Reasons for the non-use of Project Risk Tools and Techniques in the Manufacturing Sector

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And, to the respondents from the investigated organisations that provided us with their valuable opinion on the issues that were examined.

THANK YOU VERY MUCH, GRAZIE MILLE, TACK SÅ MYCKET

Giulio Rastrelli & Eugenio Ricca
Summary

Project Risk Management (PRM) plays an important part in determining project success and it is considered an essential activity for companies. The literature provides a vast amount of tools and techniques created to help project managers to deal with project risks. However, in practice, project managers use few tools and techniques. The aim of this research is to understand the reasons for the non-use of PRM tools and techniques by project managers when dealing with risks in the Swedish manufacturing sector.

In order to provide evidence on why project managers do not use PRM tools and techniques, this study identifies a list of tools and techniques to investigate, and a list of possible reasons. Both these lists derive from the existing literature and past research. This qualitative study is based on multiple case studies of seven companies with nine respondents. The companies are based in the Umeå region and operate in the manufacturing sector.

This study has revealed that project managers, within the sample, prefer to use qualitative tools and techniques such as meetings and expert judgements when dealing with risks. On the contrary, most of the tools and techniques for quantitative risk analysis are not used. There is a lack of awareness regarding the existing tools and techniques, and in general regarding the basic concepts of Risk Management (RM). Project managers tend to heavily rely on intuition and past experience when dealing with project risks. Other reasons that account for the non-use of tools and techniques are lack of resources and an unwarranted use in relation to the project type. In some cases project managers might avoid or delay the management of negative risks and therefore do not use tools and techniques. Furthermore, two more reasons emerge from the analysis of data, which contribute to a better understanding of the reasons behind the non-use of PRM tools and techniques. These reasons are small increment in quality of RM by using PRM tools and techniques and complacency by project managers when using PRM tools and techniques.

This research extends prior literature by providing evidence on the use and non-use of PRM tools and techniques and the reasons for their non-use in a sector where there is a lack of research. Finally, two more reasons are discovered and can contribute to a better understanding of the existing gap between theory and practice of RM.

KEY WORDS: Risk, Non-use, Tool, Technique, Reasons, Project, Manufacturing, Project Management, Project Risk Management.
Abbreviations

APM BOK – Association of Project Management Body of Knowledge

APM – Association for Project Management

CPI – Cost Performance Index

EMV – Expected Monetary Value

EV – Earned Value

MCS – Monte Carlo Simulation

P-I Matrix – Probability Impact Matrix

PM – Project Management

PMBOK® GUIDE – Project Management Body of Knowledge Guide

PMI – Project Management Institute

PRAM – Project Risk Analysis and Management

PRM – Project Risk Management

RM – Risk Management

SME – Small and Medium Enterprise

SPI – Schedule Performance Index

UAI – Uncertainty Avoidance Index
Concept Definition

Project – “a project is a temporary endeavour, undertaken to create a unique product or result” (PMI, 2013, p. 3).

Project Management - “the application of knowledge, skills, tools, and techniques to project activities in order to meet or exceed stakeholder needs and expectations from a project” (PMI, 2013, p. 5).

Project Risk Management - “processes of conducting risk management planning, identification, analysis, response planning, and controlling risk on a project...The objectives of project risk management are to increase the likelihood and impact of positive events, and decrease the likelihood and impact of negative events in the project” (PMI, 2013, p. 309).

Risk – “an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives” (PMI, 2013, p. 310). Similarly, the APM states: “risk is an uncertain event or set of circumstances that, should it occur, will have an effect on the achievement of the project’s objectives” (APM, 2012, p. 178).

Technique – “a defined systematic procedure employed by a human resource to perform an activity to produce a product or result or deliver a service, and that may employ one or more tools” (PMI, 2013, p. 564).

Tool – “something tangible, such as a template or software program, used in performing an activity to produce a product or result” (PMI, 2013, p. 565).
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1. Introduction

The aim of this chapter is to introduce the theoretical background of the research where the gap in the literature is identified. The chapter concludes with the research question and objectives as well as the limitation of this thesis.

Figure 1. Introduction.

1.1 Background

Projects are more and more used today in organisations. The management of projects is recognised as an important part of business activities. Since projects are widely spread across organisations project management (PM) is a discipline that also gained increasing attention in academia (Mir & Pinnington, 2013, p. 1). Indeed, there is a vast amount of publications and professional organisations that discuss the best approach in managing projects. In a fast changing and highly competitive environment, PM has to deal with project risk (Raz, et al., 2002, p. 101), since risk can emerge in any aspect of a project (Zhang & Fan, 2014, p. 412). Risk management (RM) is beneficial if implemented in a systematic, formal manner from the planning stage through project completion (Dikmen, et al., 2008, p. 47). Continuously evaluating and assessing risks can help project managers to make better and more balanced decisions during the project life cycle and increase the likelihood of achieving project’s objectives. RM is thus a critical factor to a successful PM.

There is a considerable amount of literature that has developed the tools and techniques of Project Risk Management1 (PRM). Many authors have developed (e.g. Marcelino-Sádaba, 2014; Nguyen, et al., 2013; Cagno, et al., 2007; Goh, et al., 2013) or further improved (e.g. Ackermann, et al., 2007) tools and techniques that allow managers to better deal with risks in organisations’ projects. According to A Guide to the Project Management Body of Knowledge (PMBOK®Guide) by the Project Management Institute (PMI), a tool is “something tangible, such as a template or software program, used in performing an activity to produce a product or result” (e.g. checklist) (PMI, 2013, p. 565), while a technique is “a defined systematic procedure employed by a human resource to perform an activity to produce a product or result or deliver a service, and that may employ one or more tools” (e.g. meetings) (PMI, 2013, p. 564). The current state-of-art of PRM literature, as well as professional organisations such as the PMI, argue that RM tools and techniques involve the assessment of both positive (opportunities) and negative (threats) risks. Despite the large body of knowledge and continuous development of the RM discipline, the effective use of PRM seems to be controversial in practice. For example, de Bakker et al. (2010, p. 501) analysed the literature of RM from 1997 to 2009 about IT projects and concluded that the empirical knowledge is largely based on how RM should work instead of focusing on how it is actually used in project practice. In fact, although there are many tools and techniques available, prior studies show that only few of them are actually used (Forbes, et al., 2008, p. 1241; Raz, et al., 2002, p. 107). Researchers underline the existence of a gap

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1 As a clarification, from now on the terms Risk Management (RM) and Project Risk Management (PRM) are used as synonymous.
between theory and practice of RM. They argue that the adoption by practitioners of RM tools and techniques in projects is limited; that is, few tools and techniques are used. Furthermore, these studies are sector- and country-specific (Table 1). Several papers studied the actual practice of risk assessment and showed practitioners’ opinion regarding available tools and techniques. Raz & Michael (2001) found the sector-specific tools that can deliver the greatest contribution to a PRM process in Israeli software development projects. Wood and Ellis (2003) made a qualitative research about the RM practices of UK cost consultants, while Lyons and Skitmore (2004) investigated project risk tools in Queensland (Australia) engineering construction industry. Both of them show the lack of use of tools and techniques underlying the strong reliance on intuition and personal judgement. These findings are also consistent with a survey made by Tang et al. (2007) in the Chinese construction industry. Khumpaisal et al. (2010, p. 163) found that in Thai real estate sector there is not a tool that is suitable for risk assessment. Riabacke (2006, p. 6) stated that in Swedish forestry industry, few managers use computer-based tools for RM and Kutsch & Hall (2009, p. 72) found that IT project managers do not frequently apply PRM. Adedokun et al. (2013) studied qualitative risk analysis tools in the Nigerian construction industry and concluded that these tools are seldom applied. It is important to extend prior research and assess the actual practice of PRM tools and techniques in other industries or sectors where projects are usually used (cf. Raz & Michael, 2001, p. 17) as in the manufacturing sector. It must be noticed that since the use of tools and techniques is country and sector-specific there is not a common list of assessed tools and techniques among the studies aforementioned. Each researcher has focused, therefore, only on a specific set of tools and techniques that vary from author to author.

A stream of research has investigated the reasons that can limit implementation of RM tools and techniques in practice. Raz et al. (2002, p. 107) and Akintoye & MacLeod (1997, p. 36) claim that there is a lack of awareness and understanding of tools and techniques and over-optimism of project managers. Kutsch & Hall (2009, p. 74) argue that project managers might not have the available resources (e.g. money, time, technology) to apply RM tools and techniques. Time constraint, unjustified efforts in PRM and lack of information for the identification and quantification of risk estimations, are primary reasons for the scarce application of tools and techniques. In particular, Raz & Michael (2001, p. 14) claim that for some project managers RM is a redundant activity. Forbes, et al. (2008, p. 1242) argue that there is not a clear understanding by project managers of when the application of a certain tool or technique is more suitable and can give the highest quality of information. Kutsch & Hall (2009, p. 74) suggest that project managers do not apply PRM because since every project is unique and new, there are always risks that cannot be identified. Hartono et al. (2012, in Hartono, et al., 2014, p. 407) argue that the preference for intuition and experience by project managers accounts for the non-use of tools and techniques and might lead project managers to systematic judgemental errors. In addition, project managers might have a prejudice against statistics and mathematical models, preferring their judgement or qualitative tools and techniques instead of quantitative ones (McCray, et al., 2002, p. 52). According to Kutsch & Hall (2005, pp. 594-595), in some cases the existence of threats is denied because these are considered a “taboo”, something that might worry the client; therefore their management is not carried out and tools and techniques are not used. It is hence necessary to explore further these and other reasons that would account for a non-use of PRM tools and techniques.
Overall, prior studies of PRM mostly focus on certain industries or sectors and countries, as shown in Table 1. Taroun (2014, p. 102) argue the importance of understanding how managers assess project risks and respond to the business environment in order to extend existing tools and techniques and support their use in practice.

<table>
<thead>
<tr>
<th>Findings</th>
<th>Authors (Year, Industry/Sector, Country)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scepticism about the utility of complex tools and techniques. Preference of qualitative and simple tools and techniques.</td>
<td>Wood and Ellis (2003, Consultancy, UK).</td>
</tr>
<tr>
<td></td>
<td>Tang et al. (2007, Construction, China).</td>
</tr>
<tr>
<td>Strong reliance on personal judgement and experience in RM.</td>
<td>Wood and Ellis (2003, Consultancy, UK).</td>
</tr>
<tr>
<td></td>
<td>Akintoye &amp; MacLeod (1997, Construction, UK).</td>
</tr>
<tr>
<td>RM as a redundant activity and risk tools and techniques are not used.</td>
<td>Kutsch &amp; Hall (2009, IT, UK).</td>
</tr>
<tr>
<td></td>
<td>Adedokun et al. (2013, Construction, Nigeria).</td>
</tr>
<tr>
<td>Unfamiliarity with PRM tools and techniques.</td>
<td>Wood and Ellis (2003, Consultancy, UK).</td>
</tr>
<tr>
<td></td>
<td>Akintoye &amp; MacLeod (1997, Construction, UK).</td>
</tr>
<tr>
<td></td>
<td>Adedokun et al. (2013, Construction, Nigeria).</td>
</tr>
<tr>
<td></td>
<td>Tang et al. (2007, Construction, China).</td>
</tr>
<tr>
<td></td>
<td>Khumpaisal et al. (2010, Real Estate, Thailand).</td>
</tr>
<tr>
<td></td>
<td>Kutsch &amp; Hall (2005, IT, not specified).</td>
</tr>
</tbody>
</table>

Table 1. Industry/sector and country of research related to PRM tools and techniques.
1.2 Research question and objectives

A large amount of researches (Table 1) has observed that project risk tools and techniques are not adopted as PRM theory suggests. This happens for a number of reasons, e.g. lack of knowledge, lack of resources, preference for intuition and experience, prejudice against statistics and mathematical models and so forth. The research gap identified, therefore, consists in the need for further research in the application of PRM tools and techniques and the reasons behind their non-use in the specific context of the Swedish manufacturing sector. The research question of the thesis is:

*What are the reasons for the non-use of PRM tools and techniques by project managers in the Swedish manufacturing sector?*

The research question of the thesis is broken down into research objectives. Due to the lack of research in the Swedish manufacturing sector on the use of PRM tools and techniques, the authors cannot identify a priori what tools and techniques are used and not used. Therefore, the first objective of this study is to identify a list of the most cited tools and techniques in PRM literature. For most cited it is meant that these tools and techniques are discussed, studied and assessed by different authors as well as prescribed by the PMBOK®Guide.

The second objective is to identify in PRM literature and put together, the various reasons behind the non-use of project risk tools and techniques.

Given the list of most cited tools and techniques as identified in the first objective, a third objective is to empirically assess the use and non-use of these project risk tools and techniques in Swedish manufacturing companies.

Finally, the fourth and most important objective of this research is to explore what are the reasons for the non-use of the most cited tools and techniques identified, which are found to not be used in Swedish manufacturing companies.

The sample will be based on companies operating in the manufacturing sector where projects are used, and risk incurred. All sample companies are based in Sweden and more precisely in the Umeå region.

1.3 Limitations

This thesis aims to investigate the reasons behind the non-use of project risk tools and techniques in the Swedish manufacturing sector. The authors of this study do not claim that the findings obtained can be applicable to all the companies in the manufacturing sector or other sectors, within or outside Sweden. Although the research has not any purpose of generalizability, the authors do believe that the findings can be deemed interesting and a valuable contribution to the existing literature.

1.4 Research disposition

Chapter 1: Introduction

Chapter 1 aims to introduce the theoretical background of the thesis. The gap in the current literature on PRM is identified, the objectives of the thesis are outlined and limitations of the study are provided.
Chapter 2: Academic Starting Point

Chapter 2 discusses the ontological and epistemological stance of the authors, to understand the choice and appropriateness of the research approach. In addition, their values and preconceptions are explicated. Finally, the process of acquisition of sources (e.g. books, academic articles and so forth) for the literature review is explained.

Chapter 3: Theoretical Frame of Reference

Chapter 3 aims to illustrate the previous academic studies and theories within PRM field relative to the identified gap. In particular, the concept of risk and RM is assessed. The most cited tools and techniques in the PRM literature are identified and described. Finally, the main reasons for the non-use of tools and techniques are identified and discussed.

Chapter 4: Research Strategy

Chapter 4 describes and supports the choice of a qualitative research strategy. Then, it presents a detailed description regarding the use and limitation of case studies as a method for this research. Finally, the criteria for the sample, the companies, the interviewees, the non-respondent analysis, and the characteristics and limitation of the interviews are described.

Chapter 5: Sector and Country Setting

Chapter 5 introduces the context in which the data collection takes place. In particular, it gives a brief overview of the Swedish manufacturing sector as well as the perception of risk in Swedish culture. This chapter is necessary to understand better and contextualise the answers provided by the respondents of the study.

Chapter 6: Data Analysis and Findings

Chapter 6 aims to provide the relevant evidence obtained during the interviews. In addition, it is designed to follow the theoretical frame of reference to understand the data gathered. Analysis of the data is conducted continuously in the chapter in order to comprehend the meaning of the data and their implication.

Chapter 7: Conclusions

Chapter 7 restates the research question and objectives of the study. It is also considered whether the objectives have been achieved. In addition, the most important findings, the implications of the study and its contribution to knowledge development are discussed.

Chapter 8: Truth Criteria

Chapter 8 aims to assess the goodness of the research in respect to the criteria set for qualitative research and societal issues.
2. Academic Starting Point

The aim of this chapter is to introduce the authors’ preconceptions and their ontological and epistemological stances in order to facilitate a critical examination of the study. Finally, a description on the acquisition of the literature is provided.

2.1 Preconceptions

In order to critically review and understand the appropriateness of the methodological choices made in this thesis, it is necessary to start with the authors’ values and thoughts, which may influence the validity and objectivity of the research. Indeed, previous experience and pre-understanding of reality may influence researcher’s choice in the design and approach of the study. Values influence also, what researchers observe (Bryman & Bell, 2011, p. 27). Therefore, the authors are aware of the thorny situation and will carefully reason their previous beliefs when conducting this study.

The authors became interested in the topic of PRM through their Master course in Project Risk Analysis and Management (PRAM). The decision to investigate the reasons for the non-use of tools and techniques when dealing with project risks is because, through an initial literature review, it was found that this aspect was underdeveloped even though it is a relevant element. Indeed, the authors believe that every project manager should employ tools and techniques in order to identify, analyse, assess, control and manage risks in projects. Before the PRAM course, none of the authors had previous knowledge or work experience on this particular aspect of PM. However, the authors both had previous knowledge and understanding regarding the concept of risk. One of the authors had previously studied physics and mathematics; in particular, he attended a course in geophysics where risk was defined as a hazard event related to possible seismic or volcanic activities that would cause social, environmental and economic harms. Therefore, in geophysics, risk is always identified as a threat while in PM it presupposes a neutral connotation, meaning both threats and opportunities. Furthermore, seismic and volcanic risks are defined and assessed in a manner purely objective. PM, instead, is part of social sciences, and the subjective dimension of the individual is very important; risk might hence be perceived or even defined in different ways by different individuals (see subsection 3.5.1). The thesis author aforementioned is aware of these differences and does not adopt a view purely objectivist regarding the concept of risk in PM, nor a view purely negative that sees risk merely as a threat. The other author has a background in Business Administration. His previous understanding of risk was that risk is considered as a negative event that can affect the desired outcome of a certain activity. Therefore, the positive side of risk (i.e., opportunity) was not considered as an aspect of risk. Moreover, he was aware of the different perceptions that individuals have on risk since it is also observable in the daily life as some people are more caution than others when approaching an uncertain event. Prior to this master, the authors had never been in Sweden, and none of them had working experiences in the manufacturing firms. However, the authors’ previous (and actual) idea of Sweden is that it is a country where there is a tendency to careful
planning and dealing with problems proactively, without waiting and see whether a possible issue occurs. To sum up, despite the authors do not have direct experiences of any kind in PRM as well as in the manufacturing firms and Sweden, they are aware of their preconceptions. Having this awareness present in their minds, the authors try as much as possible to carry out the research in an unbiased manner.

2.2 Ontological and Epistemological stance

The choice and adequacy of any research method cannot be independent of assumptions regarding ontology and epistemology. Social ontology can be defined as the “assumptions held about the nature of social reality” (Long et al., 2000, p. 190). It is related to the view regarding the nature of reality (Morgan, 2007, p. 57). The aim of the research is to understand the reasons behind the non-use by project managers of the most cited tools and techniques provided by the literature when dealing with risks in projects. As explained in more details in chapter 4, the authors use interviews to assess the subjective reality of project managers. Thus, the authors seek to highlight their perceptions. Subjective perception is influenced by experience (Regev, et al., 2006, p. 24; Taroun, 2014, p. 108; Raz & Michael, 2001; Wood & Ellis, 2003, p. 261; Lyons & Skitmore, 2004, p. 54; Akintoye & MacLeod, 1997, p. 36), culture (Liu, et al., 2014, p. 10), risk tolerance and so on. However, the authors do believe that risk objectively exists without the influence of individuals’ minds and values; for instance, almost everyone consider risks related to mortality, health or economic turndown as possible negative events. Nevertheless, the authors are convinced that the way risk is perceived in a company, as well as the use of risk tools and techniques, is highly dependent on the subjective perception of risk. In other words, the authors will observe risks from the project managers’ perspective, which is influenced by psychological elements and organisational interests (cf. Zhang, 2011, p. 10). This belief has consequences on how risk communication should be. The authors believe that risk communication is two-way; it is important to understand and include the stakeholder's perspective and logic of other people in order to improve one's own method (Zhang, 2011, p. 10). The authors believe that practitioners should consider the context (e.g. organisation) and the different perceptions that all the actors involved in the project may have regarding the same risk. For instance, the delay of a particular activity might be seen as having a high impact on a supplier while for the project sponsor is not so harmful.

Therefore, the authors’ ontological stance is placed between the two extremes “objectivism” and “constructivism” of the continuum and it is closely associated to critical realism. Critical realism emphasises the interaction between how the reality is objectively observed and how its phenomena is perceived and comprehended by the actors involved and affected by the phenomena. It aims to reduce the gap between external reality and the subjective reality of a given phenomenon (Ojiako et al., 2012, p. 130). This stance is particularly beneficial for this study on the reasons for the non-use of the most cited PRM tools and techniques because, as Ojiako et al. (2012, p. 130) argue, the stance is suitable for researchers who wish to analyse RM practice.

It is important to bear in mind that the authors do not claim that their view of reality is the more suitable for this study, as Bryman & Bell (2011, p. 15) argue; critical realism implies that researcher’s conceptualisation of reality is one of the perspective of knowing reality. Therefore, it cannot be said that it is the best solution to adopt, rather is one of the possible solution for critically analysing reality (Hodgkinson & Starkey, 2012, p. 607).
Questions regarding social ontology cannot be separated from the issues related to the conduction of the business research (Bryman & Bell, 2011, p. 21). Epistemology can be defined as “a belief systems that influence how research questions are asked and answered” (Morgan, 2007, p. 52); it concerns what is or what should be considered as acceptable knowledge in a discipline (Bryman & Bell, 2011, p. 13). The research question aims to investigate the reasons for the non-use of PRM tools and techniques by project managers and therefore it seeks to understand rather than explain human behaviour. The relationship that we will have with the subject of study and the participants in the study will be cooperative, interactive and participative. This rapport may influence both the researchers and the phenomena under investigation throughout the research process. Consequently, the reality the authors investigate is affected by their perspective and interpretation of the interviewees’ answers. In addition, as explained in more details in chapter 4, the data will be collected on location in Sweden, where the authors will be able to experience the context of the respondents participating in their study since both the authors live and study in Umeå (Sweden). Consequently, the authors’ epistemological position is more closely associated with the epistemological stance of interpretivism in which the researcher’s goal is to understand human behaviours (Bryman & Bell, 2011, p. 16) through the interaction between the researcher and the phenomena under study (Long et al., 2000, p. 191).

