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A new maturity model for analysing project risk management in the global automotive industry

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List of Abbreviations

BP	Base Practices
BSC	Balanced Score Card
CEB	Corporate Executive Board
CMMI	Capacity Maturity Model Integration
CPM	Critical Path Method
DB	Database
DIN	Deutsches Institut für Normung (German Institute for Standardisation)
ERP	Enterprise Resource Planning
EV	Earned Value
FMEA	Failure Mode and Effects Analysis
ERM	Enterprise Risk Management
EV	Earned Value
EVM	Earned Value Management
EVPM	Earned Value Performance Measurement
FMEA	Failure Mode and Effects Analysis
IJMPB	International Journal of Managing Projects in Business
IJPM	International Journal of Project Management
IJPOM	International Journal of Project Organisation and Management
IPMA	International Project Management Association
IS	Information Systems
ISO	International Organisation for Standardization
ISS	International Space Station
IT	Information Technology
KPI	Key Performance Indicator
NPD	New Product Development
NPV	Net Present Value
OEM	Original Equipment Manufacturer
OPM3	Organisational Project Management Maturity Model
PDCA	Plan – Do – Check – Act
PERT	Program Evaluation Review Technique
PM	Project Management
PMBoK	Project Management Body of Knowledge
PMI	Project Management Institute
PMJ	Project Management Journal
PMO	Project Management Office
PRAM	Project Risk Analysis and Management
RaaSC	Risk as a Subjective Construct
RISC	Rudimentary Intermediate Standard Corporate
RM	Risk Matrices

List of Abbreviations

R&D	Research and Development
SHAMPU	Shape, Harness, And Manage Project Uncertainty
SPICE	Software Process Improvement and Capability dEtermination
VDA-QMC	Verband der Automobilindustrie - Quality Management Center

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Abstract

Project risk maturity models, which encompass change management, continuous improvement and knowledge management issues, can be used to improve risk management in projects. The purpose of this research is to develop and apply a new maturity model for the assessment and on-going management of project risk management capability in the automotive industry. The success of strategic projects is critical for innovation in the automotive industry, and project outcomes directly influence time to market and future revenues for companies operating in this sector. Projects in this industry are generally characterised as high risk. The belief that the use of carefully acquired information put into some kind of rational order can avoid poor decision making and project failure is the foundation of traditional project management and, by extension, of project risk management. Prescriptive guides and methodologies are often too mechanistic and simplistic as regards the risk management process. This research presents a theoretical framework applying the centricity concept to four major project risk management dimensions, namely risk identification, risk assessment, risk allocation and risk appetite. The centricity concept was critical in the development of several of the labels that are an integral part of the maturity model, thereby furthering the understanding of risk management.

The research design is based on a multi-project case study analysis in a major German automotive company. The approach is qualitative and inductive, using 12 in-depth interviews with major stakeholders in the project management function in the company to provide data for the construction of the initial maturity model. This model is then verified and refined via an online survey and three further follow-up interviews. The findings provide material for the construction of a new maturity model that can be used for the assessment of project risk management capability and as a tool for on-going monitoring and improvement. The model is structured around the four dimensions of risk management – identification, assessment, allocation and appetite – and has four maturity stages – rudimentary, intermediate, standardised and corporate. The model is based on a detailed analysis of in-depth interview material in a specific industry sector. The model adds to existing risk management maturity models and is unique in being specific to the automotive industry. It can be used by risk and project managers, and can also be adapted to other industry sectors.

1 Introduction and overview

1.1 Introduction

In this chapter, the background to project risk management in the automotive industry is provided, and the concept of a maturity model for organisations is briefly presented. Further, the significance of risk management in practice, and risk aspects such as subjectivity and knowledge, are discussed. In the following section, the research motivation, aim and objectives are introduced. The methodology applied is briefly explained and the research process is outlined. Next, the thesis structure is presented, and the chapter finishes with a brief summary.

If product development projects are critical for project-oriented organisations' innovation and profitability, information technology (IT) projects are critical for most businesses because of organisational reliance on computer-based systems to stay competitive. Organisations are sensitive to selecting the right projects, and project management is seen to yield value in enterprises from such projects. In parallel to the quick turnaround time to satisfy customer demand, project complexity and related risks have also increased. Management of risk assists in detecting technical and managerial issues before they materialise (Javani & Rwelamila, 2016). This situation has led to a higher focus on management of risk which aims to minimise risks and augment the opportunities in the project life cycle. Javani and Rwelamila (2016) consider risk management the cornerstone of successful projects. Similarly, Kutsch and Hall (2005) see risk management as the most important factor for avoiding project failures. Javani and Rwelamila (2016) suggest that organisations cannot effectively manage their project risks if they do not manage their knowledge; in other words, knowledge is one of the most influential tools in managing risks in projects.

The recognition of risk management as providing a knowledge base is a fundamental aspect of the successful application of project risk management. Maturity model assessments are intrinsically related to knowledge management and organisational learning. A significant factor of organisational maturity is the level of documentation of lessons learned. Appropriate systems to process lessons learned support the reduction of project risks and risk assessments. The maturity model assessment, the development of subsequent coordinated action plans and its execution ensure knowledge has been valued and utilised (McClory, Read, & Labib, 2017). The

responsibility for these three activities, the model assessment, creation and execution of the plan reside in the parent organisation.

1.2 Background

It is estimated that more than a fifth of the world gross domestic product, over 12 trillion dollars, was planned to be spent on projects in 2014 (Adler, Pittz, & Meredith, 2016). Effective risk management can help to deliver projects to meet the triple constraints (cost, schedule, and specification), and avoid painful and expensive firefighting. However, implementation of risk management in the context of product development or IT projects in the automotive industry requires adaptation to the specific needs and challenges of those projects (Kwak & Dixon, 2008). It is recognised that project managers and senior managers resist putting effort into improving risk management, in part because of the mistaken belief that the highly risky and innovative nature of the projects being conducted makes it nearly impossible to predict and manage risks effectively.

Research on strategic projects suggests that firms use contracts to scope out projects, manage joint ventures, encourage cooperation, and, in general, implement the firm strategy (Adler, 2007). Risk can be classified into three distinct contract risk-sharing profiles: risk born primarily by the seller of products and/or services, risk born primarily by the buyer of the products and/or services, and risk that is shared between the buyer and the seller. Adler et al. (2016) explored whether the contract risk profile is related to key contract outcomes such as cost and scheduling budget overruns, and engineering change proposals that occur during the life of the project contract. Contractual relationships heavily geared toward buyer or seller risk can achieve a transactional purpose but may limit the amount of learning and new ideas that can be achieved during a project where risk is shared. Adler et al. (2016) find evidence that space is created for organisational learning when risk is shared and contracts are designed for protecting each party's self-interests. Pooling risk in a project contract, particularly in research and development (R&D) or new product development (NPD) can engender a sense of interdependence toward project objectives and the lessons learned can become more permanently ingrained as a firm strategy.

1.3 Research subject and significance

Project management is supposed to make organisations more flexible and innovative, and increase the ability to solve complex problems (Schoper, Wald, Ingason, & Fridgeirsson, 2017). Strategic projects' success in project-oriented organisations is critical for the organisation's performance in terms of sales and profit. This is particularly noticeable for companies in the automotive industry in which innovation plays a significant role. The significance of project management is evidenced by recent estimations of total project work as a percentage of total working hours in Germany to be 35%, Norway 33% and Iceland 28% (Schoper et al., 2017). According to Schoper et al. (2017), total project work as a percentage of total working hours, also called 'level of projectification', in the manufacturing sector in Germany is at 42%.This is already higher compared to other sectors; and it is expected to increase to nearly 50% by 2019. To aid with the increasing level of requirements project management is facing, different project management and project risk management standards and guidelines have been developed and widely deployed. Proper risk management helps practitioners to assess the real status of the projects (Bañuls, López, Turoff, & Tejedor, 2017). A review of current literature undertaken by Frank, Sadeh, Ashkenasi (2011) reveals project risk management as one of the top ten critical success factors. Other aspects are: clearly defined objectives and requirements, top management support and involvement, proper planning, vendor and customer involvement and partnership, appropriate staff selection and training, the existence of the required technology, customer and end-user satisfaction, good control, monitoring and feedback, and high levels of communication.

One major issue that remains unsolved when addressing risk is the subjective component of the risk phenomenon. Traditional project management has assumed risks objectively exist free of people's minds and values. This assumption positions risk analysis within the scope of natural sciences and technical analysis, engendering a standardisation of processes and practices. Probability is the only and most essential epistemological dimension, reducing risk analysis to a kind of quantitative analysis (Zhang, 2011).

Projects in a business environment face numerous difficulties and uncertainties. Reports indicate that over 40% of projects for the past few years do not meet their targets and business intent while the results are far better in high-

performance organisations than in underperformers (PMI, 2017). The automotive industry is not an exception. There have been recently several remarkable project failures with global suppliers' involvement e.g. Tanaka's massive problems with millions of airbags causing the largest automotive recall, Kobe Steel falsification of aluminium and copper products, Volkswagen's supplier disputes which stopped as much as six production plants and 28.000 workers or Robert Bosch's world's number one automotive supplier related diesel emission scandal - the list is long. A highly process-driven perspective dominates NPD of original equipment manufacturers (OEM) in the automotive industry. This is due to the characteristics of NPDs in this industry. A product-oriented market with a high number of customers and lot sizes and an industrialised production in contrast to individualised production typifies this industry. The ongoing trend towards a shift of the value chain, characterised by a transfer of tasks and responsibilities of NPDs from OEMs to tier-1 suppliers, leads to the high professionalisation of project management of tier-1 suppliers. When OEMs initiate an NPD, tier-1 suppliers have to accept and quickly react to all procedural requirements posed by OEMs, thus leading to the use of project development in order to implement these prerequisites. The automotive industry shows a high development of project development among OEMs and tier-1 suppliers. Despite the overall professionalisation of project development within this industry, project development is mainly a top management concern at tier-1 suppliers. This particular importance of project development is due to the required flexibility of tier-1 suppliers, which have to quickly respond to the demands of their customers, the OEMs. In contrast to the senior management of tier-1 suppliers, OEMs regard project management as having a primarily supportive function. This is also the rationale for the setting up of Project Management Offices in these company types. This illustrates the criticality of collaboration between suppliers directly working with OEM's for reducing risks in projects (Müller, Wald, & Görner, 2012).

The meaning of mobility as a service is changing the automotive industry. Autonomous driving, electric and hybrid motors are examples of product innovation or the complete reinvention of entire companies. Some component sectors such as gasoline and diesel powertrain will see dramatic decreases in volumes (Collie, Rose, Choraria, & Wegscheider, 2017). Three categories of innovation projects can be identified: breakthrough projects, platform projects and derivative projects. The risk propensity that determines the ability of a firm to invest either in breakthrough

projects, platform projects or derivative projects can be assessed based on its innovation strategy archetype. The willingness of senior managers and executives to devote a large part of the investment to breakthrough projects depends on the firm's innovation strategy archetype that reflects the risk propensity of the firm (Brook & Pagnanelli, 2014).

The significance of project risk management in the automotive industry has motivated the researcher to produce several articles focused on the implication of risk subjectivity in project management practice (Irizar & Wynn, 2013) including the use of the centricity concept applied to some key elements of risk management (Irizar & Wynn, 2014, 2015) and finally the development of a new maturity model for risk management in the automotive industry (Irizar & Wynn, 2018).

1.4 Research motivation aim, questions and objectives

The belief in a strict logic, such as a mathematic model, to deduce certain, absolutely infallible, conclusions, by which we can organise our lives in terms of this knowledge has been a constant in history. Starting with the Greek literature of the classical age, e.g. Plato, followed by other thinkers in the Renaissance, such as Spinoza, up until our times the illusion of certainty has remained (Berlin, 2013). The thought that the use of carefully acquired information put into some kind of rational order can avoid tragedy, vice and stupidity is the foundation of traditional project management and by extension of project risk management. Management guides and standards attempt to provide answers to questions such as 'What should I do' or 'What ought I do' or 'What would it be right or appropriate for me to do'. However, authors who follow the ideal of Enlightenment, e.g. Montesquieu recognise certain relativism. Individuals in different conditions or cultures may want different things, which contradicts the proposition of objective, uniform, eternal, fixed entities. Hume's proposition goes further, Hume says we cannot demonstrate physical objects exist. Demonstration remains in the areas of logic, arithmetic or geometry which follow artificial rules. What about risks? How can I demonstrate it exist? As Berlin (2013) puts it, "I cannot prove with mathematical certainty that anything exists, all I can say is that, if I ignore a thing, I shall rue it". And this should also apply to risk. Montesquieu says that not everything is everywhere at the same; Hume tells us there are no certainties but only probabilities.

