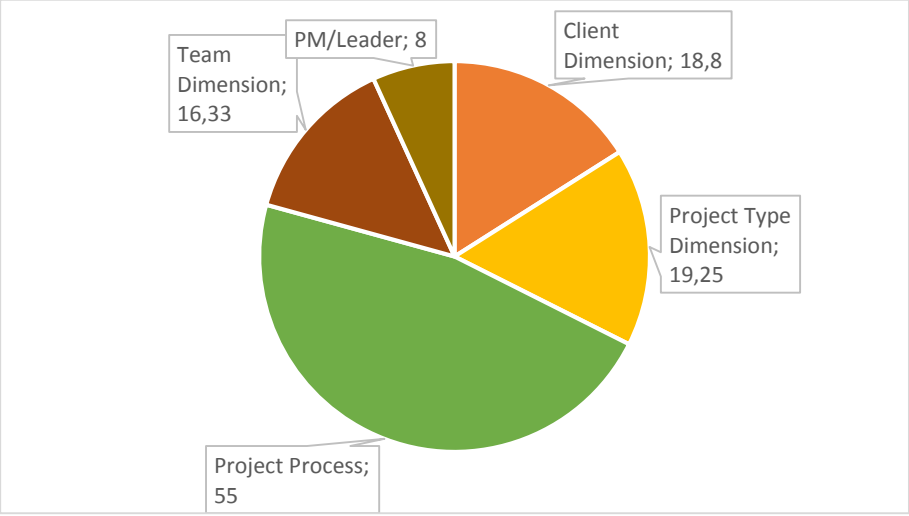


Source: the Author

To fulfil the left part of the model we found a total of 54 leadership competencies. However, these competencies were further classified toward the fifteen competencies proposed by Dulewicz and Higgs (2005b). To improve comprehension, the resulting set of competencies are going to be used to replace the variables Competency 1 – Competency N, from the initial model, rather than using each competency separately (see Figure 36).

To instantiate contingency factors, additional analysis had to be conducted. We found five aggregating dimensions that were said to affect the relevance of the leadership competencies. Furthermore, we have discussed each dimension separately against the list of competencies. Therefore, the first step for the model fulfil was to replace the variables CF 1-CF N of the initial model with the five dimensions found (see Figure 36). However, we was still not able to represent the arrows in the model, considering the impact that each dimension has on each leadership competency.

Figure 37. Relative Weighting of the impact of each Dimension

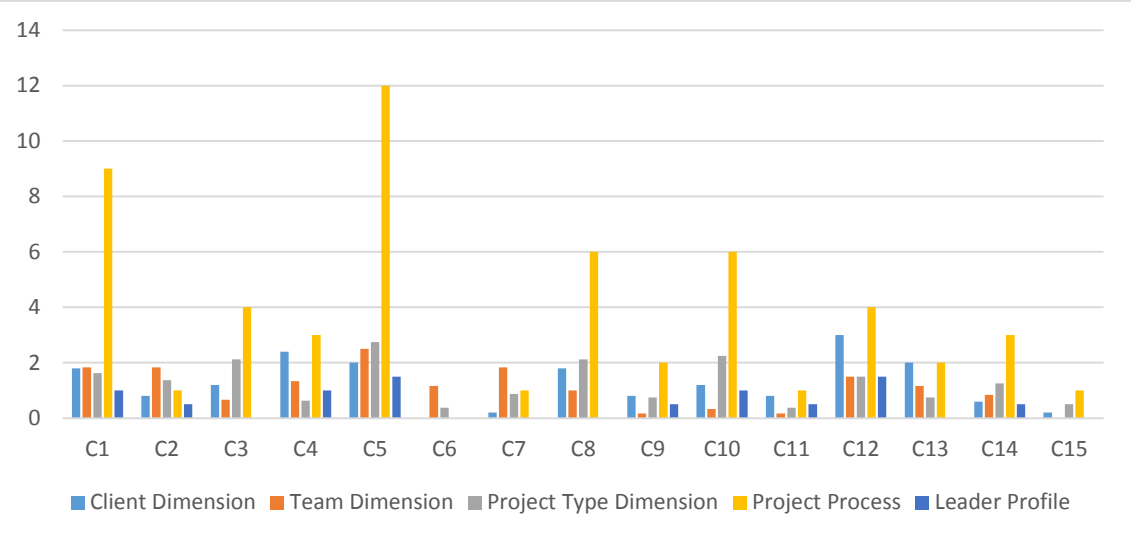


Source: the Author

Additional analysis was performed to understand the relative weight of each dimension in the set of the mentioned factors. The results were obtained by considering the number of citations by the number of factors of each dimension. The distribution is shown in Figure 37. As already mentioned before, the dimension of Project Process was that which was shown to influence leadership competencies most. Type of project, client and team demonstrated a similar medium influence. Finally, the dimension of leader profile showed a minor influence.

Nevertheless, this analysis only gives some clues as to the overall impact of the competencies. It does not tell us anything about the relative impact of each dimension for each competency. Accordingly, we further examined each competency separately, to assess the relative impact of each dimension. The results can be observed in Figure 38.

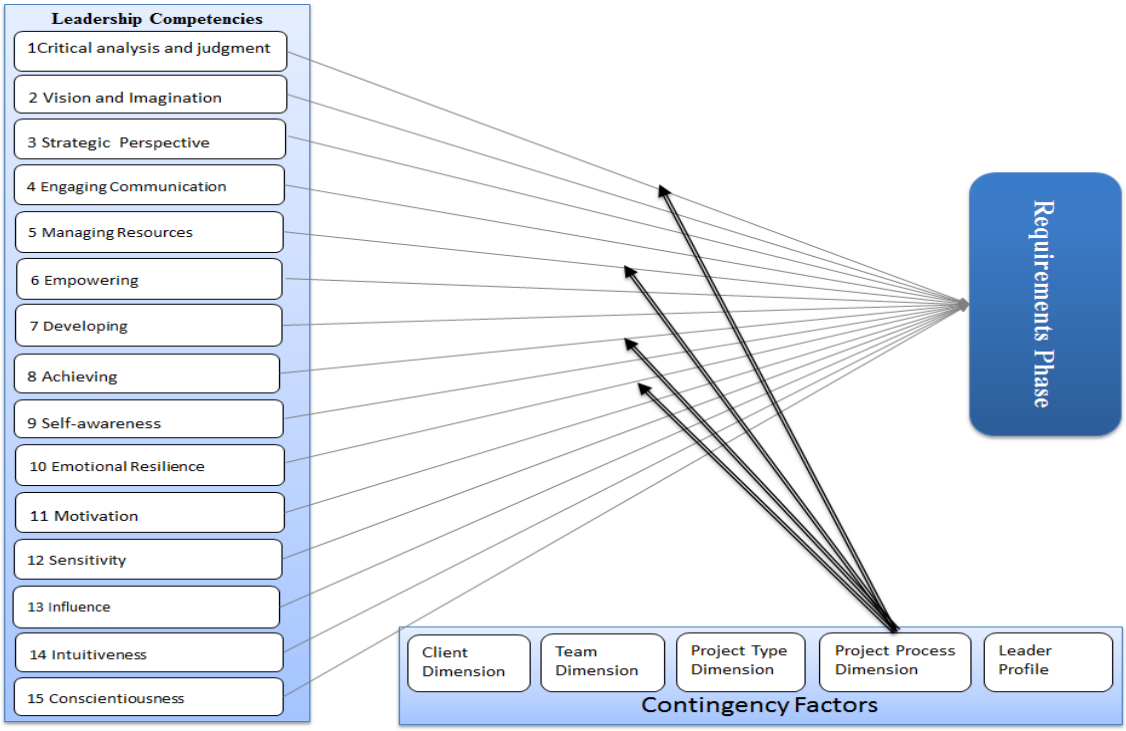
Figure 38. Distribution of the relative weight of each dimension in the impact on each leadership competency



Legend: C1 - Critical analysis and judgment; C2 - Vision and Imagination; C3 - Strategic Perspective; C4 - Engaging Communication; C5 - Managing Resources, C6 – Empowering; C7 – Developing; C8 – Achieving; C9 - Self-awareness; C10 - Emotional Resilience; C11 – Motivation; C12 – Sensitivity; C13 – Influence; C14 – Intuitiveness; C15 – Conscientiousness.
Source: the Author

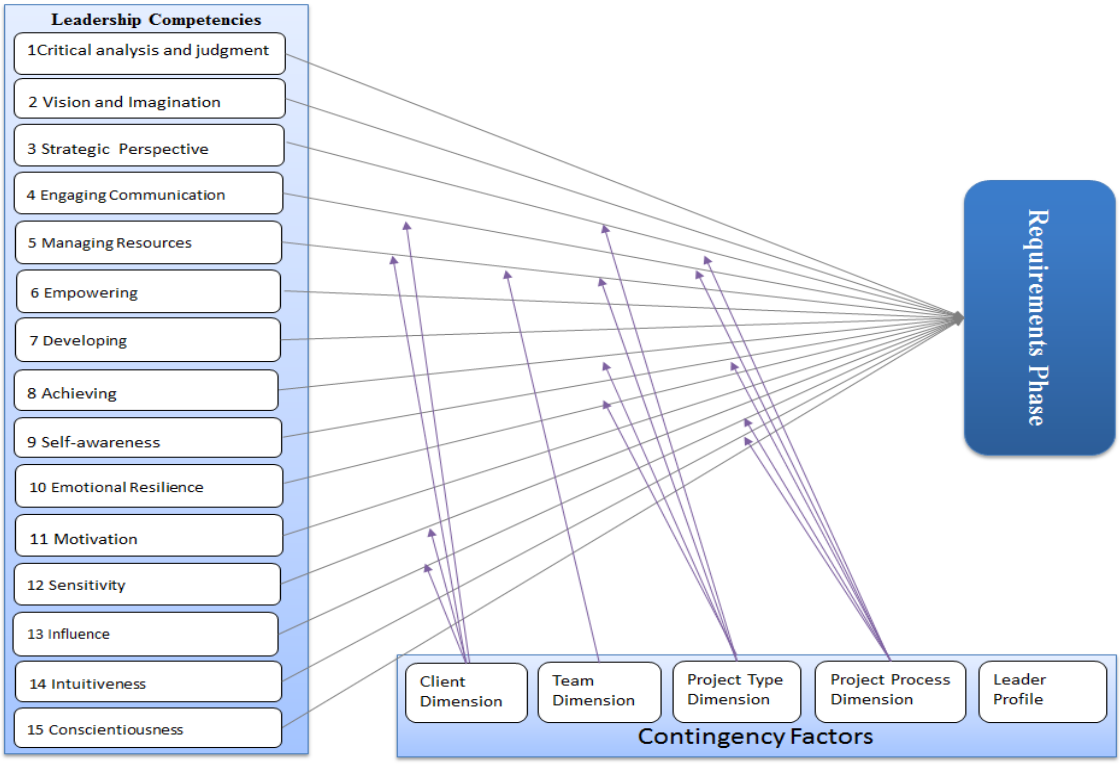
Once again, Figure 38 shows that Project Process is the only dimension that appears to have a high relative influence on some of the competencies. Even so, the medium influence presents a more varied distribution for other dimensions. To represent these differences on the research model, we divided the influence into three classifications: high impact is represented with a double arrow, which means a relative impact of equal or greater than 6 (the middle point); medium impact is represented by a normal arrow, which includes the values from 2 to 6, and; low impact is represented by a broken arrow for values under 2. Dimensions with no influence on competencies are not represented in the model. Despite the differentiation of arrows, a single model containing the different impacts would be incomprehensible. Thus, we divided the results into three identical models, each representing a level of impact (see Figure 39 for high impact dimensions, Figure 40 for medium impact dimensions, and Figure 41 for low impact dimensions).

Figure 39. Results of the Research Model for the influence of dimensions of contingency factors on each leadership competency (Relative High Impact)



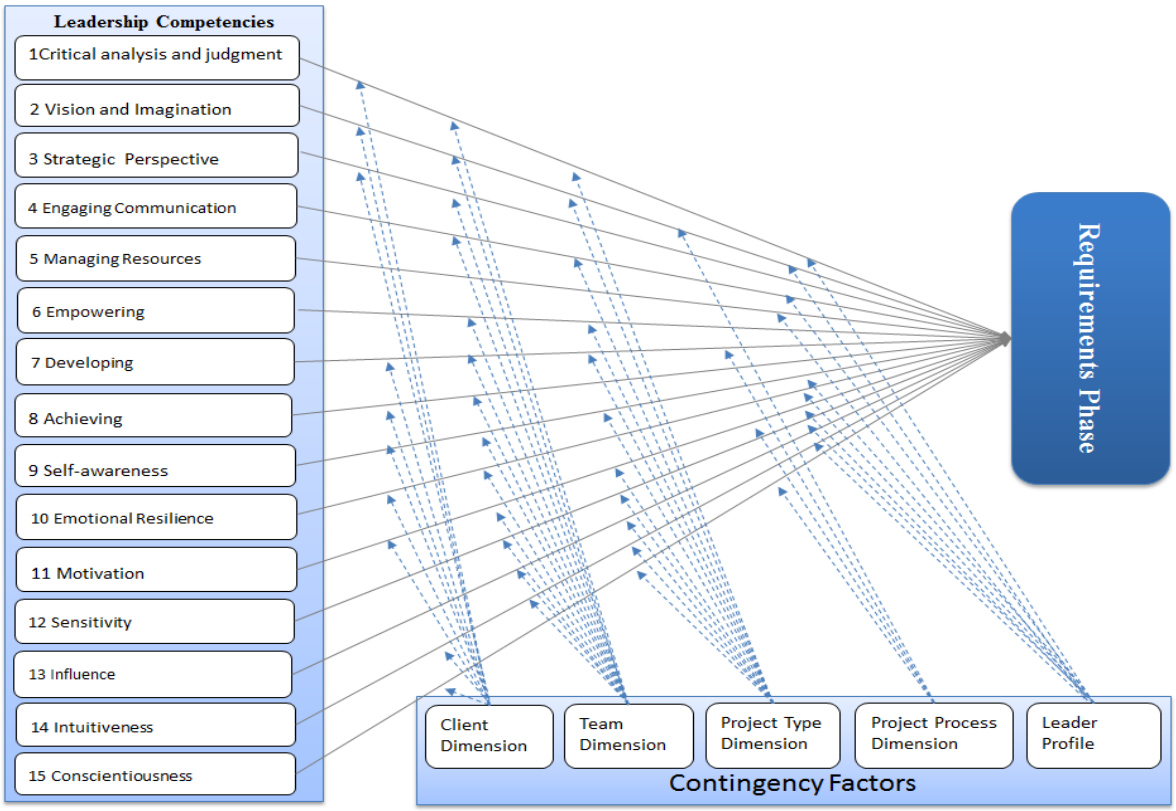
Source: the author

Figure 40. Results of the Research Model for the influence of dimensions of contingency factors on each leadership competency (Relative Medium Impact)



Source: the Author

Figure 41. Results of the Research Model for the influence of dimensions of contingency factors on each leadership competency (Relative Low Impact)



Source: the Author

With the conclusion of the analysis of the open exploration of leadership competencies and their contingency factors, we proceed to the next subsection to analyse the adequacy of the leadership competencies proposed by (Dulewicz and Higgs, 2005b) during the requirements phase. To do so, we make an assessment of the relevance of each competency, considering the set of the main activities performed in this phase.

4.4.4 Leadership Assessment throughout the Requirements Phase Activities

In the previous sections, the set of leadership competencies needed for the requirements phase were explored. Additionally, a discussion was made about the contingency factors that may impact on the relevance of such competencies. The justification for the competencies found concerns the particularities and difficulties of this phase of the project development life cycle. According to several authors, a project is

performed through a series of phases, each with characteristics and goals that differentiate them from the rest (Pressman, 2005; Byrne and Barling, 2015). Thus, a successful leader should be one who has the ability to adapt and switch their leadership style accordingly (Shenhar and Wideman, 2000 ; Prabhakar, 2005; Muller and Turner, 2010; Skulmoski and Hartman, 2010; Byrne and Barling, 2015).

Specifically, the requirements phase was mentioned to be particularly critical for the project success. In this phase, the client and the supplier parties should established an emphatic relationship that could foster the execution of the project activities (Skulmoski, 2005). Moreover, they should come up with a suitable solution that must get the approval and commitment of all involved. However, the context of great uncertainty and ambiguity that is commonly mentioned in this phase makes it hard to manage the project solution (Chiocchio et al., 2005). Furthermore, the eventual high number of stakeholders involved with divergent interests in the project hinders the process of decision-making and solution approval. On the other hand, team formation is usually performed in this phase which may increase the complexity of this phase.

Howsoever, we were expecting that our respondents could distinguished leadership competencies largely required in this particular phase. But, this was not always the case. We noted a division in the participants' opinion. While some argued that the set of competence would be the same whenever the leadership should act, others stressed variations on their relevance to certain circumstances.

Extracted from interviews:

"[The set of leadership competencies] is not affected by anything, because regardless of any factors, all phases have to be performed, although not in the same order, limits or size. For this reason, the observed competencies didn't change" [JN01I1].

"I believe it may vary. For example, during the requirements phase, a person will probably have to have a different set of skills than during the development phase, i.e. throughout the project, I think that always one person should exists, whether a leader or not, to control the project, and they may be the project manager, or not. (…) During the requirements phase, this person will probably have to have good negotiating skills and good communication skills with the client, and be someone who is pragmatic, i.e., who can do good things, and not just say the optimum... Therefore, during the implementation

phase, there must probably be a person who already has a more technical background, who can motivate the team, who can manage resources, who can manage tasks, and who can manage time... Therefore, I believe a number of different competencies are probably required during the various phases" [ST09I2].

To ascertain possible variations among the competencies, we proceed to the next step of this analysis: to assess the suitability of the framework of competencies proposed by Dulewicz and Higgs (2003b) during the requirements phase. In the analysis we also included the main activities performed during this phase. As these activities have different goals and contexts, the aim was to understand whether they lead to any variation for the relevance of these competencies. To do so, we asked participants to complete a double entry table containing the leadership competencies from the referred framework and the activities described (Pressman, 2005). In each cell, participants should indicate whether the competency would be relevant for each activity.

The preliminary analysis showed that generally participants advocate some variation of the competencies that are applied to each activity. This conclusion can be drawn as no table was found with any pattern of the responses for all activities. The justifications given are not far removed from those described so far. They are based on two main key points: the need for interaction with the client (and other stakeholders), and the type of task that the team has to perform.