The authors, as researchers, are aware of the existence of several and equally valid realities, which therefore make the knowledge created, not total (Long et al., 2000, p. 191) as the way research is carried out depends on the context and the values of the researchers as well as their interpretation of the findings.

### 2.3 Research approach

In every research, it is important to understand the relationship between theory and research. The research approach can be either deductive, inductive or a mix of the two (i.e. abduction) as shown in Table 2.

<table>
<thead>
<tr>
<th>Research Approach</th>
<th>Relationship between theory and data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deductive</td>
<td>Theory → observation/findings</td>
</tr>
<tr>
<td>Inductive</td>
<td>Observation/findings → theory</td>
</tr>
<tr>
<td>Abduction</td>
<td>Theory → observation/findings</td>
</tr>
<tr>
<td></td>
<td>Observation/findings → theory</td>
</tr>
</tbody>
</table>

Table 2. Difference between research approaches.

For the present study, a deductive process to link theory and data is adopted. A deductive approach consists on the testing of a particular hypothesis based on what it is known in a particular field or theory (Bryman & Bell, 2011, p. 9). Although the authors do not test any hypothesis with quantifiable data, their objective is to prove whether the reasons for the non-use of project risk tools and techniques identified in the literature are applicable in the manufacturing sector. In other words, a deductive approach is used to examine theoretical ideas developed by academics. From what is known in the literature of PRM theory, the authors first observe if the use or non-use of the most cited PRM tools and techniques is observable in the Swedish manufacturing companies and then they aim to investigate the reasons for the non-use of these tools and techniques by project managers.
2.4 Acquisition of the literature

In order to be able to assess the use of PRM techniques and investigate the reasons behind their lack of usage in practice, a literature review is required. The search of relevant literature is made through the library’s website of Heriot-Watt University. The main databases used are ScienceDirect, Emerald, EBSCOHOST and Business Source Premier. Detailed information on the search words and their results are in Appendix 1. In this study, it is important to have articles about RM tools and techniques used in projects, therefore, peer reviewed journals, such as International Journal of Project Management and Project Management Journal are mainly considered. Besides academic articles, it has also been used the PMBOK®Guide by PMI and the APM BOK by IPMA since these are the reference manuals for PM standards. In addition, due to the poor amount of articles related to PRM tools and techniques in projects related to manufacturing companies, the authors include studies related to other sectors (e.g. IT, Construction) so as to have a broader knowledge on the topic. The authors do not consider findings from other sectors generalizable to the manufacturing sector. All the articles the authors evaluate are written in English because the most important journals publish articles in this language. Therefore, the research is based on a literature that excludes other sources not written in English. When assessing the search results, the authors read each article's abstract, and if found pertinent to the thesis subject, the articles are reviewed in further detail. The period used for the articles is from the year 2000 to the year 2014. It is important to bear in mind that when reading articles, concepts cited by other authors and judged as important, were further searched and analysed; even if the year of publication is older than 2000. Therefore, no secondary sources were used to avoid misperceptions or misunderstanding. However, if a researcher refers to his or her previous work, the authors consider the source reliable since the person should know his or her research.

Summary

The assumptions related to how the authors see reality and what knowledge should be considered as acceptable, are primarily important for a researcher. The authors’ ontological stance is closely associated to critical realism while their epistemology is similar to interpretivist position. Consistent with these assumptions, the authors see risk as an objective fact; however, its perception is influenced by the context and personal factors, which lead individuals to have different viewpoints and understanding of risk. Furthermore, the authors use a deductive reasoning for this study with the aim to investigate the reasons for the non-use of RM tools and techniques in projects implemented by manufacturing companies, to contribute to theory development.
3. Theoretical Frame of Reference

This chapter presents the theoretical frame of reference that is used for this study. First, the definition of risk and its complexity are described. Then, PRM and its processes are shown. Finally, the presentation of the most cited tools and techniques identified in the literature and the main reasons for the non-use of tools and techniques are given.

Figure 3. Theoretical Frame of Reference.

3.1 Projects and Project Management

Projects have always been present in human kind history as a mean to achieve a stated objective and deliver value. In the current fast changing, globalised and uncertain environment, organisations are realising that projects are a useful instrument to drive change (Marcelino-Sádaba, et al., 2014, p. 327; Haniff & Fernie, 2008, p. 3), boost growth (Marcelino-Sádaba, et al., 2014, p. 328), innovate (Nguyen, et al., 2013, p. 214), create and capture market value. Projects are the building blocks of a firm’s strategy (Cleland & Ireland, 2007). Almost all companies, from small and medium enterprises (SME) (Marcelino-Sádaba, et al., 2014, p. 327) to multinational organisations, are engaged in project activities (Maylor, et al., 2006, p. 663). The term “projectification”, which refers to the project approach in both business (Midler 2005, p. 363; Haniff & Fernie, 2008, p. 5) and society (Maylor, et al., 2006, p. 666), has become widespread. Being used in every business or industry, the concept of “project” has a very general and broad meaning. One of the most recognised definitions is the one provided by the PMI (2013, p. 3): “a project is a temporary endeavour, undertaken to create a unique product or result”.

Since 1990’s organisations have been changing from operations to projects as part of their competitive advantage strategy (Maylor, et al., 2006, p. 663). As a result, PM has grown up till to become a recognised discipline in firms, such as finance or information technology, and has been used as an instrument to boost organisation’s productivity (Mir & Pinnington, 2013, p. 12; Thomas & Mullaly, 2007, p. 77). The PMI conducted a study regarding the value of PM concluding that PM creates benefits (Thomas & Mullaly, 2009, p. 139). Following the definition of PMI (2013, p. 5), PM is “the application of knowledge, skills, tools, and techniques to project activities in order to meet or exceed stakeholder needs and expectations from a project”.

3.2 Defining risk

3.2.1 Risk concept

PM deals with risks because projects are unique and temporary (Lechler, et al., 2012, p. 59; Regev, et al., 2006, p. 24). Indeed, each project has always a feature that distinguished it from other projects hence, data from past experiences are not fully reliable and future represents a source of uncertainty (Kutsch & Hall, 2009, p. 74). Since risks potentially jeopardise the possibility of project managers to meet project objectives of scope, time and cost (Akintoye & MacLeod, 1997, p. 33; Kutsch & Hall, 2009, p. 139).
(Kutsch & Hall, 2009, pp. 72-73), it is important to identify, assess and properly manage risks. However, risk is not a clear and homogeneous concept and it has been long debated in the academic community. Ackermann, et al. (2007, p. 40) defined risk in terms of “risk systemicy”: risk can be represented as a network of interconnected possible events, which the likelihood of one may have repercussion on another event. The PMI (2013, p. 310) defines risk as “an uncertain event or condition that, if it occurs, has a positive or negative effect on a project’s objectives”. Similarly, the Association for Project Management (APM) states: “risk is an uncertain event or set of circumstances that, should it occur, will have an effect on the achievement of the project’s objectives”, (APM, 2012, p. 178). In other words, risk is a potential event that may change (positively or negatively) a project’s baseline (Lechler, et al., 2012, p. 59). In this thesis, the authors adopt the definition of risk provided by PMI as PMI is considered the most influential organisation (Lenfle & Loch, 2010, p.32) which provides best practices on PM (Kutsch & Hall, 2010, p. 245; Kutsch & Hall, 2009, p. 72). Furthermore, negative risks can also be called threats while positive risks are also called opportunities (PMI, 2013, p. 310).

A possible explanation of why in the literature, as well as in practice, there is not a unanimous definition of risk is because different individuals could have different perceptions of risk (Zhang, 2011, p. 5; Lehtiranta, 2013, p. 641; Hartono, et al., 2013, p. 402; Taroun, 2014, p. 105). In addition, projects are also based on assumptions and implemented by people who are subject to influences from the external environment such as organisational culture, country, etc. (APM, 2012, p. 178). These concepts are further developed in subsection 3.5.1.

3.2.2 Risk and uncertainty

Lechler et al. (2012, p. 64) observed that managers had often confused the concept of risk with uncertainty and therefore their different management. Although these concepts are very broad, the authors will give a brief description of their difference without going deeper in the matter since it is not part of this study. Galbraith (1977, pp. 36-37) defined uncertainty as “the difference between the amount of information required to perform the task and the amount of information already possessed by the organization”. Galbraith’s definition of uncertainty is based on the need for the individual or the organisation to have more information in order to perform a specific task or activity (Krane, et al., 2012, p. 58). Uncertainty is a knowledge gap, which is the gap between what we ought to know to assure project success and what we actually know in a precise momentum (Regev, et al., 2006, p. 18). Uncertainty is related to unpredictable situations that a project might have both positive and negative (Lechler, et al., 2012, p. 60). Therefore, uncertainty may or may not have a recognised impact while risk is classified as having an impact (Krane, et al., 2010, p. 82). In opposition to risk, uncertainty cannot be avoided and need to be handled in a different way (Lechler, et al., 2012, p. 67). In general, it is agreed that the origin of project risks is uncertainty that is present to a different extent in all projects; uncertainty and risk, hence, are not synonyms, but cause and consequence (Perminova, et al., 2008, p. 74; Thamhain, 2013, p. 22). Risk is a condition that arises when uncertainties materialise with the possibility of having an effect on project objectives and in extreme scenarios, on the whole organisation’s performances (PMI, 2013, p. 310; Lechler, et al., 2012, p. 59); in short,

2 From now on, the terms negative risk and positive risk are considered synonymous of threat and opportunity respectively.
risk is uncertainty that matters (Hillson, 2010, p. 19). Uncertainty in a steady environment tends to decrease as the project progresses due to proactive planning and relevant decision-making (PMI, 2013, p. 40). However, in more complex projects, uncertainty stays high throughout the project duration (Sanchez, et al., 2009, p. 15).

To sum up, in order to manage appropriately risks in projects by applying PRM tools and techniques, it is necessary that a project manager bear in mind where the uncertainty that causes the effect, i.e. the risk lies. Indeed, uncertainty and risk have to be managed differently and PM standards and practices do not clearly deal with the detection of uncertainties, although there are many tools that help to analyse sources of risks. The lack of a clear distinction between risk and uncertainty among managers may generate misperceptions and therefore miss opportunities for value creation (Lechler, et al., 2012, pp. 66-67).

### 3.2.3 Risk categories

Project managers deal with many types of risks in projects. The identified risks can be grouped in different categories (Wood & Ellis, 2003, p. 258; PMI, 2013, p. 317). Risk categories are “means for grouping potential causes of risk” (PMI, 2013, p. 317). Risk categories are also used to prioritise what is important (Krane, et al., 2012, p. 54). In this section, an overview of the most used categories of risk is presented in order to show the complex dimensions of risk.

Krane et al. (2010) differentiate risk between strategic and operational risks. The formers are then divided into short-term strategic risk and long-term strategic risk based on the impact that the event may have on organisation’s objectives. Operational risks regard events that may have an impact on the variation from the project plan and therefore affect project objectives (p. 60). According to Wood & Ellis (2003, p. 258), the most common way to categorise risks is by its origin or consequence (e.g. cost risks, site risks, environmental risks and so forth). Another distinction is between internal and external risks (Forbes, et al., 2008, p. 1243; Caron, 2013, p. 60). Internal risks are risks within the organisation’s control or that the source of these events is internal (e.g. processes rules and so forth). External risks on the other hand are events or conditions that the project team and the organisation have no power to control. Other authors categorise risks into major (possible events that will have a high impact on the project and therefore are managed individually with specific response actions) and residual risks (grouped of risks that are covered by a contingency reserve); specific (risks that affect only the project) and systemic risks (risks that might affect also entities outside the project); controllable (risks that can be mitigate by response actions and that lead to a reduction of the risk exposure greater than the cost of the implementation of response actions) and uncontrollable risks; insurable (risks that can be covered by insurance) and uninsurable risks and tolerable (risks which impacts on project performance is acceptable) and intolerable risks (Caron, 2013, p. 60).

In practice, there is not a clear distinction between these different types of risk as those risks are related in many ways; an operational risk can be transformed into a strategic risk and viceversa (Krane, et al., 2012, p. 59). In addition, since each person involved in the project has different priorities, each categorisation has an element of subjectivity (Krane, et al., 2012, p. 54). A limitation arising from categorising risk is that those categories are seen as independent from each other without considering the impact that one risk may have on another (Ackermann, et al., 2007, p. 40). For instance, the
bankruptcy of a supplier may affect project procurement and therefore project implementation. Project risk tools and techniques often are not able to identify the interconnection between a risk category and the other (cf. Cervone, 2006, p. 258).

### 3.3 Project Risk Management

#### 3.3.1 Definition of Project Risk Management

Risks and uncertainties rise a number of challenges when managing projects (Lechler, et al., 2012, p. 59) and play an important part in determining project success (Lehtiranta, 2013, p. 640; Zhang & Fan, 2014, p. 414). Consequently, the management of risk is gaining attention from academia as well as from industries working in the PM area (Raz & Michael, 2001, p. 9; Thamhain, 2013, p. 20; Zhang & Fan, 2014, p. 412). RM is used in a variety of sectors, from finance to manufacturing, health, environment and so on (Nguyen, et al., 2013, p. 214; Akintoye & MacLeod, 1997, p. 31). PRM is described as a major and strategic project activity (Sanchez, et al., 2009, p. 18; Krane, et al., 2010, p. 81; Cagno, et al., 2007, p. 1), the heart of PM (Krane, et al., 2010, p. 81) and the primary process associated with PM (Ramgopal, 2003, p. 21). PRM is one of the ten knowledge areas listed in the PMBOK®Guide (PMI, 2013, p. 61) and it is defined as “processes of conducting risk management planning, identification, analysis, response planning, and controlling risk on a project” (PMI, 2013, p. 309). Furthermore, “the objectives of project risk management are to increase the likelihood and impact of positive events, and decrease the likelihood and impact of negative events in the project” (PMI, 2013, p. 309). PRM allows project managers to turn uncertain efforts and events into certain positive promises and outcomes; it is hence critical the way other management areas, like scope, schedule, and cost management, support RM by sharing data and coordinating efforts in order to maximise value from projects (Ramgopal, 2003, p. 21). RM should be a constant activity in every project phase and risks should be evaluated at each step of the project (Dikmen, et al., 2008, p. 47; Akintoye & MacLeod, 1997, p. 36). RM focuses on understanding the impact of known events (Thamhain, 2013, p. 30). An effective RM can transform threats in opportunities and increase project performance (Goh, et al., 2013, p. 572). RM should be applied proactively and consistently during the entire duration of the project (PMI, 2013, p. 311).

Despite the importance received in the literature, project managers often examine issues related to risk in a superficial way (Cervone, 2006, p. 256). PRM is often seen as an activity implemented solely for having a more accurate quantification of risk impact and contingency management. However, it should also support the effective monitor of risks, the communication between project members and stakeholders (e.g. company, main contractor, suppliers, etc.) (Cervone, 2006, p. 260; Krane, et al., 2012, p. 63) and build a corporate risk knowledge system in order to have historical data on how risks can be managed (Dikmen, et al., 2008, p. 42; Cervone, 2006, p. 261).

Furthermore, managers often have an incorrect definition of risk that is mainly focused on a meaning purely negative. This is reflected in the management practices, as these tend to overlook the opportunities, while focusing mostly on negative risk. PRM is therefore viewed mainly as threat management (Ward & Chapman, 2003, p. 98; Olsson, 2007, p. 746). This has been empirically observed in several studies carried out in different periods, in different sectors and countries (Shapira, 1986, in March & Shapira, 1987, p. 1407; Olsson, 2007, p. 749; Bryde & Volm, 2009, p. 1068; Hartono, et al.,
Instead, in any situation that involves decision making both opportunities and threats are usually present, and thus, both should be managed. Concentrating on one should never eliminate interest for the other (Ward & Chapman, 2003, p. 98). Opportunities should be identified in order to enhance value for the project and the organisation (Lechler, et al., 2012, p. 67).

3.3.2 Processes of Project Risk Management

Different processes compose PRM. Project risk tools and techniques are used in different processes of PRM since a particular tool or technique should be applied in specific processes in order to obtain the highest quality of information. Therefore, it is important to describe what the processes of PRM are in order to understand in which situation a tool can be effective. In the thesis the PMI definition of process is adopted, that is “a systematic series of activities directed towards causing an end result, such that one or more inputs will be acted upon to create one or more outputs” (PMI, 2013, p. 551).

Due to the significance of RM, professional bodies (cf. PMI, 2013; APM, 2012) have developed processes that allow addressing and overcoming problems in its implementation (Goh, et al., 2013, p. 572). Risk processes describe how organisations set up RM (Lehtiranta, 2013, p. 641). In PM, projects are viewed as a life cycle process; the same view is also accepted in PRM. Indeed, PRM accompanies all the phases of a project, from its definition to its completion and closure (Raz & Michael, 2001, p. 9; Goh, et al., 2013, p. 572). Nevertheless, PM and PRM usually are processes not synchronised and with few interactions between them (Nguyen, et al., 2013, p. 216). In other words, PM and PRM are considered separate activities that have little influence and interactions among each other.

RM inspects the causes of possible events and the consequences of these events. In addition, it provides response strategies to deal with these risks; finally, based on the feedback received during the progress of the project, it reviews the previous steps of the project (Dikmen, et al., 2008, p. 42). PRM has to consider the dynamic essence of projects (Sanchez, et al., 2009, p. 15) and therefore the processes of RM have to continually evaluate and review project’s variables, plans and objectives. RM requires resources such as workforce as well as time and money to implement the processes of managing risks (Kutsch & Hall, 2009, p. 75). Yaraghi & Langhe (2011, p. 564) underline the importance of designing and implementing PRM internally, by the members of the organisations; consultants may be used but only as advisors while the key people who design, implement and run PRM should be part of the organisation that is responsible for the project. Indeed, the individuals involved in the project are those who know better the project and its risks; therefore, the implementation of PRM will be more robust.

Although there is a vast research on RM processes, there is not a universal accepted and approved standard or guideline available that allow organisations with different businesses to have the same RM process (Yaraghi & Langhe, 2011, p. 552; Kutsch & Hall, 2009, p. 73). Even though RM can be embedded in a firm’s culture, the way it is implemented tends to rely on manager’s discretion (Wood & Ellis, 2003, p. 256). Raz & Michael (2001) made a brief overview of PRM processes highlighting that there is a general agreement regarding what is included in the process, although there are differences regarding the level of details and the activities on each phases. Usually, PRM approach includes from four to six steps: identification of risk factors, assessment,
analysis and management (Krane, et al., 2010, p. 81). In the next subsections a description of the processes of PRM will be given, as described in the PMBOK®Guide (PMI, 2013). The use of these steps is due to the widely acceptance and reputation (Lenfle & Loch, 2010, p. 32) of the PMBOK®Guide as best practice (Kutsch & Hall, 2010, p. 245; Kutsch & Hall, 2009, p. 72) among project managers and academics. There are six PRM processes in the PMBOK®Guide (PMI, 2013): plan RM, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk responses and control risks.

3.3.2.1 Plan risk management

“Plan Risk Management is the process of defining how to conduct risk management activities for a project” (PMI, 2013, p. 313). The aim of this process is to guarantee that RM is equal to both the risks and the importance of the project to the organisation (p. 313). The objective of this process is to establish a methodology (i.e. definition of tools, data sources, etc. to be used to execute RM on the project), roles and responsibilities on RM, budgeting the funds needed, manage the reserves and the time plan of when RM processes will be performed in the project (p. 316). Lyons & Skitmore (2004, p. 60) argue that the planning and execution phases in RM are considered more important by project managers.

3.3.2.2 Identify risks

Although every step of RM process have been investigated (Taroun, 2014, p. 101), risk identification and assessment processes are considered to have the most impact on the accuracy of any risk assessment (Chapman, 1998, p. 333). According to PMBOK®Guide (2013, p. 319) the identification of risks “is the process of determining which risks may affect the project and documenting their characteristics”. In risk identification, project members investigate all the events within the project and then identify those that can potentially have the highest consequences on the project (Cervone, 2006, p. 258). The project team therefore, will be able to predict events because of their knowledge and ability deriving from this process (PMI, 2013, p. 319). However, it is impossible to foresee all the risks in a project, even with the use of an identification process (Osipova & Eriksson, 2013, p. 393). It is important to underline that the identification of risks should not be implemented only at the beginning of the project but it should be an ongoing process throughout project life cycle (PMI, 2013, p. 321). Although some risks can be identified at the earliest stage of the project and assigned among project stakeholders, other risks are difficult to predict (Osipova & Eriksson, 2013, p. 391). As the project progresses, conditions may change and therefore also the risks. According to Raz & Michael (2001, p. 16) the identification of risk does not depend on the adoption of a RM process. However, for analysis (see subsections 3.3.2.3-4) and control of risk (see subsection 3.3.2.6), a process is necessary.

Primary deliverable of the risk identification process is the risk register, a document where the results on the evaluation of risk and response action plan are recorded. All major risks, which may have a high impact on the project, are listed in it. It has to be continuously updated together with implementation of other RM processes (PMI, 2013, p. 327). Risk identified in the risk register are usually operational or technical risks leaving therefore a large quantity of risk (e.g. political, people, market) unmanaged (Ackermann, et al., 2007, p. 39). Ackermann et al. (2007) describe a new idea of risk register, called “risk filter” to overcome the lack of consideration of other risks in the
risk register. This deliverable includes the aspect of “systemicity” of risk, risks related to project features with the aim of be useful and beneficial for the assessment of single projects (p. 49).