When uncertainty is important, risk quantification may rely heavily on subjective estimates. Significantly, even experts may be as prone to overconfidence as lay people when forced to rely on judgement (Chapman & Ward, 2007).There have been certain attempts to reduce subjectivity when estimating risks (Alam, Khan, Shahriar, & Azad, 2014; Chapman, Ward, & Harwood, 2006; Woolliscroft et al., 2013). However, the traditional belief is that subjective risk perceptions must be irrational and need to be managed (Zhang, 2011). “If we fish for absolutes in the seas of uncertainty, all we watch are doubts” (Hock, 1999, p. 225). However, the level of project failure remains above 30%, and around 75% are not successful (Frank, Sadeh, & Ashkenasi, 2011).

Though there have been some reasonable attempts to construct models and tools to understand and manage project risk management, these are as yet underdeveloped and do not connect with the main body of literature on risk. The concept of centricity understood as the managers or organisation’s mindset or attitude, outlook and motivation in the relationship to others, can help to establish a feasible framework for integrating different risk thinking in the context of project management. Centricity applied to risk identification, risk assessment, risk allocation and risk appetite in projects can be a linking concept to integrate the two major schools of thought in risk management, risk as an objective fact and risk as a subjective construct (RaaSC). The centricity concept has been used as a stimulus for discussing good and bad risk management practice.

The model presented is relevant to organisations active in the automotive industry providing a framework for systematic and continuous performance improvement. The researcher aims to develop a framework simple in use which does not require a high degree of expertise and time when deployed in practice. The model is oriented towards beyond the identification of problems also helping in the construction of a solving problems plan. The model provides sufficient detail for assessing progress achievement and what is essential, considers the human resources or operational aspects. As suggested by Langston and Ghanbaripour (2016), the model proposed is customisable by organisations and systematic in its assessment of organisational capabilities.

The motivation for the research is to attempt to develop a new project risk maturity model for the global supplier automotive industry which will help ensure

quality outcomes and deliverables. In particular, the research aims to answer the following research questions (RQs):

1) Can the centricity concept be usefully harnessed to further our understanding of risk management?
2) Can a maturity model be developed for effectively assessing risk management capability in organisations?
3) Can this be applied operationally to enhance the overall risk management process?

Based on these RQs the following objectives are to be addressed:

1) Assess whether the centricity concept can be usefully harnessed and generate insights that could improve risk management.
2) Develop, using the centricity concept, a maturity model for effectively assessing risk management capability in organisations.
3) Analyse whether the maturity model developed using the centricity concept can be applied operationally to enhance the overall risk management process.

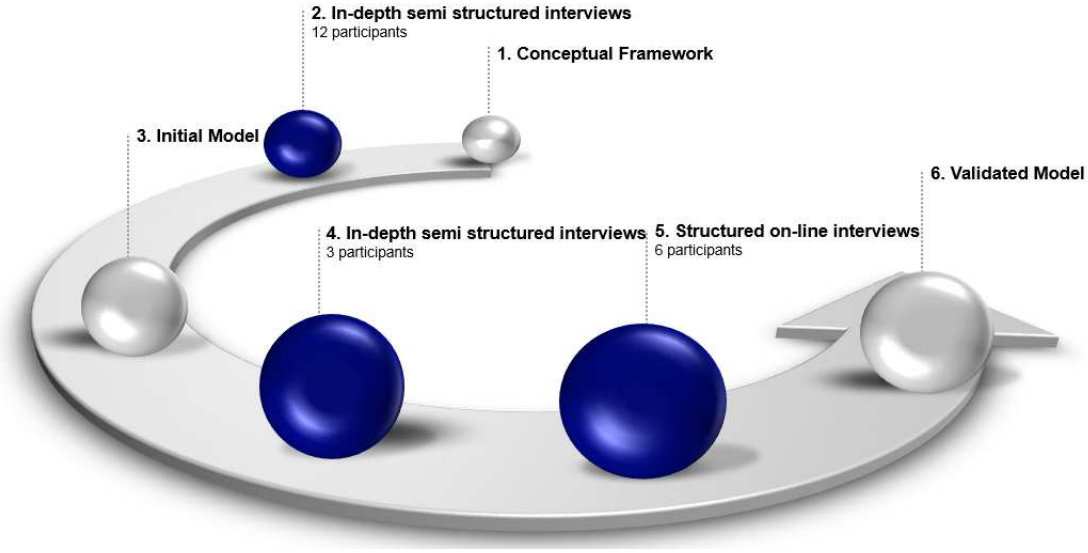
Maturity models are frameworks which enable assessing organisations' capabilities, entailing collective skills, abilities and expertise of an organisation. These models have been widely adopted for improvement project management practices. Existing risk maturity models presume project management is universal, control oriented and consistent, and the maturity is a linear process (Mullaly, 2014). In order for these to provide value, there is a need to develop models which consider the contingent and contextual approach. Now, the development of a maturity model for analysing project risk management requires an understanding of how maturity models can be developed, which dimensions are relevant as well as of the risk phenomenon itself, and the different ways in which risk management can be achieved. This is what this research project attempts to achieve.

To provide an insight into the overall research process, the following section provides a general overview of the methodology approach of the thesis.

1.5 Methodology

The research design is based on a multi-project case study analysis in a major German automotive company. The approach is qualitative and inductive, using 12 in-depth interviews with major stakeholders in the project management function in the company to provide data for the construction of the initial maturity model. This model is then verified and refined via an online survey and three follow-up interviews.

Figure 1:



Research design, model development and validation process

The overall research process (following the literature review) is depicted in Figure 1 and consists of six main steps. The process was largely sequential, although the interviews in steps four and five were conducted partly in parallel but independent from each other. The research centres on a single company case study, with two projects within that company analysed. The data collected through interviews with practitioners and executives were analysed using continual synthesis of the data, thematic analysis, data reduction and coding. The data was further processed into a set of “labels” or summary statements. Having built the initial model from data collected through the 12 semi-structured interviews, this was then tested for validity and relevance.

1.6 Thesis structure

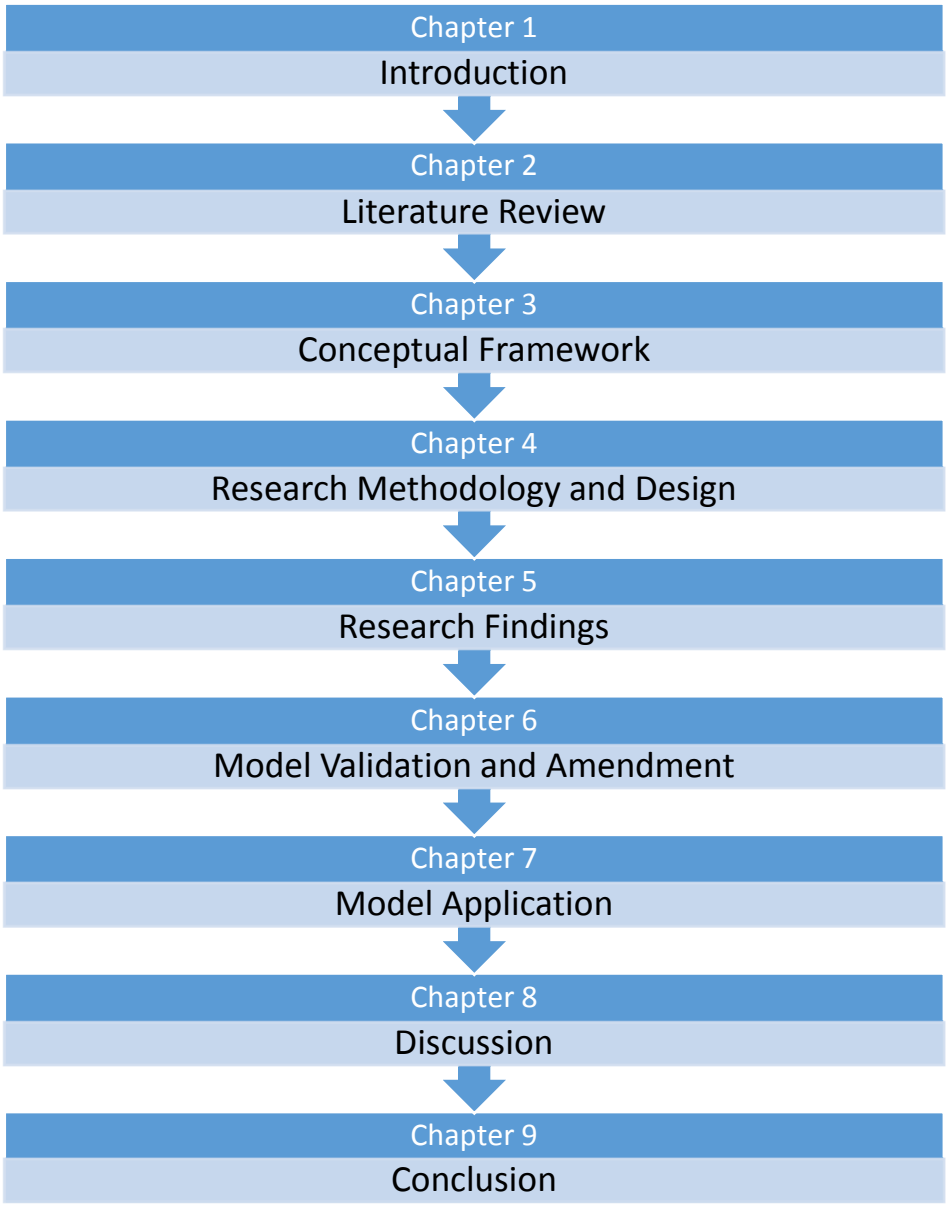


Figure 2: Thesis structure (developed for this thesis)

Following this introductory chapter, chapter two provides an overview of the literature on project risk management, its significance, current standing and major guidance and methodologies is provided. This chapter follows with a review on existing literature on objective risk identification and the concept of centricity in a management context. Risk management maturity models and their dimensions are discussed. This chapter concludes with a discussion of conclusions and the resulting questions and objectives.

Chapter three presents the risk management model based on which the project risk management maturity model was developed. The conceptual framework also provides the relationship between the selected risk maturity model dimensions and the centricity concept. In chapter four the research design is introduced. In this chapter, the research paradigm and research methodology are justified. Alternate paradigms are discussed, the case study in which this research is based is presented, and the reasons for using a qualitative approach are provided. In chapter five the application of centricity to project risk management in each of the four risk dimensions, identification, assessment, allocation and appetite is discussed. In this chapter, RQ1 is answered.

In chapter six the initially developed project risk maturity model is presented. The key objective of this model is to outline the labels that define organisation's maturity stage in each risk dimension. Chapter seven presents the changes, the rationale behind those amendments and the validated project risk management maturity model. In chapter seven RQ2 is answered. Chapter seven provides two practical examples of how the maturity model can be utilised. The output of the deployment of the modes is an action plan. Chapter eight answers RQ3. Chapter nine summarises the results of this thesis and gives conclusions about the research objectives. The contribution to knowledge and practice based on the findings of the research are outlined. It addresses the limitations of this research and possible areas for further research are discussed.

1.7 Summary

Projects in the automotive industry require major capital investments, the uncertainty, complexity, and risk are high, and the history of adopting and applying project management principles, techniques, and tools, is relatively short. Project management literature is a rich source of best practices in project management that could potentially be applied in automotive projects and in developing a maturity model for project risk management. Selection and the adaptive introduction of certain tools and techniques from the cutting edge practices of other high-technology industries can help to develop risk management in the automotive industry (Kwak & Dixon, 2008).