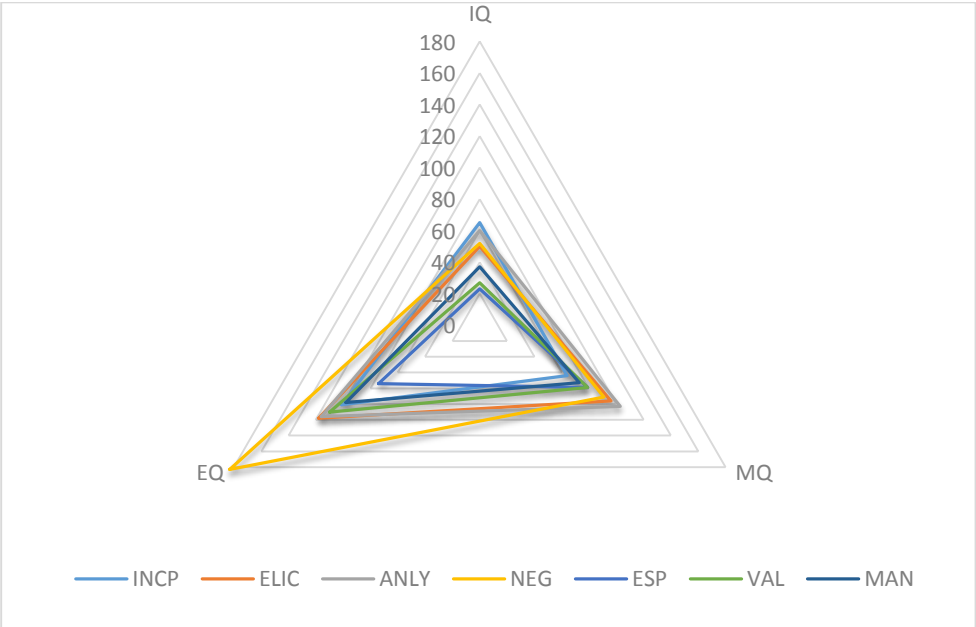
Extracted from interviews:

"Yes, Yes, Yes, Clearly! You just have to think of the basis: during the phase of requirements elicitation, I have more interaction with the client. For the analysis I probably no longer need that interaction with the client, but I would have some, but less, right? Thus, just by considering this, the leadership skills and characteristics have to be different. One thing is when I'm talking with the client, another is to be working with the project team, right?" [NV11I3]

The first analysis aimed to understand whether there is any variation in the group of competencies along the activities of this phase. We start by looking at the leadership dimensions, rather than the detailed competencies, in order to get some insight into the nature of these variations. The presentation of the results was made using a radar chart (see Figure 42). This type of chart is a useful tool for visualizing multivariate data,

allowing the comparison of several dimensions through several axes (Harding et al., 2012). In this case, the developed chart contains three axes, which represent each leadership dimensions from the framework (IQ, MQ, EQ). In turn, each coloured triangle represents an activity performed during the requirements phase. Furthermore, the position on the chart of each vertex from the triangle specifying the frequency of each leadership dimension was cited. Thus, the area of each triangle represents the necessary combination of all dimension required to perform that particular activity.

Figure 42. Leadership Dimensions Relevance for Requirements Phase Activities



Legend: INCP- Inception; ELIC – Elicitation; ANLY – Analysis; NEG – Negotiation; ESP – Specification; VAL – Validation; MAN – Management.
IQ – Intellectual; MQ – Managerial; EQ - Emotional Competencies
Source: the Author

A first look at the graph shows a uniform triangular stain, with a highlighted vertex for the axis of Emotional Competencies (EQ) dimension. In fact, we can also note a relative skew of all triangles on the same axe. Thus, we can conclude that the results suggest a general tendency to focus on the EQ competencies during the requirements phase. These results support previous studies where the relevance of EQ was showed to be critical, although in broader contexts (Turner and Muller, 2005; Ng and Walker, 2008; Dulewicz and Higgs, 2005a; Hawkins and Dulewicz, 2007).

A more careful look shows that the highlighted triangle represents negotiation activities. Apparently, during this kind of activity, the EQ dimension is much more critical

than any other one. The criticality of negotiation moments had already been mentioned during the interviews. These activities can be decisive for project execution, and have been identified as being very demanding for the application of competences [NV10I5].

On the other hand, the comparison of the three leadership dimensions showed that the Intellectual IQ dimension was the less ranked. Inceptions activities were the only exception for the need for relative IQ competencies for their best performance. All the other types of activities showed no relative need for such competencies. Once again, these results are in line with some of the findings from previous studies. For instance, Geoghegan and Dulewicz (2008) found that IQ competencies were less significant for explaining project success. Furthermore, Muller and Turner Muller and Turner (2010) found similar results when assessing the relevance of aggregating competencies.

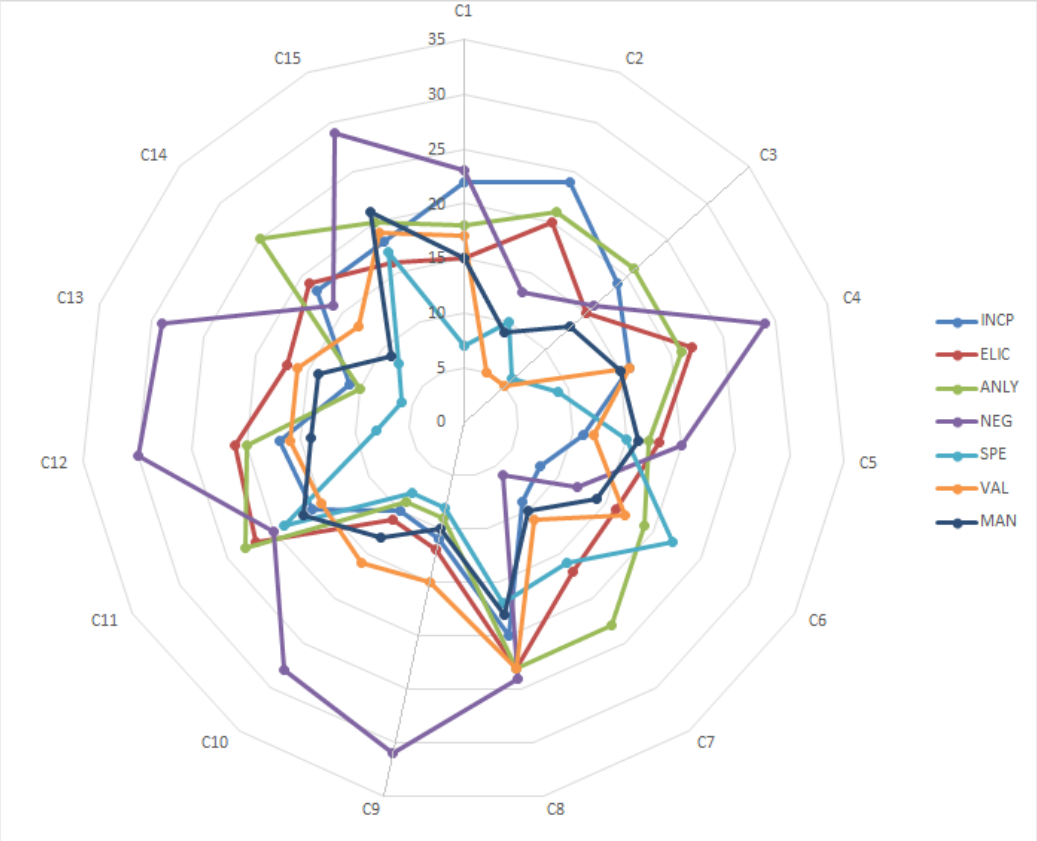
The Managerial (MQ) dimension revealed some consistency regarding its relevance throughout the requirements activities. However, a slight separation can be noted regarding the activities from the radar chart. Apparently, the activities of elicitation, analysis, and negotiation are separated from the remaining ones, showing a relative greater need for MQ competencies. Although it may not be significant when comparing the other variations in the chart, we think that it deserves a deeper look. The rational comes from the results discussed in the begging of this section. According to our respondents, the leadership competencies during the requirements phase should be used during the relationship with the client and with the team (see Figure 29). As this phase often requires a great need for interaction with the client, including this dimension seems to be valuable for the comprehension of the results.

Albeit, the conclusions drawn from the chart shows that it does not give any clues regarding the variation of each competency separately. Do all competencies follow the same variation pattern revealed by their aggregate dimension? For instance, do all competencies of the EQ dimension reveal the same criticality for the negotiation activities? Or is the skew caused by the criticality of just some of their competencies? To answer these questions, we repeated the analysis of the requirements phase activities, considering each competency separately. Once again, the results are shown using a radar chart.

Despite the uniformity showed for the leadership dimensions for the requirements activities, the results on the leadership competencies separately did not confirm this trend.

As can be observed from the radar chart of Figure 43, the uniform stain appears to no longer exist. This graph shows a great variation in the relevance of each competency, considering different activities. Apparently, the results of the leadership dimensions alone cannot represent the complexity of the phenomenon.

Figure 43. Leadership Competencies for Requirements Phase Activities



Legend:
Activities of RE- INCP- Inception; ELIC – Elicitation; ANLY – Analysis; NEG – Negotiation; ESP – Specification; VAL – Validation; MAN – Management.
Leadership Competencies:
C1 - Critical analysis and judgment; C2 - Vision and Imagination; C3 - Strategic Perspective; C4 - Engaging Communication; C5 - Managing Resources, C6 – Empowering; C7 – Developing; C8 – Achieving; C9 - Self-awareness; C10 - Emotional Resilience; C11 – Motivation; C12 – Sensitivity; C13 – Influence; C14 – Intuitiveness; C15 – Conscientiousness.

Source: the Author

To better understand the differences of the results, we added radial axes to the graph, to separate the competencies from each dimension. This allows us to draw more detailed conclusions. For instance, we are now able to observe that, although negotiation activities present a relative high frequency for most leadership competencies, especially those of EQ dimension, they do not all show the same criticality. Moreover, observing the leadership competency of Self-awareness (C9), more than thirty respondents classified that it is important for the leader to successfully perform negotiation activities. In contrast,

the relevance ranking dropped to less than a half for the remaining activities of this phase, denoting a high variety of the relevance of this competency.

However, the number of different polygons in the graph makes it difficult to read and analyse the results. Thus, an analysis and discussion will proceed for each requirements phase activity. The next subsections focusses on the set of the abovementioned relevant leadership competencies to perform each activity separately.

Inception

Inception is usually the first activity performed during the requirements phase and it defines the beginning of a project. During inception, it is expected that the basic understanding of the project will be gathered, i.e. the basic requirements and constraints for the system are evaluated in order to assess their viability. This includes tasks such as project feasibility analysis, and it often involves the establishment of the first contact with the client and stakeholders (Pressman, 2005).

Extracted from interviews:

"Initially the client contacts us, and sends some documentation, almost as if it was a BRD, a Business Requirement Document" [STO8I2 #1]

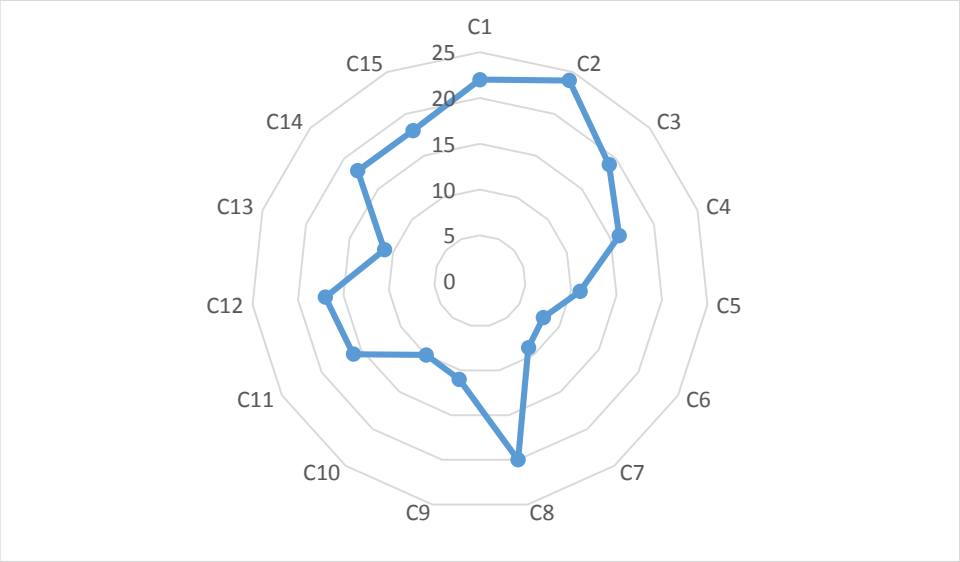
However, during the interviews, some respondents stressed that this activity was not considered to be part of the requirements phase. In some companies' processes, project inception is performed before the existence of the project, earlier to the requirements phase [AG05I1; AG05I2; AG05I3; AG05I4; AG05I5]. Nevertheless, participants have still ranked the leadership competencies, as they don't feel that it could vary the classification made.

The results from the respondents' classification about the relevance of each competency for this activity are shown on the radar chart of Figure 44. In this chart, we can observe the frequency that participants rated each competency as being relevant to this specific activity. The polygon on the graphic represents the resulting combination of competencies that the leader should have to successfully perform this activity.

As can be observed from the graph in Figure 44 that all competencies have been generally identified as being important for Inception. However, some were said to be

more relevant than others. To distinguish the competencies in terms of relevance, we consider the frequency that each was ranked. As a total of thirty two tables were filled out, we classified each competency as being relevant whenever it was reported by at least sixteen participants. The remaining are considered to be important but not critical.

Figure 44. Leadership Competencies' relevance for Inception



Legend - Leadership Competencies $C_{1..15}$:
C1 - Critical analysis and judgment; C2 - Vision and Imagination; C3 - Strategic Perspective; C4 - Engaging Communication; C5 - Managing Resources, C6 – Empowering; C7 – Developing; C8 – Achieving; C9 - Self-awareness; C10 - Emotional Resilience; C11 – Motivation; C12 – Sensitivity; C13 – Influence; C14 – Intuitiveness; C15 – Conscientiousness.
Source: the Author

Looking at the graph, we found that participants gave special relevance to competencies C1, C2, C3, C4, C8, C11, C12, C14 and C15. On the other hand, the less mentioned competencies were C6 and C7, by less than one third of the participants. The most referred competency was Vision and Imagination (C2), and the most referred to aggregate dimension was IQ (C1, C2 and C3). Generally, the main focus was given on analysing the project content and starts to align a solution that can satisfy the purpose of the project.

Apparently, the ability to critically analyse (C1) the project proposal is essential for determining its viability.

Extracted from interviews:

"What we also do when these requirements come to us, is to an independent area checks whether that which is being requested is mandatory. (...) Or, in the case of risk

office, to check whether all activities identified as mandatory are in fact needed, and if they are worth the money we are spending. (...) Whenever we send a feasibility study to be implemented, the development teams have to sort and classify what they think about the quality of the initial requirements." [AG05I1]

Furthermore, in this activity, the leader should foresee a suitable solution and advance their impact [ST06I1], however the context and scope of the project are often too ambiguous and unclear at this moment. Thus, participants said that they usually have to use competencies, such as intuitiveness (C14), to better cope with this situation [DZ12I1]. They also argue that innovative and creative ideas (C2) may help to come up with the best solution [JL03I1; ST06I1]. On the other hand, a strategic perspective (C3) may help to scope the project for the company's interests [DZ12I2], but it raises ethical concerns (C15) about the real benefits of the solution proposed [ST08I2]. To minimize mismatches, a great enhancement was given to the importance of remaining focussed in finding a solution (C8) that will keep both clients and the supplier company satisfied [OU10I3].

During Inception, it is also expected that a first impression occurs between the client and the supplier company, which may affect the establishment of an empathic relationship throughout the project [DZ12I2; DZ12I4]. This may explain the relevance of the competency of sensitivity (C12), as this was said to help with the first contacts with the client [OU10I3; DZ12I2; DZ12I4].

Comparing the results with the literature, we found that the IQ dimension has not been the most highlighted dimension in most of the previous studies (Dulewicz and Higgs, 2003a; Wren and Dulewicz, 2005; Muller and Turner, 2007; Geoghegan and Dulewicz, 2008; Muller and Turner, 2010), however exceptions exist (Turner et al., 2009). The aim of this study is different from the others, but we can still discuss some of their results. For instance, Muller and Turner (2010) concluded that for general IT projects with a fixed price contract, the competencies C1 and C3 were highly ranked. As most of our projects have fixed price contracts, the results may be applicable. Moreover, Turner, Muller and Dulewicz (2009) described unexpected results when comparing line managers with project managers. They found competencies C2 and C3 to be significantly correlated with leadership performance. The authors explain their results by suggesting that MQ and IQ are more relevant for leading projects, while the remaining competencies are critical for establishing commitment to the team. However, during inception it is uncommon to

be a team [DZ12I4; NV11I3], and this may explain the low adherence for competencies such as C6 and C7.

Skulmoski and Hartman (2010) also described that in the early phases of the project (initiation activities), some of the most relevant competencies for project managers are creativity/innovation, solution and results oriented, analytical skills, problem resolution, consensus building, persuasiveness, ethic conduct, and effective questioning and feedback. Despite the fact that the former studies use general competencies for project managers during the whole project life cycle, rather than focusing on leadership competencies for the specific activities of the requirements phase, the comparison of the results shows a high level of agreement.

The results of this study, reinforced by the comparison with the literature, suggest that the necessary competencies for this activity are more aligned with those needed for project managers, than the leader. The exception is the need for client interaction, which emphasizes interpersonal skills. However, it is important to continue to analyse each activity in order to see whether this pattern holds, or changes, depending on the activity's nature.

Elicitation

Elicitation activities include the whole process of discovery and the detail of requirements identified in the previous activity. As described by Pressman (2005), it seems easy to simply ask stakeholders what are the purpose and objectives of their new systems. However, these activities are usually far from simple. The criticality of these activities has featured in extensive literature, suggesting techniques and tools to support and improve their results, such as interviews, structured meetings, and focus groups, among others (Hadar et al., 2014).

Some of the most frequently cited difficulties are related to problems of misunderstanding, volatility and scope definition (Pressman, 2005). The general purpose of elicitation activities is to register stakeholders' needs, and then convert them into system requirements. However, the necessary information is not always easy to reach. Project objectives are frequently unclear and ambiguous (Skulmoski and Hartman, 2010). Stakeholders are not always available, or are not aware of the importance of the

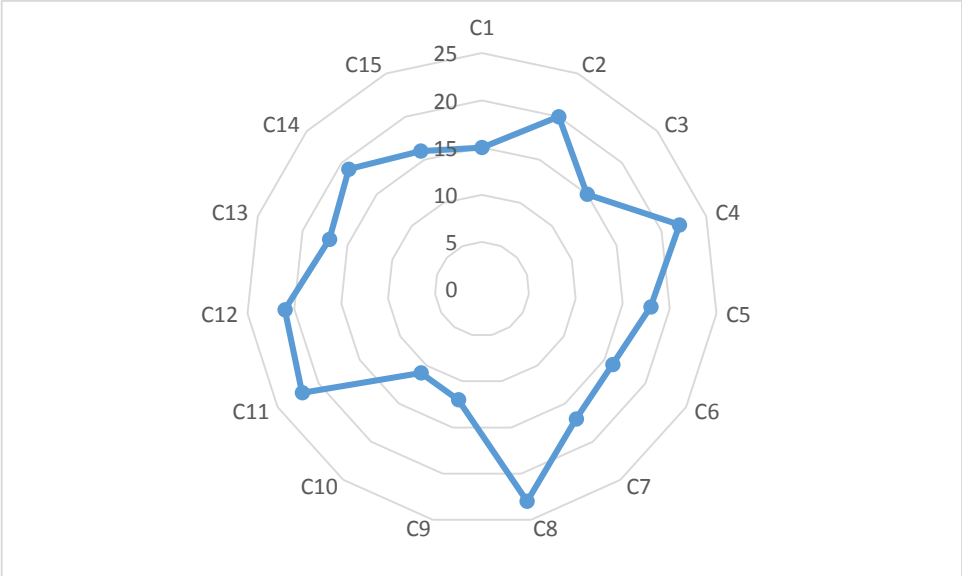
information they should give [NV10I4; OU10I1; ST06I1]. Therefore, the context of this activity is often ambiguous and involves great uncertainty (Chiocchio et al., 2005).