### 3.3.2.3 Perform qualitative risk analysis

The analysis of risks could range from wholly qualitative to complex quantitative (Krane, et al., 2010, p. 81). The PMBOK®Guide (PMI, 2013), divides risk analysis into qualitative and quantitative (see subsection 3.3.2.4).

Perform Qualitative Risk Analysis is defined as “the process of prioritizing risks for further analysis or action by assessing and combining their probability of occurrence and impact” (PMI, 2013, p. 327). Prioritising risks make risk situation more manageable in a project (Krane, et al., 2012, p. 58). This analysis provides project managers with the major risks on the project and therefore it reduces the level of uncertainty around the project (PMI, 2013, p. 327). The assessment of risks and so their prioritisation is done through the consideration of the likelihood of occurrence and the impact on project’s objective of the risk (PMI, 2013, p. 329). A risk hence, has both a consequence and a probability (Krane, et al., 2010, p. 82). This process usually requires less time and it is an easy way of prioritise risks and their response plan (PMI, 2013, p. 329).

### 3.3.2.4 Perform quantitative risk analysis

PMBOK®Guide (PMI, 2013, p. 333) defines Perform Quantitative Risk Analysis as “the process of numerically analysing the effect of identified risks on overall project objectives”. The risks are those identified and prioritised during the qualitative analysis (see subsection 3.3.2.3) (PMI, 2013, p. 333). For instance, a quantitative measurement of the risk, known as risk exposure (Caron, 2013, p. 62), is obtained with the multiplication between the probability of the event and its consequence (in monetary terms) (Krane, et al., 2012, p. 58; Lehtiranta, 2013, p. 641). The process supports decision making by producing quantitative information on risk (PMI, 2013, p. 333).

### 3.3.2.5 Plan risk responses

Plan Risk Responses is “the process of developing options and actions to enhance opportunities and to reduce threats to project objectives” (PMI, 2013, p. 342). This process is important because it allows project managers to understand what are the resources needed to exploit opportunities and decrease the likelihood and impact of threats (p. 342). Even if risks have been detected and allocated, changes in scope requires different responses (Osipova & Eriksson, 2013, p. 391). There are different strategies that project managers can adopt to reduce or enhance risks. Avoidance (elimination of the risk or protection from its impact), transfer (the risk is attributed to a third party and not anymore on the project team), mitigation (actions to reduce the probability or impact of the risk) and acceptance (no action is taken as long as the event does not occur) are strategies that can be used when dealing with negative risks or threats (PMI, 2013, pp. 344-345). Mitigation plans are the most common response actions implemented by project managers (Lyons & Skitmore, 2004, p. 60). In contrast, positive risks can be exploited (through action that ensure its occurrence), enhanced (through actions to increase the likelihood of the event), shared (through allocation of some or all responsibility of the opportunity to a third party) and accepted (do not...
actively try to increase the probability of occurrence but if it happens the project team will take advantage from it) (PMI, 2013, pp. 345-346).

3.3.2.6 Control risks

Control Risks process can be defined as “the process of implementing risk response plans, tracking identified risks, monitoring residual risks, identifying new risks, and evaluating risk process effectiveness throughout the project” (PMI, 2013, p. 349). This process helps to increase the efficiency of PRM throughout project life cycle (p. 349). However, Raz & Michael (2001, p. 11) found that tools and techniques in risk control process are not effective because practitioners do not consider them to be adequate and because project managers are more focused on earlier phases of RM.

Some researchers have highlighted some drawbacks of PRM processes. As seen in previous subsections, there is no process regarding the lesson-learned activity of PRM. Incorporate in RM a learning phase, may contribute to cope with some challenges in the risk analysis, changing the way risk are managed and thus, enhancing benefits of RM (Dikmen, et al., 2008, p. 43). In addition, most RM approaches, do not effectively deal with the needs of identification, analysis and response plans of risks in a consistent model (Goh, et al., 2013, p. 572).

A major concern regarding the adoption or improvement of a PRM process is the decisions of what tool and technique can provide the greatest benefits (Raz & Michael, 2001, p. 10) for a successful implementation of RM (Goh, et al., 2013, p. 572). The next section includes the most cited tools and techniques identified in PRM literature.

3.4 Project Risk Management tools and techniques

3.4.1 List of the most cited tools and techniques

There are many tools and techniques for RM provided by PM institutions (e.g. PMI, IPMA), national and international standards (e.g. ISO), and researchers, designed to increase the predictability of project results (Thamhain, 2013, p. 21). A formal use of tools and techniques can increase the performance of RM and consequently the achievement of project objectives (Goh, et al., 2013, p. 572). PRM as any other managerial activity has an impact on project success; therefore, the more RM tools and techniques are used, the higher is the probability of project success (Raz, et al., 2002, p. 108). Traditional RM tools and techniques rely on foresee risk and assign it to different project stakeholders (Osipova & Eriksson, 2013, p. 397). In addition, current tools and techniques are based on the view that PM should be based on control and uncertainty elimination, central decision-making, division of responsibilities and emphasis on hierarchical structure (Lenfle & Loch, 2010, p. 48).

Due to the high number of existent PRM tools and techniques present in literature, an objective of this study is to identify a short list of the most cited tools and techniques in PRM literature. For most cited it is meant that these tools and techniques are discussed, studied and assessed by different authors as well as prescribed by the PMBOK®Guide in order to provide companies with an efficient PRM and be able to deal with risks. The most cited tools and techniques identified are expert judgement, meetings, brainstorming, checklists, assumption analysis, probability-impact matrix, sensitivity analysis, Monte Carlo simulation, expected monetary value analysis and variance and trend analysis. In the next subsections, these ten PRM tools and techniques are
described and assessed. Furthermore, in Table 3 for each of these tools and techniques, it is specified whether it is a tool or a technique according to the definition of tool and technique given in section 1.1. Appendix 2 presents a list with all the tools and techniques identified in the literature review. Finally, after the presentation of the most cited tools and techniques, general criticisms to PRM tools and techniques are shown.

3.4.2 Expert judgement

The judgement of expertise of a particular project area or business, as well as project stakeholders and senior manager should be considered to assure that a consistent RM plan is established (PMI, 2013 p. 315). Furthermore, during risk identification (see subsection 3.3.2.2), expert judgement should be used to help project managers to consider all the elements of the project and give suggestions on possible events not considered by the project members (PMI, 2013, p. 327). In the probability-impact matrix (see subsection 3.4.7) expert judgement may be used to advise the probability and impact of the risk and therefore their location on the matrix (PMI, 2013, p. 333). Expert judgement is very important in the quantitative analysis (see subsection 3.3.2.4) for the evaluation of probability, the identification of strengths and drawbacks of the tools and techniques and its suitability for the project (PMI, 2013, p. 341). Experts may also be called to advice for the best risk response strategy to adopt during the Plan Risk Responses process (see subsection 3.3.2.5) (PMI, 2013, p. 346).

3.4.3 Meetings

Meetings are used to develop the RM plan (see subsection 3.3.2.1). Activities such as RM responsibilities, categories of risks and so forth are created or reviewed. Usually, project manager, project team and main stakeholders are involved (PMI, 2013, p. 316). In risk control process (see subsection 3.3.2.6), meetings are held periodically to assess RM status, review risk responses, etc. (PMI, 2013, p. 352). Workshops are also a useful technique to collect and discuss potential events in a more detailed way. All the members of the projects (stakeholders included) are rounded up in a unique place so as to increase the effectiveness of brainstorming (see subsection 3.4.4) about potential project risks (Goh, et al., 2013, p. 573).

3.4.4 Brainstorming

This technique is used to gather information for the identification of risks and has been firstly used in business management and then adopted in RM (Chapman, 1998, p. 337). The main goal of brainstorming is to obtain a detailed list of project risks (PMI, 2013, p. 324). During brainstorming session, experts (see subsection 3.4.2) may be involved. Ideas about possible events that may affect the project are generated (Chapman, 1998, p. 337; PMI, 2013, p. 324). Then, those risks are classified in categories and defined (PMI, 2013, p. 324). This technique is the most common in the identification of risks (Lyons & Skitmore, 2004, p. 60).

3.4.5 Checklists

Checklist is a tool based on information retrieved from historical data and past experience of similar projects already implemented and other sources of information as well. In addition, it is important to bear in mind that the checklist is not a substitute of risk identification (see subsection 3.3.2.2). Project members should explore risks that
are not on the checklist and update it constantly throughout the project (PMI, 2013, p. 324). A drawback of the reliance on checklist or brainstorming is their inability to prioritise risk by evaluating the likelihood and impact of risks (Goh, et al., 2013, p. 573).

### 3.4.6 Assumption analysis

Assumption analysis aims to identify what are the assumptions and hypotheses upon which a project plan is based and implemented (PMI, 2013, p. 324). Assumption analysis is one of the few techniques designated for dealing with unrealistic assumptions, since RM is mainly concerned with anticipated risk, that is risk that have been predicted early in time (Lehtiranta, 2013, p. 642). Once identified, assumptions need to be examined in order to understand their validity. Groundless assumptions may consist of inaccuracy, inconsistency, instability or incompleteness, and can therefore lead to project risk (PMI, 2013, p. 324). Questioning and awareness are crucial elements for an effective analysis (Lehtiranta, 2013, p. 648). Although this technique deals with unrealistic assumptions, these are almost never taken into account even in organisations with well-developed RM (Lehtiranta, 2013, p. 642).

### 3.4.7 Probability-Impact matrix

The probability-impact matrix (P-I matrix) (Figure 4) is one of the most common qualitative tools used for risk assessment, because it is a useful framework to identify the risks that require more attention. Risks are prioritised for further quantitative analysis and response plan based on their risk rating. The risk rating is obtained by comparing risk occurrence (probability) and risk impact on a specific objective. The risk are then ranked into very low, low, moderate, high and very high risk. P-I matrix can be used for both positive and negative risks (PMI, 2013, p. 331). This tool helps the project team to understand what the risks to be managed are and which of these need higher attention (Wood & Ellis, 2003, p. 259). P-I matrix is widely used in RM. However, such tool is not exempt from criticisms (Taroun, 2014, p. 101) and improvements have been suggested. For instance, among the others, the usage of range estimations instead of single point estimations in order to specify variability in the size of the parameters (impact and probability) (Ramgopal, 2003, p. 23). In addition, P-I matrix should also have considerations for risk interdependencies (cf. Cervone, 2006), risk controllability (cf. Cagno et al., 2007) and project vulnerability (cf. Zhang, 2007). Risk interdependency concerns the effect that the occurrence of a risk may have on another, risk controllability is “the ratio between the expected risk impacts before and after applying specific mitigation actions” (Taroun, 2014, p. 108). Finally project vulnerability refers to the influence that project environment may have on the impact of a risk.
3.4.8 Sensitivity analysis

Sensitivity analysis is a tool that aid project members to decide what are the risks that have the highest impact (both negative and positive) on the project; it is used to show how variations of the objectives of a project are correlated to variations of different uncertainties. The most common figure of the sensitivity analysis is the tornado diagram (Figure 5) (PMI, 2013, p.338). In other words, they highlight the greatest contributors to the overall risk, both positive and negative. The categories are ordered so that the largest bar appears at the top of the chart, the second largest appears second from the top, and so on. The vast use of this tool is because it gives answers to “what if” questions and, at the same time, is quite simple to use (Akintoye & MacLeod, 1997, p. 36). However, it does not suggest appropriate actions in addressing risks and does not give indications on who is the best person for managing the risks (Goh, et al., 2013, p. 573).
3.4.9 Expected monetary value analysis

Expected monetary value (EMV) analysis considers different possible future scenarios and estimates the average value of the outcome for each of them. By multiplying the value of every possible outcome and the associated probability of occurrence and summing up all these products it is possible to obtain the EMV of the project. Positive EMVs are referred to opportunities, while negative EMVs to threats. This tool assumes that the manager has a neutral perception of risk that is the manager is not risk prone nor risk averse. A typical use of EMV analysis is the decision tree analysis (Figure 6) (PMI, 2013, p. 339). However, decision trees, despite being one of the most prescribed tools in RM literature, has been found to be seldom used in software and high-tech industry practice (Raz & Michael, 2001, p.10). In the construction sector, Akintoye & MacLeod (1997, p. 36) found that 23% of project managers use decision trees diagrams.

![Decision Tree Diagram (source: PMI, 2013, p. 339).](image)

3.4.10 Monte Carlo simulation

A project simulation utilises a model that allows converting uncertainties of the project into potential impact on project objectives (PMI, 2013, p. 340). Usually those simulations are performed through Monte Carlo simulation (MCS) software. MCS is one of the few quantitative tools actually used in practice (Wood & Ellis, 2003, p. 261). The project model is calculated many times (iteration) with input values (e.g. activity duration estimate) chosen randomly from the probability distributions of these variables. The output of this process is a histogram (e.g. total cost or completion date) (PMI, 2013, p. 340). The project outcome is obtained by performing a number of iterations that depends on the level of confidence required (Akintoye & MacLeod, 1997, p. 35). The vast majority of practitioners use MCS to calculate the minimum, maximum and most likely value of each risk (Wood & Ellis, 2003, p. 259). MCS as many other RM tools and techniques assume that past data can predict the future (Regev, et al., 2006, p. 17). In addition, it does not show the aspects related to the connection of variables and the difficulties related to the selection of appropriate distribution profiles (Wood & Ellis, 2003, p. 259).
3.4.11 Variance and trend analysis

Variance and trend analysis compares actual results to the planned. It is mostly known as Earned Value (EV) analysis. This tool is used to monitor the progress of the project and their coherence with the planned activity and allow forecasting possible deviations of the project at completion from cost and schedule targets (PMI, 2013, p. 352). These deviations can be the evidence of risks. While variances in cost or schedule show project’s past performance during the work completed, index such as CPI (Cost Performance Index) and SPI (Schedule Performance Index) may be used to emphasise present trends and estimate the future performance during the work remaining (Caron, 2013, p. 22).

Although there is a vast research that outline the importance and effectiveness of project risk tools and techniques, there is a stream of RM literature that have identified some drawbacks. Traditional PM offers many tools and techniques to identify and manage project risks (Lechler, et al., 2012, p. 59; Regev, et al., 2006, p. 17). However, they do not give project managers the chances to identify conditions of uncertainty, assess opportunity and alternatives, as well as make reliable decisions that enhance project and enterprise value (Lechler, et al., 2012, p. 67). Another criticism that deserve attention in current risk tools and techniques is the lack of consideration about the possible interaction between risks that are not classified in the same category (Vidal, et al., 2009, p. 26; Wood & Ellis, 2003, p. 259). In other words, the impact of a risk (e.g. risk in an operational category) may have an effect on the probability of occurrence of another risk (e.g. a strategic risk). For instance, a delay in the delivery of a key supply may cause a delay in a particular activity and this may provoke a budget overrun, affecting the realisation of the entire project. Indeed, it is the interaction among different risks that can cause the most impact on a project (Ackermann, et al., 2007, p. 40). Wood & Ellis (2003, p. 261) discovered that RM is usually implemented through simple tools such as checklists while complex tools are seen with scepticism. According to Thamhain (2013, p. 21), there is not an analytical model that is sophisticated enough to represent the complexities and dynamics of all risk scenarios that might affect a major project. In addition, the more complex the tools and techniques are, the more data and time is required (Akintoye & MacLeod, 1997, p. 37). Since there are many different types of risks, it is impossible to identify all of them meticulously. Lyons and Skitmore (2004, p. 60) and Forbes et al. (2008, p. 1242) argued that one tool or technique cannot be applied in every circumstance or project; also a tool or technique used in a process of PRM may not be adequate for another (Raz, et al., 2002, p. 102). To overcome this problem, Forbes et al. (2008) developed a matrix that helps project managers to select the most appropriate RM tools and techniques according to the circumstance. Finally, an increasing number of organisations are using both analytical tools and managerial judgement (Thamhain, 2013, p.21). Managers recognise that, while analytical tools and techniques provide a significant toolset for RM, collective thinking, group work (Chapman, 1998, p. 333), collaboration of all stakeholders (Tang, et al., p. 950; Osipova & Eriksson, 2013, p. 393) and key personnel of the enterprise are essential methods to identify and deal with the complexity of risks in today’s business environment. Finally, it seems that practitioners prefer qualitative tools and techniques compared to quantitative ones (Taroun, 2014, p. 110; Lyons & Skitmore, 2004, p. 60; Tang, et al., 2007, p. 950) because of their ease of use and better understanding by practitioners.
### Table 3. List of the most cited tools and techniques.

<table>
<thead>
<tr>
<th>Name</th>
<th>Tool or Technique</th>
<th>Process</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert Judgement</td>
<td>Technique</td>
<td>Plan Risk Management</td>
<td>Qualitative/Quantitative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Risk Identification</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perform Qualitative Risk Analysis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perform Quantitative Risk Analysis</td>
<td></td>
</tr>
<tr>
<td>Meetings</td>
<td>Technique</td>
<td>Plan Risk Management</td>
<td>Qualitative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Control Risks</td>
<td></td>
</tr>
<tr>
<td>Brainstorming</td>
<td>Technique</td>
<td>Risk identification</td>
<td>Qualitative</td>
</tr>
<tr>
<td>Checklists</td>
<td>Tool</td>
<td>Risk identification</td>
<td>Qualitative</td>
</tr>
<tr>
<td>Assumption analysis</td>
<td>Technique</td>
<td>Risk identification</td>
<td>Qualitative</td>
</tr>
<tr>
<td>Probability-Impact</td>
<td>Tool</td>
<td>Perform Qualitative Risk Analysis</td>
<td>Qualitative</td>
</tr>
<tr>
<td>matrix</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity analysis</td>
<td>Tool</td>
<td>Perform Quantitative Risk Analysis</td>
<td>Quantitative</td>
</tr>
<tr>
<td>Expected monetary</td>
<td>Tool</td>
<td>Perform Quantitative Risk Analysis</td>
<td>Quantitative</td>
</tr>
<tr>
<td>value analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monte Carlo simulation</td>
<td>Tool</td>
<td>Perform Quantitative Risk Analysis</td>
<td>Quantitative</td>
</tr>
<tr>
<td>Variance and trend</td>
<td>Tool</td>
<td>Control Risks</td>
<td>Quantitative</td>
</tr>
<tr>
<td>analysis</td>
<td></td>
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</tr>
</tbody>
</table>

3.5 Reasons for a non-use of Project Risk Management tools and techniques

3.5.1 List of the reasons for the non-use of tools and techniques

An objective of this study is to identify and put together the main reasons for the non-use of project risk tools and techniques. Reasons that might account for the non-use of PRM tools and techniques by project managers can be identified from previous studies in different sectors and countries. These are: lack of knowledge or understanding, lack of resources, unwarranted use in relation to the project type, preference for intuition and experience, diffidence towards statistics and mathematical models, deny negative risks, avoid negative risks and delay of negative risks management. These reasons are discussed in the next subsections (3.5.2-9). Some of these reasons are based on rational motivations, e.g. lack of knowledge, training, skills and understanding about PRM tools and techniques and lack of resources to implement PRM processes, tools and techniques. Other reasons, instead, are more irrational because RM practices are influenced by risk perceptions of practitioners (Bryde & Volm, 2009, p. 1068). In fact, while promoting best practices and standardisation of processes in PRM, i.e. an objective and rational way of managing risks, the PMI itself recognises that the attitudes of individuals and groups towards risk are “driven by perception, tolerances and biases” (PMI, 2013, p. 311). Risk perceptions of project participants are originated from people’s judgements, feelings, attitudes, beliefs, groups’ influences (Lehtiranta, 2013, p. 641; Akintoye & MacLeod, 1997, p. 32) as well as from cultures (de Camprieu, et al., 2007, p. 692; Liu, et al., 2014, p. 10) and backgrounds (Krane, et al., 2012, p. 64). Therefore, tools and techniques that are suitable in a country or sector may not be relevant in another one due to a different business environment (Khumpaisal, et al.,
2010, p. 152). Many researchers (e.g. Taroun, 2014; Raz & Michael, 2001; Wood & Ellis, 2003; Lyons & Skitmore, 2004; Akintoye & MacLeod, 1997) underline the importance that personal judgement, intuition and past experience have on risk assessment and quantification. This subjective evaluation lead to the problem of different perceptions that different project stakeholders (e.g. project manager, project team, client, etc.) may have regarding the importance of risks. Therefore, collaboration between all the actors involved could help to reduce the biased perspective of project risk (Osipova & Eriksson, 2013, p. 393). In the next subsections, the main reasons identified in the literature for the non-use of risk tools and techniques are explained.

3.5.2 Lack of knowledge or understanding

Low adoption of project risk tools and techniques developed by the literature is often due to the fact that these are too sophisticated for practitioners (Hartono, et al., 2014, p. 408) making their understanding difficult. The reason behind the lack of understanding is attributed to insufficient training in using tools and techniques (Akintoye & MacLeod, 1997, p. 36). Adedokun et al. (2013) studied specific risk analysis tools and techniques, such as checklists (see subsection 3.4.5), assumption analysis (see subsection 3.4.6) and probability-impact matrix (see subsection 3.4.7), and concluded that behind a limited use of some of these, there is an inadequate training by organisations. The criteria adopted by firms in order to choose some risk analysis tools and techniques instead of others is their simplicity (p. 133). Understanding the strengths and weaknesses of risk tools and techniques is essential for the appropriateness of their implementation (Dey & Ogunlana, 2004, p. 335). Indeed, it may help project managers to use the most suitable tools and techniques based on the situation and the project, improving therefore the effectiveness of RM.