Literature review

1.8 Introduction

The main purpose of this chapter is to provide a theoretical framework for the primary research. It combines a traditional literature review and a systematic approach to discuss the concepts of subjectivity, centricity and maturity models in the field of project risk management. This literature review strategy utilises some features of the systematic literature review developed from previous studies for discussing the subjectivity aspect of risks in project management. The research approach for the rest of the identified key terms has been a traditional literature review based on synthesis. This literature review summarises, integrates, and where possible, cumulates the findings of different studies on centricity and maturity models in the area of project risk management.

The chapter contains eight sections including this overview representing the main steps taken to generate a useful foundation of literature for this study. The second section is devoted to explaining the literature review basic strategy and objectives. The third section discusses how risk management impacts on project success as well as an organisations' adherence and barriers to risk management practice. Following the description of the project risk management significance and current standing, the next section presents a review of project risk management guidance and methodologies. The following section discusses objective risk identification in conjunction with the centricity concept. The management of risk is a key element of all mainstream project management methodologies, and it has considerable implications for the effectiveness of the project management process. There are two main schools of thought regarding project risk management – 'risk as an objective fact' and RaaSC. Section four reviews how RaaSC features in existing risk management literature, and how these contributions can be classified or grouped together. While 'risk as an objective fact' considers risk to objectively exist, in the case of RaaSC, risk phenomena are subjectively constructed by the observers. In the next section, current status of project management risk organisational maturity in the literature is discussed. Section six analyses models to assess organisational project risk management maturity and reviews the dimensions or attributes selected. Section seven presents a literature review on three other risk dimensions in addition to identification: assessment,

allocation and appetite. Finall, this chapter closes with conclusions on the literature review in relation to the research questions and detected gaps in theory.

1.9 Mode of literature enquiry and review

The literature review takes as a starting point the study presented by Irizar and Wynn (2013) which used a systematic literature review to identify evidence on RaaSC. It resulted in 90 documented journal articles grouped into five areas outlining contexts to understand RaaSC. This literature review used Zhang (2011) study on objective and subjective risks sources. Zhang's sources were the International Journal of Project Management and Project Management Journal. His study period ranges from 1999 to 2009. This research extends the time frame search until 2017, and two further project management journals have been added, International Journal of Managing Projects in Business and International Journal of Project Organisation and Management. The keyword of the search is 'risk'. Search fields involve title, abstract, and keywords. This initial literature research intends to review the validity and usability of RaaSC in project risk management. The citations generated were reviewed according to inclusion and exclusion criteria defined that are explained in Table 1.

Parameters	Inclusion Criteria	Exclusion Criteria
Language	Studies written in English and German	Studies not written in English or German
Time Frame	Studies published from 1999 (inclusive) onwards	Studies published before 1999
Outcome	Articles related to risk	Little to do with risk
Technical – Non-technical evaluation	Risk analysis activities non-pure technical or value free	Activities of risk analysis pure technical
Rationality	Multiple rationalities in management of risk management	Single rationality in management of risk management
Study type	Journal articles	Any other than Journal articles

Table 1: Inclusion / Exclusion criteria of RaaSC

An example of the inclusion criteria is selecting "Peer Reviewed" - to ensure coverage of latest related research. An example of the exclusion criteria is "Publication

1999 – 2017" because few contributions to RaaSC were published before this date. In line with the evidence-based approach, the author has chosen those articles which provide examples which describe or analyse risks characterised as RaaSC. As pointed out by McDermott, Graham, and Hamilton (2004) there are different views among researchers regarding the appropriateness of the conventional systematic review methodology of integrating qualitative findings using the method of aggregating results.

Further, risk registers from 3 complex projects in which subjective documented items were analysed. Based on these observations the 'centricity concept' and its application to certain key aspects of project risk management were introduced as a mean to reduce subjectivity in the risk management process. This chapter therefore also reviews current 'centricity' concept literature in a managerial context. Subsequently, the research provides a literature review of several risk dimensions on which the 'centricity' concept can be considered with the aim to develop a deeper understanding of both the risk dimensions and the risk management process itself.

In most models of risk management, there are several key elements or dimensions of risk – identification, assessment, ownership etc. (see Figure 3). This subjective-objective construct dichotomy is particularly relevant to the identification of risk, which can also be associated with the concept of "centricity". RaaSC construct may thus be considered to be "person-centric". Centricity can also be applied to some of the other key elements of risk management, notably risk assessment, risk ownership and risk appetite.

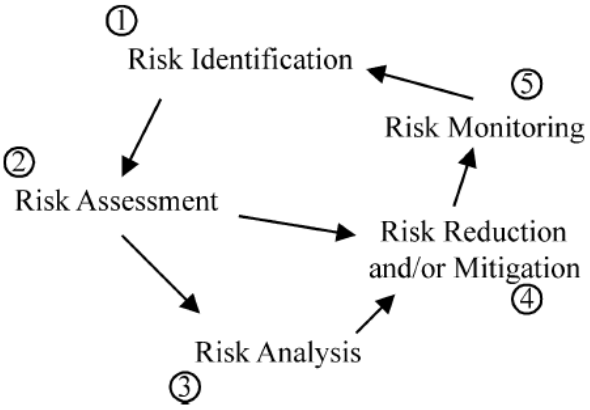


Figure 3: Generic overview of the risk management process (Patterson, Neailey, & Kewley, 1999)

Traditionally literature review in management research has been predominantly narrative. Narrative reviews have frequently been criticised for their bias, lack of establishing conditions to reuse past findings and non-adherence to the evidence-based approach (Tranfield, Denyer, & Smart., 2003). The author adopted Papineu's tree methodology for creating a network of core terms for the three research questions. The main idea of Papineu's is to develop a hierarchy of core terms within the literature. These core terms are based on identified particular contributions which are placed and criticised. The basic strategy has been to use search engines for automated search. Search engines compare the content of the research papers with the defined search terms. Literature has been mainly identified through the searching of the EBSCO Discovery Services (EDS), Google Scholar, the flagship project management journals, Project Management Journal (PMJ), International Journal of Managing Projects in Business (IJMPB), International Journal of Project Organisation and Management (IJPOM) and International Journal of Project Management (IJPM) as well as risk management journals such as the Journal of Risk Research and Risk Analysis.

The primary objectives of this review are:

- To generate insights that could inform policies aimed at enhancing current project risk management (impact of using prescriptive project risk management on project success)
- To identify and group past studies on project management that, implicitly or explicitly comprise the concept of 'centricity'
- To identify and group past studies on project management in which the concept of 'centricity' can be applied to develop the RaaSC debate to improve the understanding of risk management
- Provide insights of how project management risk maturity models are developed and applied
- To explore the literature on developing effective project risk management based on:
    - Risk identification

- Risk assessment
- Risk ownership
- Risk appetite

1.10 Project risk management, its significance and current standing

Project risk management is a fundamental discipline in most industry sectors. As a result, the management of risk is a key element of all mainstream project management methodologies. It has implications for the effectiveness of the project management process itself, and for the management and communication of knowledge that is an inherent part of that process. Several organisations have developed industry-specific formal policies and supportive analytical tools. Application of integrated risk management, early risk identification and assessment avoid schedule delays and cost overruns (Zayed, Amer, & Pan, 2008). However, there is no universally agreed definition of the risk management. Different project management bodies of knowledge and guides stress different aspects. Project risk management can be defined as the process that dynamically minimises risk levels by identifying and ranking potential risk events, developing a response plan, and monitoring actively during project execution (Zwikael & Ahn, 2011).

Practitioners and researchers agree on the existence of considerable potential in the adoption of risk and risk management concepts and methods in practice (Bannerman, 2008). Furthermore, the call for research to extend the relevance of the risk concept and risk management assumes that risk management contributes to improving project outcomes (Aloini, Dulmin, & Mininno, 2012b; Martínez Lamas, Quintas Ferrín, & Pardo Froján, 2012; Voetsch, Cioffi, & Anbari, 2004). Meanwhile, there is literature that suggests that the adoption of advanced risk management tools is directly related to the uncertainty about the final product, the greater the uncertainty of the type of project the higher use of risk management toolsets (Besner & Hobbs, 2012a). Other authors observe that the level of risk management adoption increases with the size of the project (Papke-Shields, Beise, & Quan, 2010). Finally, risk does not affect all organisations equally, those dealing more effectively with specific contingencies achieve more successful projects (Irizar, 2014).

Comprehensive risk management increases the probability of project success (Jen, 2009). Recent empirical studies show a significant positive relationship between project risk management usage and project success. Several risk-related practices are associated with a number of success dimensions. As an example, quantitative risk analysis is related to meeting technical specifications as well as quality requirements and client satisfaction (Papke-Shields et al., 2010). The effect of risk management practices on project results goes beyond the rational resolution of the identified problem, what is referred to as the instrumental effect of risk management. de Bakker, Boonstra, and Wortmann (2011) suggest project risk management contributes to project success through its communicative effect. This communicative effect occurs when stakeholders deliberately use risk management to convey messages to others, with the aim of influencing their behaviour, synchronising their perception, and making them aware of the context and their responsibilities. It stimulates action and increases the effectiveness of the action, helps to synchronise stakeholders' actions and perceptions making the situation more predictable leading to less uncertainty (de Bakker et al., 2011). Individual risk management activities have a positive effect on project success. Further, the influence of other stakeholder's perceptions and expectations through project risk management activities contribute to the creation of a common situation definition in the context of the objective world (de Bakker, Boonstra, & Wortmann, 2012, 2014a).

There appears to be a low regard for risk management activities, sometimes treated as a 'box ticking' exercise or administrative task rather than a management task (Kutsch & Hall, 2005). Certain industries report risk management only being done because it is a formal requirement for approval of the project plan (Besner & Hobbs, 2012b). Even worse, it is not seldom the case in which practitioners largely ignore risk management with the justification of the absence of an easy-to-use tool. Apparently, practitioners know that to ignore risk is irresponsible, yet they do not practice risk management (Jen, 2009). Other reasons frequently expressed for the non-use of risk management is the lack of cost justification. If project managers need to be convinced about the value of project risk management, further research could focus on the issue of whether the costs of applying project risk management are compensated by mitigating the risks that adversely influence the project outcome (Kutsch & Hall, 2009). Some practitioners claim existing risk management processes to be ineffective, with the risk register often containing 'trivial things' (Albrecht & Spang, 2014). Study

results showing that only 29% of the project offices consider managing risk databases point out the need of a stronger risk culture to increase the efficacy of project risk management (Sanchez, Robert, Bourgault, & Pellerin, 2009). These observations are consistent with the findings that risk management practices are among the least frequently utilised (Papke-Shields et al., 2010).

Prescriptive project risk management assumes a rational approach to decision-making by project managers. However, empirical studies suggest that the exercise of managerial judgment is the preferred mode of decision selection. Managerial judgement is based on situational assessment, and thus on tacit knowledge rather than the more prescriptive rational decision-making models option's evaluation (Taylor, 2004). It needs to be noted that prescriptive, probabilistic and objective based project management systems are no guarantee of success; in some cases, they can just create an illusion of control (Hodgson & Drummond, 2009).

The need to enforce and facilitate risk management in projects is commonly agreed either in response to its lack of use or practitioner's poor performance of some of the most critical risk planning processes, such as risk identification (Bannerman, 2015; Rastrelli & Ricca, 2015; Zwikael & Ahn, 2011). Voetsch et al. (2004) who confirm a direct relationship between risk management practice and project success, call attention to general control activities not identified as risk practices per se. General control activities not identified as risk monitoring practices, for instance, cost and schedule estimation, operational monitoring, financial audits, periodic performance reports and regular monitoring and controlling of issues as I will agree may be used to manage and monitor risk. The scope of project risk management may be narrow compared to the potential threats impacting product development and IT projects in the automotive industry. As pointed out by Bannerman (2008), more sophisticated organisations in project risk management integrate other threat-related management processes such as issue and crisis management in their project management practices.