Extracted from interviews:

"Our work is much more difficult when the client doesn't know exactly what they want." [ST09I3]

The radar chart in Figure 45 shows the distribution of those leadership competencies needed to accomplish the tasks of this activity. The first observable conclusion is that the polygon in the chart shows less variance between competencies. Most competencies were marked by at least half of the participants, and those that did not, remain close to the midline. Apparently, a great combination of competencies is required for elicitation activities. The list of competencies above the midline are C2, C4, C5, C6, C7, C8, C11, C12, C13, C14 and C15, but it is still possible to enhance competencies C2, C4, C8, C11 and C12 (over twenty references).

Figure 45. Leadership Competencies' relevance for Elicitation



Legend - Leadership Competencies $C_{1..15}$:
C1 - Critical analysis and judgment; C2 - Vision and Imagination; C3 - Strategic Perspective; C4 - Engaging Communication; C5 - Managing Resources, C6 – Empowering; C7 – Developing; C8 – Achieving; C9 - Self-awareness; C10 - Emotional Resilience; C11 – Motivation; C12 – Sensitivity; C13 – Influence; C14 – Intuitiveness; C15 – Conscientiousness.
Source: the Author

The necessary involvement with the client and other stakeholders to accomplish this activity can present great challenges for the leadership. The need to clearly communicate was one of the most mentioned competencies. A leader should be able to ask the right questions [NV10I5; DZ12I1], to the right people [JL04I1], in the most appropriate way [DZ12I2; OU10I2]. However, they should also have the ability to listen [ST06I1]. A leader who cannot listen to the client's needs and problems will probably not be able to come up with a solution that will satisfy all the stakeholders [JL04I1]. Therefore, it is not surprising to see that interpersonal sensitivity (C12) and engaging communication (C4) were two of the most-mentioned competencies, as they enable the leader to adapt and behave appropriately with the client [ST06I1]. Both competencies have also received high rankings in previous studies, especially for carrying out the initial project phases (Muller and Turner, 2007; Skulmoski and Hartman, 2010; Keil et al., 2013).

Nevertheless, the ability to communicate with stakeholders may not be sufficient for gathering the critical requirements for the new system. The list of client needs and requests can be large and can diverge from other stakeholders' interests, and thus the leader should also be able to control the project scope [OU10I1; ST09I2; DZ12I3] and be capable of fostering achieving consensus (during the negotiation activity). However, this process can be demanding, exhausting and tiring, due to the great pressures that may exist and the number of iterations needed to search and refine the information [ST06I1; ST09I2]. Although it may explain why motivation competency (C11) was highly mentioned in this activity, this result contrasts with other studies (Muller and Turner, 2007; Skulmoski and Hartman, 2010). In the former studies, motivation did not received much enforcement during the initial phase. However, none of these studies focusses on this phase in depth. Thus, the presented results are summarised for the entire phase, and they suggest the comparison between phases. Observing the results of the previous studies, it seems that the motivation is often highlighted during the final stages of the project. Consequently, we can expect that the results to denote the wear in the project, and not the motivation needed to develop each project task.

A leader should also be focussed on results achievement [DZ12I1]. Respondents stressed that a leader who is not focussed on creating a solution will hardly be able to successfully accomplish the project [JL03I1; ST06I1; JL04I1]. Thus, elicitation activities should be performed without losing sight of the ultimate system and the organisation goals. Furthermore, this behaviour should also be present during the moments of

interaction with stakeholders, as they can request a large number of requirements that may not be within the project scope [ST08I1; NV10I4]. Therefore, respondents referred that the Achieving (C8) and Strategic Perspective (C2) competencies may be highly important to help a leader accomplish this activity.

Extracted from interviews:

"We need someone who can almost put silence in the room and follow an idea, as otherwise, we can be there for six hours discussing everything" [ST06I1]

Although not directly included in the two entries table used in this analysis, it is noteworthy that respondents frequently cited the importance of a leader having knowledge and expertise in the project-related areas: both technical, methodological and from the business point of view. One should recall that misunderstandings are one of the major problems of the elicitation activity. Therefore, the leader's knowledge was said to improve the results of this activity in many ways: the first one being to help with communication issues, as not only will the leader be more capable of asking the right questions, using known terms and words from the business area, but they could also better understand what the client is answering and requesting [ST09I1; DZ12I1; OU10I2]. This may also improve the leader's ability to suggest better solutions: "It is important to master what is going to be computerised, as no one can computerise what they do not know" [NV11I2]. Skulmoski and Hartman (2010) have also described this relationship, stating "For a consultant, you may also be looking for opportunities, which are more evident when you have business know-how" (p.14).

Extracted from interviews:

"If we don't have this [domain knowledge], then what happens in many projects is on account of the external companies. For example, they don't know the business, and rarely know the client's business, and communication becomes complicated" [JN01I1].

Knowledge can also foster a better relationship with the client [JN01I1; NV10I4; ST08I1; ST09I4]. For as clients may feel that they are better understood and involved in the process, they are more likely to assume a collaborative behaviour [ST06I1; NV10I6]. Skulmoski and Hartman (2010) have also mentioned this issue, describing that the

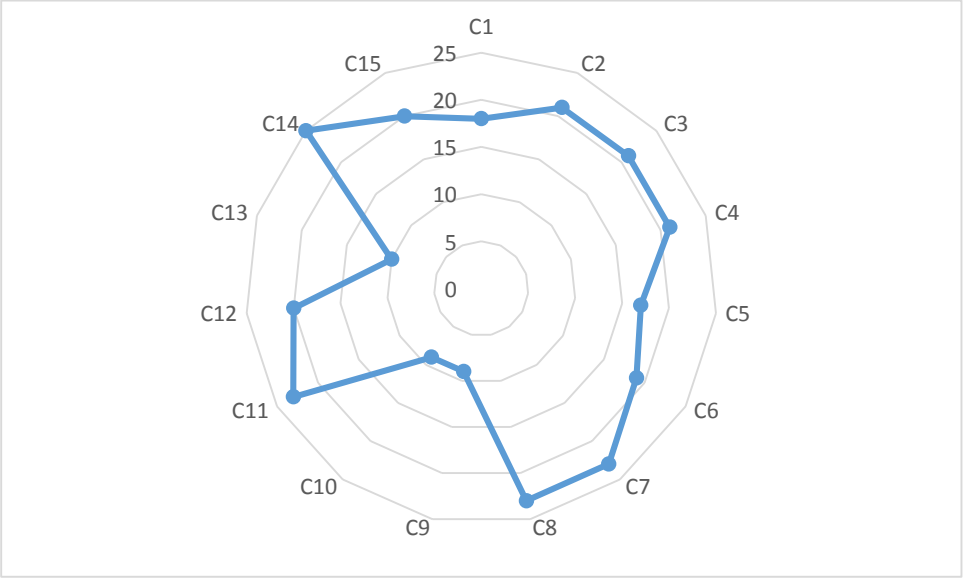
leader's know-how may also affect his reputation. Moreover, a knowledgeable leader can better check for the need of more information on a topic, or even the need to involve additional key users [DZ12I3].

Elaboration

Once the information is collected, it must be analysed and converted into the list of requirements to be implemented in the new application. This is the aim of the Elaboration or Analysis activity, namely to produce a model of the proposed solution based on the information gathered during the previous activities (Pressman, 2005).

The distribution of leadership competencies that participants ranked as being relevant to perform this activity is shown on the radar chart of Figure 46. The first conclusion that may be drawn is that all competencies were ranked as being relevant, although some more than others. The less referred to competencies were C9, C10 and C13, all from the EQ dimension. All the remaining were ranked by at least half of the participants. However, we can still highlight the C2, C3, C4, C7, C8, C11, C12, C14 and C15 competencies as being highly relevant in this activity (more than twenty references).

Figure 46. Leadership Competencies' relevance for Elaboration



Legend - Leadership Competencies $C_{1..15}$:
C1 - Critical analysis and judgment; C2 - Vision and Imagination; C3 - Strategic Perspective; C4 - Engaging Communication; C5 - Managing Resources, C6 – Empowering; C7 – Developing; C8 – Achieving; C9 - Self-awareness; C10 - Emotional Resilience; C11 – Motivation; C12 – Sensitivity; C13 – Influence; C14 – Intuitiveness; C15 – Conscientiousness.

Source: the Author

In the Elaboration activity, the leader should translate the client's needs for the requirements for the new system [DZ12I2]. These requirements should scope the solution proposed, in that they should represent the stakeholders' needs that must be met by the system. However, the information collected is often ambiguous and incomplete. The analysis should be aware of the existence of incompatible, or incomplete requirements [OU10I3]. Therefore, it is not surprising that a leader's ability to cope with ambiguity may influence the achievement of more accurate results [NV10I4; ST09I2; ST09I4]. This situation explains why respondents ranked the competency of Intuitiveness (C14) as being highly relevant.

Extracted from the interviews:

"Ambiguity is a tremendous problem. We are talking about a situation assuming certain issues, and the other side saying "yes, yes", but they may have a contradictory assumption. This ambiguity is terrible. Although we obtained an agreement, after all, we were thinking different things." [NV11I3]

On the other hand, this activity may be a meticulous and exhausting one [ST08I1]. Therefore, the leader may require additional skills to remain focussed (C8) and motivated (C11), without losing the main focus of coming up with the best solution. In the study of Skumulski and Hartman (2010), the authors also referred to this problem as being the ability of the project manager to be solutions-oriented. The authors concluded that a project manager and the team should have the necessary competencies to deal with ambiguity and to bring clarity to the project. They also stressed the need to be creative and to be concerned with the impact of the requirements on the solution and on the organisation. Competencies that may help to build a solution and help articulate the business problem with the identified requirements were said to be especially valuable in this context. All these results support that which has been described so far. Unfortunately, the discussion of our results with others studies proved to be of little interest, as no one of the others focussed on any particular project phase. Furthermore, the results they present are summarised and do not give many clues to the relevance of competencies for each specific activity type.

The activities of analysis and elaboration are usually performed internally with the team. The interaction with the client is usually lower than during the previous activities. Therefore, a lower relevance of competencies that support those moments of interaction

would be expected (for instance C4, C12 and C13). Surprisingly, the graph shows contrasting results where both C4 and C12 continued to be highly ranked. Moreover, the graph also shows a high relevance for the Developing (C7) competency. This competency is usually mentioned when a leader has to deal with teams (Skulmoski and Hartman, 2010). Therefore, we can conclude from our results that the competencies of Communication (C4) and Sensitivity (C12) are being used for effective communicate with the team, rather than with the client and other stakeholders.

On the other hand, we found that the competencies of emotional self-control (C9 and C10) did not received great relevance during this phase. Indeed, the interaction with the team tends to be less demanding in terms of stress and pressures, which justify the results obtained. Besides, it is expected that during the early phases of the project the team is being formed [NV10I4]. Thus, a higher need for the Developing (C7) competency may be plausible. Apparently, as these activities are essentially performed internally, they often provide good moments for team development and formation. Additionally, it is noteworthy that Empowering (C6) obtained the highest value so far, which strengthens the results of team formation, although it is not so relevant as the other competencies.

However, these results contrast to some extend with those described in (Skulmoski and Hartman, 2010). The former authors advocate that developing activities are especially relevant when the team is fully formed, which is usually not the case during the early phases of the project. However, some of our projects described minor variances for the team composition throughout the phases (especially for small projects). Besides, the developing competency might mean different things for each study. As the focus here is on leadership, team development may be interpreted as being the establishment of a spirit of cohesion and commitment, rather than centring on external and academic training.

Extracted from the interviews:

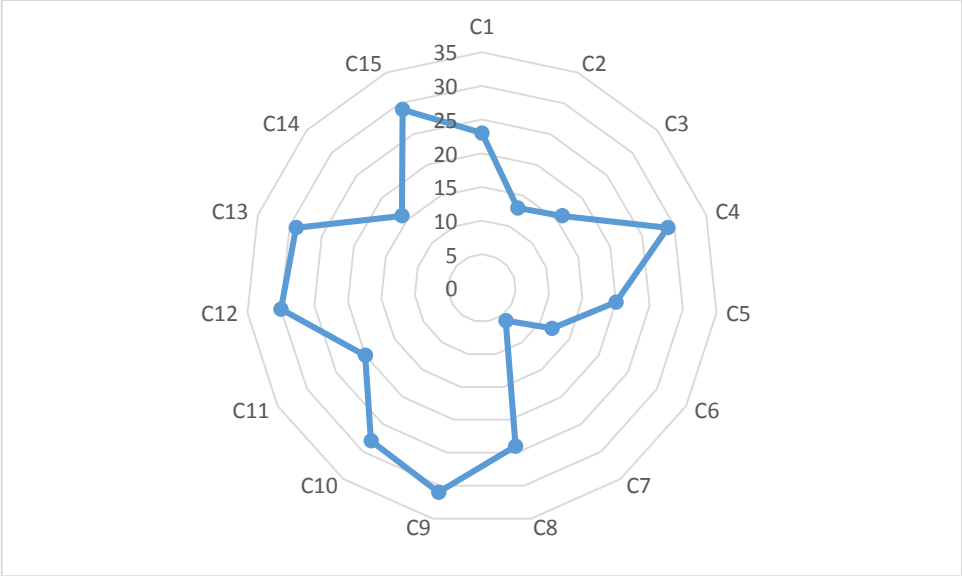
“There is something that isn’t here, although it is somehow expressed here in Point 7, the formation and development of the team, which is also the maintenance of the spirit of the team, right? (...) The creation of group cohesion and team spirit, and the team’s motivation to succeed is something, it is an aspect of leadership which is, I would say, essential, or which may be decisive for the project’s success, Okay?” [AG05I5]

Negotiation

The Negotiation activity aims to solve the problem of conflicting requirements gathered during previous activities (Pressman, 2005). One possible strategy to overcome this, is to prioritise requirements with the client, users and other stakeholders. However, the divergence and number of opinions among project stakeholders can make these tasks even harder. Therefore, it is not surprising that negotiating activity issues, together with elicitation activities and conflict management are frequently reported in the literature (Coughlan et al., 2003; Liu et al., 2011; Ronoh et al., 2015).

The results presented in the radar chart of Figure 47 show the distribution of relevant competencies for performing the Negotiation activity. Comparing these results with those discussed for the previous activities, we found a greater focus on competencies from the EQ dimension and those also related to Communication issues. It is noteworthy that, in general, competencies for this activity were mentioned more often than before. This can be visualized in the chart, where the primary vertical axis has a maximum bound of thirty five, which represents frequencies of up to thirty-one for some competencies (almost all respondents ranked these competencies).

Figure 47. Leadership Competencies' relevance for Negotiation



Legend - Leadership Competencies $C_{1..15}$:
C1 - Critical analysis and judgment; C2 - Vision and Imagination; C3 - Strategic Perspective; C4 - Engaging Communication; C5 - Managing Resources, C6 – Empowering; C7 – Developing; C8 – Achieving; C9 - Self-awareness; C10 - Emotional Resilience; C11 – Motivation; C12 – Sensitivity; C13 – Influence; C14 – Intuitiveness; C15 – Conscientiousness.

Source: the Author

Nevertheless, maintaining the midline of more than sixteen references for classifying relevant competencies, we found that all competencies were ranked as relevant, except C2, C6 and C7. However, we can still highlight competencies C1 from the IQ dimension, C4 and C8 from MQ dimension, and C9, C10, C12, C13 and C15 from the EQ dimension.

Negotiation activities include several related tasks, such as conflict resolution [JL02I1; AG05I2; ST09I3; ST09I4], requirements prioritization [JL04I1; ST09I2; DZ12I3], and solutions approval and validation [ST08I1; ST08I3]. The basis of these tasks remains the need for greater interaction with the client. In fact, some respondents mentioned that Negotiation is the activity which requires the most interaction with the client, followed by Validation and Requirements Management [ST08I1; OU10I3; ST06I1]. Therefore, it is not surprising that those competencies that foster this interaction received higher emphasis.

Extracted from the interviews:

"By [the requirements] nature, during all these phases, one has a connection with the client, but I would say that Negotiation and Maintenance are those during which we have greater contact" [OU10I3]

According to Skulmoski and Hartman (2010), negotiation skills are relevant throughout the project, albeit with special relevance during the initial phases. The authors advocate that during these phases, the project must be sold to all stakeholders and consensus must be achieved. To do so, the project manager should have selling competencies, as well as those of persuasion and communication.

Our results are in line with the study of Skulmoski and Hartman (2010), in that respondents gave great focus on the leader's ability to effectively communicate with the client (C4) and to influence (C13) stakeholders to achieve consensus. To do so, respondents highlighted the need for the leader to be able to adapt to both the client and stakeholders (C12). If the leader knows the best way to communicate and interact with each interlocutor, then it is most likely that they will be able to establish an effective communication path and an empathy relationship.

Extracted from the interviews:

“They have to be empathic, they have to be, and they have to be able to perceive the person that is in front of them, and have to have the ability to perceive whether they should be more aggressive or less aggressive, just to name an example, Ok?” [OU10I1]

“I think it's very important to first understand a little of what the client's expectation is, what they are waiting for, how they behave, and how they react to situations. Thus we can be more confident and can also know how to take advantages from this” [NV10I6]

Although no competency in the chart stands apart for these skills, both selling and persuasiveness were highlighted. It should be noted that both skills were included in the Engaging Communication (C4) competency from the framework of Dulewicz and Higgs (2005b) in Section 4.4.2. The following illustrative excerpts were taken from the interviews.

Extracted from interviews:

“Then a very commercial part follows, where one must sell: sell the idea, sell what you have understood, sell, sell. Then the client must accept it as if it were their own idea.” [ST06I1]

“To be able to sometimes persuade the client to also follow the strategy that best suits us, and what we proposed. We have to respect the budget, as we are talking about money, right? Ah, but basically this is it.” [DZ12I3]

“The higher my ability to persuade, the best I’ll be able to negotiate with the client, right? This also makes sense whenever you're talking to someone, or are having a relationship with someone, right?” [NV11I3]

As can be observed from the chart, competencies to control emotions were the most ranked ones (C9 and C10). The way a leader performs negotiation activities is critical, as the resulting tension may give rise to new conflicts [NV10I4]. Therefore, competencies for maintaining good stress resistance and good emotional self-awareness help the leader maintain a good atmosphere and relationship with the client [DZ12I2; OU10I3; ST06I1]. On the other hand, knowing how to handle the client, and knowing how to influence them, can be very useful for achieving the desired consensus. Without a good relationship between the leader and the client, the success of these activities may be compromised [JL02I1].