3.5.3 Lack of resources

RM is a discipline that often is not applied because it is not viable in commercial terms. The money and effort put in RM are not transformed in something tangible that project managers can evaluate. Since PRM is considered to prevent negative risks, the project managers often do not know if the event did not happen because of RM or for other reasons (e.g. good planning). Money and time constraints are reasons for not using risk tools and techniques (Akintoye & MacLeod, 1997, p. 37). Project managers often prefer to use the project budget for other activities such as project procurement because considered more important for project success. Therefore, the lack of use of tools and techniques by project managers may be linked to limited resources available for the project. Indeed, according to the research made by Zhao et al. (2014, p. 30), on average, only 10% of the time for the projects is dedicated to RM. Therefore, PRM tools and techniques may not be applied because of this reason. Finally, another reason may be related to the lack of human resources when applying RM and therefore project risk tools and techniques (cf. Zhao et al., 2014, p. 30). In other words, the amount of people involved in the management of risk is secondary compared with other activities. Consequently, the non-use of project risk tools and techniques might be due because of lack of personnel.
3.5.4 Unwarranted use in relation to project type

PRM tools and techniques are often not used because the project manager deems their application unsuitable to the specific project. The degree of sophistication associated to some tools and techniques is not warranted in relation to the project size and performance. Many projects are rarely large enough to justify the implementation of sophisticated tools and techniques. These considerations generate doubts whether complex tools and techniques are applicable; therefore, project managers choose to do not use them (Akintoye & MacLeod, 1997, p. 36).

3.5.5 Preference for intuition and experience

Often, project managers tend to rely on their intuition and experience for the identification, assessment and management of risks instead of using PRM tools and techniques. Although intuitions could lead in some situations to good decision results, in some other contexts this preference for intuition and experience could conduct project managers to systematic judgemental errors (Hartono, et al., 2012, in Hartono, et al., 2014, p. 407). According to cognitive psychology, the preference for intuition and experience occurs when humans attempt to maintain their thinking processes rational but the cognitive capability is confined. As a result, to make fast decisions and overcome the cognitive workload humans opt for gut feelings and intuitions (Kahneman, 2002, p. 1451). This phenomenon in decision-making is called bounded rationality. Bounded rationality is the tendency to adopt a simplified view of reality in order to take a highly complex decision with an overwhelming quantity of information, relevant and irrelevant (McCray, et al., 2002, p. 52). This means that while a particular problem, which has uncertain outcomes should be resolved by careful reasoning and rational thinking, i.e. using PRM tools and techniques such as P-I matrix (see subsection 3.4.7), sensitivity analysis (see subsection 3.4.8), decision trees (see subsection 3.4.9) and MCS simulation (see subsection 3.4.10), in practice the manager relies on intuition in order to make a fast decision (Hartono, et al., 2014, p. 407). Preference for intuition and experience might therefore account for the non-use of PRM tools and techniques since an oversimplified model of reality based on intuition and past experience is preferred to a more complex and difficult analysis carried out with risk tools and techniques.

3.5.6 Diffidence towards statistics and mathematical models

Often managers believe that an effective PRM rely on people more than on mathematical models (Akintoye & MacLeod, 1997, p. 36). Project managers prefer to rely on their judgement in order to generate a subjective “guesstimate”. Instead of leaning on more rigorous quantitative tools, there is a preference to adopt easier-to-make, but often inadequate, predictions. This is due because of scepticism towards statistical analysis and mathematical models, i.e. quantitative tools and techniques.

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3 Diffidence towards statistics and mathematical models might be related to a lack of understanding or knowledge (see subsection 3.5.2), since ignorance about statistics and mathematics is at the base of such diffidence. However, this diffidence is viewed more as a prejudice or preconception than a lack of training as described in subsection 3.5.2. Moreover, it has different implications since this diffidence might specifically account for a non-use of tools and techniques based on statistics and mathematics whereas the lack of understanding in subsection 3.5.2 is more generally related to any tools and techniques seen as too sophisticated. For these motives, the two reasons are kept separate into different subsections.
Similarly, even when some statistical analysis is carried out the results are often adjusted downward or upward depending on irrational subjective factors; for example, positive predictions are depreciated while negative predictions are increased (McCray, et al., 2002, p. 52). Diffidence towards statistics and mathematical models is hence a prejudice that might account for a non-use of risk tools and techniques such as EMV analysis (see subsection 3.4.9), MCS (see subsection 3.4.10), and value and trend analysis (see subsection 3.4.11).

3.5.7 Denial of negative risks

Often practitioners tend to refuse the existence of threats related to projects. The reasons for this is to avoid to expose the customer and other stakeholders to the fact that the project is subject to threats, since these threats would generate anxiety and doubts regarding the capability of the project team to accomplish project success. Letting the client to be aware of dangers and negative uncertainties might introduce concerns and worries in the relationship with the project team and therefore compromise the relations. The attitude to negative risk would be hence to consider it as a “taboo”. Such behaviour can be either conscious (not mentioning certain project risks is a voluntary decision) or unconscious (thinking about threats is a taboo and hence forbidden). For these reasons, RM is perceived as a negative affair. Since threats are denied they are not actively managed, and project risk tools and techniques are not used (Kutsch & Hall, 2005, pp. 594-595).

3.5.8 Avoidance of negative risks

Even when negative risks are initially identified and assessed by the project team, then they might not be effectively managed because threats are avoided. The reasons for this avoidance are two: firstly, because the customer does not recognise the existence of such threats or the need to effectively engage in their management. This situation happens when the management of such threats requires an active involvement or an investment of resources by the customer. Secondly, project managers might tend to avoid risks that are not agreed among the project team. In other words, project managers focus exclusively on easily assessable negative risks in order to reach a consensus among project team members, therefore other negative risks are avoided because an estimation agreed within the project team would require more efforts (Kutsch & Hall, 2005, p. 594). The application of tools and techniques in the risk response and control processes (see subsections 3.3.2.5-6) is hence limited due to different risk perceptions among project stakeholders (e.g. project manager, project team and the client).

3.5.9 Delay in managing negative risks

In some situations, the management of negative risks is postponed because PRM is not carried out proactively; instead, there is a tendency to manage those risks when they occur and become a problem. Hence, project managers choose to ‘wait and see’ until the uncertainty resolves itself. A reason behind this behaviour is the project manager’s preference to manage threats reactively and not proactively. Another reason is the organisation culture that considers RM in an apathetic way, as a mere administrative task (Kutsch & Hall, 2005, pp. 596-597). Finally, the management of negative risks is delayed because of the conviction that a project stakeholder (e.g. a supplier, client) will give its support if any problem related to its tasks (e.g. a material, product) arises in order to protect its own brand (Kutsch & Hall, 2005, pp. 596-597). The lack of use of
risk tools and techniques may derive from the tendency to delay the management of threats due to an over optimism by the project managers (Raz, et al., 2002, p. 107). PRM tools and techniques are therefore applied only in the identification and assessment processes, while the processes of response planning and risk control are not carried out since threats are managed if and when they occur.

Table 4 summarises the previous subsections highlighting what PRM theory claims, what PRM is in practice and what are the reasons that might account for such difference between theory and practice.

<table>
<thead>
<tr>
<th>PRM Theory</th>
<th>PRM Practice</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRM is an essential activity in projects and run it throughout the project (PMI, 2013, p. 309;</td>
<td>Superficial consideration of the whole activity (Cervone, 2006, p. 256) and higher consideration is</td>
<td>Managers’ lack of knowledge and understanding (Hartono, et al., 2014, p. 408).</td>
</tr>
</tbody>
</table>
Dikmen, et al., 2008, p. 47). Therefore, the use of PRM tools and techniques is essential. In some processes there is a lack of use of tools and techniques.

| Dikmen, et al., 2008, p. 47. Therefore, the use of PRM tools and techniques is essential. | put in the planning and execution phase of a project (Lyons & Skitmore, 2004, p. 60). Therefore, in some processes there is a lack of use of tools and techniques. | Denial, avoidance and delay in managing risks (Kutsch & Hall, 2005, pp. 594-597). Lack of resources (Zhao et al., 2014, p. 30). |

Table 4. Differences between PRM theory and practice and their respective reasons.

Summary

This chapter critically discussed the theoretical frame of reference of PRM. In particular, it has been introduced ten most cited tools and techniques proposed by PRM theory and best practices, such as PMBOK®Guide (PMI, 2013), in order to guide project managers when dealing with risks. The ten most cited tools and techniques are expert judgement, meeting, brainstorming, checklist, assumption analysis, probability-impact matrix, sensitivity analysis, Monte Carlo simulation, expected monetary value analysis and variance and trend analysis. However, many scholars noticed a number of discrepancies between theory and the actual use of tools and techniques by project managers (Table 4). Eight reasons have been identified: lack of knowledge or understanding, lack of resources, unwarranted use in relation to the project type, preference for intuition and experience, diffidence towards statistics and mathematical models, deny negative risks, avoid negative risks and delay of negative risks management. The thesis will further investigate the use and non-use of PRM tools and techniques and the reasons behind the non-use in the Swedish manufacturing sector.
4. Research Strategy

The purpose of this chapter is to present and motivate the choice for a qualitative research strategy and the methods for the collection and analysis of data. Finally, the ethical issues related to the collection of the data are shown.

4.1 Research methodology

Research methodology cannot be isolated from the researcher’s epistemological and ontological assumptions (Long, et al., 2000, p. 190) as well as the context in which the research is made (Morgan & Smircich, 1980, p. 499). Long et al. (2000, p. 194) define research methodology as “an approach to or general type of investigation”. There are two main research strategies: qualitative and quantitative. The aim of this thesis is to provide an understanding of the reasons behind the non-use of PRM tools and techniques in dealing with project risks. It is not the purpose of the research to measure the phenomena under study; rather, the authors seek to investigate it. A quantitative approach is more suitable for researchers who aim to generalize the findings through a big sample. However, this thesis does not have this purpose; rather, it seeks to understand the reasons for the non-use of PRM tools and techniques in a specific sector through a small sample. Qualitative research is hence the most appropriate research strategy for this study. Qualitative research is defined as “an approach that enables researchers to explore in detail social and organisational characteristics and individuals behaviour and their meanings” (Schensul, 2012, p. 69). As explained in section 2.3, a deductive approach is used in order to link theory and data. The authors are aware that a deductive approach is more suitable in cases where the researchers have a different epistemological assumption and for a quantitative research strategy. However, deductive and inductive approaches are more similar to tendencies rather than strict processes that researchers should follow (Bryman & Bell, 2011, p. 12), and thus, the use of a deductive approach with a qualitative research strategy is possible (Hyde, 2000, p. 82). Consistent with the use of a qualitative research strategy, the thesis is based on case studies. A case study is “an investigative tool used to thoroughly describe complex phenomena, in ways to unearth new and deeper understanding of these phenomena” (Moore, et al., 2012, p. 243). The use of case studies is appropriate for this research because the authors’ aim is to observe whether project managers use PRM tools and techniques in a specific context, i.e. Swedish manufacturing sector, as well as to learn what the reasons behind their non-use are. Case studies are appropriate for deductive reasoning as allow the researcher to test theory with the data obtained from the case (Eisenhardt & Graebner, 2007, p. 25). The findings are not based on a single company but on seven firms, therefore the research consists of multiple case studies (cf. Eisenhardt & Graebner, 2007, p. 25; Moore, et al., 2012, p. 247).

The preference of case study as a research design instead of cross-sectional design is the use in this research of qualitative data while cross-sectional design aims to collect quantitative or quantifiable data in order to have variations in the sample (cf. Bryman &
Bell, 2011, p. 53). Longitudinal design has the purpose to observe variations in time of a variable (Bryman & Bell, 2011, p. 58). This study focuses on understanding the reasons for the non-use of project risk tools and techniques in a precise point of time and it is not in its purpose to observe how these reasons change in time. Finally, the case study design is preferred to comparative design because the authors do not seek to compare contrasting situations of the same phenomena (cf. Bryman & Bell, 2011, p. 63); rather they seek to have a broader view on different cases in order to reduce the bias of a single case.

The authors are aware that critics to the employ of case studies argue that case studies have restricted validity and generalizability (Bryman & Bell, 2011, p. 55; Eisenhardt & Graebner, 2007, p. 27). As already mentioned in section 1.3, this thesis does not seek to generalize the research findings to other companies in the manufacturing sector, within or outside Sweden, or to other industries or sectors. However, even limited to the specific context, the authors do claim that the findings can help to understand the reasons for the non-use of risk tools and techniques and to contribute to PRM theory development. The use of multiple case studies generate more robust implications and conclusions because grounded in more empirical evidence in comparison to single case study researches (Eisenhardt & Graebner, 2007, p. 27). Such contributions to PRM theory should then be tested in further researches in order to become generalizable.

### 4.2 Research method

Research techniques are “the investigative tools employed by a researcher” (Long, et al., 2000, p. 195). Case studies permit the use of many data sources including archival data, observations, and interviews (Eisenhardt & Graebner, 2007, p. 28). In particular, through interviews in case studies, the authors are able to investigate individual’s thoughts and beliefs (Moore, et al., 2012, p. 251) about the reasons of the non-use of PRM tools and techniques. The authors are embedded in the context, trying to understand the meaning of the respondents’ answers in that particular time and situation (cf. Lapan, et al., 2012, p. 3). The face-to-face nature of data collection and thus, the interactions the authors have with the interviewees, are unique features that distinguish qualitative from quantitative research (Schensul, 2012, p. 70).

The authors are conscious that the use of participant observation as a technique for data gathering would have improved the understanding of social reality including deviant and hidden activities (e.g. resistance at work, conflicts and so on) (Bryman & Bell, 2011, pp. 361-362). A reason of the preference for interviews is that the time available for this research is limited; therefore, the authors are unable to observe project managers when dealing with risks directly. Furthermore, interviews are less intrusive in people's life because the time dedicated to them is less, but the information gathered are nevertheless rich and valuable (Bryman & Bell, 2011, p. 363).

### 4.3 Company sample criteria

Consistent with the qualitative research strategy, the selection of the sample is purposive. The purposive sampling is “selecting units (e.g. individuals, groups of individuals, organisations) based on specific purposes associated with answering a research study's questions” (Teddie & Yu, 2007, p. 77). The sample therefore, is selected not on statistical basis, but on the specific purpose of providing important
information that is not possible to find with other samples. Therefore, criterions are set to enable the researchers to define the proper sample based on the research objectives.

**Criterion 1: Sector**

The companies have to operate in the manufacturing sector. The application of risk tools and techniques in projects is industry or sector-specific, and in the manufacturing sector, projects are normally executed and managed. In addition, the majority of past researches focused on industries or sectors such as IT and construction, while none regarded manufacturing sector (Table 1). Therefore, companies belonging to this sector are selected.

**Criterion 2: Location**

The firms have to operate in Sweden and specifically in Umeå region. Since the application of PRM tools and techniques is country-specific and since only one study (cf. Riabacke, 2006) has been conducted in Sweden, this country has been chosen. Therefore, firms included in the sample need to have a physical office or projects running in the area to have face-to-face interviews with project managers.

**Criterion 3: Projects and websites**

In order to study the reasons for the non-use of project risk tools and techniques, the firms in the sample must run projects and have a basic PM knowledge. In order to assure that the companies operate through projects, an online search has been made. Therefore, firms that do not have a website are excluded from this research. It is also the authors’ assumption that if a company does not have a website is because it is too small, and small companies are likely to not have a PM experience, hence they would not be interesting for this research. Finally, the authors do not require firms to carry out RM processes as they are seeking the reasons for why companies do not manage risk through PRM tools and techniques.

In order to define a sample with these criteria a first list of companies operating in the sector of interest has been obtained through the municipality office of Umeå. This list constitutes of 276 companies regularly registered in Umeå region. These are, therefore, satisfying Criterion 1 and 2. However, this list comprises many small and medium enterprises (SME) which more likely do not operate through projects. By filtering them according to Criterion 3, the authors were able to identify 50 valid companies for the purpose of the study. All of them have been contacted by email and phone and have been requested one or more interviews with their project managers.

**4.4 Respondent sample criteria**

While the previous criteria are referred to companies in order to be appropriate cases in our sample, it is also necessary to set further criteria for the single respondents. The purpose of the following criteria is to assure that respondents can properly understand and answer to the questions.

**Criterion 1: English speaker**

Since the authors have very basic knowledge of Swedish, the interviewees need to be able to speak in English. This criterion is important to reduce the language barrier and allow the authors to understand fully the concepts that the respondents say. The
respondent should have a level of English that permits him or her to be able to express himself or herself freely during an interview situation.

**Criterion 2: Project managers**

In order to have valid interviews, the respondents must be familiar with PM and have knowledge and past experiences in this field. The authors do not require respondents to have knowledge or understanding of RM processes, tools and techniques as they seek to find the reasons for a non-use of these, and one of the potential reasons is lack of understanding of PRM tools and techniques (see subsection 3.5.2). Therefore, project managers that have limited knowledge in PRM are suitable respondents for the aim of this research study. Finally, the authors consider a respondent valid even if he or she does not have a formal title of project manager within his or her company. The authors seek to have an interview with people who manage or have managed projects and therefore a formal title of project manager is not needed.

4.5 Interview respondent and companies

From the 50 companies that meet the criteria, seven show an interest in the research. For each of these seven companies, a respondent has been identified, except for ABB and Seaflex where the interviewees are two. All of these companies are based in Umeå and operates in the manufacturing sector. A more detailed description of these firms is provided in section 6.1. In Table 5, the list of the companies that participate in the research, their industry as well as the respondent name of the firm is provided.

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Industry</th>
<th>Respondent</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB</td>
<td>Power and automation technologies</td>
<td>Mathias Nygren</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gustav Wållivaara</td>
</tr>
<tr>
<td>Company A</td>
<td>Agricultural machinery</td>
<td>Respondent A</td>
</tr>
<tr>
<td>Company B</td>
<td>Power line infrastructures</td>
<td>Respondent B</td>
</tr>
<tr>
<td>Ecoclime</td>
<td>Indoor heating and cooling systems</td>
<td>Lennart Olofsson</td>
</tr>
<tr>
<td>Mantena Sverige AB</td>
<td>Train maintenance</td>
<td>Anmar Farman</td>
</tr>
<tr>
<td>Seaflex AB</td>
<td>Mooring systems</td>
<td>Lars Brandt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Peter Alenius</td>
</tr>
<tr>
<td>Umeå Industriteknik AB</td>
<td>Industrial equipment</td>
<td>Morgan Isaksson</td>
</tr>
</tbody>
</table>

Table 5. Company and respondent details.

As further described in section 6.1, in this sample there is a good balance between SMEs and multinational companies so that the findings obtained are not to be considered specific of a single type of companies (e.g. only SME or only multinational). This study, therefore, provides a more detailed picture of the current status of PRM tools and techniques in a variety of companies that are different from each other so as the sample contains a good mix of elements. However, the authors do not claim, as
written in section 1.3, that the findings can be generalized, but they do believe that the findings can contribute to a better understanding of the reasons for the non-use of PRM tools and techniques.

4.6 Non-response analysis

Among the contacted companies qualified to participate in the data collection process, 43 firms did not reply or gave a negative reply to the interview request. There are several reasons to explain this result. Many companies have many deadlines and deliveries; therefore, it was difficult for them to have time for an interview and discuss the research topic. One company explicitly replied that it is not beneficial for them to concede an interview; therefore, other companies might not have replied for the same reason. Another company justified the impossibility to give an interview because they do not speak English while another firm replied that they did not want to speak English (even though they were able). In addition, 20 out of 46 companies are small enterprises with less than ten employees. These companies run small projects and therefore in their opinion; it is not useful and beneficial for them to have a PRM. Although the authors explained them that the purpose is to investigate the reasons behind the non-use of project risk tools and techniques and that, the non-implementation of any PRM process is still linked with the research question, the companies preferred to not collaborate with the authors. This is an interesting aspect that confirm previous studies (e.g. Kutsch & Hall, 2009) on the infrequent use of PRM and support the belief that in practice RM is considered a redundant activity (cf. Raz & Michael, 2001).

Among the contacted companies, 86 percent did not show an interest in participating in our research, the authors are aware of the problem of generalizability that might arise. However, the aim is not to find results that can be representative of all the companies in the manufacturing sector. The authors’ objective is to provide findings that enable the readers to understand the context in which the research is made and learn from the results obtained.

4.7 Interview procedures

Interviews can range from highly structured, with accurate and more control on the conversation, to a more flexible and informal conversation (Moore, et al., 2012, p. 256; Bryman & Bell, 2011, p. 340). In this study, semi-structured interviews are used to gain “understanding of the personal context within which the research phenomena are located” (Ritchie, 2003, p. 36). Each interview has been conducted separately and in person through face-to-face meetings to interpret the answers fully and reflect upon the interviewees’ words, body language and gestures of the respondents. In the Seaflex and ABB case, however, both the respondents were interviewed together. Nevertheless, also in this case, each respondent answered to all questions. Indeed, a key feature of semi-structured interviews is its emphasis on interviewees’ own perspective (Bryman & Bell, 2011, p. 341).

The interviews in Umeå are located in a place chosen by the respondents. This decision was made because all the interviewees are project managers who have a packed agenda with meetings and therefore the time they could dedicate to the authors would have been much lesser if the authors would have chosen the location. The time for the interview is one hour as the respondents have a very busy agenda and therefore no additional time to dedicate to the research. However, the authors believe that this period has been
sufficient for the collection of data. The respondents from Seaflex decided to meet us at Umeå University. All the other interviews were at the respondent's office. In the end, the interviews duration lasted between 38 minutes to 1 hour and 9 minutes.

The interviews have been conducted in English, and all of them have been recorded with the permission of the respondent. The authors asked the interviewees whether they would like to receive the interview guide, but none of them seemed interested in having them before. In conclusion, all of the respondents were available for further clarification if necessary.