1.11 Existing mainstream guidance and methodologies for project risk management

Project risk management is depicted in several guides, standards and frameworks. All of the mainstream methodologies have their own techniques and tools for assessing risks. A project management methodology can be conceptualised as the

application of knowledge, skills, tools, and techniques to project activities to meet a project requirements (PMI, 2013) or, using the widest definition given by Cockburn (Špundak, 2014), anything that the project management team relies on in order to successfully deliver project results. These methodologies include the Project Management Body of Knowledge (PMBoK), Project Risk Analysis and Management (PRAM), PRINCE2 and the Scrum Agile Standard. The first three of these are generally considered to belong to the so-called traditional project management approach, while Scrum is the most prominent of the new project management approaches (Špundak, 2014). Among all guides and standards, the Project Management Institute's (PMI) outreach, its proximity to the project management core theories and formalisation of processes compared to the other standards make it to the optimum standard guide for most authors (Thaheem, 2014). Practitioners enhance frameworks such as the PMBoK to their industries. Using their experience and lessons learned organisations develop specific project risk methodologies which they are able to continuously redefine, e.g. adding phases, adjusting the risk classification options or improving the documentation available for project managers and team members (Martínez Lamas et al., 2012). Nevertheless, other project risk management authors such as Chapman and Ward (2007) strongly dispute the use of certain tools and techniques advocated by PMI's PMBoK, such as the Probability and Impact Matrix for qualitative risk assessment. The academic world has long proved the misleading notion of this tool (Ball & Watt, 2013; Thomas, 2013). Experts own experience determines the probability estimate starting values, these are basically subjective, and therefore their estimates are biased. This effect is known as 'anchoring' (Tversky & Kahneman, 1974). PMI's PMBOK seems to promote on a more mechanistic model, which may be appropriate for certain situations, but may be quite inappropriate to many others, in particular, those associated with high levels of uncertainty (Morris, Crawford, Hodgson, Shepherd, & Thomas, 2006). Thus, a critical and context-conscious approach to the project risk management guides and standards is essential to develop an effective and efficient framework.

Adoption of pre-emptive design practices such as Poka-Yoke, Six Sigma or FMEA can reduce risk (Bahill & Smith, 2009). These techniques are embedded in the quality processes, in some cases are an integral part of ISO and QS certification levels. These techniques are means of capturing project risks. Poka-Yoke is a risk avoidance mechanism or means of reducing the likelihood of the occurrences of undesirable

events used in the supply chain, process and demand areas. The established process identifies deviances to perfection and triggers immediate corrective actions (Tang & Tomlin, 2008). Six Sigma is a process improvement methodology that uses statistical and other analytical measures (Niebecker, 2009). Embedding Six Sigma tools in the project risk management process can improve the management of risks by means of handling undesired effects (Tariq, 2013). Failure Mode and Effects Analysis (FMEA) is a systematic method of evaluating a process by identifying where and how it might fail, assessing the relative impact of different failures and identifying the parts of the process most in need of improvement. FMEA contributes to cost savings by decreasing development time and re-design costs, warranty costs, waste and non-value added operations and primarily is used to assess the risk of failure and harm in processes (Alam et al., 2014). Another method to identify cost, schedule and technical risks is Earned Value Management (EVM). EVM is a single method for measuring cost, schedule and technical aspects of a project integrating planning, scheduling, budgeting, work authorisation, accounting and managerial control. Earned Value Performance Measurement (EVPM) measures the status of the project and progress of a project against the baseline and forecasting the future performance. The project manager can report the status of the project whether it is on schedule, behind schedule or under budget (Niebecker, 2009). This method contributes to reducing uncertainty and is considered a technique which supports project risk analysis and management (Cabral, 2017). Recent studies from Elwany and Elsharkawy (2017) provided evidence of the positive impact for project success through the integration of EVM and risk management. All these practices and methods can be used in issue and crisis management, addressing non-foreseeable impacts which could eventually not be considered within the project risk management practice and thus, extending the means of threat management.

While analytical methods such as FMEA are essential tools for risk management to address technical risks in the project development phase (Carbone & Tippett, 2004), no analytical model seems sophisticated enough to represent the complexities and dynamics of all risk scenarios that might affect a major project (Thamhain, 2013). Early detection and risk management require an organisational environment conducive to collaboration among all stakeholders (Thamhain, 2013). Project management practitioners in industries which require intense collaboration - such as automotive product development - complain about insufficient development

of risk management methods and methods and processes not being integrated and synchronised. Lack of collaborative risk management, together with miscommunication, is the main reason for project failure in the automotive industry. Niebecker (2009) presents a collaborative project risk management model for the automotive manufacturing industry. The novelty in Niebecker's approach is his linkage between risk effects, key strategic objectives and Balanced Score Card (BSC) using a so called 'Overall Risk Index' as the leading Key Performance Indicator (KPI) that enables better forecasting when linkage to time and costs is available. While Niebecker utilises the Balanced Score Card as tool for collaboration in the project risk management context, other authors have also included the Balanced Score Card, focusing on organisational and project performance measures to identify, assess, analyze, and monitor R&D risks along the project cycle (Wang, Lin, & Huang, 2010).

External project/process dependencies are best communicated using visual representation such as risk-spider-charts which facilitate discussion and collaboration about project challenges and quick reference throughout the course of the project (Taylor, Artman, & Woelfer, 2012).

1.12 RaaSC and objective identification of risk

Risk is both fact-laden and value-laden, and it contains both objective and subjective components. It is argued that both the objectivist and the subjectivist view of risk are failed attempts to rid a complex concept of much of its complexity. The two oversimplifications both stand in the way of a more sophisticated analysis of risk (Hansson, 2010). No author presents a complete solution, and none of them proposes a risk management system that could integrate several risk constructs. At the same time, literature on risk registers and current risk management is available, but no relationship could be found between any of the existing proposals and the RaaSC concept. Just recently partial conceptual solutions attempt to develop a group based calculation that would cancel out the subjectivity factor and further add the factor of the standard deviation of the group calculation which could be used to form four different categories of risk priority numbers using FMEA (Alam et al., 2014).

While 'risk as an objective fact' considers risk to objectively exist, in the case of RaaSC risk phenomena are subjectively constructed by the observers. RaaSC may thus be considered to be "person-centric". Risk identification – how risks are identified

and by whom – is at the heart of the RaaSC school of thought. The identification of risk as a subjective phenomenon coincides with its creation – the risk exists only once the stakeholder has identified it. This is particularly noticeable for risks linked to an organisation's own qualities and deficiencies. As Zhang (2011) argues, different people identify risks differently, sometimes seeing them in contradictory ways that may result in different reorganisation policies, for example. As risks themselves are the outcome of social processes mediated by the experience and values of people or organisations, different construction of risk is a type of risk to project management. Subjective or person-centric identification can often produce inefficiencies in the management of risk that may impact detrimentally on project cost and overall project success. A move away from risk identification centricity or person-centric risk identification towards objective risk identification would benefit project outcomes (see Figure 4**Fehler! Verweisquelle konnte nicht gefunden werden.**).

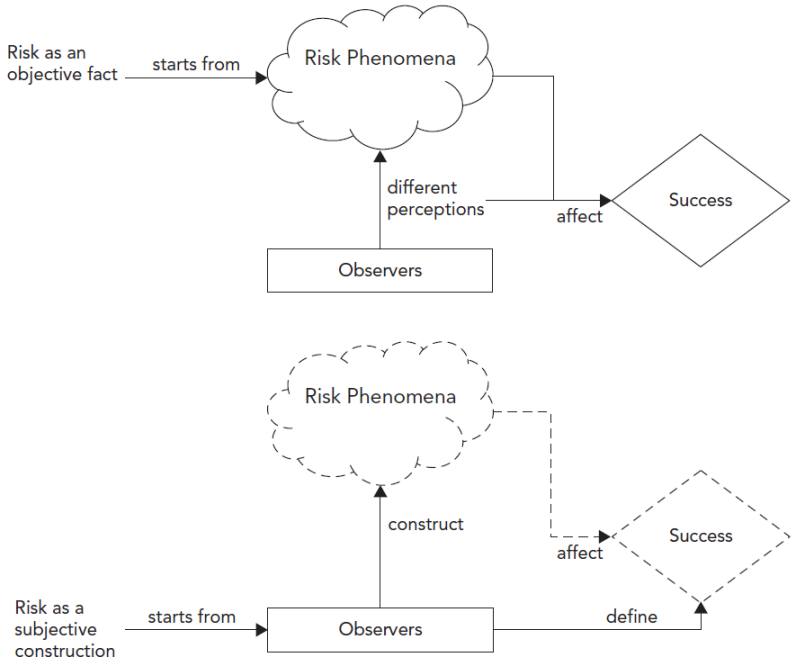


Figure 4: The two means of risk identification (Zhang, 2011)

An analysis of this literature suggests that one defining characteristic of RaaSC is the way risks are identified. The identification of risk as a subjective phenomenon coincides with its creation – the risk exists only once the stakeholder has identified it. Five areas were identified as interpretative contexts to understand RaaSC:

- Individual risk constructions
- Conflicts and contradictions

- Multiple rationalities
- Complexity - Size
- Perspective to project result/end product

As Khan and Burnes (2007) put it, whether one views risk from a subjective or objective standpoint, the key question for organisations is: how can risk be managed?

Project risk identification is the process in which the project team detects prospective events which might affect the project and documents their characteristics (Holzmann, 2012). Risk identification is considered to have the highest impact on the effectiveness of project risk management. This phase involves the detection and classification of all known, and as much as possible also unknown, risks, thus producing the foundation on which the whole risk management process can be established with an iterative approach (Chapman, 2001). Risk identification is also perceived as the most influential risk management activity (de Bakker et al., 2011, 2012). Risk identification in complex projects seems to be one of the key areas in need of improvement. Practitioners expressed it needs to be executed prior to and at the outset of the project (Harvett, 2013). Risk identification is performed in a variety of styles such as filling questionnaires, consulting experts or available documentation from previous projects, doing brainstorming sessions or conducting interviews. It positively influences objective and perceived project success. Communication between project members during risk identification plays a crucial role in this relation. This project risk management individual activity positive influence only occurs if project members discuss the risks with each other during the risk identification session (de Bakker et al., 2014a).

It is often said that ‘a picture is worth a thousand words’. Visual aids like The Visual Ishikawa Risk Technique (VIRT) overcomes the person-centric identification issue and promotes objective risk identification (Jen, 2009). Holzmann (2012) has addressed the question how to systematically use the knowledge available in the organisation in order to identify risks associated with complex projects. Her methodology integrates lessons learned based on two research techniques: content analysis and cluster analysis. Content analysis combines qualitative and qualitative procedures; cluster analysis utilises the database to develop a risk tree containing relative weights for each risk factor.

1.13 Risk centricity

Although the centricity notion itself remains largely undiscussed, centricity has been extensively analysed in relation to the customer, user and citizen concepts (Berntzen, 2013; Blakemore, 2006; Blakemore, McDonald, & Kelleher, 2007; Lamberti, 2013; McDonald, 2006)). Also, process, networks and nets-centric are the subjects of a substantial number of studies. In most of these meanings 'centric' can be replaced with 'driven'. Customer-centric from an organisational perspective is the focus on delivering customer solutions consisting of both goods and services. Drawing on this definition and in relation to complex projects, project-based-organisations should strive more towards customer-centricity as opposed to product-centricity. Ultimately the customer view towards solution exemplifies the solution-dominant logic, which can be considered the ultimate goal of service- and customer-centricity (Wikström, Hellström, Artto, Kujala, & Kujala, 2009). Customer-centricity in manufacturing industries has been measured in empirical studies using data collected from interviews and surveys with the aim to assess its interaction with innovativeness and service differentiation (Gebauer, Gustafsson, & Witell, 2011). Ting-Peng and Tanniru (2006) analysed information systems and the customer-centric to outline a customer-centric framework for information system development which has been later applied in several applications developments (Brenner et al., 2014). Similarly, government organisations evaluate their services provided to the general public based on how citizen-centric their organisational design is. Citizen-centric public service stays for transparent, engaged, flexible and agile and effective (Blakemore et al., 2007). In this context, centricity has been defined as a mindset (Berntzen, 2013). Centricity in a managerial context can be defined as the mindset or attitude that characterises the managers or organisation's outlook and motivation in the relationship to others (Olsen & Roper, 1998; Perlmutter, 1969).