Extracted from the interviews:

“I think that here there's more need for an interpersonal relationship, as this is where higher tensions may exist. That is to say, it may be during the negotiation activity that conflicts arise, as when we are gathering the requirements, of what we really want to do, it is more descriptive. But then you get to that point where, "Okay, but this is not within the project scope", and then we jump to here, jump to this activity.” [NV10I5]

“Emotional self-awareness, the ability to know and control your emotions ... this is for me critical during negotiation, you must control your emotions [laugh]. When you enter into a negotiation activity it is always... You have a lot more pressure” [OU10I3]

An interesting result was the relevance of the competency of commitment and ethical behaviour (C15) for this activity. Respondents highlighted the importance of a leader being an honest and trustworthy person. A leader should not use negotiation activities, nor their skills, to take any unethical advantage of the client [OU10I3]. The leader should not persuade a client to approve a solution that does not actually meet their interests and needs, but rather other external interests. It is the leaders’ responsibility to guarantee the integrity of the proposed solution, focussing in the first place on the satisfaction of the client [DZ12I2; ST08I3].

The study of Skulmoski and Hartman (2010) also found similar results for the competency of Ethical Conduct during the initial phases. However, this competency showed contrasting results with other previous studies (Wren and Dulewicz, 2005; Muller and Turner, 2007). In Skulmoski and Hartman’s study, competency C15 did not show to be positively correlated with successful projects. Authors have speculated as to whether this responsibility could be assigned to another role than that of project manager, but no definite explanations were given. As the focus of our study is on the initial phases of the project, where the solution must be drawn, it may be that the focus on this competence is higher than when one analyses the whole project. Respondents could drill down those competencies that are relevant separately, as occurred in (Skulmoski and Hartman, 2010), rather than making a synthesis of the whole project. Another possible explanation is that respondents could not be so aware of ethical issues at the time the study was conducted. As a more recent study of the same authors have revealed different results for the same competency, this may be a plausible explanation (Muller and Turner, 2010).

The lower relevance given to competencies C2, C6 and C7 can be explained by the main focus of this activity. As the focus here is usually on the interaction with the client and other stakeholders in getting the solution approved, all those competencies that are not aligned with this objective may be left behind. In fact, C6 and C7 are commonly competencies which focus on team issues. Furthermore, the competency C2 achieved higher frequencies during the previous activities, where requirements should be gathered and analysed to produce a suitable solution. For this activity, the solution is likely to be already proposed, and thus consensus must be achieved. Thus, it seems that the vision and imagination competency is more critical, until a solution is found.

Specification

Specification activities include the production of the requirements documents. These documents might contain artefacts written in a natural language, or in other more formalized or more graphical (Pressman, 2005). Although the development of such artefacts may involve some difficulties, generally these tasks are considered to be stable and routine. The nature of this activity contrasts completely with the previous one, as no major contacts with the client are required [NV11I3].

The radar chart of the Figure 48 shows an almost inverted polygon from the previous chart. This highlights the opposite nature of both activities, focusing on different competencies. On the other hand, it also shows a sharp decrease in the general relevance of competencies. Following the criteria for classifying the results from the graphic, only the competencies C6, C7, C8, C11 and C15 were considered relevant for this activity. However, only the C6 competency achieved a rating higher than twenty. All the remaining ones had a lower rating frequency.

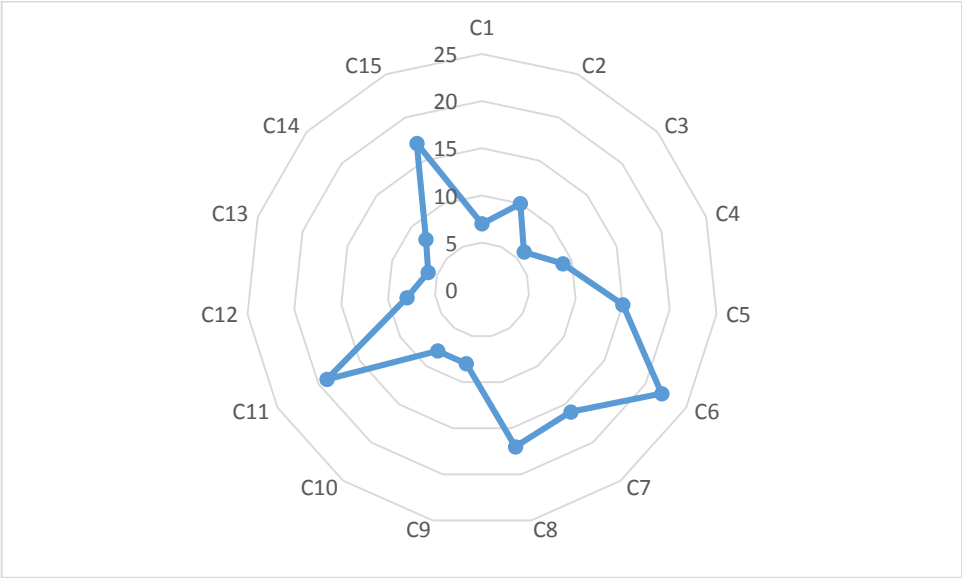
Indeed, some respondents mentioned that the leader rarely produces the specification document. This task is usually assigned to the team. Thus, one would expect that participants would have enhanced competencies that are more likely to support team work and empowerment (C6 and C7).

Extracted from the interviews:

“In relation to the specification, I'm not getting into any cross because the leader rarely specifies. Who actually does this is the rest of the team.” [ST09I1]

The leader's ability to develop the team (C7) may improve the outcomes of the team work. As described in one interview, "I tried to give much emphasis to this detail, and the people who were working on the project have to go on training programmes that we have here in the company about requirements" [OU10I3]. However, some authors agree that the early phases of the project are when the project culture begins to be developed (Skulmoski and Hartman, 2010). Therefore team building may be required whenever a team has already been assigned to the project.

Figure 48. Leadership Competencies' relevance for Specification



Legend - Leadership Competencies $C_{1..15}$:
C1 - Critical analysis and judgment; C2 - Vision and Imagination; C3 - Strategic Perspective; C4 - Engaging Communication; C5 - Managing Resources, C6 – Empowering; C7 – Developing; C8 – Achieving; C9 - Self-awareness; C10 - Emotional Resilience; C11 – Motivation; C12 – Sensitivity; C13 – Influence; C14 – Intuitiveness; C15 – Conscientiousness.
Source: the Author

In addition, respondents have highlighted the Empowering (C6) competency for this activity. Apparently, a leader is more likely to assign tasks for this activity for the team members. The nature of this activity can be a possible reason for justifying this behaviour. However, a low interaction with the client is needed, the leader may feel that the team can manage the production of documents.

Moreover, we also noted that the self-motivation (C11) competency was highlighted. As this activity can be a meticulous and wearing task (Nicolás and Toval, 2009), extra motivation may be needed to accomplish this task. The question that can be raised is whether the relevance of the empowering competency is related with the extra motivation

needed. It may suggests that leaders distribute their tasks whenever their motivation or interest is low, namely for routine tasks. However, a contrasting explanation is given in (Skulmoski and Hartman, 2010), where the authors describe the need to involve the team members in these activities, in order that they can feel engaged and motivated to obtain quality results. The results obtained in the present study do not allow one to draw more explanations. Therefore we advocate that more research on this topic would be interesting.

Good written communication skills were also mentioned to be important for this activity. The leader (and team members) should be able to faithfully reproduce the solution on paper. To do so, they must be focussed on addressing all clients' needs and other project constrains. Respondents have mentioned that the requirements document must be unambiguous, complete, consistent and verifiable [DZ12I4; ST09I3; ST08I3], and that it also must be understandable for the client [OU10I2; JN01I1]. Therefore, the leader should be results-oriented (C8) in order to maintain the focus on producing quality documents [JL03I1]. Additionally, ethical concerns (C15) were also mentioned to be relevant for this activity, as they determine how documents are created.

Validation

The output of the requirements specification activity must then be validated, formally or informally, with the client. The aim of the Validation activity is to examine the specification artefacts to ensure that all requirements are correct and unambiguously; that reflect the client' needs; and that conforms the existing standards (Pressman, 2005).

This validation should be made by the supplier team, and also by the client and other relevant stakeholders. The client must check whether their needs and requests are addressed in the specified solution. This practice improves the likelihood of the final system coverage of the initial requirements [JL02I1; AG05I4; NV10I5].

Extracted from the interviews:

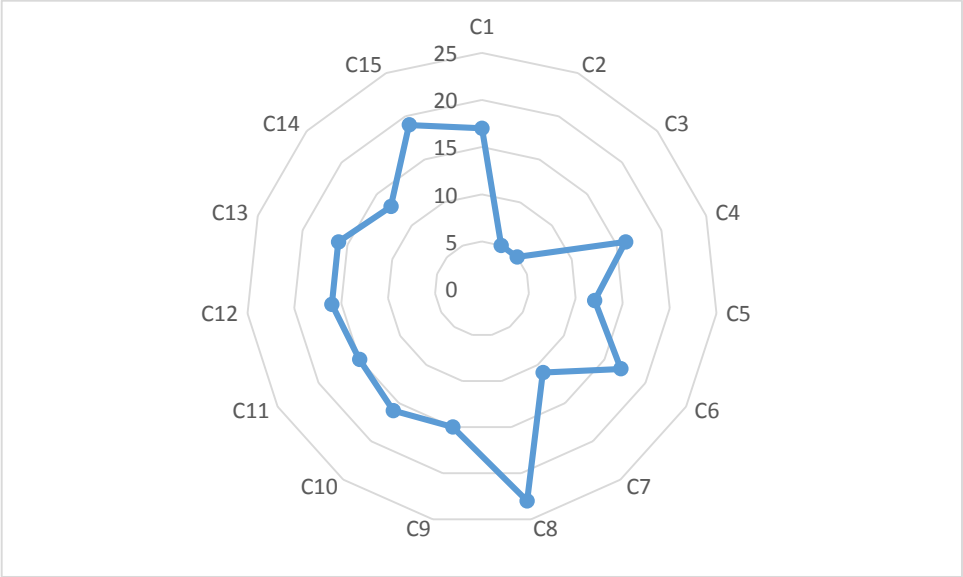
"The client must say: "yes sir, we accept that, you can proceed to the development phase". Therefore this is another factor that determines whether the activity of requirements specification was successful, or not (…) the number of problems that the

client detects in these reviews determines, ultimately, the success of this stage of requirements specification" [ST09I4]

The techniques used to validate requirements can vary from project to project (see the discussion on the techniques and tools used in the requirements phase – Section 4.3.4). However, in most cases the aim is to define the scope of the project, or even to use the client's approval as a contractual element (during negotiation activities, for instance).

However, we found from the interviews that the client does not always approve the document completely aware of its contents. Respondents have also reported situations where the client refuses to sign the requirements specification. As several project managers require document approval to enable the project to proceed, this attitude is often not well accepted by the supplier team and conflicts may arise [JL04I1; ST06I1; NV10I6]. However, due to pressures and several resources constraints, especially time, the project leaders confessed to commonly assume the risk of proceeding through the development phase, even without the client's approval [NV11I3; DZ12I2; NV10I4; OU10I3].

Figure 49. Leadership Competencies' relevance for Validation



Legend - Leadership Competencies $C_{1..15}$:
C1 - Critical analysis and judgment; C2 - Vision and Imagination; C3 - Strategic Perspective; C4 - Engaging Communication; C5 - Managing Resources, C6 – Empowering; C7 – Developing; C8 – Achieving; C9 - Self-awareness; C10 - Emotional Resilience; C11 – Motivation; C12 – Sensitivity; C13 – Influence; C14 – Intuitiveness; C15 – Conscientiousness.

Source: the Author

These constraints may frame the results shown in the radar chart of the Figure 49. As can be observed in the graphic, in general competences did not received great relevance on Validation activity. Competencies C1, C4, C6, C8, C10, C12, C13 and C15 have all been ranked above the midline, but only competency C8 was classified by more than twenty respondents.

The Achieving (C8) competency was said to be needed for focussing the leader on the project goals, together with critical analysis (C1). These goals may result in client pressure to get the document approved, but this can also explain the risk assumed by the leader in the progression of the project's development without solution approval. The pressure and persistence that the leader may apply to the client is based on communication, persuasion (C4) and influence (C13) skills, as these help the leader to be able to convince the client to approve the document. However, the leader's ability to adapt to the client's profile (C12) may help to adjust the best way to communicate and influence the client.

Extracted from the interviews:

"Beyond the decision of the project scope, these moments are also when we perceive a little the way to work with that client and to perceive how we will have to make them sign the papers. If what he says is what he will accomplish" [DZ12I2]

Respondents mentioned that these tasks can be stressful. A leader must have the ability to control their emotions (C10) in order to be able to accomplish their tasks. As described by one participant, "Our work is much based on stress, and if there is any panic, it quickly generalizes. If we have people who know, who are able to influence the moral, then we achieve our objectives faster" [OU10I2].

Moreover, the risks that the leader takes in proceeding with the project without consent may also result in greater emotional stress and wear, enhancing the need for competency C10. On the other hand, project progression may require the delegation of certain tasks to team members (C6), while the leader concludes the validation activities.

Surprisingly, the ethical and commitment issues (C15) also received a relatively high ranking. It seems contradictory that, despite the leaders' pressure to make the client sign a document or even the project's progression without the client's consent does not

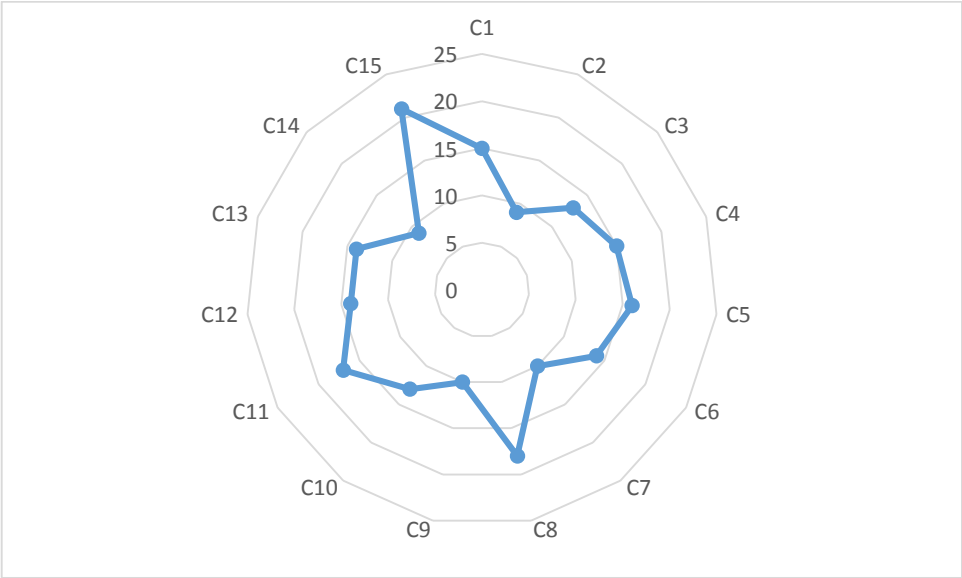
affected the need for ethical and professional conduct. Respondents highlighted that the leader must keep the integrity of the solution that is to be developed.

Management

Requirement Management or Maintenance encompasses all the activities related to the requirements that are carried out after the requirements phase. This includes the activities of identifying, controlling and monitoring requirements throughout the project lifecycle (Pressman, 2005).

Some participants referred to these activities as "re-running the cycle of the requirement activities" [DZ12I2]. The emergence of a new requirement during the project's execution may require the gathering of new information to assess its feasibility and impact, which may require negotiation activities, changes in the requirements documents (to be properly updated), and may still require validation.

Figure 50. Leadership Competencies' relevance for Requirement Management



Legend: C1 - Critical analysis and judgment; C2 - Vision and Imagination; C3 - Strategic Perspective; C4 - Engaging Communication; C5 - Managing Resources, C6 – Empowering; C7 – Developing; C8 – Achieving; C9 - Self-awareness; C10 - Emotional Resilience; C11 – Motivation; C12 – Sensitivity; C13 – Influence; C14 – Intuitiveness; C15 – Conscientiousness.
Source: the Author

However, these activities occurred in a different execution context, where the effort to correct or change a requirement is higher (Nurmuliani et al., 2004; Pressman, 2005). Therefore, participants considered variations in the relevance of leadership competencies.

The radar chart of Figure 50 shows that the respondents have ranked competencies C5, C8, C11 as relevant, but only the C15 competency as being highly relevant for this activity. All the remaining competencies were ranked less than the midline.

Commitment and ethics (C15), followed by orientation for results (C8), were ranked as the most relevant competencies for performing the requirement management activities. The leader must remain focussed on the implementation and completion of the project objectives. Competency C8 will allow the leader not to divert their focus of attention. On the other hand, during the interviews, some participants stressed that the later requirements' change may be something natural and intrinsic to their nature. As the maturity of the project increases, it can consequently bring new or changed requirements. Although the scope of the project and other restrictions (schedule and budget) must be guaranteed, some participants stressed that the main objective of the project is to satisfy the client's needs. This duality of client satisfaction versus extra effort to change requirements could represent an extra complexity for this activity. Therefore, the leader should maintain an ethical and professional approach during the decision-making, but also should have a good ability to manage all the available resources (C5). The research of (Aurum and Wohlin, 2003) presents a discussion on this topic, describing the relevance of some of these competencies for the process of the decision-making of requirements changes.

Finally, the competency of self-motivation (C11) was also considered to be relevant for this activity. As mentioned above, it is well documented in the literature that the costs to fix an error from the initial stages of the project may exponentially increase with their progression (Pressman, 2005). Therefore, it is not surprising that the leader might need additional motivation to return to the requirements activities and to rework some parts of the system.

The Management activity concludes our analysis on the relevance of competences for each activity separately. However, a final discussion is still missing. Therefore, in the next subsection we present a comparative discussion of the results obtained, and also some insights that emerge from this discussion.

Final Remarks on Leadership

After a comprehensive analysis of the leadership topic, we are now able to draft some conclusions about what motivates and varies the leadership competencies needed throughout the requirements activities.

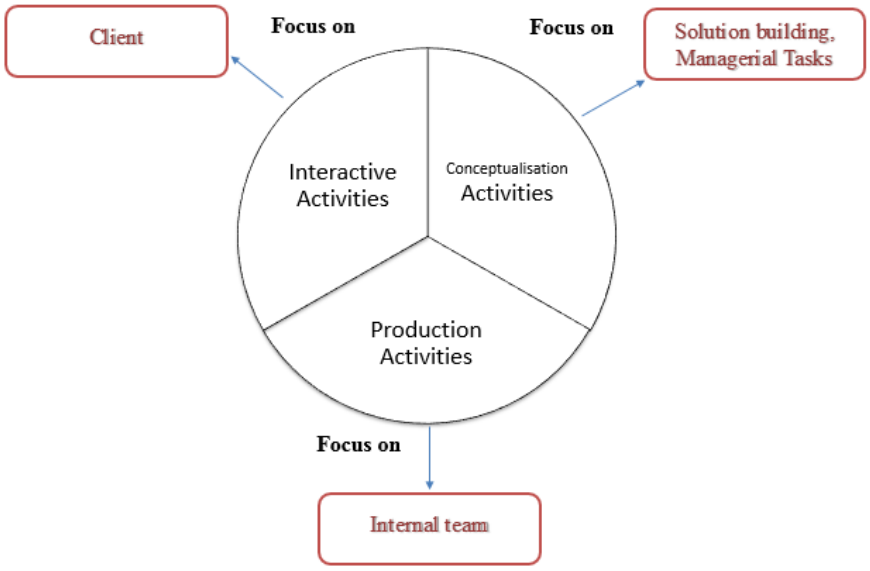
Leadership among Activity Types

From the results described to date, it seems evident that the set of relevant competencies has some variations throughout the different activities performed in the requirements phase. However, it remains to understand what globally motivates such variation. However, when comparing all the graphics to look for similarities and patterns, we found that some competencies are frequently mentioned for certain types of activity.