4.8 Interview guide design

The interviews are structured in six parts: introduction, risk definition, use of PRM tools and techniques, reasons for a non-use of PRM tools and techniques and conclusion. These sections are equal for all the interviews, but the order may slightly change depending on the context. Since the authors have semi-structured interviews, these sections are more a guidelines for the authors to be sure to cover all the main issues they wish to address as outlined by Bryman & Bell (2011, p. 343).

Part I: Introduction

First, the authors describe the study, its goals, and why each respondent and organisation can provide relevant information to fulfil the research. Then, the authors ask questions regarding personal details of the project managers (e.g. experience on projects) as well as background information about the company. This theme allows the authors to understand better the context and the experience of the respondents that might affect their answers in later stages. In addition, questions regarding anonymity and the confidentiality of the interviewees are asked as well as the permission to record the interview.

Part II: Risk definition

After the introduction, the definition of risk is asked to the interviewees. The main goal of this part is to evaluate the current knowledge and understanding by project managers about the concept of risk. In particular, the authors want to ascertain whether the interviewee is able to distinguish between risk and uncertainty and identify uncertainty as the cause of risks.

Part III: Use of PRM tools and techniques

This part aims to investigate the use of the ten tools and techniques identified in the subsections 3.4.2-11. The theme is important to increase the understanding of what are the tools and techniques used by project managers in practice. If a respondent states that a certain tool or technique is applied, but under a different name or in a non-formal way, it is then assumed that the tool or technique is used. Furthermore, a tool or technique might be used only for the management of negative risks and not for positive risks. In this case, the tool is considered as used and the reasons why it is not applied for the management of opportunities are not further investigated since they are outside the scope of the present thesis. The aim of the research is to understand what are the reasons for the non-use of PRM tools and techniques, not their misuse. Therefore, this study focuses only on the reasons for the non-use of PRM tools and techniques.
Part IV: Reasons for a non-use of PRM techniques

After having established, in Part III, what are the ten project risk tools and techniques that respondents used in their projects, questions regarding reasons for the non-use of PRM tools and techniques present in the list, are asked and investigate. Therefore, a number of questions are dedicated to investigating the reasons identified and described in subsections 3.5.2-9.

Part VI: Conclusion

The final theme concerns the concluding remarks that either project managers or the authors have. In addition, the possibility for further clarifications in case of additional questions or clarification is inquired.

4.9 Interview limitations

Although interviews are efficient method for the collection of data, these data are biased by the past experience and belief of the respondents (Eisenhardt & Graebner, 2007, p. 28). A solution to overcome this drawback is to have more interviews within the same company or more companies (Eisenhardt & Graebner, 2007, p. 28) in order to have different perspectives on the same phenomena, reducing thus, the bias. In this study, seven companies from the manufacturing sector for a total of nine respondents are investigated, therefore, the authors believe that they can obtain a more unbiased assessment of the phenomena under study.

The authors are conscious that interviews with risk managers or risk practitioners within the organisations under study would increase their understanding of the reasons for the non-use of PRM tools and techniques, making their findings more robust and less vulnerable to bias. However, due also to time constraint, the authors are more interested in the perspective of project managers as they are accountable for project deliverables and therefore dealing with risks is an activity that highly affect their work.

4.10 Ethical considerations

In many stages of business research, researchers have to deal with ethical issues (Bryman & Bell, 2011, p. 535). Indeed, in recent years, changes in laws and legislation about data protection and privacy have arisen the need by researchers to have a more responsible behaviour when conducting researches (Social Research Association, 2003, p. 7). The Social Research Association (2003) developed ethical guidelines that researchers should follow about society, funders and employers, colleagues and subjects. Although all of these aspects are important, the authors consider in this section only the guidelines related to subjects since they are more linked with the methodology chapter. The societal aspects are discussed in chapter 8. The ethical aspects concerned the respondents are divided into six different principles: avoiding under intrusion, obtaining informed consent, modification to informed consent, protecting the interest of subjects, preventing disclosure of identities, enabling participation.

Avoiding under intrusion

Researchers should be aware of the intrusive potential that their work may cause to the respondents (Social Research Association, 2003, p. 25). In section 4.2, the authors highlight the decision of using interviews instead of participant observation because it
has a lower level of intrusion in the interviewee’s work life. In addition, all the respondents voluntarily decided to participate in the study; they decided the time and the location for the interviews. Therefore, the authors believe that as researchers they have minimised the level of intrusion in informants’ lives.

**Obtaining informed consent and modification**

Gaining informed consent is “a procedure for ensuring that research subjects understand what is being done to them, the limits to their participation and awareness of any potential risks they incur” (Social Research Association, 2003, p. 28). In order to obtain the interview, the authors describe the research study and the data that they would like to acquire from the interview. In addition, before starting an interview, the authors always ask the permission to record, underlying that it would have been used only for this research purpose and it is needed in order to review some part of the conversation that the authors might not have been caught during the interview. Although the authors did not explicitly state that the respondent could also refuse to respond to their questions, the authors felt that participants were available and interested in the research as many of them said it would increase their knowledge on PRM. In the case, changes occur, or data might be used for other purpose, it will be the authors’ primary concern to inform all the subjects in this study. Therefore, the authors believe that they informed the respondents about the data they would like to obtain and the methods to obtain them in the most transparent manner.

**Protecting the interest of subjects**

Researchers should always try to minimise the potential harm that the research and the methods used to investigate the phenomena may have on the subjects. Damages may derive from “undue stress through participation, loss of self-esteem, psychological injury or other side effects” (Social Research Association, 2003, p. 35). The authors believe that the research does not provide any side effect as it aims to understand the reasons behind a non-use of PRM tools and techniques. It is not the purpose of this study to comment on a single respondent or company. Therefore, the authors believe that as researchers and through this study, they do not give any potential harm, both psychological and physical, to the respondents.

**Preventing Disclosure of identities**

In case a participant does not give the consensus to disclose his or her identity in the research, social researchers should “take appropriate measures to prevent their data from being published or otherwise released in a form that would allow any subject’s identity to be disclosed or inferred” (Social Research Association, 2003, p. 38). In this research, two interviewees preferred to remain anonymous. Therefore, the authors decided not to provide a description of the respondents as it might contribute to the disclosure of their identity. In addition, in chapter 6, the authors try to minimise the information regarding the respondents when reply to an answer in order to keep their anonymity. The authors, as researchers are not responsible for the other respondents who freely choose to reveal their participation in this study (cf. Social Research Association, 2003, p. 38).
**Enabling participation**

Researchers are responsible “to ensure inclusion in research projects of relevant individuals or groups who might otherwise be excluded for reasons of communication, disability, comprehension or expense” (Social Research Association, 2003, p. 37). The research’s target is project managers. Thus, other actors of the organisation would not be considered. Although the authors require a good knowledge of English and they focus solely on project managers, the authors were open to any project managers, regarding the gender, age, disability and so on and they have not refused any person who was interested in the research. Therefore, the authors believe they did not exclude any participant in this research.

4.11 Data analysis

Chapter 6 presents the data obtained and data analysis. The purpose of this single chapter is to alternate the presentation of the data and their analysis in order to avoid unnecessary repetition. This approach allows the starting of the analysis after the collection of some data to shape, through their implication, the next steps in the data collection process. This is one of the main features that distinguish qualitative data analysis from the quantitative one (Bryman & Bell, 2011, p. 425). By using a single chapter, the authors aim to gain insights from the empirical material by integrating the previously developed knowledge. Therefore, it is appropriate to combine empirical description with the analysis (cf. Glaser, 1965, p. 437).

Interviews provide qualitative data that take the form of large amount of unstructured text, which is difficult to analyse (Bryman & Bell, 2011, p. 424). According to Yin (2003, p. 110), there are three strategies that a researcher can use: developing a case description, thinking about rival explanations and relying on theoretical propositions. This study uses a deductive approach; the following chapter follows the design and contents of the theoretical frame of reference provided in chapter 3 (cf. Saunders, et al., 2009, pp. 489-490). Therefore, in this thesis, the authors adopt a strategy for data analysis that relies on theoretical prepositions. Consistent with this strategy, the authors use a “categorisation of meaning” as a process for qualitative data analysis. Categorising data consists in creating meaningful categories and then attaching these categories to significant information (Saunders, et al., 2009, p. 492). Indeed, the authors will use categories that reflect the literature and prior studies and then develop the analysis based on the data gathered during the interviews, attaching them to the respective categories.

**Summary**

Consistent with the authors’ ontological and epistemological position, they use a qualitative research strategy to investigate and answer the research objectives. Multiple case studies have been chosen as the methodological approach whilst semi-structured interviews are employed for the collection of data. The sample is based on seven companies in the manufacturing industry with a total of nine respondents.
5. Sector and Country Setting

This chapter gives a brief overview of the industrial and cultural setting. A description of the Swedish manufacturing sector is provided in order to explicate the context in which the research is carried out. The last section provides the peculiar cultural characteristics of Sweden to understand how Swedish people perceive risk.

5.1 Manufacturing sector

Sweden is an export-oriented mixed economy. Its economy is mostly based on timber, hydropower and iron ore (CIA, 2014). In addition, Sweden's engineering sector accounts for 50% of output and exports, while telecommunications, the automotive industry, industrial machines, precision equipment and the pharmaceutical industries are also of great importance (IEA, 2013, p. 4). Industry accounts for the 31.3% of Swedish GDP (CIA, 2014). Sweden manufacturing sector is composed by many SME. Despite this feature, Sweden ranks number one in the “Innovative Europe Index” because it has high investments in R&D (World Economic Forum, 2012, p. 20) and an excellent collaboration between universities and companies in research. Although Sweden has not been hit hard by the economic crisis as other European countries, the value of industrial production in 2012 was SEK 1519 billion; 4.6% less than the year before (SCB, 2012, p. 22). Umeå is part of the Västerbotten province, one of the most industrial areas of Sweden. Indeed, Västerbotten is the second largest region in terms of growing companies per inhabitants (VIA, 2014b) while Umeå municipality is the fourth in Sweden for business growth in 2013 according to the report “The Business Municipality of the year” (VIA, 2014a). The main challenge of the manufacturing sector in Sweden is to keep sustainable growth during this economic crisis that have an impact on the Swedish exports markets (IEA, 2013, p. 4).

5.2 Swedish culture and risk

The application of PRM tools and techniques is influenced by the perception of risk held by project managers (Bryde & Volm, 2009, p. 1068). The different ways in which risk can be perceived in turns originate from many factors (e.g. people’s judgements, attitudes, groups’ influences and so on), one of which is national culture (de Camprieu, et al., 2007, p. 692; Liu, et al., 2014, p. 10). As Raz & Michael (2001, p. 17) recognise, a limitation of their research about the use of PRM tools and techniques in Israeli companies is the unique characteristics of the Israeli national culture. This culture emphasises the importance of personal initiatives, improvisations and a tendency to solve problems when they occur (i.e. reactively). Setting a systematic and methodical work process, such as the one that should be carried out for PRM, has little value in that specific country (p. 17). Accordingly, the authors deem important to contextualise their research to the Swedish culture since all the managers interviewed are Swedish and work in Sweden.
In his research, Hofstede analysed more than 70 countries and studied their cultures from six different dimensions: power distance, individualism versus collectivism, masculinity versus femininity, uncertainty avoidance, long-term orientation and indulgence versus restraint. Uncertainty avoidance is “the extent to which the members of a culture feel threatened by ambiguous or unknown situations and have created beliefs and institutions that try to avoid these” (The Hofstede Centre, 2014b). In other words, it expresses the degree to which the members of a society feel uncomfortable with uncertainty and ambiguity (Hofstede, 1999, p. 41). Sweden has a low uncertainty avoidance index (UAI) with a score of 29. This score means that generally, Swedes have less concern on avoiding uncertainty and that deviation from the baseline or the norm is easily tolerated; schedules are flexible and innovation is not seen as a threat (The Hofstede Centre, 2014a). Because of this tolerance towards uncertainty managers might not feel the need to apply tools and techniques to manage risks. In addition, the fact that uncertainties and ambiguities do not generate anxieties in the Swedish culture (The Hofstede Centre, 2014a) might be related with threats denial (see subsection 3.5.7) as a reason for the non-use of some PRM tools and techniques. Since there is not an anxiety associated with the presence of threats, these might not be denied, and their management might not be considered as a negative affair.

Another cultural dimension is masculinity versus femininity. This dimension refers to “what motivates people, wanting to be the best (masculine) or liking what you do (feminine)”. Having a score of five, Sweden is a feminine society. In this kind of societies, managers tend to assure a consensus, even though this might require long discussions and efforts (The Hofstede Centre, 2014b). This aspect is related to one of the reasons why risks are avoided (see subsection 3.5.8), i.e. that project managers avoid the management of some threats because it is not possible to reach a consensus within the project team. This behaviour, therefore, might be not so present in Swedish companies.

A further dimension that might have an interesting link with this research is indulgence versus restraint, which is “the extent to which people try to control their desires and impulses”. With a score of 78 Sweden is a society characterised by indulgence. Among the various implications, this means that Swedes in general have a positive attitude and tend to be optimistic (The Hofstede Centre, 2014a). However, over optimism by project managers can lead to a delay in the management of threats and therefore to a non-use of PRM techniques as explained in subsection 3.5.9.

Note that it is not in the aim of this thesis to establish any cause-effect relationship between aspects of the Swedish culture with the application of PRM tools and techniques and the reasons behind a non-use. The aim of this section is to contextualise the application of PRM tools and techniques to the Swedish culture and highlight possible connections between cultural aspects with the various reasons that account for the non-use of PRM tools and techniques. Finally, not all the interviewees are expected to have these common aspects of Swedish culture since each person's risk perception can differentiate to some extent from the cultural ground.
6. Empirical Findings and Analysis

This chapter provides the description of the companies that participate in this study. Then, the data obtained are described and analysed. The chapter follows the design of the theoretical frame of reference.

6.1 Company description

The following sections introduce the companies that participate in this study. It is important to describe the firms that participate in the research as the respondents’ answers depend on the context in which they work daily. In other words, the type of projects the interviewees manage, the industry and the company size highly influences the use of PRM and thus the use of tools and techniques. Therefore, having some insights about the firms can help to understand better the data collected.

6.1.1 ABB

ABB is world leader in power and automation technologies for the improvement of performances whilst reducing environmental impact. Its main office is in Zurich (Switzerland); the company employs 145,000 employees globally (ABB, 2014). In Umeå, 50 people work to deliver power products, power systems and process automation. Therefore, projects are used to deliver the required solution to the client.

6.1.2 Company A

Company A is a project-based and world leading company in the manufacturing of agricultural vehicles. Its headquarters is based in Umeå where almost 200 people work while the remaining 450 are based in other countries. Projects are used mainly for product development.

6.1.3 Company B

This company supplies electricity, heating and broadband to customers around Umeå County. It is divided in five business areas: electricity trading, electrical networks, renewable energy, broadband and heating. It has 350 employees. Projects are implemented in order to design and build power lines infrastructures and equipment. Therefore, projects are not used to deliver a final service to an external customer but to improve and develop the Company B’s business operations.

6.1.4 Ecoclime AB

Ecoclime is a public company and a young manufacturing business focused on indoor comfort. It has been established in 2013 and the business is based on a unique patented technology for climate control heating and cooling systems. “Our climate control concept is based on a patented heating absorbent and a patented application of this
absorbent to indoor climate control” (Ecoclime, 2014). Umeå office has three employees who are responsible for the marketing, sales and administration while in Vilhelmina there is the factory where the comfort panels are made. In addition, offices in Stockholm and Arvika are used for sales and technical services. Projects are implemented to deliver the final product to the client, from the design phase to the delivery.

6.1.5 Mantena Sverige AB

Mantena Sverige AB was established in 2002 and it is a wholly owned subsidiary of the NSB Group (Mantena, 2014). The core business of the company is to provide maintenance and production of substitute parts for the trains. Therefore, projects are implemented for each train that needs to be repaired. In the Umeå factory, there are 17 employees, up to 21 in the busy periods. The whole company has 89 employees.

6.1.6 Seaflex AB

Seaflex AB is a family business with a long and established reputation in the design and production of mooring systems. Its unique mooring system is called Seaflex and is “an elastic mooring system that moors pontoons and buoys in every ocean on the planet, under all weather conditions. SEAFLEX moorings are highly resistant to corrosion and are unrivalled in their ability to safely and securely adjust with tides and wave motion” (Seaflex, 2014). Established in 1969, Seaflex has continuously expanded its business till arrive at the current dimension of ten employees. In addition, it has another office in California (U.S.A.) because its main customers are from Europe and the United States (Seaflex, 2014). Projects are mostly used to deliver the final product to the client, from the design phase to the delivery since each Seaflex mooring system is unique.

6.1.7 Umeå Industriteknik AB

Umeå Industriteknik AB is a manufacturing company that produces machines for the production line of other manufacturing companies (mostly automotive) in order to reduce production costs and improve competitiveness (Umeå Industriteknik, 2014). It has 15 employees and its customers are usually Swedish companies. Projects are used mainly to deliver a new product to a client, from its design to the final delivery. Each product is unique and has features that are tailor made for the customer.

Table 6 summarises key information regarding the respondents. The name, as referred in the data findings and discussion in the next sections, the position within the company, whether the respondent has any project management certification and the interview duration. As already mentioned in chapter 4, in two cases, the interview has been conducted with two respondents; in the next sections these are often referred as Nygren & Wälivaara and Brandt & Alenius, indicating that both respondents have shared a certain finding or implication.
As shown in table 6, most of the respondents do not have a formal title of “Project Managers”. However, in the interviews, the authors have asked if the respondents are accountable for the project deliverables as well as if they are in charge of the project itself. All the respondents have replied that they are responsible for the project, although no formal title of “Project Manager” is given. A reason behind this is that some companies such as Seaflex AB and Ecoclime are SMEs; therefore, the owners of these firms are also responsible for the execution of the projects. In Mantena, there are different project managers that work in different aspect of the project (e.g. economic project manager, safety project manager, etc.). Farmar is in charge of the maintenance of the train; therefore, he is a project manager since every maintenance work is a project. Respondent B, on the other hand, supervises all the projects that are running in company B and is in charge of the development and establishment of PM standards. Although Respondent B does not have now a formal title of “Project Manager”, he/she has been for several year a project manager within the company, so his/her experience in PM make him/her a suitable candidate for the research.

In the next sections, the empirical findings are presented. The interview guide is provided in Appendix 3. As already mentioned in section 4.11, the exposition of the findings is carried out together with their analysis. A comparison with theory is made in order to support the respondent’s analysis. This chapter follows the same structure of chapter 3, so that the line of argument of the thesis can be followed easily. Hence, the

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4 For the interviews’ answers, please contact the authors.
next sections are divided in risk definition (6.2), use or non-use of the most cited tools and techniques (6.3) and reasons for a non-use of PRM tools and techniques (6.4).

6.2 Defining risk

In this section, the empirical findings and the analysis regarding the evidence on risk is carried out. First, the definitions of risk given by the respondents are presented and compared with the definition provided by the PMBOK®Guide and adopted in this thesis (see subsection 3.2.1). Afterwards, it is described how the respondents differentiate between the concepts of risk and uncertainty; this is also compared to theory and past research (Table 7) as explicated in subsection 3.2.2.

6.2.1 Risk concept

The concept of risk held by the respondents is various and inconsistent; its definition is always fuzzy and vague. For many, it is addressed as a potential event that if it occurs has consequences on the project; these consequences are mainly, if not entirely, negative (Olofsson, Brandt, Alenius, Isaksson, respondent A, Nygren, Wälivaara). The word “event” is never used and risk is always explained as “something” unknown that can happen. Only the answer from respondent B is clearly stated and combine negative and positive sides: “risk is an uncertainty which can affect the outcome in a positive and negative direction. I am not of the opinion that risk is only a negative outcome”. This is exactly the definition provided by PMI (2013, p. 310). On the other hand, Olofsson, Alenius, Wälivaara & Nygren state that the concept of risk never includes a positive side, and “should be avoided as much as possible” (Olofsson). Furthermore, for Olofsson risk not only is “something that can go wrong, that you cannot plan”, but also something similar to a “feeling”. In Brandt’s view, risk is negative or positive depending on the point of view of the person that is considered the risk; if the risk is on him then it is a problem, but if it is a client’s risk then it is an opportunity for him to help the client to manage the risk. Brandt adds that risk is present in every decision and it is something that might not develop in a way that you have planned; in the end, every risk has economic consequences. According to respondent A, Wälivaara and Isaksson risk is positive or negative depending on the ability to manage it: “when [a risk] happens and you do not handle it, then it is of course negative, but when it happens and you take care of it and do not ignore it, then it is good. Positive or negative depends on the way you take care of” (respondent A). Farman believes that risk is “not something that we have in mind, [something that] you don’t know, everything can happen”. In Farman’s view project risk is primarily “anything that can affect people’s life”, since the projects related to his position regards train maintenance; trains have to be safe for the passengers and for the personnel that is working on them. Project risks related to extra costs and delays are an “everyday issue”. Risk is negative, but can be seen also as a challenge or an opportunity in order to, for instance, find cheaper solutions without affecting safety (Farman).