Interestingly, Gummesson (2008) uses centricity as a pivotal term to further research holistic scenarios in the marketing arena. The centricity term is used for the analysis of major marketing concepts. Gummesson elaborates on supplier-centricity and customer-centricity as one-party centricity to then develop balanced centricity epitomised by the concept of many-to-many marketing. Balanced centricity is characterised in the marketing context as all stakeholders' right to their satisfaction of needs and wants. Although a sounded conceptual construct the author ends the

centricity construct at the conceptual and theoretical level with no empirical support, leaving the door for useful and practical means also in other disciplines as project risk management.

Joustra (2010) refers to project risk management as a set of activities often perceived as a bolt-on-extra or rather than integrated with the project management process and organisation. Centricity in the specific context of project risk management can be understood as the integration of risk management activities in the overall project management process as opposed to a specialist activity, perceived as alien to the project stakeholders. The centricity concept can be applied in a more nuanced manner to different aspects or dimensions of risk management such as risk identification, assessment and ownership. These risk management dimensions are outlined in section 2.8 and discussed in more detailed in Chapter 8. Some examples of a risk-centric approach to project management in general are provided, relating to specific industries:

- NASA (2005) designers defined a risk-centric view of the mission architecture and vehicle design which complemented their traditional performance-centric view through a risk-informed design. The integration of risk assessment as an integral element of the architectural design process allowed designers to examine risk trades concurrent with the design process. This approach resulted in an architecture that met vehicle and mission requirements for cost and performance, while ensuring that the risks to the mission and crew were acceptable.
- Feather, Cornford, and Moran (2004) present a risk-centric perspective for spacecraft technology decision making. Risks are used as a reasoning step to interpose between mission objective and risk mitigation measures. This risk-centric perspective starts with a broad definition of risk, encompasses risk of failing to design a system with adequate performance, compatibility and robustness in addition to more traditional implementation and operational risks. The risk-based decision-making methodology comprises architectural and design choices, technology plans and technology back-up options, test-bed and simulation options, engineering models and hardware/software development techniques and other more traditional risk reduction techniques such as tests, analyses and inspections. The risk-centric

perspective is manifest by the quantitative treatment of the relationships among risk and objectives or mitigation, were it to be applied, and likelihood/impact of the risk.

- Neogi, Hayhurst, Maddalon, and Verstynen (2016) developed a risk-centric certification requirement guide for an unmanned rotorcraft performing agricultural application operations.

This risk-centric view has not only found significant acceptance within the high-tech industries. Also, the audit and risk controls function responsible to develop the enterprise risk management (ERM) within the organisations have adopted a risk-centric approach in their modus operandi as described in the references below. Enterprise risk management (ERM) is a process applied in strategy setting across the enterprise designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives. Here follow few authors using the risk-centric concept:

- Clayton (2009) established a risk-centric management control maturity matrix to support the auditing process. This maturity model integrates a risk-centric approach into risk assessment and audit performance. The key connecting concept is management control, which represents management response to key risks that threaten the achievement of key strategic and business objectives. Management sets objectives, identifies risks, and responds to those risks based on the organization's risk appetite. Management control effectiveness is defined by taking the key objectives within any area, identify the key risks to meeting those objectives, and then analyse how vulnerable the operations are to the risks at the highest level. The author’s "maturity frameworks" of ERM and internal control helps auditors capture this management vulnerability. Vulnerability is measured by comparing management's response to key objectives with ideal management control.
- The value of internal audit is not that much performing audits but to provide the board and executive management with assurance that the organization’s risks are understood and managed within board-established risk tolerances. Integrated and state of the art systems are

required for providing stakeholders with assurance on a continuing basis that the more significant risks are managed and related controls are operating effectively. This is only feasible when organisations adopt risk-centric mind-sets, "shifting from an internal audit model focused on controls assurance to a risk-centric model where risk and control assurance are based on the effectiveness of risk management processes developed by management" (Business Objects, 2009).

- Sikdar (2017) refers to embedding a risk-centric culture as the effective approach to face vulnerabilities in organisations. The author points out how the organisation's risk appetite determines risk treatment; whether or not risks are to be shared, avoided, retained or tolerated, and also whether these treatments transferred some are to be implemented or postponed to some future date. The level of risk management maturity needs to be considered before designing risk strategy to embed risk within the culture of the organization.

This apparently obvious approach should not be confused with 'everybody does risk management' or 'everybody is in charge of risk' attitude. Accepting 'driven' as a matching synonym for 'centric', centricity may have different organisational implications. Project-oriented organisations pursuing complex, technological innovation with high intrinsic risk may adopt a risk management model with risk review boards. These boards, made up of external experts challenge the project design, risk assessment and risk mitigation decisions. The board owns the authority to assign reserves or contingency funds. For those organisations operating on more stable technological and market environments which primary risks may origin from apparently unrelated operational choices, risk facilitators from a central risk expert team are responsible for assessing projects risks and allocating funding to projects that reduce risk effectively. A third option is embedded experts working side by side with the project managers (Kaplan & Mikes, 2012; Kaplan & Mikes, 2016). These three distinct approaches show how the standardisation of the function is as complex as centricity elusive.

Based on the literature review presented in this section, the integrative aspect of centricity in the specific context of project risk management appears to be a relevant factor in the successful implementation of project risk management in different

industries. Further, the risk centric approach plays a key role in the development of risk maturity models as in the case of Neogi et al. (2016). However, there has not been explicit research on how the centricity concept can be used to better understand project risk management.

1.14 Project risk management organisational maturity

Maturity is a term introduced in business and management literature about 25 years ago, with the aim of assessing organisational capabilities. These capabilities encompass the collective skills, abilities, and expertise of an organisation. Maturity can be understood as a measure of organisational performance in applying these capabilities. There are several different maturity models in circulation, each addressing specific aspects of the organisation. Depending on the model, these identify different key contextual factors relevant to the stakeholders and provide descriptions of skilful individuals' engagement with environmental factors (Buckle, 2017).

A maturity model is an appropriate systematic framework to reflect the organisation's strengths and weaknesses of their project risk capabilities; thereby the organisation can plan and prioritise improvement initiatives (Backlund, Chronéer, & Sundqvist, 2015). The objective of maturity models is to provide an assessment framework that enables an organisation to compare its delivery with best practice or against competitors (Iqbal, 2005). The two major approaches to organisational maturity are the Organisational Project Management Maturity Model (OPM3) and the Capacity Maturity Model Integration (CMMI). OPM3 measures the organisational maturity based on the level of best practices deployment while CMMI assesses the maturity based on the organisational process effectiveness (Man, 2007). Further, organisational capabilities may refer to processes and projects (Maier, Moultrie, & Clarkson, 2012).

One of the major criticisms in regards to the development of maturity models is the complexity of maturity itself, as a phenomenon related to intricately-related factors. Developers of maturity models have been criticised for not having considered these interactions (Killen & Hunt, 2013). Other major criticism is the lack of consideration of real-world impediments to mature behaviour – while describing the maturity levels is relatively easy, a guidance to overcome such impediments is missing in most models (Buckle, 2017).

However, Brookes, Butler, Dey, and Clark (2014) argue the very high levels of variability in individual's project management maturity assessments. The authors suggest using the so called 'wisdom of crowds, by which participants agree with the aggregate maturity produced by averaging all of the individual assessments. This enables to arrive at estimations better than could have been done by any single individual. Other findings were that organisations with lower levels of project management maturity need for a simple but formal project management approach. On the contrary, organisations with higher levels of maturity seek to improve maturity in certain areas highlighted by the maturity model.

Assessing the organisation's project risk management maturity level is appropriate for developing its project capability and performance. Risk management maturity reflects the organisation's understanding of its risk portfolio and its attitude towards those risks. Risk management maturity can provide a guideline for assessing the current risk capability of organisations. Organisations intending to implement or improve their project risk management need a framework against which they can benchmark their current practice (Zou, Chen, & Chan, 2009). Maturity models can be developed and used to identify the priority or weakest areas needed for improvement and actions can be taken to increase the performance (Hopkinson, 2012). Determination of the project risk management maturity level may highlight an organisation's strengths and weaknesses from which a prioritised list of measures is derived, whose implementation helps to fill existing gaps in project risk management (Ciorciari & Blattner, 2008).

Risk Maturity Model	Description	Process area	Maturity levels
Hillson, Towards a Risk Maturity Model, 1997	• Description: Risk Maturity Model suggested by Hillson - this enables organisations to benchmark its maturity and capability in managing risk, using a generally accepted framework to assess levels objectively and assist in defining progress towards increased maturity • Aim: Risk management maturity assessment model for organisations • Scope: Risk Management • Administration: Not mentioned	• Number: 5 • Label: Attributes • Items: Definition; Culture; Process; Experience; Application	Naïve, Novice, Normalized and Natural
Zou et al. risk management maturity model RM3, 2009	• Description: Establishing risk management maturity in an organisation should be the starting point when embarking on a review of current risk management practices, systems, and culture • Aim: Risk management maturity assessment model for construction organisations • Scope: Risk Management in the construction industry Asia and Australia • Administration: Questionnaire	• Number: 5 • Label: Attributes • Items: management, risk culture, ability to identify risk, ability to analyse risk, and application of standardised risk management process/system.	Initial, repeated, managed and optimised

Risk Maturity Model	Description	Process area	Maturity levels
Yeo, KT, Ren, Yingtao Risk Management Capability Maturity Model for Complex Product Systems (CoPS) Projects, 2009	• Description: The maturity of risk management capability can improve the production and performance of complex product systems projects. From a change management perspective addressing and analysing issues in the organisational culture, risk management process and risk management knowledge, guided by strategic and performance measurement requirements • Aim: Risk management maturity assessment model for complex product systems projects • Scope: Risk Management in the Offshore and marine projects in Asia • Administration: Questionnaire, all questions/statements same weight with five choices, ranging from “strongly disagree” to “strongly agree.”	• Number: 3 • Label: Attributes • Items: Organisation culture, risk management process, and risk management knowledge/technology from the perspective of strategic change management with 9 Key attributes 1. Attitude towards risk and uncertainty 2. Stakeholders 3. Leadership and commitment to risk management 4. Risk identification 5. Risk analysis 6. Risk mitigation 7. Integration with other processes 8. Management of risk knowledge 9. Experience and competence.	Initial repeatable define managed optimised

Risk Maturity Model	Description	Process area	Maturity levels
Hopkinson, Martin The project risk maturity model: measuring and improving risk management capability	• Description: The project risk maturity model provides an assessment framework and development pathway for risk management in projects • Aim: For organisations to benchmark their project risk processes, and support introduction of effective in-house project risk management • Scope: Risk Management projects in Asia • Administration: Questionnaire,50 questions administered by self-assessment, an independent assessor, a full process audit or project team workshops	• Number: 6 • Label: Attributes • Items: Project stakeholders, risk identification, risk analysis, risk responses, project management and risk management culture.	Naïve, Novice, Normalised and Natural

Table 2: Risk Maturity Models (source: derived from Maier et al. (2012))

Hillson (1997) was a pioneer in the introduction of risk maturity models. Hillsons's approach consists of four dimensions (culture, process, experience and application) and four levels of maturity. His model is not industry specific and does not focus on risk in projects, but is a general organisational approach against risk. The dimensions embodied in his model do not address individual risk management process steps. Instead, it considers the risk process management availability and the depth of its application. Culture and experience share characteristics such as 'awareness' where experience could be argued is a consequence of the organisation's culture after a specific time. Although the model possibly allows organisations to allocate these to a single level, the lack of details in the risk management process misses the opportunity to address specific critical activities in the process.