We have already described from the analysis of the interviews that respondents have mentioned that a critical feature of this phase is the need of a lot of interaction with the client, which could impact on leadership competencies. In contrast, activities with a low need for such an interaction would enhance internal concerns, especially with the team that typically includes production tasks, such as project solution or requirements documents, or solution conceptualization.

Given the results obtained, we decided to classify the requirements activities according to their need for interaction, establishing a task classification of: Conception, Production, or Interactive. Conceptualisation activities are those that involve reflection and solution creation about the project, including problem analysis and the comparison of alternative solutions, focussing more on managerial tasks. Production activities stand for tasks focussing on internal team issues and artefacts production. Interactive focusses on the interaction with the client, and all tasks performed with the client. Although this may seem a simplistic classification, it is partially in line with the study of (Young and Dulewicz, 2008). These authors studied the set of leadership competencies among four types of activities: Conceptualisation, Align, Interact and Create Success. While the Conceptualization and Interact types of activities are similar to those used in this study, the remaining two types do not fit the context under study. Figure 51 shows a graphical representation of the focus of the activities of each type.

Figure 51. Focus of each Activity Type



Source: the Author

Table 58 shows the result of the requirements activities classification, based on the descriptions of the interviews and literature review. Nevertheless, not all the activities could be promptly classified. The most challenging were Validation and Management that remained difficult to classify despite the general descriptions made in the interviews.

Table 58. Requirements Activities' Classification

Activity	Activity Type
Inception	Conceptualisation
Elicitation	Interactive
Elaboration	Conceptualisation
Negotiation	Interactive
Specification	Production
Validation	Interactive
Management	Production

Source: the Author

Management activities were said to be a recall of other activities, and their nature may depend on the internal practices of each company. However, during the content analysis of the responses, we found little enhancement of the team production, and thus we decided to classify it as a Production activity. On the other hand, Validation activities that were expected to include a great interaction with the client to get the approval of the solution did not generally received a great focus. It is possible that participants had included the main issues of Validation in Negotiation activity, or that they may not fully understand this activity. Nevertheless, we decided to maintain the Interaction type of activity, following the descriptions in the literature (Pressman, 2005).

Considering this classification, we re-looked at the results to assess the existence of any competency patterns by activity type. The first analysis performed tried to identify the patterns of the competencies that could somehow be predicted for the type of activity. To do so, we used the relevance classification from the previous analysis, considering the competencies to be: High relevance (more than 20 references); Low relevance (less than the midline of 16 references), and Medium relevance (all references between the other two ratings). The results of this analysis by activity type are shown in Table 59. Note that the competencies were reordered, in order to highlight the main similarities found.

Table 59. Leadership Competencies' Relevance by Activity Type

Requirements Activity	Activity Type	High	Medium	Low
Inception	C	C8, C2, C1	C3, C4, C11, C12, C14, C15	C9, C10, C13, C5, C6, C7,
Elicitation	I	C8, C4, C12, C11, C2	C5, C13, C15, C14, C6, C7	C9, C10, C3, C1
Elaboration	C	C8, C2, C3, C4, C11, C12, C14, C15, C7,	C1, C5, C6	C9, C10, C13
Negotiation	I	C8, C4, C12, C11, C5, C13, C15, C9, C10, C1	C14, C3	C2, C6, C7
Specification	P	C6	C8, C11, C15, C7	C9, C10, C13, C3, C4, C14, C1, C2, C12, C5
Validation	I	C8	C4, C12, C6, C9, C10, C13, C15, C1	C2, C3, C7, C14, C5, C11
Management	P	C15	C8, C11, C5	C9, C10, C13, C3, C4, C14, C1, C2, C12, C6, C7

Source: the Author

The first conclusion that may be drawn is that some of the competencies are relevant for the whole process, regardless of the activity type classification, while others were considered to be relevant only for performing certain tasks. Achieving (C8) and Conscientiousness (C15) were considered as having high or medium relevance for all activities, showing a great need to be results-oriented, ethical, and committed. These results are in line with the previous studies that reported similar levels of relevance for both competencies (Dulewicz and Higgs, 2005a; Turner et al., 2009; Skulmoski and Hartman, 2010).

Furthermore, we found some patterns for each type of activities which are described below (see Table 60 for a summary):

Conceptualization Activities: both activities emphasize the need of the competency C8 and C2. Moreover when jointly analysed, we found that in the medium and high relevant competencies, the pattern may be extended for competencies C1, C3, C4, C11, C12, C14 and C15. On the other hand, those which proved equally less relevance in both activities were C9, C10 and C13.

Production Activities: for production activities, no patterns were found for the most relevant competencies, which may be explained by the difficulties in classifying the management activity. However, if we merge high and medium relevant competencies, we can see that C8, C11 and C15 were all said to be needed for both activities. Apparently, self-motivation (C11) was highlighted every time the task is likely to be routine and repetitive. As for the conceptualization activities, competencies C9, C10 and C13 were also found to be the less relevant ones.

Interactive Activities: for these activities, we found a clear difference between the first two activities and the validation activity. This was expected, as respondents did not give special focus to the later activity, but it also enhances the eventual misclassification of the validation activity. We advocate that further research should be conducted to clarify this issue.

Nevertheless, patterns emerged. Additional to the C8 competency, referred to in all activities of this type, the C4, C12 and C11 were highlighted during elicitation and negotiation. However, the aggregate analysis of medium and highly relevant competencies extend this pattern, showing that the validation activity also supports the

need for competencies C4 and C12, besides C13 and C15 which are needed for all of them. This is not surprising, as communication and the ability to adapt to the client were two of the most enhanced competencies during the interviews.

The first two activities have also showed similarities to the C5 and C14 competencies, while the comparison between the elicitation and validation activities showed a moderate relevance for competency C6. It is worth noting that competencies C9 and C10 were only highlighted for negotiation and validation activities. This can be explained by the pressures and likelihood of conflicts described for these two activities. Regarding the less relevant competencies, we found none to be identified with the three activities together. With less consistency in all the interactive activities, we also found that the competencies C4, C12 and C15 were highly relevant for this type of activity.

Table 60. Summarised Results of Leadership Competencies' Similarities by Activity Type

Activity Type	High Relevance	High + Medium Relevance	Low Relevance
Conceptualisation	C8, C2	C8, C15, C2, C3, C4, C11, C12, C14	C9, C10, C13
Production	-	C8, C15, C11	C9, C10, C13, C3, C4, C14, C1, C2, C12
Interactive	C8	C8, C15, C4, C12, C13	-

Source: the Author.

In conclusion, these results come to show that companies should be aware of developing their leaders for a diverse set of competencies which allow them to effectively perform all the activities of this phase. Furthermore, we can also conclude that the results of this study show clear evidence for considering the different types of activities as being differentiating factors for the relevance of leadership competencies. Thus, we advocate that this emerging factor should not be excluded from the study of contingency factors for leadership skills.

Leadership Styles

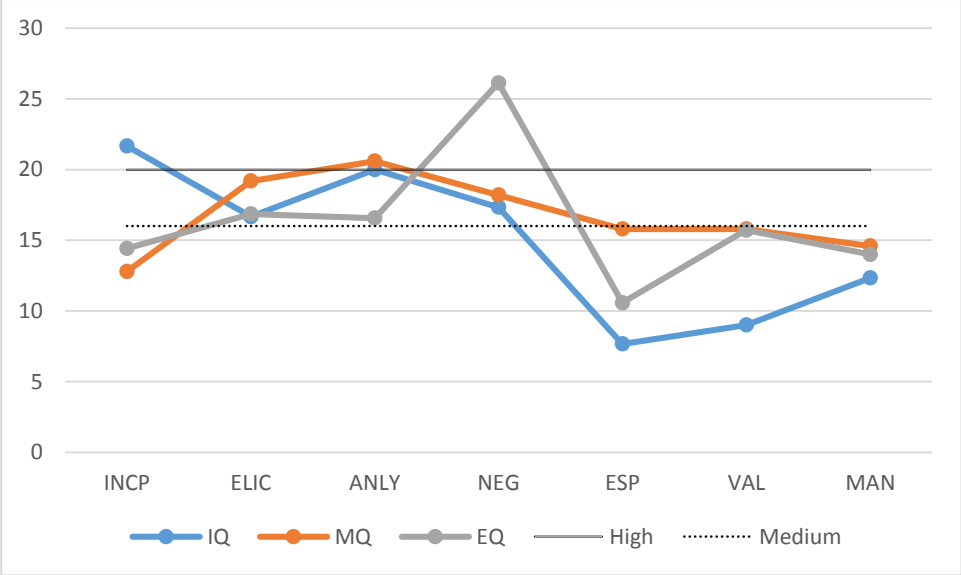
To conclude the analysis on leadership competencies by considering the various activities of the requirements phase, we return to the relevance of each group of competencies proposed by (Dulewicz and Higgs, 2005b), namely: intellectual IQ ,

managerial (MQ), and emotional (EQ). We are now interested in comparing the results obtained with the leadership styles proposed by the former authors.

Are any of the proposed leadership styles suitable for the requirements activities? Does the variability of the relevance of leadership competencies also make changes to the respective leadership style? To answer these questions, we produced the graph in Figure 52, which represents the average frequency of the competencies, grouped by each leadership dimensions. Each line in the graph represents the variations in the relevance of one dimension among the requirements activities.

Furthermore, we also included two trendlines in the graph: one to distinguish the low and medium relevant competencies, and the other to distinguish highly relevant competencies. This may help us to understand whether some leadership dimension was frequently cited, and was eventually considered highly relevant to perform that activity.

Figure 52. Differences of the Relevance of Leadership Dimensions among Requirements Activities



Legend: Requirements Activities: INCP- Inception; ELIC – Elicitation; ANLY – Analysis or Elaboration; NEG – Negotiation; ESP – Specification; VAL – Validation; MAN – Management. Leadership Competencies Dimensions: IQ – Intellectual; MQ – Managerial; EQ - Emotional Competencies

Source: the Author.

The results of the graph shows that for the first activity (Inception), the most cited dimension was IQ (high relevance), followed by the EQ and MQ (low relevance) dimensions. To infer the appropriate leadership style for this activity, we analysed the

relevance of the proposed standard styles. Figure 53 shows that the leadership style that enhance the IQ dimension is the style Goal. Employing the appropriate cautions for obvious methodological differences, we could then suggest that this would be the closest style described by the participants in the study, despite the low relevance of the EQ dimension. However, these results are contradictory, as, according to Dulewicz and Higgs (2003b), this style is well-fitted to a relatively stable context, with well-understood goals, which has not been the case for any of the abovementioned activities for this phase.

On the other hand, the activity of Negotiation was shown to highlight the EQ dimension, while MQ and IQ showed just moderate relevance. The closest style from Figure 53 is Engaging and the definition of this style is also fitted the interview descriptions more, and also the literature review.

Surprisingly, we did not find any relevant pattern for the competence dimensions in the remaining activities. The Elicitation activity showed moderate relevance in all dimensions, with a special focus on the MQ dimension. The Elaboration activity classified both IQ and MQ dimensions as being highly relevant, but the EQ dimension as being only moderately relevant. The Specification activity showed that only the MQ dimension was considered moderately relevant, whereas the remaining were considered to be of low relevance. Similarly, the Validation activity was show to be moderately required for the MQ and EQ dimension management, while IQ remained less mentioned. Finally, the activity of Management showed little relevance for all dimensions. These results can be disturbing, considering that the literature also stresses the need for a "strength of fit" of the leadership style to predict high performance leaders (Hawkins and Dulewicz, 2007).

Generally, we noted that the EQ dimension received less relevance than in most of the previous studies, and that the enhancement of MQ competencies partly contrast some of them (Dulewicz and Higgs, 2005b; Dulewicz and Higgs, 2005a; Turner et al., 2009; Muller and Turner, 2010). Moreover, as Dulewicz and Higgs (2003) have described leadership as depending mainly on the emotional competencies of the leader, we may question whether the descriptions made by our interlocutors really focus on the leader's role, as described in the literature. In fact, the analysis of the competencies were shown to be quite aligned with the responsibilities of project managers, even though few similar

studies on leadership were available for comparison, and the analysis of leadership styles did not show great support.

Figure 53. Leadership Competencies and the leadership styles of (Dulewicz and Higgs, 2003b)

Group	Competency	Leadership style Goal	Involving	Engaging
Intellectual (IQ)	Critical analysis and judgement	High	Medium	Medium
	Vision and imagination	High	High	Medium
	Strategic perspective	High	Medium	Medium
Managerial (MQ)	Engaging communication	Medium	Medium	High
	Managing resources	High	Medium	Low
	Empowering	Low	Medium	High
	Developing	Medium	Medium	High
	Achieving	High	Medium	Medium
Emotional (EQ)	Self-awareness	Medium	High	High
	Emotional resilience	High	High	High
	Motivation	High	High	High
	Sensitivity	Medium	Medium	High
	Influence	Medium	High	High
	Intuitiveness	Medium	Medium	High
	Conscientiousness	High	High	High

Notes: Goal-oriented leadership – a style that is focused on delivering results within a relatively stable context. This is a leader-led style aligned to a stable organisation delivering clearly understood results. Involving leadership – a style that is based on a transitional organisation which faces significant but not radical changes in its business model or *modus operandi*. Engaging leadership – a style based on a high level of empowerment and involvement appropriate in a highly transformational context. Such a style is focused on producing radical change with high levels of engagement and commitment

Source: (Turner et al., 2009)

Several explanations can be given under this assumption. The first leads us to consider that practitioners' maturity and alignment of these topics with the state-of-the-art literature. Comparing the responsibilities described for leaders in this study (see Table 50) with the division of responsibilities between the leader and the manager as proposed by Young and Dulewicz (2008), we found that it is not always clear what is the role that we are dealing with. On the other hand, according to the former authors, nowadays there seems to be a tendency for good leaders to also be a good manager, which may make it difficult to clearly separate the functions in practice.

However, as several participants were referred to as having certifications of project management, it could eventually influence how they see and understand the topics in this field. As stated in some interviews, leadership is often regarded as being a competence of project management, rather than of being a construct that can be decomposed into their own set of competencies [DZ12I2]. This different perspective on leadership has also been

reported in some other studies (Keil et al., 2013), and thus it could be a plausible explanation. Nevertheless, we think that it would be beneficial to evaluate the actual maturity of practitioners of these issues, in order to better fit future research.

5 Conclusion, Contributions, and Future Research

5.1 Conclusions and Future Research

The aim of this research was to explore the relevant leadership competencies to perform the requirements phase of the software development project life cycle. The first step of the analysis was to contextualize the phenomena. Therefore, we characterize the projects described during the interviews in a project characterization chart drawn from the literature. Furthermore, we also analysed the requirements phase, taking into considering the main topics that emerged from the interviews.

The second part of the analysis was to explore the leadership competencies that interviewees value during the requirements phase. The resulting list of competencies was then compared with the main literature of this study. Additionally, participants were invited to identify the most relevant factors that may cause variation in the relevance of the competency explored.

The final part of the analysis aimed to evaluate the adequacy of the leadership competency framework as proposed by Dulewicz and Higgs (2005b) in the study context. We go a step further by including the main activities performed in this phase of the project life cycle in this analysis. Each of these activities was analysed and discussed separately, but a comparative analysis was also performed to gain a global view of the phenomenon.

The findings of this study were presented and discussed throughout the analysis chapter. Conclusions arise whenever the understanding of a certain topic was improved. A summarised enumeration is a hard task, as some of the topics call for further research. Indeed, the conclusions led to new reflections that could be addressed with future research. It is noteworthy that the essence of an exploratory study is to develop new ideas, constructs and/or theory (Dubé and Paré, 2003). Therefore, it becomes difficult to separate conclusions from these suggestions for future research, so both are presented in an interlinked way.

The choice of methodology for this study cannot be detached from its limitations, especially those regarding generalization issues. Therefore, the results described herein relate only and exclusively to the cases studied. Comparisons with the literature allowed us to assess their compliance with the previous studies, but this should not be interpreted

as being an attempt to create generalizations. At most, they intent to create assumptions that need a confirmatory analysis to assess its generalization for broader contexts.

Although the findings of this study relate to their three major research topics of: projects, the requirements phase and leadership, the conclusions are oriented towards the research questions. Therefore, the rest of this section is going to briefly address each research question with the results obtained.

(R01) Understand how the requirement phase is undertaken.

The first research question aims to contextualize the phenomenon being studied, namely how the requirements phase is accomplished. However, requirements are performed in the context of a project. Therefore the analysis started with the characterisation of the projects described during the interviews.

A preliminary list of attributes was drawn from the literature. However, as the interviews progressed, we realised that not all the attributes received the same acceptance. The data analysis reinforced the need for different attributes. The purpose of the project characterization was not to create project typologies, but rather the enhancement of the defining characteristics of each project. Therefore, the objective was to find a set of characterizing attributes that may be representative of the nature of the projects under study.

Consequently, the Project Characterization Chart of Figure 17 emerged. The main differences compared with the original set of attributes include the use of perceptions, rather than more objective measures. This allows for the evaluation of the impact of these perceptions (e.g., project size and duration) on the resulting behaviours. Surprisingly, most of the previous studies that were reviewed do not take perceptions into consideration, even when the study focusses on human behaviour (see for instance (Muller and Turner, 2007; Muller and Turner, 2010)). As leaders (and project managers) are more likely to adequate their behaviours under certain perceived circumstances (Skulmoski, 2005; Byrne and Barling, 2015), we advocate that this type of attributes should be included for contextualizing future research.

Another difference was the inclusion of attributes to characterise the team, the client, and the methodology used to develop the project. These emerged from the emphasis given by the interviewees. Moreover, we found that any of the three attributes may impact on the relevance of leadership competencies for the requirements phase.

The consequent step of the context analysis was to understand the requirements phase of a project. To benchmark the main issues of this phase, the interview guide provided an open question so that respondents could highlight what they think are the fundamental aspects. As expected, the analysis of the interviews revealed some similarities and patterns in their responses. While some of them have been addressed in the literature for some years, new insights also emerged.

Participants discussed some topics related to the definition and intrinsic nature of requirements, namely requirements volatility. They also stressed some of the critical factors that enable the achievement of success. Finally, we found that the descriptions of the requirements phases showed some patterns in the form and contents discussed. However, the review of the literature showed no consistent practices when characterizing the requirements phase, revealing a potential gap. Therefore, we suggest a model for categorizing the requirements phase (see Figure 22). The main conclusions on each of these topics are briefly discussed below.

Requirements Volatility

Requirements volatility is the amount of change that a requirements may have throughout the project. The results show that practitioners are now more aware of the issues related to volatility, and that they continue to report problems of scope definition and a high variation of requirements as being major obstacles to achieving project success. Furthermore, we found different attitudes towards this phenomenon. While some participants described volatility as being something normal and inherent to requirements that is somehow desirable, while others classify it as being something undesirable, as it can affect the success of this phase. However, from the practices identified towards volatility, there were few behaviours or procedures that distinguish these different attitudes.