Different project managers within the sample conceive risk in different ways. This result is in accordance with other literature findings since different individuals could have different meanings and perceptions of risk (Zhang, 2011, p. 5; Lehtiranta, 2013, p. 641; Hartono, et al., 2013, p. 402; Taroun, 2014, p. 105). Furthermore, most of the project managers’ risk definition is not in line with the definition provided by the PMI (2013, p. 310). Most of the respondents admitted that they never thought about a definition of risk before (Brandt, Olofsson) and showed insecurity and hesitation when
answering (Isaksson, Wälivaara, Nygren). This confirms a lack of knowledge regarding the definition of risk, despite the fact that risks are managed on an everyday basis in these firms. While theory asserts a definition of risk encompassing both a positive and a negative meaning (PMI, 2013, p. 310; Ward & Chapman, 2003, p. 98; Lechler, et al., 2012, p. 67), in practice risk is viewed only or mainly as a negative outcome. This result is in line with many other researches carried out in different sectors and countries (Shapira, 1986, in March & Shapira, 1987, p. 1407; Olsson, 2007, p. 749; Bryde & Volm, 2009, p. 1068; Hartono, et al., 2014, p. 402). In addition, even in the case of respondent B who states a correct definition of risk, the respondent argues that in the end “we spend 90% of the time on the negative [risks]”. Therefore, PRM is mostly used as the management of threats (Ward & Chapman, 2003, p. 98; Olsson, 2007, p. 746).

6.2.2 Risk and uncertainty

The differentiation between the concepts of risk and uncertainty by the respondents is problematic. In literature, Galbraith’s definition of uncertainty, as stated in subsection 3.2.2, considers uncertainty as a knowledge gap between what is known in a certain moment in time and what should be known in order to perform a task or activity and assure project success (Galbraith, 1977, pp. 36-37; Krane, et al., 2012, p. 58; Regev, et al., 2006, p. 18). In practice, a similar concept has been found in one case, that is when uncertainty has been addressed as a lack of information when a person has to decide, and this can lead to risk (Isaksson). In other cases, uncertainty is seen as an “event” (respondent B), “something that one can analyse” (Olofsson), a “measurement of the risk”, for example the probability of occurrence (Nygren). In two cases, there is no clear distinction between the two concepts: “all uncertainties are risk. Before starting the project, everything is uncertain, hence all the uncertainties should be explored and those that cannot be handled at the beginning should be put on a risk list so that one is aware of them and can be monitored throughout the whole project” (respondent A). In the other case uncertainty and risk have been both defined as “[something that] you do not know”.

In PRM theory, uncertainty may or may not have an impact (Krane, et al., 2010, p. 82) while risks have an impact on project objectives. In other words, risk is uncertainty that matters (Hillson, 2010, p. 19). In practice, this differentiation can be found only in Alenius since “risk is a stronger [negative] term” while “uncertainty might not necessarily mean negative consequences”.

Furthermore, in theory uncertainty and risk are cause and consequence (Perminova, et al., 2008, p. 74; Thamhain, 2013, p. 22). In practice, only for respondent B there is a cause-effect relationship between uncertainty and risk. In another case it is recognised a relation between the two concepts since the bigger the uncertainty the bigger the risk. However, this relation is not cause-effect since risk has “certain roots” while uncertainty, if it can be solved, can be used to keep risk down (Brandt).

These results are in line with previous research that shows that managers often confuse the concept of risk and uncertainty and hence their different management (Lechler, et al., 2012, p. 64). Some of the respondents explicitly pointed out that the difference between risk and uncertainty is something they never thought about before, admitting a need for further thinking (Olofsson, Brandt, Wälivaara). All the respondents showed hesitation when answering. These behaviours confirm a certain lack of knowledge and awareness among project managers.
### Risk Concept

<table>
<thead>
<tr>
<th>Theory</th>
<th>Nygren</th>
<th>Wäliavaara</th>
<th>Respondent A</th>
<th>Respondent B</th>
<th>Olofsson</th>
<th>Farman</th>
<th>Brandt</th>
<th>Alenius</th>
<th>Isaksson</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Risk is an uncertain event or condition that, if it occurs, has a positive or negative effect on a project’s objectives” (PMI, 2013, p. 310).</td>
<td>“Something that could go wrong, unknown, [...] that you do not know a priori”.</td>
<td>“Risk is something unpredictable that can happen. Positive or negative depends on the way you take care of”.</td>
<td>“Risk is an uncertainty which can affect the outcome in a positive and negative direction”.</td>
<td>“[Risk is] not something that we have in mind, [something that] you do not know, everything can happen”.</td>
<td>“[Risk is] something that can go wrong. A feeling”.</td>
<td>“[Risk is] a possible negative outcome”.</td>
<td>“[Risk is] something that does not develop in a way that you have planned”.</td>
<td>“[Risk is] a bad thing if it happens”.</td>
<td></td>
</tr>
</tbody>
</table>

### Risk and Uncertainty

<table>
<thead>
<tr>
<th>Theory</th>
<th>Nygren</th>
<th>Wäliavaara</th>
<th>Respondent A</th>
<th>Respondent B</th>
<th>Olofsson</th>
<th>Farman</th>
<th>Brandt</th>
<th>Alenius</th>
<th>Isaksson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uncertainty and risk are not synonyms, but cause and consequence (Perminova, et al., 2008, p. 74; Thamhain, 2013, p. 22).</td>
<td>“Uncertainty is more a measurement of the risk, how the probability to happen”.</td>
<td>“You can have risks that you know and exist. Uncertainty will be more like an unknown”.</td>
<td>“All uncertainties are risk. You cannot get that uncertainty to be handle before the project start and then you put it on the risk list”.</td>
<td>“It is not uncertainty in the world, but it is some event that can cause something to happen which gives a positive or negative outcomes in a project”.</td>
<td>“The bigger the uncertainty the bigger the risk, but uncertainty is not the cause of risk”.</td>
<td>“Uncertainty might not necessarily mean negative consequences”.</td>
<td>“If you have a lot of info you can reduce the risk and you can do the right decision”.</td>
<td>“If you have a lot of info you can reduce the risk and you can do the right decision”.</td>
<td></td>
</tr>
</tbody>
</table>

Table 7. Summary of respondents’ answers regarding risk concept and the difference between risk and uncertainty.
6.3 Project risk tools and techniques

In these subsections, findings regarding the use of the most cited project risk tools and techniques are presented. As explained in section 4.8, the following subsections describe only the tools and techniques that are used, whilst the cases in which the tools and techniques are applied are not further investigated (Figure 10). For those that are found to be not used, an explanation of the reasons given by the respondents is presented in section 6.4. At the end of this section, Table 8 summarises which tools and techniques are used and which are not.

![Image of decision tree diagram](image)

**Figure 10. Schematic description of interviews.**

6.3.1 Expert judgement

Expert judgement is a technique that has been found to be commonly used among the interviewees. In most of the cases, internal experts (e.g. senior managers and engineers) are used because the risks on which they focus are related to the companies’ core business (Brandt & Alenius, Farman, respondent A, respondent B, Nygren & Wålivaara). In few cases experts are external (e.g. engineers, client’s experts and lawyers) since the risks on which they focus are not common but their potential impact is deemed high (respondent A, Isaksson, Brandt & Alenius, Olofsson, Farman, Nygren & Wålivaara). In other words, external experts are used for the management of risks not related to the core business of the company. Experts’ judgement areas are mainly engineering, safety, technical and legal (Brandt & Alenius, Isaksson, Farman, Nygren & Wålivaara). This technique is usually employed in all the processes of a project (Olofsson, respondent B). Respondent B affirms that in order to manage risks properly, it is always preferred to rely on people, including experts, instead of other complicated tools.

To sum up, as indicated by theory experts are used in order to identify risks (PMI, 2013, p. 327) and advise about the risk response strategy (PMI, 2013, p. 346) while for the quantification of risks are not used. None of the respondents denied the use of experts; therefore, this technique is not further investigated.
6.3.2 Meetings

According to respondent B, meetings are set in order to plan the project; it is included a part specifically for identifying and analysing project risks. Similarly, Farman asserts that meetings are held to discuss about the project, including the risks. Brandt & Alenius state that there are no meetings deliberately focused, and named, for identifying, assessing and controlling risk; however the PM processes are structured in order to “mitigate something that is not defined as a certain risk, but we all know that if we do not do this seriously enough then there will be negative consequences” (Brandt). Nygren & Wålivaara have meetings specifically for project risks, where also the client is involved: “we sit together and have a workshop [about risks in the project]”. Moreover, respondent A normally holds meetings with the project team to discuss about risks. For Isaksson, meetings are set in order to deal with technical and financial project risks. Finally, Olofsson argues that since there are no RM processes, meetings about risks are not set.

In PRM theory, meetings are a technique that should be used in order to develop a RM plan, define responsibilities and categories of risks (PMI, 2013, p. 316). Project manager, project team and main stakeholders should be involved in the meetings (PMI 2013, p. 352). Meetings should be held periodically in order to assess risks status and review risk responses (PMI 2013, p. 352). All these activities have been found in respondent B and Nygren & Wålivaara while other respondents have less structured meetings, as it will be discussed in section 6.5.

6.3.3 Brainstorming

Respondent B affirms that brainstorming sessions are held during the meetings about the projects: “we usually have brainstorming around the WBS in which for each work package we try to figure out what risks can be connected with it”. Nygren & Wålivaara use it specifically for RM: “after explaining to everybody what the final product should look like, everyone has some minutes to write down all the risks that one can think. Then, all the risks are grouped in categories on flip charts”. Farman uses brainstorming inside the meetings in order to generate ideas on how to deal with risks. In another case brainstorming sessions are “mostly used for solving problems, not specifically for risks” (Olofsson). Finally, Isaksson, Brandt & Alenius and respondent A, do not use this technique. According to Alenius, “if you look at the type of risks we face in general in projects, they are not that many”, therefore it is believed that there is no need for a brainstorming session.

To sum up, brainstorming is a technique that only few respondents of the sample use and mainly in order to think about what risks might affect the project. This is coherent with the prescriptions from the theory (Chapman, 1998, p. 337; PMI, 2013, p. 324) and it is in line with what Lyons & Skitmore (2004, p. 60) found in engineering construction industry where brainstorming is used for the identification of risks. The reasons why the other respondents do not use brainstorming is further discussed in section 6.4.

The Work Breakdown Structure (WBS) is “a hierarchical decomposition of the total scope of work to be carried out by the project team to accomplish the project objectives and create the required deliverables” (PMI, 2013, p. 132). Its main goal is to give a clear view of the various activities in the project. Each of these activities can be subject to one or more risks.
6.3.4 Checklists

Brandt & Alenius state that the checklist is a tool used specifically for technical risks. If a risk in the checklist has an assessed impact level of “intermediate”, then the engineer should request a support, if the assessed risk is bigger, then a meeting should be set (Brandt). Isaksson has a checklist that concerns with risks related to their products; it is mandatory for them to follow the Maskindirektivet (Machinery Directive): “we do the ‘CE’ logo on every machine [therefore] we have to fulfil all the requirements. It is about safety. (...) It is a standard template where you have several questions [about risks]”. On the contrary, Nygren & Wälivaaraa assert that checklist has been used only for two big projects: “we have not done [checklists] so much, for big projects we can check to previous risk lists” (Nygren). Farman uses a checklist that is not an explicit list of risks but it aims to check whether technical activities are executed correctly in order to avoid risks. Another checklist regards the analysis of risks in terms of cost and time of activities. The rest of the respondents do not use any checklist for the management of project risks. Respondent B says: “I wish [but] we are not there yet. It always come down to priorities [and this] has not been my priority”. Respondent A, Farman and Olofsson have checklist but not related to project risks specifically: “yes, but it is more to keep track of the activities [and] to support project managers to do not forget any of the standard activities. We have that checklist for all the phases: what it is important for this phase and activities, what is important for these other activities and so on” (respondent A).

Some respondents of the sample (Brand & Alenius, Isaksson, and Farman) use checklists. As suggested by theory, checklist is a tool based on information retrieved from historical data and past experience of similar projects already implemented; only Brandt & Alenius use checklist in this way. In addition, it is important to bear in mind that the checklist is not a substitute of risk identification (see subsection 3.3.2.2). Project members should explore risks that are not on the checklist and update it constantly throughout the project (PMI, 2013, p. 324). This aspect has been argued also by Nygren by affirming that “it is dangerous [to use a risk list from past projects] because then you think ‘yeah, that should be the risks’ and you have the list”, and “maybe you can use it to complement the risks [identified in the workshop]”.

6.3.5 Assumption analysis

Brandt & Alenius state that often the client provides product requirements that are found to be inaccurate and therefore judged as groundless assumptions. Numbers and data from the client are questioned in order to avoid unrealistic assumptions. Therefore, assumptions are identified in some specific situations, but not in a structured way because of a lack of competences of the company’s managers (Brandt). Olofsson, Isaksson, respondent A, respondent B, Farman, Nygren & Wälivaara do not use assumption analysis.

Most of the respondents in the sample do not use this technique. This result is in line with what is stated in the literature about the non-use of assumption analysis. Many project managers, even in companies with mature RM processes, usually do not deal with unrealistic assumptions about the project (Lehtiranta, 2013, p. 642).
6.3.6 Probability-Impact matrix

P-I matrix is used by Isaksson, respondent B, Nygren & Wälivaara and respondent A in order to assess the impact and the probability of risks and prioritise them. Isaksson applies this tool as part of a standardised procedure that must be done in order to be able to put the ‘CE’ logo on the machines they produce. For respondent B it is an easy tool since one can visualise the risks, positives and negatives, although in the end “the project managers spend 90% of the time on the negatives”. On the other side it is “much more unscientific than it seems” since the estimations of probability and impact are “very subjective”. In addition, Nygren & Wälivaara normally apply this tool: “when we have all the risks, then we put the probability and the impact for that risk and we have a matrix”. Afterwards “we get a risk value [i.e. the expected value] and a mitigation plan. Then we prioritise [the risks]”. Respondent A states that P-I matrix is used since “it is a simple way to think about everything”. However, respondent A explains that for projects that have little innovation, risks are considered to be always the same, therefore it is not used; he relies on the project team’s experience. Farman states that a similar assessment of risks is done but “it is not a formal matrix, we assess it in our minds”. Finally, Brandt & Alenius and Olofsson affirms that they do not know this tool.

Most of the respondents of the sample declare that P-I matrix is used (Isaksson, respondent B, respondent A, Nygren & Wälivaara). This finding is in line with the results of previous studies in other sectors (e.g. Wood & Ellis, 2003) where the P-I matrix is one of the most used tools in RM.

6.3.7 Sensitivity analysis

Sensitivity analysis is not used by any of the respondents in the sample. The reasons behind this result are outline in section 6.4. This result is in line with what found in the literature about the seldom used of quantitative tools (cf. Taroun, 2014, p. 110; Lyons & Skitmore, 2004, p. 60; Tang, et al., 2007, p. 950).

6.3.8 Expected monetary value analysis

Expected Monetary Value (EMV) analysis is a tool that is not used by Olofsson, as any other quantitative tools. Brandt affirms that he is not aware of the existence of EMV analysis, while Alenius knows it but states that it is not used in Seaflex because there are few uncertain variables in the engineering phase of the project, therefore it would be a “waste of time”. In addition, Isaksson asserts that EMV analysis is not used since he does not know this tool. Respondent B knows EMV analysis but he/she does not use it; he/she affirms that when one starts to use some tools, there is an immediate increase of quality in the management of risks, however when “you reach 99% [of RM quality], the amount of effort needed to arrive at 99.1% is better to put it in other areas”. In addition, Farman, Nygren & Wälivaara do not use it. Respondent A does not use decision tree diagrams for calculating different scenarios in terms of money, but this tool is used in order to foresee all the different situations that can happen in case a product malfunction occurs; it is used for safety and it is a legal requirement to fulfil.

EMV analysis is not used by any respondent of our sample with the exemption of respondent A that use it only for a specific purpose. This result is in line with other researches carried out in other sectors (Raz & Michael, 2001, p. 10; Akintoye & MacLeod, 1997, p. 36) where EMV is seldom used.
6.3.9 Monte Carlo simulation

Respondent A uses a software (Crystall Ball) that is an extension of Monte Carlo simulation in order to “estimate the cost of the projects (...) since costs [of materials] vary so much over time”. However, respondent A affirms that it is not used for project duration estimations since “we rely on experience, I do not know how many generations have done these products”. Olofsson, Brandt, Isaksson, Farman, Nygren & Wälivaara state that they never heard about MCS. Isaksson affirms that in the past his company was using another simulation programme “for capacity production, but not anymore”. Alenius is aware of the existence of this tool but does not use it because it is “too advanced” for the type of projects implemented and “takes too much work and time”. Respondent B is aware of the existence of MCS but it is not used since “we are not trained to use it” and “it is too complicated, the project manager would put too much time working in the analysis instead of proactive risk management. If we had bigger projects over a longer period of time I think I would have seen it differently”.

These results are in contrast with what identified by Wood & Ellis (2003, p. 261) regarding the use of MCS as one of the few quantitative tools actually used in construction projects. Indeed, in the sample of companies operating in the manufacturing sector, MCS is not used.

6.3.10 Variance and trend analysis

Nygren & Wälivaara and respondent A use variance and trend analysis, although it is not seen for preventing or understanding the risk source: “we monitor [the project] if we are on track and the cost is what was planned” (Nygren). Respondent A says: “This is where we put the most work” in order to understand if there are sources of risk. Farman does not personally use it, but other managers in his company use it in order to check whether the project is being implemented as planned. Olofsson and Brandt are not aware of its existence while Alenius, Isaksson and respondent B know the tool but they do not use it.

These results are in line with other research studies showing that quantitative tools are seldom used in sectors other than manufacturing (cf. Taroun, 2014, p. 110; Lyons & Skitmore, 2004, p. 60; Tang, et al., 2007, p. 950).

Table 8 summarizes the results obtained in section 6.3, showing for each tool and technique, which respondents use it and which do not use it.

<table>
<thead>
<tr>
<th>Tool/Technique</th>
<th>Used</th>
<th>Not Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert judgement</td>
<td>Brandt &amp; Alenius, Isaksson, Farman, Nygren &amp; Wälivaara, respondent A, respondent B, Olofsson</td>
<td>None</td>
</tr>
<tr>
<td>Meetings</td>
<td>Brandt &amp; Alenius, Isaksson, Farman, Nygren &amp; Wälivaara, respondent</td>
<td>Olofsson</td>
</tr>
<tr>
<td>Tools and Techniques</td>
<td>Respondent</td>
<td>Used in Research</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Brainstorming</td>
<td>B, Nygren &amp; Wälivaara, Farman, Olofsson</td>
<td>Brandt &amp; Alenius, respondent A</td>
</tr>
<tr>
<td>Checklists</td>
<td>Brand &amp; Alenius, Isaksson</td>
<td>Respondent B, respondent A, Nygren &amp; Wälivaara, Farman, Olofsson</td>
</tr>
<tr>
<td>Assumption analysis</td>
<td>Brandt &amp; Alenius</td>
<td>Isaksson, Brandt &amp; Alenius, Olofsson, Farman, Nygren &amp; Wälivaara, respondent A, respondent B, Olofsson</td>
</tr>
<tr>
<td>Probability-Impact matrix</td>
<td>Isaksson, respondent B, respondent A, Nygren &amp; Wälivaara</td>
<td>Brandt &amp; Alenius, Olofsson, Farman</td>
</tr>
<tr>
<td>Sensitivity analysis</td>
<td>None</td>
<td>Brandt &amp; Alenius, Isaksson, Farman, Nygren &amp; Wälivaara, respondent A, respondent B, Olofsson</td>
</tr>
<tr>
<td>Monte Carlo simulation</td>
<td>Respondent A</td>
<td>Brandt &amp; Alenius, Isaksson, Farman, Nygren &amp; Wälivaara, respondent A, respondent B, Olofsson</td>
</tr>
<tr>
<td>Expected monetary value Analysis</td>
<td>Respondent A</td>
<td>Brandt &amp; Alenius, Isaksson, Farman, Nygren &amp; Wälivaara, respondent A, respondent B, Olofsson</td>
</tr>
<tr>
<td>Variance and trend Analysis</td>
<td>Nygren &amp; Wälivaara, Farman, respondent A</td>
<td>Isaksson, respondent B, Olofsson, Brandt &amp; Alenius</td>
</tr>
</tbody>
</table>

Table 8. Tools and techniques that are used and non-used by the respondents.

6.4 Reasons for the non-use of Project Risk Management tools and techniques

In this section, the respondents’ answers regarding the reasons for the non-use of PRM tools and techniques are analysed, discussed and compared with the reasons proposed in PRM literature (see section 3.5).
6.4.1 Lack of knowledge or understanding

Within the research sample, lack of knowledge or understanding by managers is a reason that accounts for the non-use of assumption analysis, P-I matrix, sensitivity analysis, EMV analysis, MCS and variance and trend analysis. All the respondents ignore the existence of assumption analysis as a formal technique. Brandt & Alenius, however, have some form of questioning of groundless assumptions, as discussed in subsection 6.3.5, even if they are not aware of such technique. P-I matrix is not known by Olofsson and Brandt. Regarding P-I matrix, as well as any quantitative tool or technique, Olofsson states that he does “*not use any of these methods, because [he has] never learned them*”. He is aware that these tools and techniques would be helpful; however, he does not know how to use them, not because they are too sophisticated but because of a matter of priorities. This answer can be interpreted also as a lack of resources, as discussed in the subsection 6.4.2. Sensitivity analysis is an unknown tool for Olofsson, Brandt, Farman and Nygren & Wälivaara. Isaksson does not use EMV analysis because he is not aware of it. Olofsson, Brandt, Isaksson, Farman, and Nygren & Wälivaara ignore MCS. Variance and trend analysis is an unknown tool for Olofsson and Brant, while for Isaksson the reason he does not use it is that “*you need to be trained*”, that is lack of understanding. Respondent B is aware of all the previously mentioned tools (except assumption analysis) but he asserts that these are not used because “*we are not trained to use them*”, that is because of a lack of understanding. Alenius affirms that he is aware of the existence of these tools and techniques, but these are not used because of other reasons than lack of knowledge and understanding. Respondent A asserts, “*If I had a lot of money I would not put them in tools (...), not directly, I would do it in a way that you can educate [people to understand PRM]*”. Having another tool or technique for PRM does not help to manage risks, “*it is more important how well people understand PRM and processes (...) and take the most from it*” (respondent A). From respondent A’s point of view, the lack of basic knowledge of PRM is more important than the non-use of tools and techniques, since these can be used only if there is a good understanding of PRM.