	LEVEL 1 - NAIVE	LEVEL 2 - NOVICE	LEVEL 3 - NORMALISED	LEVEL 4 - NATURAL
DEFINITION	Unaware of the need for management of risk. No structured approach to dealing with uncertainty. Repetitive & reactive management processes. Little or no attempt to learn from past or to prepare for future.	Experimenting with risk management, through a small number of individuals. No generic structured approach in place. Aware of potential benefits of managing risk, but ineffective implementation, not gaining full benefits.	Management of risk built into routine business processes. Risk management implemented on most or all projects. Formalised generic risk processes. Benefits understood at all levels of the organisation, although not always consistently achieved.	Risk-aware culture, with a proactive approach to risk management in all aspects of the business. Active use of risk information to improve business processes and gain competitive advantage. Emphasis on opportunity management ("positive
CULTURE	No risk awareness. Resistant/reluctant t to change. Tendency to continue with existing processes.	Risk process may be viewed as additional overhead with variable benefits. Risk management only used on selected projects	Accepted policy for risk management. Benefits recognised & expected. Prepared to commit resources in order to reap gains.	Top-down commitment to risk management, with leadership by example. Proactive risk management encouraged &
PROCESS	No formal processes.	No generic format processes, although some specific formal methods may be in use. Process effectiveness depends heavily on the skills of the in-house risk team and availability of external support.	Generic processes applied to most projects. Formal processes, incorporated into the quality system. Active allocation & management of risk budgets at all levels, Limited need for external support.	Risk-based business processes. "Total Risk Management" permeating entire business. Regular refreshing & updating of processes. Routine risk metrics with constant feedback for improvement
EXPERIENCE	No understanding of risk principles or language.	Limited to individuals who may have had little or no formal training.	in-house core of expertise, formally trained in basic skills. Development of specific processes and tools.	All staff risk-aware & using basic skills. Learning from experience as part of the process. Regular external training to enhance skills.
APPLICATION	No structured application. No dedicated	Inconsistent application. Variable availability of staff. Ad hoc collection of tools and methods.	Routine & consistent application to all projects. Committed resources. Integrated act of tools and methods.	Second-nature, applied to all activities. Risk-based reporting & decision-making. State-of-the-art tools and methods.

Table 3: Attributes of Hillson's Risk Maturity Model (Hillson, 1997)

Yeo and Ren (2009) developed and tested a five-maturity level model (Initial, Repeatable, Defined, Managed, and Optimizing) with three key capability areas: organisation culture, risk management process, and risk management knowledge/technology from the perspective of strategic change management for complex product systems. This maturity model development was limited to Asian offshore and marine projects.

Key attributes	Items
1. Attitude towards risk and uncertainty	-Scope of freedom to act -Risk and uncertainty awareness -Open communication about risk and uncertainty -Find root causes and deal with risks systematically -Early use of risk management -Recognition for good risk management practice -Willingness to manage risk proactively
2. Stakeholders	-Relationship with project's lead customer -Relationship with main contractors -Climate of trust within project team -Risk Share with lead customer -Risk Share with main contractors -Roles and responsibilities of managing risk -Risk information communication -Stakeholders involved in risk management process -Quality of reporting to stakeholders

3. Leadership and commitment to risk management	-Roles and responsibilities of senior management -Role of the project manager -Recognition of the value of risk management -Corporate resource allocation -Establish an organisational policy -Established ad defined process -Risk management training -Review status with higher level management -Valuing employees' contribution to risk management
4. Risk identification	-Risk accountabilities -Combination of risk identification techniques -Identification of non-compliance risks -Breadth of risk identification -Identification of new risks -Use of learned experience for risk identification and assessment -Breadth of responsibility for risk identification
5. Risk analysis	-Analysis of risk at source -Risk ownership -Assessment of probabilities -Assessment of impacts -Analysis of secondary effects -Use of priority ranking -Risk estimating: -Quantitative risk analysis (Monte Carlo analysis) -Maintenance of fallback plans
6. Risk mitigation:	-Utilization of fallback decision points -Different risk mitigation strategies -Utilization of cost/benefit comparisons -Focus on risk mitigation actions -Implementation of risk mitigation actions -Monitoring of risk mitigation actions -Scanning of external opportunities and threats -Analysis of risk post mitigation
7. Integration with other processes	-Alignment of risk management objective with project success criteria -Project team risk management responsibilities -Relationship between risk and project plans -Maintenance of project risk records -Quality and breadth of risk reporting -Arrangements for risk reviews -Use of risk data for financial forecasts -Linkage to communication with stakeholders -Use of metrics/performance management -Linkage with strategic goals
8. Management of risk knowledge	-Post project evaluation -Risk database -Understanding of risk management concepts and principles -Knowledge of risk management techniques/tools -Knowledge of risk management process -Collect process improvement information -Establish a risk management information system -Maintenance of historical risk data -Access to specialist support
9. Experience and competence	-Risk management competencies of project team -The experience and expertise in risk management tools -Sharing of risk management knowledge -Access to qualified staff in the organisation -Range and depth of experience of people in risk management -Skills and capabilities of people responsible for risk management -Training/personal development on risk management

Table 4: Items of measuring key attributes (Yeo & Ren, 2009)

Yeo and Ren (2009) first dimension is organisational culture which covers key attributes groups such as 'attitude towards risk and uncertainty', 'stakeholders' and 'leadership and commitment to risk management'. The second dimension, process examines dimension risk identification, risk analysis and risk mitigation. Risk ownership is one of the items in the risk analysis group. The third dimension, knowledge three groups, integration with other processes, management of knowledge and experience and competence. The assessment procedure requires that all the 75 items be evaluated, eventually those that are not relevant to the project of the organisation. The results may direct into actions not wished or of no value to the

organisation. Process knowledge and culture receive in the assessment each the same weight as the risk process execution.

Also, industry-specific, in this case, the construction industry, is the focus of Zou et al. (2009) risk management maturity model addressed to Asian and Australian organisations with four maturity levels: initial, repeated, managed and optimised. The maturity assessment entails five dimensions: management, risk culture, ability to identify risk, ability to analyse risk, and application of standardised risk management process/system. The author argues the selected dimensions could be extended and considers these sufficient for the construction industry. Culture and management focus mainly on the overall operations of an organisation. Risk identification, risk analysis, and standardised risk management process are focused more specifically on risk events. However, it does not explore the risk ownership and risk allocation practice in projects, which is critical in an extremely collaborative environment such as the automotive industry. The model was validated by a group of 6 experts in the construction industry, all of them with over 11 years of experience in construction management. The subsequent test of the model on a multinational company was done through the input of 8 of their employees.

Attributes	Descriptions or questions
Management perspective (people and leadership) in relation to risk)	• Upper management actively takes part in risk activities, supports and encourages risk management • How often are the risk management capabilities assessments held within the organisation • To what extent is risk management information distributed and communicated to all project participants within the organisation • To what extent is risk management tools and techniques integrated and used in projects • To what extent are resources dedicated to projects in accordance with the severity of risk events identified
Organisational risk culture	• There is a build-up of trust within the organisation and project teams in relation to risk management • To what extent are team members taking risk ownerships during project implementation • Responsibilities for managing risks are distributed and carried out by all team members • To what extent was risk event openly communicated within the organisation • Risk management is widely accepted and practised at all levels within the organisation
Identifying risks	• Potential risks are identified each time for new projects • A systematic identification method is used to ensure major risks are identified • Information on risks identified are processed, grouped and communicated to all project participants • Risks identified is consistently revised and revaluated throughout the project process • Actual risks found are compared against to initially identified risks

Analysing risks	• All project participants are capable of basic risk analysis skills such as qualitative or quantitative analysis • The likelihood of occurrence and magnitude of impacts of risk is thoroughly assessed upon identification • Qualitative and/or quantitative risk analysis tools and applications are used to assess identified risks • After analysing the analytical results of risks identified, it is used to aid in decision making for risk responses • The results of risk analysis are used as a basis for resource allocation and distribution to projects
Standardised risk management process	• Risks are consistently identified, analysed, responded, and continuously monitored throughout the project lifecycle • The flow of risk management information is passed on and communicated throughout the entire project lifecycle • Risk management process is woven into daily business processes of the organisation • A standardised risk management process is applied to all projects within the organisation • How often is risk management process reviewed to ensure the process is effective

Table 5: Descriptions and Questions for the Five Attributes in (Zou et al., 2009)

An extension of Hilson's maturity model is Hopkinson's 'The Project Risk Maturity Model'. Hopkinson (2012) lays out a framework for assessing risk management capability against a recognised standard. Hopkinson's model offers a working model to assess risk management capacity and presents an equipment procurement case study, in which the model has been systematically used. Hopkinson's 50 questions form addresses project stakeholders, risk identification, risk analysis, risk responses, project management and risk management culture. Risk allocation is reviewed in the risk analysis section. Organisations with the highest mature capability 'understand and describe risks with sufficient depth to provide a consistent basis for risk estimating, allocation of risk ownership, understanding relationships…'. Ownership of risks, which is obviously very linked to risk allocation is discussed in the model within the project stakeholders attribute, however with the main emphasis on the project team's contracting function and very specifically on commercial risk ownership. Risk ownership is also reviewed when analysing risks responses and the quality of risk response plans. Hopkinson's view on risks that have overarching responses should be owned at senior levels, and therefore not necessarily be delegated.

Some relevant considerations stated by Crawford (2006) are to be considered when developing project management related maturity models. One is the intrinsic subjectivity associated with the determination of the organisation's maturity model. Achieving the next level of maturity should not be an objective in itself. Important is

that organisations need to determine their minimum level of maturity at which desired value is achieved (Crawford, 2006).

Maier et al. (2012) established a roadmap to develop maturity grids for assessing organisational capabilities. This roadmap entails four phases: planning, development, evaluation, and maintenance. The authors consider among 31 other maturity grids the first risk maturity model developed by Hillson (1997),

Referring to the review on existing maturity grids, Maier et al. (2012) discern different underlying notions, namely:

1. Existence and adherence to a structured process (e.g., infrastructure, transparency, and formality);
2. Alteration of organisational structure (e.g., job roles and policy)
3. Emphasis on people (e.g., skills, training, and building relationships)
4. Emphasis on learning (e.g., awareness, mindset, and attitude)

Maturity grids according to Maier et al. (2012) are built upon conceptual models that in their own right provide insights into the author's perspective of the factors relevant to an organisation. Thus, the maturity grid-based assessment methods collectively offer a contemporary representation of different conceptualisations of organisational practices and capabilities that are viewed as important for success. De Bruin, Freeze, Kaulkarni, and Rosemann (2005) propose a generic methodology for the development of maturity models in various domains. This methodology based on business processes combines maturity stages with capability levels for realising organisational objectives. There are also several project management maturity models. However, the Project Management Institute (PMI), which launched the organisational project management maturity model (OPM3) program as a best practice standard for assessing and developing capabilities in portfolio management, program management, and project management in response to the many competing models, presents a long story of controversy among practitioners. After removing the 'Capability Statements' from the OPM3 may have missed its original goal, as with the newest release it just presents a very generic and non-practical guide. In 2015 the debate worsened when PMI ended the OPM3 certification program and thus withdrew the OPM3 Capability Statements.

Mullaly (2014) pose some provoking questions to the avalanche of maturity models issued in the past few years. The major criticism is about whether improvements in maturity lead to improvements in organisational capability and performance. The inherent presumptions of the maturity models such as the goodness of maturity and better-ness of more maturity, the emphasis on standards, controllability of risks, elimination of uncertainty and control feasibility are critiqued as naïve, may amplify problems and cause projects to fail faster. However, maturity models' which consider organisation's capabilities allow the effective identification of risk management strategies.

1.15 Other dimensions of risk management

Other dimensions relevant to the risk management process in addition to the previously discussed risk identification are risk assessment, allocation and appetite. These three dimensions are process phases or cross phase in the project life cycle. The dimensions are another key point based on the findings of this literature review. Risk assessment has been selected because of being the next major task in the risk management process. Another reason for its selection is its criticality for the risk mitigation success, which is the project risk management primary role. Collaboration in project risk management, lack of which has been pointed out as the main reason for project failure in the automotive industry should be reflected in mature risk allocation. Thus, risk ownership allocation has been selected as the third dimension for the maturity model. Finally, risk appetite in organisations overarches all phases in the project management process. What is most important, the organisation risk appetite determines the organisation's proactivity to anticipated risks, and reactivity to unanticipated risks. At the same time, the organisation's risk appetite is a crucial mean of addressing, questioning and improving unrealistic assumptions, such as the ones biased through subjectivity or overconfidence in development costs (Lehtiranta, 2014).