On the other hand, participants stressed the importance of distinguishing what is called in common slang "Change requests" from other amendments to the requirements.

From the interviews, a "Change request" is an event that rarely impacts on the project, as it only exists when there is a *a priori* understanding that the requirement must be changed from that which was initially established.

To face the effects of the requirements changes in a project, participants described the use of incremental methodologies and the use of the requirements document as being a contractual artefact, regardless of the reasons that lead to the change. Both strategies were shown to be used to control the scope of the project, which eventually suggests contractual changes.

However, no systematic procedure was found to predict the risks associated with these changes, nor to resolve or improve the impact of these changes. At least part of this difficulty arises from the nature of the problem and the people involved. While some procedures can be used to clearly systematize the parts of the requirements processes, there are others that are derived from the unstable and ambiguous context of the requirements phase. Therefore, it is not always easy to understand what kind of phenomena project managers are dealing with, or who is to be blamed: Was there any problem in the specification and documentation of the requirements that justify the change? Or is this just a result of the expected maturity of knowledge in the project? Are the expectations from what to expect from each stakeholder aligned? These questions are not easy to answer and we advocate that further exploratory research should be conducted to address them.

Requirements Success

The main problems identified in the interviews affecting the success of this phase have also been discussed in previous studies. The extensive literature has been proposing formalized practices, methodologies, techniques, frameworks and tools to improve requirements success. However, practitioners have been reporting the same problems for over 35 years ago (Simons et al., 2003).

Accordingly, our study participants showed to have a clear perception of the requirements and their particularities. However, it seems that the augmented understanding of the phenomena do not imply, in practice, in a more and sophisticated

adoption of any methodologies or practices to resolve them. There is a better knowledge but old problems.

It was expected that the greater focus given to this phase that would improve the knowledge and use of best practices. However, the results of this study support several previous studies (Aurum and Wohlin, 2005; Nasir and Sahibuddin), in that effective project management skills and methodologies are not always used in practice, or at least in the most convenient way. Simons and his co-authors (2003) have argued that the reasons cannot yet be fully understood, but there seems to be a clear difficulty in addressing the abstract nature of software.

Requirements Phase Categorization Model

The Requirements Phase Categorization Model emerged from the interviews and literature review. As no similar approach could be found in previous studies, we proposed a four attribute model. The model is not intended to be exhaustive, but only to be representative of the descriptions made by the interviewees. It includes the duration of the phase; team size; knowledge of the system domain; and the strategies for addressing the requirements phase. The discussion of this model naturally raises new inquiries for future research, namely the number and relevance of the attributes, but also their impact on the leadership of this phase. The conclusions drawn for each attribute from the proposed model are presented below.

Duration: The requirements phase duration has been related to the phase's success. Our participants stressed some of the problems derived from time-compressed requirements phases. However, this problem is not new in the literature, as previous studies have reported that time granted to perform this stage is a potential risk factor for their accomplishment (Chatzoglou; Fernández et al., 2012a).

The duration of the phase was not always easy to ascertain. Not all projects were concluded at the time that the interviews were held. Furthermore, the methodology used was shown to vary the duration of the requirements activities. An iterative methodology uses several small frames of time for requirements activities, while in the case of a more linear methodology, the phase duration is more concentrated in a single point of time.

Despite these complications, we measure the time spent during the requirements phase, and also the percentage of time allocated for this phase, compared with the total duration of the project. This allowed us to understand the relative importance given to this phase, and also enabled us to get some clues as to the origins of some of the related problems affecting the requirements phase. We believe that the comparison of the resources assigned to this phase, in contrast to the whole project, may explain some of results and complaints of the project managers. Will a requirements phase that has large time constraints be able to produce adequate and quality results such as another with a more comfortable planning? To answer this, and other similar questions, we advocate that this topic needs additional research.

Team Size: Teams from the supplier or the client. A different kind and roles. Different sizes from each part related to user involvement?

The size of the team is one of the attributes that characterizes a project. However, during the interviews, we found that the size of the team in the requirements phase is usually smaller than the team during the remaining phases of the project. These results support previous studies (Skulmoski and Hartman, 2010), in that in the early phases of the project, it is frequent that the team is not fully formed yet.

However, participants mentioned some problems related to teams during this phase (see Table 43). The problems related to the size of the teams have been extensively explored in the literature and thresholds exist to improve project results (Curral et al., 2001; Rodríguez et al., 2011). Nevertheless, most teams mentioned in the interviews were shown to have a small size considering the recommendations. This may explain the problems of the lack of diversity and richness of the solutions proposed.

Moreover, participants continued to report problems and concerns about the difficulty in working with the client company's teams. Some stressed that both the supplier team and the client team should be seen as part of the project team, as they must work together for the same purpose. This approach is somehow surprising and new to the literature and we believe that it deserves a careful analysis.

Under this assumption, we determined the size of the client teams, alone, and in addiction to the supplier teams. The results showed that the joining of both teams greatly increases the number of teams above the desirable size. Consequently, the participants'

complaints achieved increased meaning and support from the literature. Furthermore, this approach also brings new challenges, as these two teams, despite their common objective, are likely to have different cultures, interests and procedures, which may increase the difficulty to manage team diversity.

Another analysis performed on the teams attribute includes the definition and diversity of the assigned roles. The results showed that the project manager is the most common role assigned to the requirements phase team. Although this result may be consistent with many previous studies (Guinan et al., 1998b), the same is not true for the second most referred role: the programmer. According to Guinan (1998), the responsibilities of a programmer are often ambiguous and therefore it may be possible, due to their expected greater availability, that they end up assigned to tasks that were not originally intended. On the other hand, as the third-mentioned role was that of the technical manager it is also possible that in the organisations where this role does not exist, it is the programmer who replaces them.

Furthermore, some similarities and patterns were found in the assignment of team roles for each company. This may raise a question about the criteria used to assign roles to the team during the requirements phase: does it depend on the company's culture? Does it influence the results? This topic of teams has shown new interesting topics that consequently raises a number of questions for future research. We believe that more exploratory research should be carried out on this topic, in order to address the issues described above.

System Knowledge: Domain knowledge was shown to be critical to address some of the most typical problems of the requirements phase (Hadar et al., 2014). Their importance is often implicit within several critical factors identified in the literature, such as the suitability of schedules and plans for the project (Realistic Schedules and Realistic Budget); the elicitation of clear and complete requirements (Clear requirements and specifications); the establishment of good communication practices, which can provide a common base for communication (Effective communication and feedback), in (Nasir and Sahibuddin, 2011). However, some studies stressed that domain knowledge can also bring some disadvantages for the requirements phase, as it inhibits ideas generation, the exploration of alternative solutions, and document reviewing (Mehrotra, 2011).

Surprisingly, the analysis of the interviews revealed that domain knowledge is critical not only for the supplier team, but also for the client. A client with poor knowledge of project domain may cause several problems that affect the smooth implementation of the project. One of these disadvantages can occur during the decision-making process. These activities should be performed based on an accurate understanding of the system domain and a detailed understanding of the software product that are going to be developed. Otherwise decision-making can be made with great uncertainty, thus increasing the risk of the project being unsuccessful. Furthermore, without the proper knowledge of the projects, clients may feel unsafe to take certain decisions. This was described by participants as being "worse than a bad decision, is indecision" [OU10I1].

On the other hand, participants showed concern about the lack of client involvement and commitment during this phase, as they constitute a key part in defining a project's scope, it is expected that it confers a greater uncertainty and abstraction regarding the project's solution. Moreover, this situation has been reported as being a potential cause of demotivation for the supplier team, as they assume responsibilities to devise a solution with less knowledge and support than would be expected. However, there is still a gap in understanding whether the lack of involvement and commitment is caused by the lack of knowledge in the project area, which may lead to a poor understanding of the phase outcomes. Consequently, clients may feel that they were not able to understand the project, as they would not have the necessary skills. Or, in contrast, clients do not feel compelled to perform certain tasks during the project, and consequently it would be understood as being a lack of knowledge.

It may seem controversial that the results of this analysis showed that clients were mentioned less times as having higher knowledge than the supplier, and that more than one third of clients have been identified with a low knowledge of project domain. However, clients do not always perform in the same context where the system should be implemented. Hence participants have highlighted the importance to include key users of the application during this phase, which is not always common practice currently.

Furthermore, these results raise some questions about the motivation to build new systems, and also about the expectations that should exist for the involvement and commitment of clients. Besides, as the results only account for one of the parties involved in the process, it may be that the supplier team is emphasizing a situation that hides other

issues, namely their supplier super-ego, i.e. the lack of coincidence between the proposed solution and the interests of the client may be seen as being the incapacity of the client (Fisher Berry 2005; Niknafs and Berry, 2013). In our opinion, these insights are relevant and should be the subject of future research.

Strategies: Currently, the set of the best techniques, methods, tools and principles to reduce the problems related to development systems, and in particular the requirements phase, has been referred to as a " methodology jungle " (Avison and Fitzgerald, 1995). However, despite all the literature and other suggested standards (for instance, CMMI and SPICE (Schneider and Berencach, 2013)), the results of this study show that its use is still poorly established. Chatzoglou (1997) found similar results and stressed that the incorrect, or non-existent use of methodologies and tools in the requirements process may explain some of the problems found in the literature that impact on the planning activities. Furthermore, the author justifies the result as being due to the lack of initial information, the lack of experience of the analysts, the lack of stakeholder involvement, and scope changes, amongst others.

The analysis of our interviews revealed that there is no clear understanding of the existing methodologies, which may explain its poor adoption. However, even when some are applied, this is often done incorrectly, or incompletely, due to several restrictions, particularly regarding time. On the other hand, the participants mentioned that clients do not always feel comfortable with certain practices, arguing that they do not have the skills and/or the availability to accomplish them.

Nevertheless, we analysed the models used in each project, considering the sequence of their activities. The results showed that most projects used linear models (twenty three), followed by an iterative version of the linear models (thirteen). As noted in the literature review, many studies previously found that the linear models are still currently the most used in projects, despite their criticism (Petersen et al., 2009). However, there is a growing concern about the use of more flexible and modular methodologies (four) to "get the teams to develop some things earlier" [DZ12I3] and to better address client needs.

Although these results do not focus on the requirements phase, fourteen participants mentioned the use of specific methodologies during this phase. These were described as being linear, establishing a set of activities to be performed within a rigid sequence, producing a set of outputs supported by the use of techniques and tools. These results,

although not addressing how these methodologies are used in practice, are not far from the results obtained by Chatzoglou (1997).

As noted in the literature, the use of the existing techniques, as also happens with the methodologies, supports and improves the activities and output of the requirements phase (Davis, 2006; Fernandez et al., 2012a; Carrizo, 2014). However, the diversity of techniques and their appropriateness for specific projects was highlighted during the interviews. Although the criteria that determine the use of each technique has not been clarified, the participants described that typically they use a standardize set of practices which can then be supplemented (or reduced) according to the specific project characteristics. As a result of this lack of systematization in the choice of techniques, some situations were reported of poor results of its use.

On the other hand, the analysis of the techniques used grouped of all those mentioned in the interviews into: 1) traditional techniques; 2) group elicitation techniques; 3) prototyping; 4) model-driven techniques; 5) cognitive techniques, and; 6) contextual techniques. Although the focus is on the requirements phase, some of the above mentioned techniques are transversal to other phases:

We found that the traditional and group elicitation techniques were the most mentioned, in particular document production and meetings. Comparing these results with the literature review, we conclude that the adoption of tools at this stage is not yet well established and that the outputs produced are still far from the existing recommendations (Fernández et al., 2012a).

Surprisingly, the analysis of the tools used showed that twenty four projects used some tool, and of these, nineteen specifically support the requirements phase. These results show better results when compared with those obtained in Portillo-Rodriguez et al. (2012). However, further analysis showed that most tools were based on internal procedures and standards, revealing that the awareness of these topics come from the standardize processes, rather than from a greater maturity of requirements issues.

Furthermore, the benefits of their use remains to be ascertained. Although the impact of the use of tools for the development of software projects have not achieved consensus among researchers, we were not content to observe that results remaining below expectations. With the number of tools proposed both by industry and academia, one

would expect a widespread use, as they aim to address some of most referred-to problems affecting this phase.

In conclusion, after a general assessment of projects in terms of the practices applied, we found some immaturity in these topics. This conclusion is drawn from the comparison with the literature's state-of-the-art. Nevertheless, this does not mean that the general results are very different from the results obtained in other empirical studies. The comparison with the results of international repositories found that the results do not vary much from those documented. This suggests that the problem may eventually not be affected by culture or by country context. However, in order to confirm this assumption, more studies are required.

The academic literature is not always available to practitioners, and also they rarely have the availability required to stay abreast of the latest trends. Thus, one could wonder whether the information sources and paths are efficient. Understanding the way companies obtain their information and what motivates them to incorporate these practices into their internal processes can be a starting point to improve the overall use of the best practices.

(1) Which leadership competencies are relevant for the requirements phase?

(R03) Check the relevance of competencies proposed by Dulewicz and Higgs (2003b).

(R04) Identify any other leadership competencies relevant to the requirement phase of the software development project's life cycle.

Despite the order of the research questions, the exploitation of leadership competencies was carried in reverse. We decided to start by exploring the relevant competencies without any limits or constrains, and only then did we compare the results against the proposed framework.

The first conclusion that may be drawn, is the recognition by most participants of the importance of leadership in software development projects, in particular for the requirements phase. Moreover, it has been found in the results obtained, a great variability in the set of competencies needed for the requirements phase globally, also on account of their main activities.

The leadership of this phase was also mentioned to include competencies that foster the relationship with the client, and also the management of the project and the internal team. Clients should not be treated as regular team members, or followers, as their profile is quite different: the client, as the owner of the project, is expected to also act as the leader, with a high power position. Therefore, the study's participants emphasized some necessary competencies that need to act on the different relationships.

In response to the open question of which are the relevant leadership competencies for the requirements phase, the participants identified a total of 54 competencies, which were grouped into seven categories (adapted from (Skulmoski, 2010)), namely: Personal Attributes, Communication, Negotiation Skills, Social Skills, Job-Relevant Knowledge, General Management Skills, and Team Management Skills. Of all those identified, the most frequently reported competencies aim to support communication and adaptability (Good communication skills, Common Communication Language, and Interpersonal Sensitivity), those for guiding and motivating the team (Guide the team, Provide the Vision, and Motivate the Team), and those that help the leader keep focussed on the achievement of project objectives and solution building (Guided to achieve the results, Focus, Experienced, Technical knowledge, and To know and Dominate the Business Area).

Communications was said to be critical for almost all those activities that should be performed by the leader. As this phase is prone to client interactions, this competency assumes even more relevance. However, it seems that the ability to communicate depends on the person that the leader is dealing with. The leader should be able to recognize their interlocutor in order to adapt a suitable style to promote the generation of a relationship. Relationship with the client was mentioned to impact on the success of major activities during this phase. The client should be able to trust, empathize, and recognize the leader. They must feel that their wills and needs are being properly addressed and this seems to be critical for the commitment and approval of the project solution

However, leaders should also manage their team. This includes protecting, guiding, and developing the cohesion between the team members. Team members should trust and recognize their leader. Additionally, leaders should develop a suitable and creative solution, albeit even considering that they may not always have the most accurate or complete information. In this context, leaders' expertise and knowledge from the field

were referred to as being critical. These two competencies can also influence the leader's capability to communicate with the client, to guide the process of elicitation, and also to obtain recognition from team members

However, some participants emphasized that the mentioned set of competencies would probably not be exhaustive. This could partly explain why the competencies usually related to emotional intelligence have not received special enhancement, which would be expected from the literature review (Dulewicz and Higgs, 2003a; Muller and Turner, 2007; Geoghegan and Dulewicz, 2008). On the other hand, we found a large coverage of the competencies described in the present study and also those described in the study of Skulmoski and Hartman (2010). However, the latter study focusses on the general competencies of the project manager, rather than specifically of the leader.

To address the (R03) sub question, we tried to compare those competencies found here with the framework proposed by Dulewicz and Higgs (2005b). However, we found that not all could be easily fitted into the dimensions of the referred framework. Therefore, a different strategy was adopted to broaden the scope of each dimension, namely redefining and clarifying dimensions and competencies from the framework. This allowed us to fill the framework with the identified competencies.

The analysis of the relevance for the framework dimensions, considering the data obtained during the interviews, strengthened Managerial competencies (MQ), rather than Emotional (EQ) and Intellectual IQ. We argue that in the open analysis of the competencies the respondents did not depart from the project manager competencies. Emotional competencies and their relevance seem to be neglected compared to those most used in management activities. Indeed, in the second part of the study, where a list of competencies was given, the results showed an improvement of EQ classification.

One possible reason may be that respondents are still not sufficiently aware of the need and relevance of emotional skills. The focus on management seems to be clear and the leaders' role, from the participants' point of view, becomes diffuse. Perhaps it would be beneficial if the organisations could enhance and clarify the value of an effective leadership, and particularly the value of emotional competencies.

Furthermore, some of the respondents reported to have certifications in the area of project management. This type of training is usually more focussed on management skills

and refers to the leadership as being one of them (for instance PMI and APOGEP). This may cause different perspectives on leadership, as respondents may be using their training background to address these issues. To put it in different words, some respondents may have had some difficulties in considering leadership as being a set of competencies *per se*, due to their training background. Furthermore, it might be interesting to further explore these results, and to assess whether they remain the same if a *a priori* list of competencies could be provided to foster discussion.

(2)* How can leadership competencies help to achieve leadership effectiveness in the requirements phase*?

(R02) Understand how leadership may influence the success of this phase.

As mentioned earlier, leadership was found to be relevant for this phase for the majority of participants of this study. However, not all agreed that the set of leadership competencies would differ among the project life cycle phases. However, it was well accepted that some competencies may present a greater relevance for performing certain tasks.

To assess how leadership may influence the success of this phase, respondents identified a list of leadership objectives. These objectives represent tasks that should be performed by the leader and that are critical to the success of this phase. Indeed, the comparison of these objectives with the critical factors for success described in the requirements phase description showed a great overlap. Therefore, we may conclude that the results apparently suggest that the leader is called on to solve the aspects considered to be most critical for this phase, as if its proper implementation depends on the leader. Therefore, based on the kind of tasks assigned to the leader, we can note that:

- Leaders must be oriented towards the achievement of results, in the sense that their ultimate goal should be to find a viable solution to the problem, for both the supplier and the client side. They must be able to plan and assign tasks in order to achieve the results and to keep the project on track.
- Leaders must be focussed mainly on the client, but should not neglect their followers' needs. A leader must be able to meet clients' needs and wills, and to do so, they must engage and persuade all the members of the project in

order to gain acceptance and commitment to the solution proposed. Thus, they may eventually maximize the overall satisfaction of the project results and enhance the productivity of the unifying team. This shows that the leader should also be a visionary and a seller of ideas and solutions.

- Leaders should act during the early phases of the project life cycle, when a formal team does not always exist. Therefore, they should also be able to facilitate the formation of the team and the establishment of a spirit of cohesion.