These findings are coherent with what prior studies argued. Indeed, lack of understanding may be attributed to insufficient training in using tools and techniques (Akintoye & MacLeod, 1997, p. 36) as well as lack of awareness and knowledge about them. The results suggest that one of the main reasons for the non-use of PRM tools and techniques (especially quantitative tools), is because project managers do not know about their existence or are not trained to use them. Table 9 summarises what tools and techniques are not used because of lack of knowledge and understanding.

<table>
<thead>
<tr>
<th>Tool/Technique</th>
<th>Lack of knowledge</th>
<th>Aware, but lack of understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brainstorming</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Checklists</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Assumption analysis</td>
<td>Brandt &amp; Alenius, Isaksson, Farman, Nygren &amp; Wälivaara, respondent A, respondent B and Olofsson</td>
<td>None</td>
</tr>
</tbody>
</table>
6.4.2 Lack of resources

Lack of time has been addressed as one of the reasons why tools and techniques are not used (respondent A, Farman, Olofsson, Brandt & Alenius, Isaksson). Respondent A affirms that in general “it takes time to understand all the tools and processes [of PRM]”. Farman states that one of the reasons why P-I matrix is not used is “lack of time”; furthermore, decision tree diagrams are not used because “it will take me time to do it and I [prefer to] do a quick calculation”. As mentioned in the previous subsection, the main reason why Olofsson does not use P-I matrix and any quantitative tool or technique (decision trees, MCS, variance and trend analysis, sensitivity analysis) is lack of knowledge since he has other “priorities”. It can be implied that if he had more time and money he could learn about these tools and techniques. Therefore, also the lack of resources can be interpreted as a reason for the non-use of quantitative tools and techniques by Olofsson. For Brandt & Alenius one of the reasons why tools and techniques for quantitative analysis are not used is “too much work and time” (Alenius). Isaksson acknowledges that MCS and variance and trend analysis are not used because it is necessary to spend resources in order to “maintain the knowledge”, while these resources are needed for “other priorities”. Similarly, respondent B argues that the non-use of checklists is a matter of priorities. However, MCS is too sophisticated and the project manager would spend too much time on it instead of doing proactive RM, especially considering that the size of the projects implemented do not justify the efforts needed to use it (respondent B). In this sense, the non-use of MCS includes three different reasons: lack of training (see subsection 6.4.1), lack of time, and unwarranted use in relation to the project (see subsection 6.4.3). In addition, Nygren & Wälivaara deny that a lack of resources is a reason for not using tools and techniques, such as MCS; they state that “if we need [a tool or a technique], then we use it”.

To sum up, in practice it has been found that lack of resources is acknowledged as a reason for the non-use of several tools and techniques (respondent A, Farman, Olofsson, Brandt & Alenius, Isaksson, respondent B). This result is claimed also by Akintoye & MacLeod (1997, p. 37) and by Zhao et al. (2014, p. 30) in their studies regarding the construction sector. However, in one case lack of resources is not a valid reason for the non-use of tools and techniques (Nygren & Wälivaara). Lack of resources is also a main reason accountable for the non-use of PRM tools and techniques in this sample. Table

<table>
<thead>
<tr>
<th>Probability-Impact matrix</th>
<th>Olofsson and Brandt</th>
<th>Respondent B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity analysis</td>
<td>Olofsson, Brandt, Farman, Nygren &amp; Wälivaara</td>
<td>Respondent B</td>
</tr>
<tr>
<td>Monte Carlo simulation</td>
<td>Olofsson, Brandt, Isaksson, Farman, Nygren &amp; Wälivaara</td>
<td>Respondent B</td>
</tr>
<tr>
<td>Expected monetary value Analysis</td>
<td>Isaksson</td>
<td>Respondent B</td>
</tr>
<tr>
<td>Variance and trend Analysis</td>
<td>Olofsson and Brandt</td>
<td>Isaksson and Respondent B</td>
</tr>
</tbody>
</table>

Table 9. Tools and techniques that are not used because of lack of knowledge or understanding.
10 summarises the tools and techniques that are not used because of lack of resources by the respondents.

<table>
<thead>
<tr>
<th>Tool/Technique</th>
<th>Not use because of lack of time or money</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brainstorming</td>
<td>None</td>
</tr>
<tr>
<td>Checklists</td>
<td>Respondent B</td>
</tr>
<tr>
<td>Assumption analysis</td>
<td>None</td>
</tr>
<tr>
<td>Probability-Impact matrix</td>
<td>Farman, Olofsson, Brandt &amp; Alenius</td>
</tr>
<tr>
<td>Sensitivity analysis</td>
<td>Olofsson, Brandt &amp; Alenius,</td>
</tr>
<tr>
<td>Monte Carlo simulation</td>
<td>Olofsson, Brandt &amp; Alenius, Isaksson and</td>
</tr>
<tr>
<td>Expected monetary value analysis</td>
<td>Olofsson, Brandt &amp; Alenius</td>
</tr>
<tr>
<td>Variance and trend analysis</td>
<td>Olofsson, Brandt &amp; Alenius</td>
</tr>
</tbody>
</table>

Table 10. Tools and techniques that are not used because of lack of time or money.

6.4.3 Unwarranted use of tools and techniques in relation to project type

Many respondents underline the inadequacy of PRM tools and techniques specifically for their projects. Unwarranted use in relation to project type is accounted to be the reason for the non-use of brainstorming, checklist, assumption analysis, P-I matrix, sensitivity analysis, MCS and variance and trend analysis by some of the respondents within the research sample. According to Brandt & Alenius, brainstorming sessions are not used because the risks that might affect their usual projects are “not that many”: technical and legal risks are always the same and already well managed. Therefore, the tool is not needed (Alenius). The use of checklists is considered by Nygren & Wällivaara unwarranted for their usual projects; checklist has been used only in two big projects (Nygren). Wällivaara considers unsuitable assumption analysis for the type of projects implemented; he states that assumption analysis would better fit development projects where the possibility of inaccuracies and groundless assumptions is higher. P-I matrix is not used by respondent A because, in projects that have little innovation, risks are considered to be always the same; therefore P-I matrix is not used as the project team’s experience is enough (respondent A). Isaksson deems sensitivity analysis not suitable for the type of projects implemented. The use of MCS is unwarranted according to respondent B and Alenius. As anticipated in the previous subsection, respondent B does not use MCS because of three reasons: lack of training, lack of time (already discussed) and unsuitability for the type of project they have. Indeed, respondent B asserts, “if we had bigger projects over a longer period of time I think I would have seen it differently”. Therefore, respondent B would deem MCS more useful for bigger and more complex projects. Similarly, Alenius asserts that MCS is a tool “too advanced” for the type of projects implemented. Alenius state the same justification for variance and trend analysis. According to Farman, checklists and quantitative tools are not needed for the usual projects, “maybe if [I will have] bigger projects, (...) I will use it”.

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These results support the findings observed by Akintoye & MacLeod (1997, p. 36) in the construction industry where project managers do not use PRM tools and techniques for their projects as they are considered too sophisticated or unsuitable for the type of projects they manage. Therefore, unwarranted use of tools and techniques in relation to project type is a main reason for the non-use of PRM tools and techniques. Table 11 summarises the tools and techniques that are not used because of their unwarranted use in relation to project type.

<table>
<thead>
<tr>
<th>Tool/Technique</th>
<th>Un warranted use in relation to project type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brainstorming</td>
<td>Brandt &amp; Alenius</td>
</tr>
<tr>
<td>Checklists</td>
<td>Nygren &amp; Wälivaara and Farman</td>
</tr>
<tr>
<td>Assumption analysis</td>
<td>Nygren &amp; Wälivaara</td>
</tr>
<tr>
<td>Probability-Impact matrix</td>
<td>Respondent A</td>
</tr>
<tr>
<td>Sensitivity analysis</td>
<td>Isaksson and Farman</td>
</tr>
<tr>
<td>Monte Carlo simulation</td>
<td>Brandt &amp; Alenius, respondent B and Farman</td>
</tr>
<tr>
<td>Expected monetary value analysis</td>
<td>Farman</td>
</tr>
<tr>
<td>Variance and trend analysis</td>
<td>Brandt &amp; Alenius</td>
</tr>
</tbody>
</table>

Table 11. Tools and techniques that are not used because of their unwarranted use in relation to project type.

6.4.4 Preference for intuition and experience

In the research sample, several respondents acknowledge a reliance on intuition and experience (Olofsson, Brandt, Isaksson, respondent A, respondent B, Farman) when dealing with project risks. Olofsson states that instead of carrying out complex mathematical calculations he prefers to rely on intuition and experience: “I calculate in my mind, not mathematically”. Brandt affirms that he carries out “a little analysis [of complex situations], but not very elaborated and detailed”. Instead, there is a preference to lean on experience. In addition, Isaksson and respondent A admit that often they prefer to rely more on experience in the evaluation of risk probability when using P-I matrix. Respondent B states that the assessment of probability and impact of each risk is “very simple” since the project manager subjectively assign a value on a scale from one to three. Farman asserts: “we do not assess the probability for each risk in a quantitative way. We always think ‘that part will probably get damaged, that issue will probably happen’. I do not use any matrix [i.e. P-I matrix], but [I think about it] in my mind. I rely on my experience and intuition”. However, regarding some specific risks he states that some calculations on cost and time are carried out.

From these responses, it is possible to state that often there is a reliance on intuition and experience (Olofsson, Isaksson, respondent A, respondent B) together with some simple analysis (Brandt). This is in line with a previous research carried out by Hartono et al. (2014) that claim that the majority of project managers in construction projects rely heavily on intuition or simple analysis. While in the cases of respondent B and Isaksson
this reliance on intuition and experience is not a reason for the non-use of any quantitative tool, vice versa, in other cases (Olofsson, Farman, Brandt, respondent A), this leads to the non-use of PRM tools and techniques. Therefore, it can be stated that preference for intuition and experience accounts as a main reason for the non-use of PRM tools and techniques in this sample. Table 12 summarises the findings regarding preference for intuition and experience.

<table>
<thead>
<tr>
<th>Preference for intuition and experience instead of using tools and techniques</th>
<th>Reliance on intuition and experience but not in place of tools and techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olofsson, Farman, Brandt &amp; Alenius and respondent A</td>
<td>Respondent B and Isaksson</td>
</tr>
</tbody>
</table>

Table 12. Findings about the preference for intuition and experience by the respondents.

6.4.5 Diffidence towards statistics and mathematical models

The respondents are not diffident towards statistics and mathematical models. Olofsson says “I do not [have any diffidence], I have a lot to learn”. Similarly, Brandt & Alenius do not consider statistics and mathematical models as unreliable or untrustworthy. Isaksson is not sceptical about statistics and mathematical models: “I do not see so many good examples of these [tools and techniques]”. Respondent B believes that mathematical models can serve a nice purpose; however, “I believe PM is a lot about leadership and I do not want people to sit in their rooms and work with tools (...). I try to avoid complicated tools and methods in order to have continuously people working in RM, not working with tools. I have seen people setting days trying to quantify but I want people to manage risks, not use tools”. It is hence possible to grasp a certain diffidence towards quantitative tools and techniques because managers spend a lot of time in order to understand the tool or technique instead of managing risks. Similarly, Farman does not consider mathematical models reliable because “the reality is not as exact as the calculation, I rely on the reality, on my experience. The calculation is good to have; it as a road plan, something to look at, but the reality is way different”. Quantitative tools and techniques are therefore seen in a sceptical way because of their inability to reflect reality. Finally, Nygren & Wälivaara deny any diffidence or mistrust.

Many respondents’ answers demonstrate that the non-use of quantitative tools and techniques do not depend on scepticism about statistics and mathematical models. However, one case confirms what observed by Akintoye & MacLeod (1997, p. 36) that is RM should rely more on people instead of mathematical models (respondent B). In another case, quantitative tools and techniques are seen inadequate to grasp reality and managers prefer to rely on experience (Farman) as observed by McCray et al. (2002, p. 52). Therefore, in this sample, the diffidence towards statistics and mathematical models is perceived as a reason for the non-use of PRM tools and techniques. Table 13 summarises the findings regarding diffidence towards statistics and mathematical models.

<table>
<thead>
<tr>
<th>Diffident towards statistics and mathematical models</th>
<th>Not diffident towards statistics and mathematical models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondent B and Farman</td>
<td>Olofsson, Brandt &amp; Alenius, Isaksson, respondent A, Nygren &amp; Wälivaara</td>
</tr>
</tbody>
</table>

Table 13. Findings about the diffidence towards statistics and mathematical models by the respondents.
6.4.6 Denial of negative risks

Within the investigated sample, none of the respondents acknowledges the intentional denial of the existence of negative risks in order to not worry the client. Olofsson states that, since the priority is to sell the project to the client, sometimes, negative risks are not communicated, however risks are always managed in order to not lose reputation (Olofsson). Brandt affirms that risks are not denied, at least consciously, but always identified and managed proactively; since quality is a top priority risks cannot be denied only because talking about them to the client might generate anxieties. In addition, respondent B excludes the possibility that this happens consciously, however the respondent is aware of the fact that this might happen unconsciously: “I think that can be so [that negative risks are considered as a taboo], unintentionally”. Regarding the assessment of risk impacts and probabilities, respondent B acknowledges the possibility that these are assessed with “too low numbers” so that these risks do not have to be managed: “sometimes it is uncomfortable to raise the risk probability or impact to the highest level. (...) Psychology is difficult to manage”.

These results show that, at least consciously, no respondents consider risks as a “taboo”, nor RM as a negative affair. On the contrary, all the respondents deem very important to manage risks in order to preserve the quality and safety of the project product. Therefore, denial of negative risks seems a weak reason for the non-use of PRM tools and techniques and it is in contrast with what found by Kutsch & Hall (2005, pp. 594-595) where threats are denied and then not managed. However, being also an unconscious or unintentional reason it is very difficult to grasp and manage (respondent B). Therefore, the authors cannot entirely exclude denial of negative risk as a reason for the non-use of tools and techniques. This aspect will be considered for further research, in section 7.4. Table 14 summarises the findings regarding the denial of negative risks.

<table>
<thead>
<tr>
<th>Intentional denial of negative risks</th>
<th>Non intentional denial of negative risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Not observable. Further research is needed.</td>
</tr>
</tbody>
</table>

Table 14. Findings about the denial of negative risks by the respondents.

6.4.7 Avoidance of negative risks

Negative risks might be avoided in two situations: when the client does not want to put resources and get involved in the management of threats and when it is not possible to reach a consensus on the assessment of risks within the project team. Regarding the first situation, Brandt & Alenius state that in some projects the client does not want to be involved in the management of technical risks. In these cases, without the client’s efforts, the company is not able to deliver a completely safe product and hence start the project. The contract is therefore not signed. Although Isaksson admits that “we do not want to bother too much the client [by asking additional resources and support]”, he states: “we tried to manage threats anyway”; hence threats are not avoided. Farman distinguishes between risks of primary importance and risks that are secondary. He admits that sometimes the client does not want to help to manage negative risks, however “If I do not have any other solution, I will manage [the risk] anyway”. Secondary risks are instead left unmanaged because there are other priorities (Farman). Nygren & Wälivaara state: “The client are very interested about the project because
they are the one who are affected by it so they want to know everything”, therefore, all the risks are managed with the support of the client.

Regarding the second situation, Olofsson confirms that often there is a lack of consensus among the project team members in the risk assessment, hence the risks are left unmanaged and tools and techniques are not used. Isaksson admits that if a consensus is not reached then “sometimes we go on without the consensus but we try to find the consensus”. Respondent A says that “if you do not come to consensus often you do not [manage the risk]”. Similarly, Farman says “yes [we concentrate more on risk that we all agree on], otherwise [if] everything goes wrong I will be the person who takes all the blame, so you need to get with you all the parts that are involved in that issue”. For Alenius, even though there is not a structured process, usually efforts are put in order to reach a common agreement about the identification and assessment of risks. Furthermore, since different people, e.g. the engineer and the salesperson, have a more advanced expertise in managing their respective risks their judgement is generally followed. Therefore, threats are not avoided. Respondent B affirms that the project team analyses all the risks, even if these are not totally agreed. In this case, negative risks are never avoided.

These results are in line with what the literature suggests as one of the reason for the non-use of PRM tools and techniques (cf. Kutsch & Hall, 2005, p. 594). Indeed, some of the respondents admit that many risks are not managed because there is not a consensus among the project team (respondent A, Farman, Olofsson) while another one (Farman) affirms that less important risks are not managed because of a lack of support from the client. This reason is considered an important element for the non-use of PRM tools and techniques in the research sample. Table 15 summarises the findings regarding avoidance of negative risks.

<table>
<thead>
<tr>
<th>Risk avoidance due to lack of support from the client</th>
<th>Risk avoidance due to lack of consensus within the project team</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farman (only for secondary risks)</td>
<td>Olofsson, respondent A and Farman</td>
</tr>
</tbody>
</table>

Table 15. Findings about the avoidance of negative risks by the respondents.

6.4.8 Delay in managing negative risks

The management of negative risks is carried out proactively in some cases within the sample, and not delayed (Brandt & Alenius, respondent B, Nygren & Wälivaara). However, in other cases, the management of negative risks is delayed and tools and techniques are not used (Olofsson, Isaksson, respondent A and Farman). Olofsson states that there is a delay in the management of negative risks because it is expected that the client will provide support in case a problem arises: “when you develop new [projects] then you have to have a good relation with the [client], so (...) you can rely on [the fact] that he will help you if something goes wrong and he will understand, because he knows that I’ll solve for him [any problem] if we help each other”. Isaksson says: “if the solution is to minimise the risk we ask the client. We always try to anticipate”, however “we are human beings, and sometimes we wait and see”. In this case, therefore, there is an attempt to manage risks proactively but in some situations, there is a choice by the project manager to wait and see, hence the management of threats is delayed. In addition, respondent A and Farman delay the management of threats; however, their motivation is different from the ones identified in the literature. Respondent A asserts,
“I delay the management of the risk as long as it is agreed with the client”. Farman as well delays the management of a risk only if it is in accordance with the client: “if I know that there is that problem but I do not have time, then (...) I will talk to my client. (...) We delay the management”, but “everything is agreed with the client”. The delay in the management of negative risks therefore occurs also for these respondents and it is the consequence of an agreement between the project manager and the client.

Instead, the other respondents always manage risks proactively. Brandt & Alenius assert that in past years the RM used to be more reactive, problems were managed only when they arose, but afterwards the company developed “guide documents” in order to document failures and successes and be able, respectively, to avoid them and reiterate them (Brandt). It does not happen that the management of some risks is delayed because if a problem arises the client will help and support in order to fix it. Risks are always managed proactively (Brandt & Alenius). Similarly, respondent B argues that he/she tries to handle everything and not delay anything. Finally, Nygren & Wälivaara affirm that “if it is a risk that we can solve or connected to the customer we always talk to the customer, we do not wait” (Nygren) because “we have that type of relationship with the client in which we are transparent and we always talk about risks” (Wälivaara).

These results show that some respondents always manage negative risks proactively (Brandt & Alenius, respondent B, Nygren & Wälivaara). Other respondents tend in some situations not to manage negative risks proactively because there is a preference to manage the risk reactively (Isaksson). Other motivations are that the project manager expects a support from the client in case a problem arises (Olofsson) or because there is an agreement between the project manager and the client to wait and see (respondent A, Farman). Delay in managing negative risks is a reason for the non-use of PRM tools and techniques in the companies within the sample. Table 16 summarises the findings regarding the delay in managing negative risks.

<table>
<thead>
<tr>
<th>Delay in managing negative risk</th>
<th>Managing risks proactively</th>
</tr>
</thead>
<tbody>
<tr>
<td>Because the project manager expects a support from the client in case a problem arises</td>
<td>Respondent A, Farman</td>
</tr>
<tr>
<td>Because the project manager prefers to manage reactively</td>
<td>Brandt &amp; Alenius, respondent B, Nygren &amp; Wälivaara</td>
</tr>
<tr>
<td>Because an agreement between the project manager and the client</td>
<td></td>
</tr>
</tbody>
</table>

Table 16. Findings about the delay in the management of negative risks by the respondents.

6.5 Other reasons

This section considers a number of reasons identified in respondents’ answers for the non-use of tools and techniques. These reasons are deemed to be significantly different from the reasons identified in the literature and discussed in previous subsections.

Regarding the non-use of checklists, Nygren states that “it is dangerous [to use a risk list from past projects] because then you think ‘yes, that should be the risks’ and you have the list”. For Nygren & Wälivaara, instead, prefer to identify risks for each new project throughout a well-structured workshop in which it is included a brainstorming
The checklist is seen as a dangerous tool as the project team might be tempted to skip the brainstorming and use directly the list of risks considered in past projects. This drawback regarding checklists has already been identified in literature (PMI, 2013, p. 324), therefore it cannot be considered as a new finding. Nevertheless, it has been argued as a reason for the non-use of checklists.