1.15.1 Risk assessment

Project risk assessment is the stage in the risk management process at which each identified risk is assessed for its probability (likelihood) of occurrence and its impact, in terms of time, cost and quality, on either the project phase or the entire project, should it occur (Patterson, 2002). Risk assessment entails the study of the probability of occurrence and any associated consequences. Generally speaking, two

broad categories of risk assessments have been used, namely qualitative risk assessment and quantitative risk assessments (QRA) (Dawotola, Gelder, & Vrijling, 2012).

Qualitative risk assessment makes use of descriptive scales for the assessment of probabilities, such as risk scores. These scores or rankings are subject to interpretation and therefore entail an inherent level of subjectivity (Dawotola et al., 2012). The application of qualitative risk assessment presents some serious limitations, mainly the subjectivity of the values estimated. Qualitative risk analyses are flawed in the sense that they can produce wildly different results (Emblemsvåg & Kjølstad, 2006).

Organisations have developed checklists based on how risk assessment is performed. Research shows that perception of risk varies between stakeholder groups, over time, across project and life cycle stages, and between cultures. This leads to the conclusion that risk assessment based on published checklists may be biased and/or limited in scope (Bannerman, 2008).

Quantitative risk assessment uses numerical values for both the assessment of probabilities and assessment of consequences. The first quantitative technique in modern project risk management was the Gantt chart, developed by Henry Gantt in 1917 (Galway, 2004). The Gantt chart shows linearly tasks and status. The Gantt chart's major limitation is the difficulty in representing interrelationship of tasks in complex projects. Other techniques developed in the 1950's are the Program Evaluation Review Technique (PERT), a network representation of interdependency of tasks, and the Critical Path Method (CPM), a network planning representation. One of the most popular quantitative risk assessment technique is the Monte Carlo simulation, usually performed through Monte Carlo simulation software. The underlying assumption of this technique as many others is that past data can predict the future. The project outcome is obtained by performing a number of iterations that depends on the level of confidence required by calculating the project model iteratively several times (Hubbard, 2009; Rastrelli & Ricca, 2015).

The existence of a gap between research and practice in project risk management is generally accepted. Taylor et al. (2012) 5 years' work aims at transferring research to practice. The authors develop and document the use of a risk

assessment process as part of a case study they based on a risk spider chart as primary tool. This visual approach transforms risk into a graphic format which is founded in research and practical in its application. The major novelty of their approach is the use of project dimensions to estimate project complexity and therefore its inherent risks. Instead of attempting to assess the extent of a project's requirements uncertainty, and its impact and probability the risk assessment is based on the knowledge that the high end of these dimensions is typically associated with poorer project performance. Chapman et al. (2006) development of 'rational subjectivity', which counters subjective judgements about uncertainty and corporate culture cultural conditions known as 'conspiracy of optimism', and 'irrational objectivity' could also be complementary methods to obtain objective estimations.

Risk matrices are one of the most popular risk assessment methodology employed across many industries. These provide the graphical output that enables the communication of risk assessment. The development of risk matrices (RMs) has taken place isolated from academic research in decision making and risk management – risk matrices produce arbitrary decisions and risk-management actions. These problems cannot be overcome because they are inherent in the structure of RMs (Thomas, 2013). Their theoretical basis is superficial, and the validity of the qualitative information they employ is highly suspect. Assessments of the likelihood of occurrence and their impacts suffer all the shortcomings associated with subjective assessment (Wall, 2011).

Although not directly related to project management, there have been attempts to combine expert judgement with probabilistic models, called Bayesian networks. Fenton and Neil (2011) compare their proposed model with other standard statistical approaches to risk assessment. The model serves well explicitly model causal factors; it can help to make predictions with incomplete data and even combine diverse types of evidence including subjective beliefs and objective data. The study demonstrates how Bayesian networks address in some individual cases limitations of data-driven statistical approaches and risk registers. This is particularly relevant in cases of correlation between two factors, which could lead to false predictions. It is, however, difficult to include this approach with traditional risk registers. More important, it is useful for risk events for which not much or any relevant data is available. This leaves a single activity not applicable to a great number of risk items documented on the

traditional risk registers, and this approach can only be considered complementary to other statistical approaches which are generally included on the risk registers. The question remains open, how to balance short-term need to take actions by the time spend modelling risks.

Risk interdependency is a critical aspect of project risk management. The evaluation of risk factors a risk is influenced by on the one hand and estimation of factors an individual risk influences, on the other hand, has a direct impact on risk prioritisation. Analysis of risk interdependency enables the classification of risk management actions. The number of articles proposing specific risk management approaches methodologies and techniques considering risks interdependency is very limited. Aloini et al. (2012b) present a practical solution based on systems engineering theory which they enhance with the FMEA approach to prioritise risk factors using the Risk Priority Number.

1.15.2 Risk management ownership

Recognising that different parties have different objectives, perceptions of project risk and different capabilities for managing associated sources of uncertainty makes clear that risk ownership allocation is a major task in the risk project management process (Harvett, 2013). Chapman and Ward (2007) consider risk ownership a relevant phase within their formal process framework SHAMPU (Shape, Harness, And Manage Project Uncertainty). Ownership is concerned with allocating responsibility for managing project uncertainty to appropriate project parties. These allocations are fundamental because allocations can strongly influence the motivation of parties and the extent to which project uncertainty is assessed and managed by each party (Harvett, 2013). This can be particularly relevant to consider a contractor's perspective, and the need to align client and contractor motivation.

Allocation of risks serves three purposes:

1. to distinguish the sources and associated responses that the project client (owner or employer) is prepared to own and manage from those the client wants other parties (such as contractors) to own or manage
2. to allocate responsibility for managing uncertainty owned by the client to named individuals

3. to approve, if appropriate, ownership/management allocations controlled by other parties.

Explicit ownership is required to comprehend the implications of contractual arrangements for motivating parties to manage uncertainty, including inappropriate use of simple contracts. The deliverables provided by the ownership phase are explicit allocations of ownership and management responsibility, efficiently and effectively defined, and legally enforceable as far as practicable. Ownership is considered in managerial and financial terms.

Diffuse ownership hinders organisational agility for risk management and incident response, creates gaps in risk coverage, and distributes responsibility. Ironically, when organisations throw a lot of their best resources at the problem, nobody knows what he or she are supposed to do or own (Corporate Executive Board, 2014). The allocation of risk ownership can be ranged from ‘forced’ to ‘voluntary’. The range of ownership can be explained by the extent that the negative impact can have for the associated party (Harwood, Ward, & Chapman, 2009).

Risk ownership is related to business ownership. In the past, IT or engineering functions used to own the risk in their related projects exclusively. Instead, the trend is now for the function in charge of the project, e.g. engineering or IT, to help the business partners to make a better-informed risk decision on their own. IT or engineering, in this case, share ownership of risk management with business leaders assisting them to make assessments and follow compliance mechanisms by themselves (Chobanova, 2014).

1.15.3 Risk appetite

Risk propensity, what can also be described as risk appetite is the organisational behavioural tendency upon how to take reasonable risks; recognise, assess and manage risks (Harwood et al., 2009). Risk appetite reflects organisational risk culture and the individual risk propensities of key stakeholders in a given situation (Hillson, 2012). Overall risk-averse organisational risk propensity, or low ‘risk appetite’ is judged to be the amount of tolerable and justifiable risk.

Several authors have tried to develop a measurement of risk appetite. However, there is a criticism about the lack of analytical process transparency between the

questions asked of individuals and the eventual risk propensity profile. Because it depends on the situation that is being faced, it cannot be seen or measured directly. In fact, every action we take in relation to the perceived level of risk exposure is affected by the risk appetite. The risk appetite influences the risk treatment and the risk steps in the risk process. Project risk treatment is the stage at which the risk strategy is defined. The strategy defines how to manage the risks; this can be: reduce exposure, mitigate the impact, transfer / externalise and accept risks. The decision to choose any of these responses can be supported by a framework providing risk factors dependency and priority (Aloini et al., 2012b). The risk steps are the identification of threats and opportunities, assessment and prioritisation of identified risks and selection and implementation of appropriate risk responses, risk ownership allocation, and risk control and reporting (Hillson, 2012).

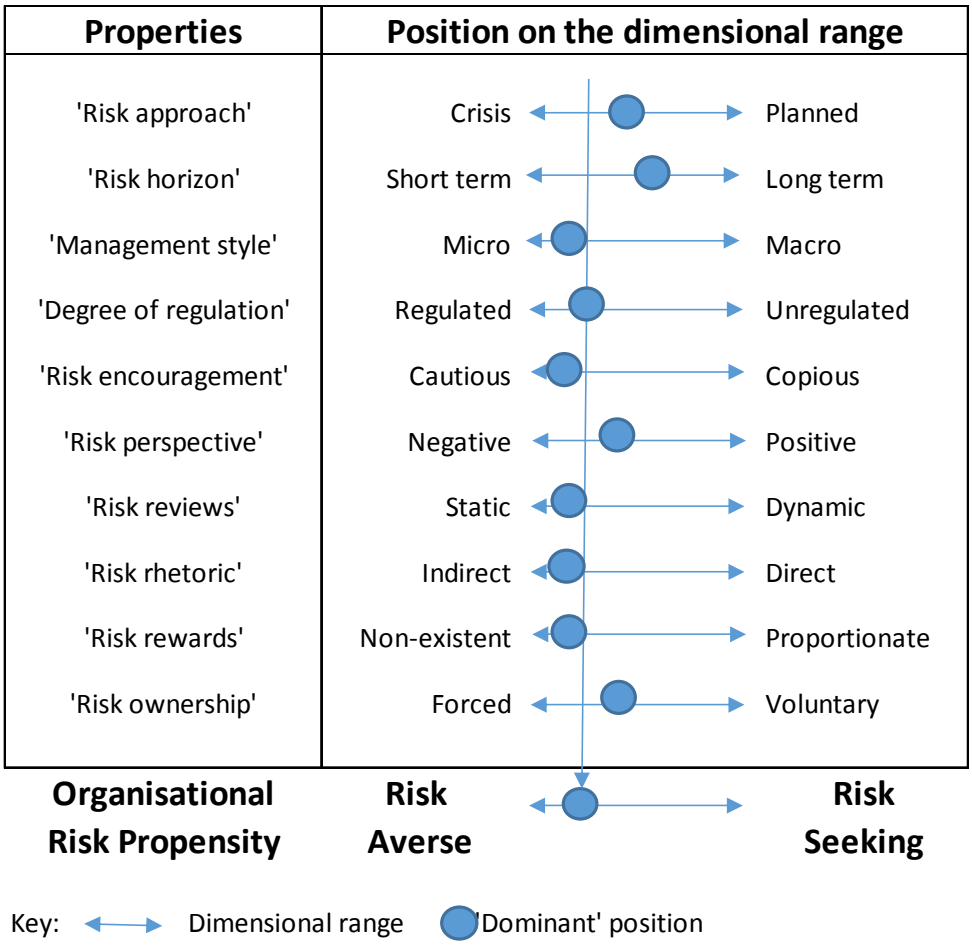


Figure 5: Integrative framework of organisational risk propensity (Harwood et al., 2009).

A logical extension to (Harwood et al., 2009) would be to develop a survey instrument from the identified properties and associated dimensions and conduct a larger positivistic piece of research in a broader range of situations in order to enhance

the robustness of the integrative framework. Risk treatment depends on the risk appetite or attitude to taking risks. The behaviour to taking risks may change over time through education, training and experience. A balanced risk treatment will probably increase the threshold at which point the organisation is willing to take risks. As a result, the organisation could improve its competitive advantage. If it is averse centric in its treatment of risk, it will be less likely to take risks – i.e. a lower propensity for risk-taking.

A balanced risk treatment would be one focusing both on risk and reward. An overemphasised focus on risk versus reward may have considerable influence in the strategic decisions such as entering new markets, developing new products or targeting new merger and acquisitions (Corporate Executive Board, 2014). Executive inaction may result in loss of potential revenue growth rate. Education and training in 'advanced' project risk management with subsequent additional experience in the organisation may lead to better understanding of risk and reward. People are the biggest source of risk and education, training and experience make them part of the solution. Proper risk management will then be understood as a protection shield, not an action stopper. Manager and employees learn through education and training to take and manage risks, not to avoid them. The organisation will treat risk appropriately and not circumvent it.