The relevance given to the ability of the leaders to establish an effective relationship with the client suggests that leadership during this phase should also be relationship-oriented. Furthermore, it was generally accepted that the leaders must have the ability to adapt their attitudes and communication channels for the client profile, in order to create that kind of relationship. Additionally, leaders should be flexible about the task type and the context of the project. The different roles that the leader must assume, both within and outside the organisation, suggests some compliance with the basic principles of contingency theories, namely the Path-Goal Theories of Leadership (House, 1971).

In addition to these results, the second part of this study has also given some insights into how leadership competencies may impact on this phase. The fill of the double entry grid to evaluate the relevance of competencies proposed by Dulewicz and Higgs (2005b) of the main activities of the requirements phase, has highlighted variations in the set of competencies found. The results suggest that for different activities, different skills must be combined, in order that the leaders can address the challenges of each activity.

Thus, in this context, we found some patterns of the responses that suggested that the classification of each activity is according to the nature of their tasks. The classification resulted not only from the descriptions given by the study participants, but also from their comparison with the literature (Pressman, 2005; Geoghegan and Dulewicz, 2008). Therefore, three types of activities emerged: Conceptualisation, Production, and Interaction, which focus respectively on: activities of reflection and the production of the solution; activities of internal production of artefacts by the project team, and; activities that require greater interaction with the client (and other stakeholders).

Consequently, we found that not all competencies received the same relevance among the requirements activities, although both competencies C8 and C15 were ranked

transversally. In brief, Conceptualisation activities showed an increased need for competencies C8, C2, C1, C3, C4, C11, C12, C14 and C15 (high and medium relevance), whereas competencies C9, C10 and C13 were the less-mentioned ones. Production activities enhance the C8, C11 and C15 competencies (high and medium relevance), whilst C9, C10 and C13 were also found to be the less relevant ones. Interactive activities showed more divergence on the competencies patterns, but it was still possible to highlight competencies C8, C4, C12, C13 and C15 (high and medium relevance). It is also worth noticing that the competencies from the emotional dimension received the greatest highlight for this type of activity, and that the reason mentioned regards the difficulties of the relationship with clients and conflict resolution.

(3) Which factors can influence the relevance of competencies during the requirements phase?

(R05) Identify the contingency factors of the project that influence the competencies during the requirement phase.

As was mentioned in the previous question, the variations of the set of leadership competencies were not always consensual among the study respondents. Nevertheless, it was possible to identify some general factor that may affect the relevance of competencies.

During the interviews, questions were asked about the factors that could lead to variations on the relevance of competencies. The first one followed the open question to identify the relevant leadership competencies, and maintained the same open structure. Therefore, respondents could freely reflect on the factors that may impact on the competencies they had just described.

From the analysis of these responses a list of twenty-two factors emerged, which were then grouped into five dimensions: client; project team; project type, project process and leader profile. Furthermore, the analysis of the results from the completion of the double-entries table revealed that the relevant set of leadership competencies may also vary depending on the activity that must be performed. Thus, we suggest a sixth dimension that reflects the nature of these activities.

At the end of the double-entry table filling, we additionally asked some questions about which would be the factors that the participants thought could alter the classification made. This aimed to validate the factors previously identified, and also to get a new view of possible factors, taking into account the list of competencies provided and the activities. However, we could not fully address these questions. While some participants showed more time constraints regarding their participation in the interview, others did not show to be so available to perform this exercise at the end of the interview. We believe this to be a limitation of this study, which we intend to solved with future research.

To maintain the chain of evidence throughout the described conclusions, further insights into this topic are provided regarding the conclusions of the next question (4).

(4) How can these factors influence the relevance of competencies during the requirements phase?

(R06) Assess how these factors lead to variations in the set of relevant competencies.

As mentioned before, the analysis of transcriptions from the interviews showed five major dimensions that participants said to impact on the relevance of leadership competencies: client; project team; project type, project process and leader profile.

The client dimension includes factors that characterize the specific profile and motivation of the client, and also factors that characterize the Client Company industry sector and context. Respondents stressed the need for a leader to be able to adapt their style and attitudes towards different types of clients. Also, they frequently highlighted the need for the leader to communicate effectively, in order to foster a close and trustful relationship with the client.

The analysis of the interviews also showed that the project teams may impact on the leadership competencies. The team members' characteristics and background, namely their seniority and expertise, were said to impact both positively and negatively on the relevance of some competencies. Although it may reduce the project risk, improving the existing domain knowledge and the richness of the possible solutions, more senior and experienced members were said to be more likely to have disruptive behaviours, especially rejecting or affecting the leaders' reputation.

The team dimension also includes factors that describe the geographic location of teams (which was most frequently mentioned), as well as the size and turnover of team members. The first factor, apparently, can bring additional challenges to communication issues, to establishing a spirit of cohesion and motivation, but also to maintain the reputation of the leader. In turn, the size of the team can influence the relevance of the competencies of the management and development of the team members, as well as the establishment of a common vision and strategy.

To assess the project type, participants reported some of the project attributes presented in the project categorization chart. The main focus was on project size, duration, contract type, strategic level, complexity, and where (or by whom) the project was developed. Also, the application type was shown to impact on leadership, as projects that develop a bespoke solution are more likely to be performed under greater ambiguity and uncertainty.

Project duration was the most frequently-cited factor to impact on the relevance of competencies, namely due to the project team feeling worn out. For instance, long projects may need extra motivation, but also additional strategies to maintain a healthy relationship with both the client and the team members. On the other hand, project complexity was said to impact on the leader's ability to manage all the resources, and also on their ability to maintain a strategic perspective of the project.

The leaders' own profile and involvement, although less cited than the rest of the dimensions, were said to impact on the leader's ability to manage the resources and to adapt to the client and the team members. Although poorly cited, we think that this factor can be relevant for further research. In fact, some emerging literature discusses the impact of the leader's personality characteristics on their ability to apply some of the competencies.

Finally, the project process was the most-mentioned dimension to impact on the relevance of the competencies needed. The process is represented by the methodologies and techniques used for project development, particularly during the requirements phase. In summary, the interviews analysis showed a major variability of the leaders' ability to critically analyse and judge, to manage resources, and to be emotionally resilient throughout the process. These may be needed more or less, depending on the

methodology applied, especially for the traditional and linear methodologies, such as the Waterfall Model, and for more iterative methodologies, such as the Agile one.

Structured methodologies may help the leader to better orientate the project's progression. However, it raises some concerns about deliverables approval. One of such concerns relates to the solution that must be fully defined and approved by the head of the project. As the maturity of project knowledge may not be yet achieved, this solution may be compromised by the existing (and likely incomplete) knowledge. Consequently, several problems may arise which could impact on the rest of the project development.

On the other hand, Agile methodologies were said to require a disciplined leader that is able to keep the project focussed on its objectives. This means orientating the project and maintaining the focus on results achievement. Furthermore, it was also said to reduce the need to deal with greater ambiguity, to reduce the emergence of conflicts, and to ease negotiation activities with the client during the process. The most frequently-mentioned concern was the ability of the leader to manage the project scope. If the leader is not able to do this, then projects are likely to become "never ending projects".

As a result of these conclusions, the initial research model was instantiated to represent that which was mentioned to influence the set of identified leadership competencies. However, in order to improve the model's clarity and comprehension, we separated it into three models to represent the different impact levels (high, medium and low) of each factor's dimension. Nevertheless, further research is needed to assess their generalisation, quality and reliability.

Furthermore, the analysis of the second part of this study - the double-entry table, revealed that there may be an additional factor that impacts on the relevance of leadership competencies. A careful look at the main activities of the requirements phase, i.e. the activities that are commonly performed, showed a great variation of the set of leadership competencies that were ranked by the participants.

The results suggested that activities could be broadly classified according to their nature and focus, namely by: conceptualization, production and interactive. The first activity type respondents highlighted the relevance of leadership competencies which may improve the critical analysis of the project domain and focus, in order to come up with innovative and creative solutions. These solutions should guarantee the ethical

resolution of the client's needs and requests, and also their alignment with the strategy and culture of the supplier team. Moreover, competencies that may improve the leader's ability to establish an emphatic and trustful relationship with the client were also referred to, as this may be the part of these activities that first has contact with the client.

Production activities respondents mentioned the importance of the leader to stay motivated, even in the most routine and repetitive tasks, but also to maintain a good analytical ability and commitment to the project. It is worth noting that for both types of activities described so far, emotional awareness and control competencies were the least emphasized, suggesting that they may not be as relevant during this stage. Possibly as these are very early project activities, there may still be no great need to use these skills. On the other hand, we found a slight increase of empowering competencies, which may possibly suggest that at this stage leaders delegate tasks that they may feel less motivated to do, although more research is needed to draw stronger conclusions.

For Interactive activities, respondents highlighted the need for leaders to establish effective communication strategies, which includes their ability to adapt to the client's profile. Moreover, they should remain focussed and committed to the project goals, influencing the clients (and other stakeholders) to obtain consensus and to achieve the approved solution. Specifically for negotiation activities, the respondents highlighted the leader's important need of self-awareness and emotional resilience, especially for conflict resolution.

However, further empirical studies are needed to better understand the existence of these (or other) competency patterns, especially those competencies that were not so clearly expressed in the framework. Furthermore, the contingency factors should be considered to assess whether they impact on such patterns.

Future Research

Dubé and Paré (2003) argue that the essence of an exploratory study aims to develop new ideas, constructs and / or theory. In fact, as conclusions lead to new reflections on the topics under study, further research naturally emerge. Therefore, we advocate that more empirical studies should be performed to better understand the phenomena, eventually getting answers to some of the questions posed during the analysis and discussion of each topic.

Additionally, the conclusions drawn in this research study may need confirmatory analysis to assess its generalization to broader contexts. Such studies may also overcome some of the limitations of this study, namely the data collection from the client side and the consideration of several projects with similar characteristics. We believe that further studies exploring the behavioural component of the IS/IT development projects, considering the inherent differences of the overall set of activities performed may be fruitful.

5.2 Contributions

Every research study has the ultimate goal to generate contributions, both theoretical and/or practical, and to improve the existing body of knowledge to address some of the gaps and problems encountered in the literature. This study is no exception. We believe that the insights that emerged from this study can contribute both to the fields of research and practitioners.

The aim of this research study was to improve the existing knowledge on leadership competencies that act in the context of the requirements phase of a software development project life cycle. We intended to identify and understand the impact of the set of competencies that are critical for addressing the challenges of this phase, but also for identifying any factor that could vary the relevance of these competencies.

Furthermore, we were interested in exploring the existing state-of-art-of-the phenomena of the requirements phase, in order to contribute to its improvement. Thus, we believe that this study opens new avenues of research regarding the characteristics of leadership during the early stages of software development projects, which may contribute to better performance on these phases.

Theoretical Contributions

Byrne and Barling (2015) stated that contexts where projects are performed with ambiguous and ill-defined goals are important areas for future research. This research answered this quest, as the requirements phase of the project development life cycle is

usually considered to be the most ambiguous one. Both supplier and client teams have to work in a coordinated manner to exploit the solution for a project.

Three main research fields were involved in this research, namely: general projects, requirements engineering, and leadership. Despite our combined results, we believe that they bring some theoretical contributions to each of these research bodies of knowledge.

The first contribution is related to project categorization research. The conclusions of this study confirmed that which the main authors advocate as being the need to adapt the characterizing attributes to the context that they apply to, either within scientific research, or for business use. Therefore, we explored a set of attributes that better represent the study projects. These attributes were compared with those used in early studies and some conclusions were drawn. We highlighted the need to consider perceptions, rather than measurement attributes, when studying behaviours, as they may be predictors of different attitudes. However, we add to the previous studies on characterization systems to foster discussion among researchers about the future development of similar studies.

For the requirements field, our contributions improved the existing body of knowledge in three ways. First, we started by giving the participants' perspective of some of the hot topics of this research field. We described the state of maturity that participants have regarding issues related to requirements, especially its nature, volatility and critical success factors. From this discussion, new insights have emerged which we believe to be topics for future work and reflection.

The second contribution was the characterization model explored from the interviews and literature review. Similar models already exists for other research areas, such as project characterization, but no study was found on the requirements area. The actual literature gap on a standardized model to characterize the requirements phase may start to be addressed through our contributions.

From the former discussion, we can highlight contributions to each attribute included in the model. First, we described the state of art of the use of practices for the requirements phase, at least in the studied projects. To name just some examples, we assessed the percentage of time usually allocated for these activities, and also the methodologies and techniques used to achieve the desired results. Next, new insights emerged from the

descriptions of the interviewees, especially considering the team performing during this phase, and the consequences of the lack of existing domain knowledge, both for suppliers and clients. We believe that our findings can enrich the discussion on these topics.

The third contribution was the enhancement of the relevance of the human and behavioural aspects for the success of the requirements phase. This assumption has already been introduced in previous studies, and was confirmed in this study.

Finally, for the field of leadership, we believe that our conclusions improve the current body of knowledge. We now have a deeper understanding on how leadership competencies can be applied to this stage of the project life cycle to improve its success. Previous studies have failed by not considering the different aspects of each of the project phases. We believe that our results may clarify some of the results and questions raised in previous studies, including that of Turner and Muller (2010).

Our analysis highlighted the major variances of the set of leadership needed to perform each activity of this phase. We found that, besides the list of contingency factors mentioned by the study participants, leadership competencies also vary according to the nature of each activity performed. This nature was defined according to the need of interaction with the client and other stakeholders. While the majority of studies focussed on leadership versus leader-followers, this study suggests that the interaction with the clients may be a relevant factor of variance on the competencies needed

Practical Contribution

Although not generalizable, the results of this study may be of interest for practitioners. First, we explored the project categorization attributes, which improves the overall understanding of the actual project categorization systems. The resulting set of project categorization attributes can help both researchers and practitioners reflect on the suitability of their current practices.

Moreover, the suggested model for the requirements phase categorization can also help practitioners understand and adjust their internal processes. The assessment of the general state of maturity can also help them find gaps in the current application of best practices, as some of the referred problems affecting this phase are now addressed in the

literature. We believe that this information is available, but is not reaching practitioners. Therefore, we intent to bridge this gap, fostering the spread of valuable research findings.

Is was interesting to see that most of the critical success factors mentioned by the participants were also assigned to the leaders' missions for this phase. It seems that a leader could really improve the overall success of this phase. Therefore, another contribution of this research may be the resulting set of competencies that were said to be relevant during the execution of the various requirements activities. Practitioners can now be more aware of what kind of leader profile they should apply, considering a different set of factors. These were explored as contingency factors, and we found that they may impact on the relevance of some of the leadership competencies.

Additional insights about the relevance of this study's contributions for practitioners was assessed during the interviews. The two excerpts above illustrate some of the contributions that participants mentioned during the interviews.

Extracted from the interviews:

"Intuitively there is always... when we are looking for a project, we always try to identify the most appropriate person for that project. A person who has worked before in that area, who already has expertise in that area, and who is experienced and more trained. We try to somehow pick the best person for the project. This study, or a study of this kind, could help identify or know how to choose the best person for the project, especially if that person is someone who does not have this experience, but wants to know how... I'm going to choose someone to lead a project, whom I am supposed to remember? What ... what ... what am I supposed to consider? To help making the decision as to who would be the best person to develop a project." [JL02I1]

"I see this study as... like... maybe as a guide to identify best practices. I am very glad about best practices. I think what is regarded as best practices can apply to certain situations or red flags about leadership. I'm realizing that this study is very focussed on leadership. As I said, it may be important for a manager to have a warning - "Look, perhaps during the requirements phase we should pay special attention to this, and this, because best practices say that, or the experience of our colleagues says that, "It happens that we learn from the experience a lot, so it would be good to have a warning, almost like the older person advisor." [NV10I4]

Finally, the conclusions of the present study are expected to allow managers to be aware of the need to consider or develop different skills and characteristics of the project leader, depending on which activities and context they have to perform. In particular, we believe that this study may allow for some reflection about the current relevance and differentiation that has been given to leadership and emotional issues about projects, comparing to that which has been suggested and emphasized in the literature.

Questions from (Walsham, 2006)

In order to evaluate the contributions of any research, Walsham (2006) suggested a set of criteria, based on four questions, which every author is recommended to answer. Following their approach, we conclude the study contributions by answering each of these questions:

1. *Which is our type of audience or audiences?*

This work aims to address some problems felt in organisations, especially when carrying out projects. Therefore, the results obtained can be of interest to IS practitioners, such as project managers, due to their potential for improving their current practices, or at least to improve their perception about their limitations. Nevertheless, as scientific research, this work clearly intends to stimulate discussion among researchers interested in the areas covered in this study, namely leadership and general IS project management, particularly those who are interested in the requirements research field.

2. *What literature are we aiming to contribute to?*

This study aims to contribute to general IS project management and leadership literature. Since the main focus is on the requirements phase, we also aim to contribute to the requirements research field, more specifically to the literature that explores the social and behavioural aspects of this phase.

3. *What do we claim to offer in this work that is new to the audience and the literature?*

This study integrates different research streams to understand their interlinked relationship. We focussed on one of the most-mentioned critical phases of the project life cycle, the requirements phase, in order to understand how leadership competencies may

contribute to its success. As a result, we instantiated a model of the most relevant leadership competencies for performing the requirements phase activities, but also the main factors that were said to impact on these competencies.

Furthermore, we intended to ascertain the suitability of the competency framework proposed by Dulewicz and Higgs (2005b) to a different context from that which has been carried out to date. For the projects studied, we found that there is a relationship between the set of relevant competencies and the nature of the activities performed, in particular those regarding the interaction between the client and other stakeholders. As far as can be ascertained, no previous research has been conducted to study the impact of leadership competencies in this critical phase of software development projects, and thus we believe that this may improve the body of knowledge of behavioural and social aspects of this phenomenon, thus opening new research perspectives.

4. How should others use the work?

The conclusions of this study can be used by practitioners and researchers alike. Practitioners may use the study's results to reflect and adjust their practices, in order to improve their effectiveness as project managers or leaders, particularly when applied to the requirements phase. They can also provide training sessions for managers for developing the set of skills that is showed to impact on the success of this phase.

Academics can use these results as a base to extend their research work by focussing on those social and behavioural factors that can influence the success of the requirements phase. Furthermore, by contributing to the body of knowledge, we intent to foster discussion about these research areas.

5.3 Limitations

This research study, as with most of the other research projects, has limitations regarding the literature reviews, sample, methods and results. The literature review was performed only within the research topics of this study, and no other research areas were included. Furthermore, the review followed a conductive strategy, which means that we have not read all the articles from the research fields, as this would probably be unproductive, given the extensive reach of these research areas. In addition, the literature review only included published research written in Portuguese and in English, despite the potential valuable findings that may arise from studies in other languages.

We used a purposive sample for this study, rather than a random one. However, the purpose of this study is not to get generalizable results, neither to represent the existing population. We were interested in collecting different perspectives about the phenomena, and therefore random sample would not be the most appropriate strategy.

However, the sample target of this study is already a limitation. Managers and consultants are usually professionals with major restrictions for participating in this kind of study. Time constraints and availability were considerable restrictions for this research, especially the time needed for data collection. For instance, some of the final topics of the interview guide were not possible to ascertain for some respondents, as they were shown to be tired, restless and less collaborative. Consequently, these topics were not possible to analyse, and thus were not included in the study. Moreover, the lack of participants' availability made it not possible to exploit the different methodological strategies, such as the data collection by iterations.