Regarding the non-use of quantitative tools and techniques, respondent B asserts that “when you start to use tools you have an increase of quality [of RM] and the effect of using the tools is very obvious, the positive outcome comes very soon. However, you reach a certain point where the effort you put in using a new tool only improve the outcome by a small margin”. Therefore, according to respondent B it is better to put efforts in other areas rather than trying to increase the level of RM by using additional tools and techniques as complex as those for quantitative risk analysis. This reason might be related to a lack of resources since it regards the efforts to adopt PRM tools and techniques instead of focusing on other areas that are considered more important. However, a new element differentiates this reason from a lack of resources. A certain number of tools and techniques are already used for managing risks and the use of additional tools and techniques increase the quality of RM only by a small margin. Therefore, there is a saturation in the use of PRM tools and techniques. Consequently, the authors deem necessary to consider such saturation as a separate reason for the non-use of PRM tools and techniques.

Respondent A argues: “I do not think you should rely too much on [tools and techniques] (...) Sometimes people say I used this [tool or technique] at the beginning of the project, now everything is good. [However], one tool do not take care of all the risks”. The use of tools and techniques is seen as an excuse to do not deal with risks throughout the project, having a passive behaviour towards the new identification and assessment of previous and new risks that might arise as the project progresses. Tools and techniques are deemed to increase complacency among project managers, decreasing their attention on possible events that can cause a negative outcome on the project. In other words, project managers may consider PRM tools and techniques a sufficient method for managing risks. No additional actions are taken as the project progresses, and risks are not monitored anymore in the project. Therefore, PRM tools and techniques may not be used in order to avoid the passive management of risks preferring a more active and attentive RM. This reason may be linked with the belief of respondent B that RM is about people and not “working on tools”.

6.6 Additional analysis

It has been explained in the study (Figure 10) that the PRM tools and techniques present in the list of the most cited tools and techniques have been assessed in order to understand which ones are used and which are not used by the respondents, to investigate the reasons for their non-use. However, very often the distinction between the use and non-use of a tool or technique by a respondent is very blurred, because it can be used in unstructured, informal or partial ways. In general, in order to clearly separate those tools and techniques that are not used, from those that are used, it has been considered that if a tool or technique is used in some way, even to a little extent, it can be considered as used, and therefore not further investigated (Figure 10). Consequently, being out of the thesis scope (Figure 11) and not directly linked to the research question, the following findings have not been previously discussed. However,
they represent a relevant information in order to understand better the use of PRM tools and techniques for further research as it will be discussed in section 7.4.

Many tools and techniques are used by respondents in ways that are not completely in line with what suggested in the literature or are used only partially. This is due to the non-existence in many cases of a formal and structure RM (Brandt & Alenius, Olofsson, Isaksson). For instance, all the respondents use experts and they are mostly considered for the identification of risks and the response actions to mitigate or avoid risks. However, the PMI (2013, p. 341) suggests that the use of experts is beneficial also for the quantification of risks and in this sample this has not been observed. In addition, the employed experts in projects can be specific on risks or on general project areas, which indirectly include also the management of risks (Oloffson, Brandt & Alenius, and respondent B). In the first case, since experts are explicitly involved in order to manage the risks, their use is considered formal. In the second case, since experts are not explicitly involved in the RM, but for different aspects of the project which include risks, their use is considered to be informal. Another example is the use of meetings. According to the PMI (PMI, 2013, p. 316) and Goh et al. (2013, p. 573), meetings should be set specifically for risks, however, the quasi-totality of the respondents does not have a specific meeting for RM, but identify and assess risks when discussing the project in general. Therefore, it can be argued that many tools and techniques are not properly used.

Figure 11. Description of the interview’s procedure.

In many cases (Brandt & Alenius, Olofsson, Isaksson) RM processes are run in an informal way and highly rely on the project manager. Therefore, within the company, different project managers may manage risks differently. In other circumstances, project managers apply tools and techniques in an informal way. For example, Brand & Alenius have a sort of questioning in order to identify groundless assumptions; however, this is done in a non-systematic way and without carrying out a formal assumption analysis. Therefore, it can be argued that the use of PRM tools and techniques is not formalised and objectively written down for future consultations or reviews.

Another aspect that deserves attention and that has been found in many other researches (Shapira, 1986, in March & Shapira, 1987, p. 1407; Olsson, 2007, p. 749; Bryde & Volm, 2009, p. 1068; Hartono, et al., 2014, p. 402) is the focus on the identification,
assessment and control of negative risks. Consistent with their definition of risk, all the respondents focus solely on threats while the management of opportunities (i.e. positive risks) is not seen as an objective of RM. Therefore, tools and techniques are only used for the management of negative risks. However, the PMI and other academics (e.g. Ward & Chapman, 2003, p. 98; Olsson, 2007, p. 746) point out the necessity for RM and therefore tools and techniques, to exploit possible events that can have a positive outcome on the project.

Summary

This chapter describes the data collected during the interviews, and the analysis made in order to obtain relevant information. The definition of risk as well as the difference between risk and uncertainty held by the respondents are unclear and confused. All the respondents but one identify risk solely as a negative event. The most used tools and techniques identified in the sample are expert judgement, meetings, brainstorming and P-I matrix while checklist and variance and trend analysis are used by some respondents. MCS expected monetary value analysis, sensitivity analysis and assumption analysis are the tools and techniques that the majority of the respondents do not use. Lack of knowledge or understanding, lack of resources, unwarranted use of tools and techniques in relation to project type, preference for intuition and experience are been found to be major reasons for the non-use of tools and techniques. Avoidance of negative risks, diffidence towards statistics and mathematical models and delay in managing negative risks also account for the non-use of tools and techniques, while (intentional) denial in managing negative risks is considered a weak reason.
7. Conclusion

This chapter aims to prove that the research question and objectives are met. In addition, it provides the implication of the study and its contribution to theory development. Finally, the authors provide suggestions for further research.

7.1 Summary of findings

The aim of this thesis is to study what are the reasons for the non-use of PRM tools and techniques in order to deal with project risks in the Swedish manufacturing sector. PRM is a fundamental discipline within PM for dealing with risk when managing projects (Lechler, et al., 2012, p. 59). It gives a key contribution in order to achieve project success (Lehtiranta, 2013, p. 640; Zhang & Fan, 2014, p. 414). Therefore, PRM processes, tools and techniques should be applied in a proactive way and systematically throughout the project (PMI, 2013, p. 311). Nevertheless, a considerable amount of past studies pointed out that managers only use few PRM tools and techniques. In addition, the adoption of PRM tools and techniques is sector- and country-specific. Therefore, in order to have a more effective PRM, it is crucial to identify and understand the reasons for the non-use of tools and techniques. A reason is a subjective explanation or justification of why a certain fact happens. Thus, it has been necessary to approach this study through a qualitative research method in order to be able to understand the complexity of the phenomena. Semi-structured interviews have been carried out for the collection of empirical data.

Since the research question regards the reasons for the non-use of PRM tools and techniques, it has been necessary first, to know which tools and techniques are not used by project managers. However, due to a lack of past studies, it has not been possible to consider a set of tools and techniques not used by project managers in the Swedish manufacturing sector beforehand. Therefore, the first objective of the present study has been to identify a list of PRM tools and techniques to be investigated. This has been achieved through a literature review. These tools and techniques are expert judgement, meetings, brainstorming, checklists, assumption analysis, probability-impact matrix, sensitivity analysis, Monte Carlo simulation, expected monetary value analysis and variance and trend analysis. This list comprises simple and sophisticated, qualitative and quantitative tools and techniques belonging to every process of PRM (planning, identification, qualitative analysis, quantitative analysis, risk responses and control).

A second objective consisted in the creation of a list of reasons for the non-use of tools and techniques. It has been accomplished through a literature review. These reasons are lack of knowledge or understanding, lack of resources, unwarranted use in relation to the project type, preference for intuition and experience, diffidence towards statistics and mathematical models, denial of negative risks, avoidance of negative risks and delay in the management of negative risks. This list comprises rational and irrational reasons.
The third objective has been to assess the use and non-use of tools and techniques in the list. This objective has been achieved through the participation of seven companies comprising nine respondents. The findings confirms the results of past researches (Wood & Ellis, 2003, p. 261; Tang, et al., 2007, p. 950; Taroun, 2014, p. 110; Lyons & Skitmore, 2004, p. 60) on the tendency to adopt simple and qualitative tools and techniques, while more quantitative and sophisticated tools and techniques are not used. Simple and basic tools and technique, such as expert judgments and meetings, are applied by almost all the project managers within the sample because do not require a formal PRM in order to be used. Hence, these tools and techniques have not been further investigated. The other qualitative tools and techniques, such as brainstorming sessions, checklists and P-I matrix are used only by some project managers. Regarding quantitative tools and techniques, sensitivity analysis, Monte Carlo simulation and expected monetary value analysis are not used, while few project managers use variance and trend analysis.

The fourth objective has been to assess the reasons for the non-use of those tools and techniques by project managers. Lack of knowledge and understanding, lack of resources, unwarranted use in relation to project type and preference for intuition and experience can be regarded as main reasons for the non-use of most of the tools and techniques. Diffidence towards statistics and mathematical models has been found as a reason the non-use of quantitative tools and techniques by some project managers. Finally, while avoidance of negative risks and delay in the management of negative risks have been found to be valid reasons for the non-use of tools and techniques because risks are left unmanaged, (intentional) denial of negative risks is found to be weak reasons.

The present study has found that many reasons for the non-use of PRM tools and techniques are interrelated to each other. For example, PRM tools and techniques (in particular the quantitative ones) are not applied by project managers because they are not aware of their existence or because they are not trained to use them. This reason can be coupled to a lack of resources. Project managers and project team members have to be trained in order to learn these tools and techniques. Thus, companies have to invest resources that however are contended with other activities. Nevertheless, for bigger projects the amount of resources available for PRM increases and the use of more sophisticated tools and techniques is justified. Therefore, reasons for the non-use of PRM tools and techniques cannot be considered independently from each other.

Furthermore, it has been found that project managers are not aware of the definition of risk and the distinction between risk and uncertainty. These concepts constitute the knowledge at the base of PRM. An effective RM should start from an understanding of risk concept and project managers should be aware of this. Resources should be first placed for enhancing the basic knowledge of PRM among project managers and project team members so that they can take the most from the use of tools and techniques. Therefore, a good understanding of basic knowledge of PRM is a pre-condition for the use of tools and techniques.

Another important finding that constitutes a new reason for the non-use of PRM tools and techniques is the fact that the quality level of the RM is already saturated by the use of certain tools and techniques. Additional tools and techniques would increase this level only by a small amount, hence are considered unnecessary.
Moreover, project managers may consider the use of tools and techniques when dealing with project risks as a sufficient method for managing risks and no additional actions are taken. Therefore, risks are not monitored anymore in the project. This perception of PRM tools and techniques may account for a new reason for the non-use of PRM tools and techniques. Project managers perceived insufficient the only used of tools and techniques and thus they prefer to rely on their experience and on an active RM instead of spending time on tools and techniques that might be inadequate for the management of risks.

7.2 Managerial implications

Theory and practice should always go hand in hand in order to effectively apply management theories to business. Therefore, to reduce the gap between the PRM tools and techniques proposed by theory and their effective use in practice, two ways should be pursued. The first one, discussed in this section, aims to help project managers to be familiar and confident in the use of PRM tools and techniques. The second, discussed in the next section, aims to build better theories by taking into account the managers’ perspective regarding PRM and the use of tools and techniques. Hence, the authors deem important to include recommendations, to provide useful insights for project managers that have to deal with risks. However, it is crucial to bear in mind that these recommendations are built upon the findings of a qualitative research around a small sample of companies. Since a statistical generalisation is not possible, project managers should evaluate to which extent these insights are applicable to their PM context.

Lack of knowledge and understanding about the existence and use of PRM tools and techniques by project managers is one of the main reason found in this study for the non-use of PRM tools and techniques. Companies should increase their awareness of the existing tools and techniques and rely less on intuition or experience since experience and intuition may lead to underestimate or wrongly estimate risks. A number of guidebooks developed by PM organisations and institutions specifically for project managers are available. An example is the Project Management Body of Knowledge (PMBOK®Guide) by the PMI. In these guidebooks, project managers cannot only learn about many tools and techniques that might be suitable for their RM, but also learn the basic concepts of PRM.

One of the findings of this study is the poor knowledge around the basics of PRM. In order to be able to judge correctly whether a risk tool or technique would be useful in a project or in a process, a project manager should have a basic understanding of what risk is, from both negative (threat) and positive (opportunity) point of views. Risk should not be seen only as a negative event that can affect the project but also as an opportunity, that if occurs can provide benefits for the project. RM and thus PRM tools and techniques should be used for the identification, assessment and control of positive risks. Finally, understanding the differences between uncertainty and risk, as well as how PRM should be structured into processes, are crucial aspects that project managers should consider in order to have a more robust and effective RM. Collaborations with universities are also a viable solution for enhancing awareness and knowledge around PRM tools and techniques or RM in general.
7.3 Theoretical implications

The present study contributes to PRM literature by carrying out an in-depth investigation about the reasons for the non-use of risk tools and techniques by project managers in a sector where prior research is missed. It contributes to reduce the gap between theory and practice. In addition, it provides useful findings and a starting point for further investigations on the use and non-use of PRM tools and techniques in the manufacturing sector as well as other sectors that are under-investigated. As already mentioned, generalizability of the findings is not claimed. Nevertheless, as it will be explained in subsection 8.1.2, the authors deem that the criteria of transferability is satisfied.

The findings emerged in this study are mostly in line with prior studies about the use and non-use of PRM tools and techniques and the reasons for their non-use. One of the reasons that accounts for the non-use of many tools and techniques within the sample is lack of resources. As discussed in subsection 6.4.2, quantitative risk analysis tools and techniques require companies to spend resources in order to maintain a knowledge system while these resources are contended by other priorities. Therefore, when developing and prescribing quantitative tools and techniques, scholars should bear in mind that these tools and techniques have to be economically viable. In addition, one reason identified in the literature has been considered weak in this sample (i.e. (intentional denial of negative risks). Therefore, scholars should consider these findings as a possible change in the reasons for the non-use of PRM tools and techniques.

In addition, the new findings outlined in section 6.5, constitutes an interesting contribution of the present study to the literature in order to understand better the non-use of tools and techniques in practice. Contrarily to past researches that were concentrating on few reasons for the non-use of tools and techniques, this study grouped together eight different reasons identified in the literature and assessed them. This aspect gives to the present study a broader view and a new perspective for the non-use of tools and techniques.

This study provides a list of the most cited tools and techniques identified in the literature as well as the main reasons for the non-use of such tools and techniques. The lists can be considered beneficial in order to assess the use and non-use of PRM tools and techniques or the reasons for the non-use of PRM tools and techniques in sectors or industries where there is a lack of studies. Therefore, these lists are helpful tools for researchers who wish to investigate contexts that are unfamiliar because of lack of research. Finally, the present study filled a literature gap by investigating PRM tools and techniques in the Swedish manufacturing sector.

7.4 Limitations and further research

Regarding the denial of negative risks, it has been found that this is a weak reason for the non-use of PRM tools and techniques. Nevertheless, as explained in this study, it can also be unconscious to think about threats as a "taboo" and the project manager might be not aware of it. Hence, this phenomenon should be further investigate with a more in-depth study.

The present study have identified what are reasons for the non-use of certain risk tools and techniques in a small sample. This study can be considered a valid starting point for
further research aiming at testing these reasons on a larger scale in the manufacturing sector in Sweden and outside Sweden; to understand to which extent these are present among project managers and which ones are the most important. These further studies can be both qualitative and quantitative.

Further research should also investigate what are the reasons for an informal and unstructured use of PRM tools and techniques. Having a structured RM is crucial for companies in order to achieve project success. Therefore, it should be implemented in a systematic and formal way throughout all stages of the project (Dikmen, et al., 2008, p. 47). It is hence necessary to seek what are the reasons that do not allow companies to adopt formal PRM tools and techniques.

Finally, linked to the previous issue, since risk is defined both as a negative and positive event that might affect project objectives, a formal RM should pursue opportunities besides dealing only with threats. The present study confirms the results obtained by past researches that project managers do not include opportunities in the risk definition, nor in their RM practices. Further research is needed in order to understand what the reasons for the non-management of positive risks are.
8. Truth Criteria

The chapter provides the criteria for the assessment of this study and societal consideration regarding the work of the authors.

8.1 Trustworthiness

A research is assessed not only by its contribution to knowledge development but also from other evaluation criteria. Internal validity, generalizability, reliability and objectivity are criteria suitable for quantitative research (Bryman & Bell, 2011, p. 287). Qualitative research, on the other hand, may need different criteria. Lincoln & Guba (1986, p. 18) introduced the concept of trustworthiness, which grouped the criteria to assess the rigor of the research and are similar to the criteria used for quantitative research: credibility, transferability, dependability and confirmability (pp. 18-19).

8.1.1 Credibility

Credibility deals with the acceptability by others of researcher's study (Bryman & Bell, 2011, p. 288). Credibility is an important criterion to assess whether the researcher had an extensive contact with the phenomena under study (Lincoln & Guba, 1986, p. 18). The aim of this research is to understand the reasons for the non-use of PRM tools and techniques in the Swedish manufacturing sector. The authors have been able to gather in-depth knowledge about the tools and techniques used to deal with project risks and the reasons for the non-use of other tools and techniques. In addition, the interviews have been conducted in person and mostly at the respondents’ offices in order to have a better understanding of the context in which these tools and techniques are used and not used. Nine respondents have participated in this study. Therefore, the authors have been able to compare the data gathered among the different respondents in order to increase the credibility of the study (cf. Lincoln & Guba, 1986, p. 18). During the interviews, the authors repeated what the respondents expressed, to be sure that the idea and concepts of the respondents have been understood correctly. This method allows the researcher to ensure credibility of this research through member checks (cf. Lincoln & Guba, 1986, p. 18). Therefore, the authors believe that the findings of this research are credible and valid.

8.1.2 Transferability

Qualitative findings tend to mirror the “the contextual uniqueness and significance of the aspect of the social world being studied” (Bryman & Bell, 2011, p. 289). In case other researchers wish to apply all or part of the findings to another sample of manufacturing sector or in another sector, in Sweden or outside Sweden, the authors have presented the context in which the data have been gathered. Section 6.1 described the companies that participate in the sample while Swedish culture and the Swedish manufacturing sector are presented in chapter 5 in order to define the context in which
the findings are obtained. In addition, Appendix 3 shows an example of the interview guide with the purpose of having the collection of data transparent and easily comparable with other situations of the same character (cf. Lincoln & Guba, 1986, p. 19). The aim of this research is to understand the reasons behind the non-use of PRM tools and techniques when dealing with project risks. Although the results may be relevant and similar to prior and future studies, the authors do not claim that these findings are generalizable to other sectors or countries. In addition, due to the small sample, the authors also do not claim that the research is generalizable to all the manufacturing companies operating in the Umeå region. The authors believe that the description provided about the context and the culture related to this study may be useful to understand whether the findings are transferable to other milieu (cf. Lincoln & Guba, 1986, p. 19; Bryman & Bell, 2011, p. 289). Therefore, the criterion of transferability is met.

8.1.3 Dependability

During the writing of the thesis, external audit has been carried out by the authors’ supervisor and peer students feedback through seminars and private meetings. In particular, the authors’ supervisor and colleagues have reviewed research question, the theoretical frame of reference, methodology, findings and analysis several times. External auditing is important in order to fulfil the criterion of dependability as Lincoln and Guba (1986, p. 19) argued.

8.1.4 Confirmability

Confirmability concerns with the acting in good faith of the researchers and that “personal values or theoretical inclinations sway the conduct of the research and its findings” (Bryman & Bell, 2011, p. 289). The authors conduct the research in a transparent and fair behaviour as underlined in the ethical issues (see section 4.10), and societal considerations (see section 8.2). In addition, the authors have conducted their research in the fairest and most open way being aware of their prejudices and prior beliefs on the results of the study itself. Therefore, the criterion of confirmability has been satisfied.

8.2 Societal considerations

Researchers have to conduct their researches in conformity with the appropriate legislation of the country and be aware that the possible effects that laws may have on their studies (Social Research Association, 2003, p. 16). This study aimed to understand the reasons for the non-use of PRM tools and techniques. The authors have not infringed any law during the study, and no laws affected the conduction and the findings of the study.

According to the Social Research Association (2003, p. 17): “Social enquiry is predicated on the belief that greater access to well-grounded information will serve rather than threaten the interests of society”. This study does not aim and does not wish to create resentment among the sample investigated or to other individuals or groups. Indeed, the primary goal of the thesis is to understand the reasons behind the non-use of PRM tools and techniques in order to increase awareness of the necessity to reducing the gap between theory and practice so to better manage risk and achieve project
success. Therefore, the authors hope that this work will be not seen as a threat but as an opportunity to development.


Umeå IndustriTeknik. 2014. Umeå IndustriTeknik AB’s website. [Retrieved 2014-12-06]


## Appendix

### Appendix 1 - Literature acquisition

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<tr>
<th>Source Name</th>
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<th>Search limitations</th>
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### Appendix 2 - PRM tools and techniques identified in the literature

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<td><strong>Benchmarking</strong></td>
<td>● Raz &amp; Michael (2001)</td>
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<td>● Chapman (1998);</td>
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Table 18. List of tools and techniques cited in the literature.

Appendix 3 – Interview design
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</tr>
</thead>
<tbody>
<tr>
<td>Preference on intuition and experience</td>
</tr>
<tr>
<td>Diffidence towards statistics and mathematical models</td>
</tr>
<tr>
<td>Denial of negative risk</td>
</tr>
<tr>
<td>Avoidance of negative risk</td>
</tr>
<tr>
<td>Delay in managing negative risk</td>
</tr>
</tbody>
</table>

Table 19. Example of interview guide.