The chosen methodology also brings inherent limitations, although we have addressed the main strategies proposed in the literature to overcome them. Generalization and reliability of the results are the most common criticism for a study using this methodology. However, the exploratory nature of the study minimizes the goal for generalisation. On the other hand, the use of triangulation techniques (sources and methods), the development of the study protocol, the development of the cases evidence database, and the execution of multiple case studies revealing some diversity, all allow for maximizing the quality of study (Yin, 2013).

Finally, the data also has some limitations. The first one is the inclusion of opinions from only the supplier side. Clients are an important vertex of this leadership relationship, and thus we think that their point of view of the phenomena should also be relevant for drawing more complete and accurate conclusions. Opinions from team members, from both sides, would also be valuable to enrich the results.

From the results, it was not possible to draw conclusions about the relationship of competencies found with the described projects, as the variety of topics did not allow us to keep the interviewee focussed. Moreover, during the filling of the two-entry table, respondents naturally describe their particular project at the beginning of the interview. The urgency in describing situations and real problems opened the scope of the interview, inhibiting the desired focus to track all the projects described.

However, we collected a few notes about the factors that may cause changes in the competencies classified. Thus, we intend to develop future research, not only to better explore the contingency factors, but also to compare the results from those found to date.

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Appendix 1

Brief description of leadership competencies [from (Dulewicz and Higgs, 2003b)]

Intellectual dimensions- IQ

1. Critical Analysis and Judgement

A critical faculty that probes the facts, identifies advantages and disadvantages and discerns the shortcomings of ideas and proposals. Makes sound judgments and decisions based on reasonable assumptions and factual information, and is aware of the impact of any assumptions made.

2. Vision and Imagination

Imaginative and innovative in all aspects of one's work. Establishes sound priorities for future work. A clear vision of the future direction of the organisation to meet business imperatives. Foresees the impact of external and internal changes on one's vision that reflect implementation issues and business realities.

3. Strategic Perspective

Sees the wider issues and broader implications. Explores a wide range of relationships, balances short- and long-term considerations. Sensitive to the impact of one's actions and decisions across the organisation. Identifies opportunities and threats. Sensitive to stakeholders' needs, external developments and the implications of external factors on one's decisions and actions.

Managerial dimensions (MQ)

4. Engaging Communication

A lively and enthusiastic communicator, engages others and wins support. Clearly communicates instructions and vision to staff. Communications are tailored to the audience's interests and are focused. Approach inspires staff and audiences. Communication style conveys approachability and accessibility.

5. Resource Management

Plans ahead, organises all resources and coordinates them efficiently and effectively. Establishes clear objectives. Converts long-term goals into action plans. Monitors and evaluates staff's work regularly and effectively, and gives them sensitive and honest feedback.

6. Empowering

Knows one's direct report's strengths and weaknesses. Gives them autonomy, encourages them to take on personally challenging and demanding tasks. Encourages them to solve problems, produce innovative ideas and proposals and develop their vision for their area and a broader vision

for the business. Encourages a critical faculty and a broad perspective, and encourages the challenging of existing practices, assumptions and policies.

7. Developing

Believes others have potential to take on ever more-demanding tasks and roles, and encourages them to do so. Ensures direct reports have adequate support. Develops their competencies, and invests time and effort in coaching them so they can contribute effectively and develop themselves. Identifies new tasks and roles that will develop others. Believes that critical feedback and challenge are important.

8. Achieving

Willing to make decisions involving significant risk to gain a business advantage. Decisions are based on core business issues and their likely impact on success. Selects and exploits activities that result in the greatest benefits to the organisation and that will increase its performance. Unwavering determination to achieve objectives and implement decisions.

Emotional dimensions (EQ)

9. Self-awareness

Awareness of one's own feelings and the capability to recognise and manage these in a way that one feels that one can control. A degree of self-belief in one's capability to manage one's emotions and to control their impact in a work environment.

10. Emotional Resilience

Performs consistently in a range of situations under pressure and adapts behaviour appropriately. Balances the needs of the situation and task with the needs and concerns of the individuals involved. Retains focus on a course of action or need for results in the face of personal challenge or criticism.

11. Motivation

Has the drive and energy to achieve clear results and make an impact and, also, to balance short- and long-term goals with a capability to pursue demanding goals in the face of rejection or questioning.

12. Interpersonal Sensitivity

Is aware of, and takes account of, the needs and perceptions of others in arriving at decisions and proposing solutions to problems and challenges. Builds from this awareness and achieves the commitment of others to decisions and action. A willingness to keep open one's thoughts on possible solutions to problems and to actively listen to, and reflect on, the reactions and inputs from others.

13. Influence

Persuades others to change views based on an understanding of their position and a recognition of the need to listen to this perspective and provide a rationale for change.

14. Intuitiveness

Arrives at clear decisions and drives their implementation when presented with incomplete or ambiguous information using both rational and "emotional" or intuitive perceptions of key issues and implications.

15. Conscientiousness

Displays clear commitment to a course of action in the face of challenge and to match "words and deeds" in encouraging others to support the chosen direction. Shows personal commitment to pursuing an ethical solution to a difficult business issue or problem.

Appendix 2

Covering Letter

Filipa Pires da Silva
Lisbon School of Economics and Management
Lisbon University
(…)

Ass: Research project for doctoral program

Dear. Sir/Madam,

First allow me to introduce myself: my name is Filipa Pires da Silva, and I am a teaching assistant at ISEG - School of Economics and Management, in the field of Information Systems. Currently, I am preparing my doctoral thesis under the supervision of Professor Antonio Palma dos Reis and co-supervision of Professor Paulo Lopes Henriques, after having finished my master's degree at Faculty of Science and Technology, New University of Lisbon, about Software Engineering.

I decided to send you this letter in order to request for your cooperation in the project I am developing. Such project must obeys to rigorous rules of scientific research, guaranteeing reliability, workability and confidentiality as any other credible research project.

This project is developed for the field of management of information systems projects, focusing on the exploration of the relevant skills that a leader must possess to perform during the requirements phase of the project life cycle. This phase is often considered by many researchers and practitioners as one of the most critical phases of the entire development cycle of information systems projects and that it may even cause capital losses to organizations when not successfully performed.

Furthermore, this research uses a multiple case study strategy, where employees interviewing is fundamental (1 hour to 1 hour 30 minutes duration expected). The analysis of the current practices and project management policies, and the submission of questionnaires may also be required to conceptualize the study and strengthen the

information obtained. The interviews' target should be employees who perform as managers of software development projects.

The choice of your reputable institution has to do with your dimension and relevance within the industry sector which you belong, but also your diversity and experience in developing information systems projects.

Grateful for your attention. I make myself available to give you any additional explanations about this research project and eventual participation conditions.

Best regards,

Filipa Pires da Silva

Appendix 3

Case Study Protocol

Study Aim

This research project belongs to the information systems project management research field. Considering the sequence and diversity of the phases of a software life cycle, we decided to focus on the requirements capture and analysis phase (RCA phase), also known as Software Engineering, as the main subject of this study, since it is often considered to be a critical stage in the development of a new system. Within this research scope we aim to explore topics related to leadership: it relevance for this study context, which competencies are most relevant for a leader and which factors may influence the leadership effectiveness in this phase.

Research Questions

This research, as any other, is guided by the research questions. The aim is to accomplish all the research objectives through the data collection and analysis. These questions also establish which should be the questions to inquiry during the interviews. Therefore, this research study aims to answer the following questions:

(1) Which leadership competencies are relevant in the requirements phase?

(2) How can leadership competencies help to achieve leadership effectiveness in the requirements phase?

(3) Which factors can influence the relevance of competencies in the requirements phase?

(4) How can these factors influence the relevance of competencies in the requirements phase?

Data Collection Procedure

1. Data Collection

Data collection will proceed through two main techniques: semi-structured interviews and documents analysis. Documents should be collected prior to the visit as it may help to prepare each interview and contact with the study participant. Moreover, it may help to understand the company context and thus adequate communication to the target. Additionally, documents may also be collected during the visit to better understand internal procedures and practices, namely for project management, requirements management. Also interesting would be those documents about the personal and professional competency development programs, and also the assignment of profiles to certain projects.

The Interview Guide

1. Interviews Aim

The main objective of the interviews is to collect data on the research topics in order to establish empirical evidence. Each interview is individually conducted and we pretend to motivate and encourage the interviewee to share their beliefs about the key concepts of the study (e.g. leadership and competencies), as well as to describe the process were their apply (e.g. the Requirement Capture and Analysis phase)

2. Topics for the Interview

a) Researcher Presentation:

My name is Filipa Pires da Silva, and I am a teaching assistant in the ISEG – Instituto Superior de Economia e Gestão, in the field of Information Systems. I recently finished my Master's degree on Software Engineering (FCT – NOVA University) and I am currently working on my PHD work with supervision of Professor António Palma dos Reis and co-supervision of Professor Paulo Lopes Henriques.

b) Research Aim and Objectives:

The research study follows a multi-case study strategy as proposed by (Yin, 2013). The data collection will proceed through in-deep interviews to project managers, the analysis of current practices and management procedures, document analysis that enable project characterization and questionnaires to data triangulation.

c) **The researcher must explain the interview context: each interview should be recorded and is strictly confidential. It should also be explained how and when data will be stored and analysed. Consensus must be achieved to conduct the interview;**

Any research project should follow rigorous rules of reliability, workability and confidentiality to be considered a credible research. Conducting such study one should follow high ethical concerns without which the study can not be considered valid.

Thus each interview follows a previously prepared and revised protocol, which establishes the following procedure. Each conference shall be held individually and will have an average estimated duration of 1 hour to 1 hour and 30 minutes. This should be preferably recorded (without prejudice to be taken by the investigator auxiliary notes), always with due authorization, to allow subsequent transcription and analysis, and to allow better monitoring in the interview course. But this record is strictly confidential, and no point forward it will be disclosed the identification of the respondent, organization or target project.

d) **Questions Guide to the interview:** the questions from the interview guide come from the research questions and main research objectives, but also from the extensive literature review. All questions are organized by topics following the same structure of the Phd Thesis. These questions should be considered as supporting topics for inquiry, but do not inhibit any additional question that can emerged from the interview progression.

d1) **Project Characterization:** to answer the following questions you should consider the most recent project were you have been involved.

This project should be finished or at least the RCA phase should be considered closed.

- **i.** How do you define the project?
- **ii.** Classify the project (each) in accordance with the items on the table 1?
- **iii.** Under the project' development, have you considered any specific development methodology? Which one?

d2) Requirement Engineering:

- **i.** Can you describe how did the RCA phase? Who were involved and which activities were performed?
- **ii.** Have you considered any methodology or tool to support the RCA' activities? Which one?
- **iii.** Can you explain how the success of the RCA phase can impact the overall project success?
- **iv.** Can you describe what means to you the success of the RCA phase?

d3) Leadership: Accordingly to the literature, one of the factors that most influence the project success is the leadership.

- **i.** Do you consider the leadership relevant to an IS/IT project? (If the answer is yes: Can you give some empirical evidence that demonstrates this relevance? If the answer is no: Why?)
- **ii.** Can you describe how leadership can contribute to the success of such projects? And to the RCA phase success?
- **iii.** (If it has not been addressed in the previous question) How do you consider one can assess the influence of the leadership in achieving the success of the RCA phase?

d4) Competencies

- **i.** How do you define competency?
- **ii.** Which leadership competencies are most relevant in the RCA phase?
- **iii.** Can you relate the competencies, you just referred, with the activities that were performed in the RCA phase, showing their importance to achieve success through leadership?

iv. Classify the competencies reported on table 2, considering their importance to each function of the requirement engineering process.

v. Which factors do you think that can affect and change your classification of the previous question?

vi. Compare the factors identified in question v. with those on Table 3.

vii. Do you consider that the set of relevant leadership competencies to the RCA stage are different from those required in the remaining phases of the IS/IT project life cycle?

d5) General and generalization questions:

i. Do you consider the study of the IS field a relevant one? How different do you consider this specific field is from the others?

ii. Do you consider both relevant and useful such type of study? What contributions and benefits would expect from this study?

d6) Interviewee Demographic Characterization

i. How many years of experience do you have in Information Systems area?

ii. How do you divide your years of experience within the following sectors:

1. Private Sector
2. State Owned
3. Non-Governmental
4. Volunteering
5. Other

iii. What is your educational level (degree, master, PhD, technical certification…)?

iv. What is your gender? -> don't ask

v. How has been your experience in IS projects?

vi. How long have you been in this organization?

vii. Which kind of functions have you performed? (Programmer, analyst, project manager …)?

viii. How long have you been in your current position?

ix. What is your age group?

1. 20-30
2. 30-40
3. 40-50
4. 50-60
5. > 60

Table 61 - Project's Classification

Project Attributes	Classification
1) Size (Big, Medium, Small)	
2) Duration (Long, Medium, Short)	
3) Complexity (High, Medium, Low)	
4) The type of the problem (Well defined; moderately defined; poorly defined)	
5) Applicability (Generic, Bespoke)	
6) Where (or by whom) it is developed (In-house; consultants; external) (Software houses; industry; consultancies; academics)	
7) Strategic level to the organization (High, Medium, Low)	
8) Application area (industry) (Engineering and construction; Information systems; Organization and business)	
9) Contract type (Fixed price; Incremental)	

Table 62 – Seven functions of RCA phase

Function	Description
1) Inception	Where analysts and all the stakeholders establish the basic requirements of the problem, define constraints, and agree the key features that must be present in the system.
2) Elicitation	Where information from the first function will be refined and detailed, often making use of well known techniques as structured meetings, descriptions of user scenarios, among others.
3) Elaboration	Where all information obtained will be used to develop a technical model, also called analysis model, using a variety of modeling notations.

4) Negotiation	Since conflicting requirements are relatively common among different customers and stakeholders
5) Specification	Where, after the requirement negotiation, documents will be created (ideally combining natural language descriptions and graphical models) presenting the results of previous phases in a consistent and understandable way.
6) Validation	Where the specification of requirements will be analyzed to ensure that all requirements have been stated correctly and unambiguously.
7) Management	Where activities are performed to help the project team to identify, control and track requirements along the project life cycle.

Table 63- Leadership Competencies

Competency	Description
1) Critical analysis and judgment	A critical faculty that probes the facts, identifies advantages and disadvantages and discerns the shortcomings of ideas and proposals. Makes sound judgments and decisions, and is aware of the impact of any assumptions made.
2) Vision and Imagination	Imaginative and innovative in all aspects of one's work. A clear vision of the future direction of the organisation to meet business imperatives. Foresees the impact of external and internal changes on one's vision that reflect implementation issues and business realities.
3) Strategic Perspective	Explores a wide range of relationships, balances short- and long-term considerations. Identifies opportunities and threats. Sensitive to stakeholders' needs, external developments and the implications of external factors on one's decisions and actions.
4) Engaging Communication	A lively and enthusiastic communicator, engages others and wins support. Clearly communicates instructions and vision to staff. Communications are tailored to the audience's interests and are focused.
5) Managing Resources	Plans ahead, organises all resources and coordinates them efficiently and effectively. Establishes clear objectives, monitors and evaluates staff's work regularly and effectively, and gives them sensitive and honest feedback.
6) Empowering	Knows one's direct report's strengths and weaknesses. Gives them autonomy, encourages them to take on personally challenging and demanding tasks.
7) Team Developing	Believes others have potential to take on ever more-demanding tasks and roles, and encourages them to do so. Develops their competencies, and invests time and effort in coaching them so they can contribute effectively and develop themselves.
8) Achieving	Willing to make decisions involving significant risk to gain a business advantage. Selects and exploits activities that result in the greatest benefits to the organisation and that will increase its performance.

9) Self-awareness	Awareness of one's own feelings and the capability to recognise and manage these in a way that one feels that one can control.
10) Emotional Resilience	Performs consistently in a range of situations under pressure and adapts behaviour appropriately. Retains focus on a course of action or need for results in the face of personal challenge or criticism.
11) Motivation	Has the drive and energy to achieve clear results and make an impact and, also, to balance short- and long-term goals with a capability to pursue demanding goals in the face of rejection or questioning.
12) Interpersonal Sensitivity	Is aware of, and takes account of, the needs and perceptions of others in arriving at decisions and proposing solutions to problems and challenges. Builds from this awareness and achieves the commitment of others to decisions and action.
13) Influence	Persuades others to change views based on an understanding of their position and a recognition of the need to listen to this perspective and provide a rationale for change.
14) Intuitiveness	Arrives at clear decisions and drives their implementation when presented with incomplete or ambiguous information using both rational and "emotional" perceptions.
15) Ethics and Conscientiousness	Displays clear commitment to a course of action in the face of challenge and to match "words and deeds" in encouraging others to support the chosen direction. Shows personal commitment to pursuing an ethical solution to a difficult business issue or problem.
16) Other	

Table 64- Leadership Competencies according to the functions in the RCA phase

	1. Critical analysis and judgment	2. Vision and Imagination	3. Strategic Perspective
Inception			
Elicitation			
Elaboration			
Negotiation			
Specification			
Validation			
Management			

	4. Managing Resources	5. Engaging Communication	6. Empowering	7. Developing	8. Achieving
Inception					
Elicitation					
Elaboration					
Negotiation					
Specification					
Validation					
Management					

	9. Self-awareness	10. Emotional Resilience	11. Motivation
Inception			
Elicitation			
Elaboration			
Negotiation			
Specification			
Validation			
Management			

	12. Sensitivity	13. Influence	14. Intuitiveness	15. Ethics and Conscientiousness
Inception				
Elicitation				
Elaboration				
Negotiation				
Specification				
Validation				
Management				

Table 65– Contingency Factors

Contingency Factor	Description
1. Duration of the project	Long, medium or small project's duration
2. Application area (industry)	Engineering and construction; Information systems; Organization and business
3. Complexity of the project	High, medium or low project's complexity
4. Size of the project	A large project, medium or small
5. Contract type	The project' contract is incremental, fixed price, etc
6. Strategic Level to the organization	The Project is low, medium or highly strategic to the organization
7. Type of the problem	The problem is well defined, moderately defined or poorly defined
8. Where (or by whom) it is developed	The Project is developed internally or externally to the organization, in a software house, etc
9. Applicability	It is a generic project or a bespoken one
10. Other	

Organization of the thesis document

The document that are going to contain the description of the research process, analysis and discussion of the results is organized as follows:

1- Introduction

2- Literature Review

3- Research Methodology: theoretical aspects and practical instantiation

4- Analysis and discussion of results

5- Conclusions, Contributions and Future Work

Chapter 4 presents a discussion of the results oriented by the order of the interview questions. This strategy allows to maintain the chain of evidence of the data, as presented by the participants. Therefore, it begins to address the topics related to the projects described in the interviews, namely their characterization. This is followed by the discussion of the emerging topics related to the requirements phase. However, this topic is still to ascertain since the questions to assess the requirements process are quite open. The third part of the chapter presents the results on leadership. It begins with the free exploration of the leadership competencies and the contingency factors, and proceeds with the discussion of the results of the completion of the adequacy and relevance of each competency from the framework to the activities performed during this phase.