The organisation's risk appetite needs to be explicit, and aligned and communicated with the organisation's strategy through the leadership team. Then decision quality improves, and executive actions accelerate (Corporate Executive Board, 2014).

1.16 Summary, research gap and review of RQs

The main objective of the research project is to produce new insights which improve our understanding of risk management with the use of the centricity concept to develop the RaaSC debate (RQ1), develop a maturity model for assessing risk management capability (RQ2) and develop a modus operandi for its application in the automotive industry (RQ3).

The literature review suggests that both researchers and practitioners agree on the potential of risk management. However, project risk activities are of low standing within overall management activities. The review revealed that when applied, project

risk management suffers firstly from the subjectivity when identifying and documenting risks. Subjectivity is a constituent part of risk identification. The deployment of the appropriate risk assessment methodology is limited by the organisation's capability, the restricted risk allocation process and the lack of risk appetite in the organisations. The centricity concept defined as the mindset or attitude that characterises the managers or organisation's outlook and motivation in the relationship to others in a managerial context has not been considered to improve the understanding of project risk management.

There are hints that risk identification is the most critical process in project risk management. There is evidence that subjectivity has a considerable impact in the risk identification process. There is no scientific and complete framework for integrating different thinking and viewpoints for identifying, analysing and managing project risks (Zhang, 2011). Literature considering project risk maturity in the automotive industry, other than in software development has not been identified and remains an area for further research in practice. None of the existing risk maturity models considers specifically subjectivity, and what is more important, none of these explains how the attributes building their models have been validated prior to their deployment within organisations.

RQ1. Can the centricity concept be usefully harnessed to further our understanding of risk management?

In the works of several authors reviewed in Section 2.6, the centricity concept, is seen in the context of the integration of risk management activities, and as a significant contributor to the improvement of the project risk management process. It should be noted that none of these authors referenced present a clear definition of centricity and neither propose a structured model on how to apply such a centric approach. In most cases, the authors just present descriptions and narratives on how the organisations apply project risk management. The research question addresses a gap in the existing body of knowledge by firstly, introducing a clear definition of centricity in the context of project risk management. Secondly, this research presents a framework that facilitates the discussion of good risk management practices through using centricity to enhance the maturity model of risk management.

The centricity concept can help to further understand risk management in several areas. Take ‘driven’ as matching synonym for ‘centric’ and ‘balanced centricity’ as converse to ‘subjectivity’, the term centricity may help to improve the risk identification process. Applied to the risk assessment process, the centricity concept may illustrate the organisation’s capability to utilise the optimal methodology for the given situation. In regard to risk ownership allocation, project-centricity may direct to a narrow involvement of stakeholders in this activity. Finally, averse-centric risk treatment may indicate a deficit on risk awareness and risk knowledge in the organisation. Along these lines, Irizar and Wynn (2015) present an analysis of existing literature, allied to empirical data and observations in large project environments, in which the authors develop a conceptual framework for research in the following areas:

- Person-centric risk identification vs objective risk identification
- Methodology-centric risk assessment vs multidisciplinary/ eclectic risk assessment
- Project-centric risk ownership allocation vs devolved ownership allocation
- Averse-centric risk treatment vs balanced risk treatment

The approach assumes that it is feasible and sensible to cumulate findings and generalise results to create new knowledge.

RQ2. Can a maturity model be developed for effectively assessing risk management capability in organisations?

The literature review establishes that the area of project risk maturity models in the global automotive industry has not been covered sufficiently by academic literature. The literature review provided studies illustrating the execution of suggested generic methodologies for creating maturity models in the domains of Business Process Management and Knowledge Management. Other authors present not only guidance for developing a maturity grid. They also offer empirical research to assess communication management in engineering design and examples on how to use their suggested roadmap to develop the maturity grid, select process areas, dimensions and delivery mechanisms. On the other hand, some project risk management maturity models have been discussed, some generic, others applicable in construction, offshore and marine industries. Different aspects of project risk management in the automotive

industry were not discussed in existing literature. For example, current maturity models do not consider the four risk dimensions selected in relation with centricity: identification, assessment, allocation and appetite.

These four risk dimensions and its relationship with centricity have been identified under section 2.8 of this literature review as important factors for project success. Following Maier et al. (2012) guidance these four dimensions can be process areas to develop the maturity model for effectively assessing risk management capability in the automotive industry.

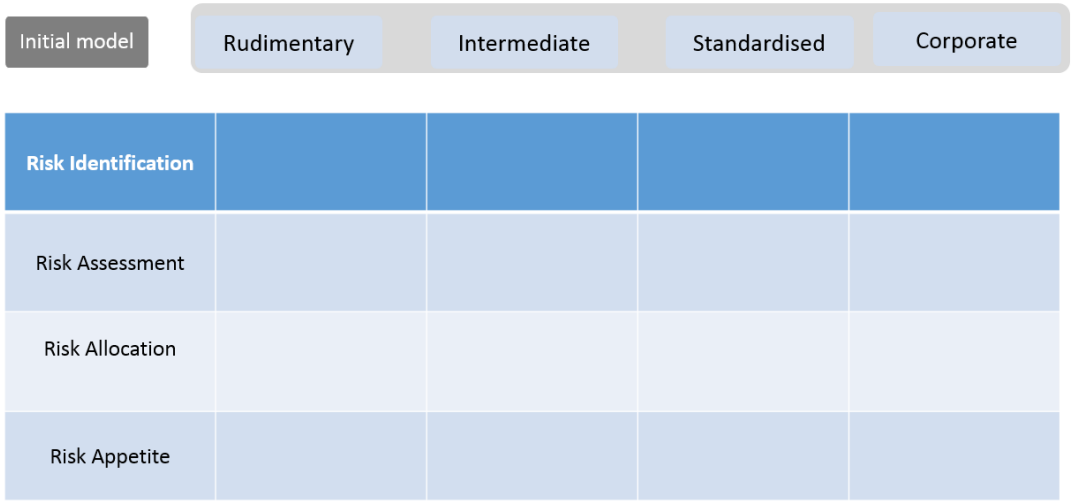


Figure 6: Initial maturity model structure with stages (columns 2 – 5) and process areas (rows 2 – 5) for effectively assessing risk management capability (developed for this thesis)

Thus, the research question addresses a gap in the existing body of knowledge as no risk maturity model has been developed specifically in the automotive industry. RQ2 addresses a further gap, which is the development of the maturity model based on the centricity concept. The centricity concept leads to the four risk dimensions in which a risk-centric approach can be used for identifying good risk management practices. Finally, as explained on Section 2.7 of the literature review, there are several authors who propose either generic or specific models applied to non-automotive industries. None of the authors provide details on how the model development took place, how the model evolved and what validation was done.

RQ3. Can this be applied operationally to enhance the overall risk management process?

The risk maturity model once developed and validated can be used as assessment framework to compare the organisation's delivery with best practice or against other groups. Risk maturity models can reflect organisations' weaknesses and based on them the organisation can plan improvement activities to enhance their risk processes. However, an important part of an effective risk maturity model for projects in the global automotive industry is guidance to overcome real-world impediments to mature behaviour. Another critical factor when applying maturity models operationally is the company-specific ideal level of maturity. Requirements within ~~on~~ higher risk maturity stages may be perceived as resource consuming and at the same time not value adding by the organisation (Albrecht & Spang, 2014). Generic maturity models miss the contingency perspective, an effective risk maturity model needs to consider organisational culture and context.

None of the risk maturity models presented in the Section 2.7 address the subjectivity and centricity concept in relation to the risk dimensions identification, assessment, ownership and appetite. The operational application of a maturity model which considers a centric risk approach in the four risk dimensions is new and addresses a gap in the existing body of knowledge in the field of risk management.

2 Conceptual framework

2.1 Risk management model

Risk management is generally perceived as a way to reduce uncertainty and its consequences, which in turn will improve the chances of success (Besner & Hobbs, 2012b). There is evidence that higher levels of risk management are associated with higher levels of project success. The manufacturing industry and the automotive industry in particular typically adopt risk management as a rational process which prescribes processes for managing project risk. The management of risk as a rational process assumes that processes are predefined and the related tasks can be planned (Bannerman, 2015). The iterative execution of risk management tasks or activities contributes to project success through both, instrumental and communicative effects. The majority of the prescriptive risk management guides describe a similar process that explicitly outlines the most influential activities or techniques, those being: risk identification, risk analysis, risk allocation, risk reporting and risk control (de Bakker et al., 2012).

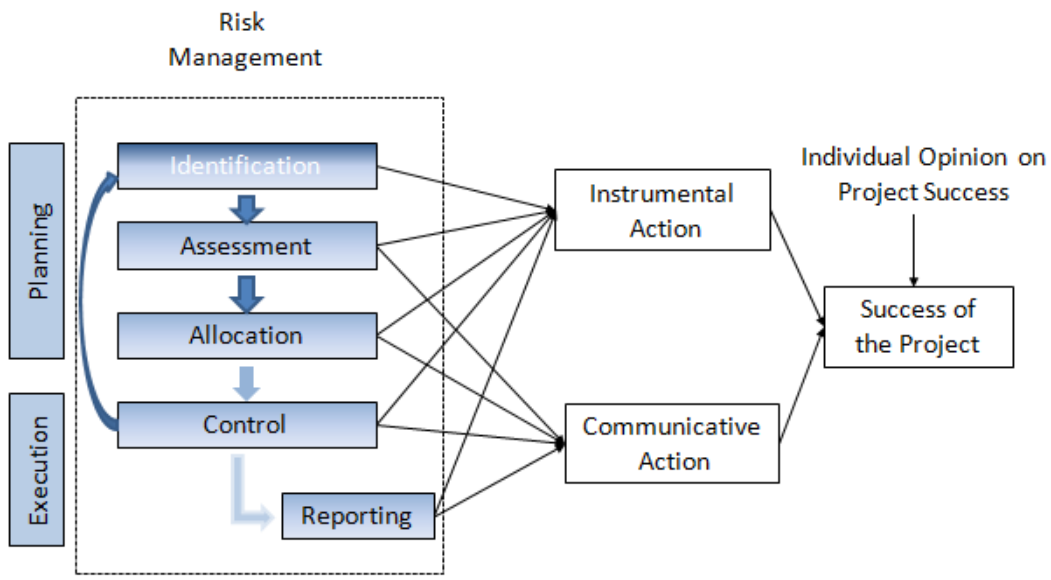


Figure 7: Broader view of Project Risk Management Process, iterative steps based on PMBoK guide (developed for this thesis)

2.2 Project risk management maturity model

Whilst some of these maturity models are of value in certain industry contexts, there is no maturity model specifically geared to project risk management in the automobile industry. This research thus addresses this by building and verifying a maturity model for the automotive industry in Germany. The initial conceptual framework for this model builds upon the four dimensions of risk discussed above – identification, assessment, allocation and appetite. These can be defined as:

- Risk identification: The process by which the project team detects prospective events which might affect the project and documents their characteristics (Holzmann, 2012).
- Risk assessment: The stage in risk management at which the identified risk is assessed for its probability (likelihood) of occurrence and its impact, in terms of time, cost and quality (Patterson & Neailey, 2002).
- Risk allocation: The assignment of the responsibility for managing specific project risks or uncertainty to appropriate project individuals or parties (Harvett, 2013).
- Risk appetite: The organisational (or individual) behavioural tendency regarding how to take reasonable risks (Harwood et al., 2009).

The research attempts to identify typical risk characteristics that can be associated with each of these four dimensions of risk at different stages of maturity in the risk management process. Like some of the models discussed in the literature review, the proposed model was assigned four stages with provisional stage labels of Rudimentary, Intermediate, Standardised and Corporate. Maturity models typically have either four or five stages, but in the five-stage models, the difference between stages one and two are generally minimal, with stage one often describing a non-existent or minimal initial capability. Four stage models have the additional benefit of avoiding an assessor's tendency to select middle values (Zou et al., 2009).These can be defined as follows:

- Rudimentary: the organisation has no sense of need for risk management, teams do not follow any common approach managing risks. Project risk activities are reactive and no lessons learned, or

improvement process is established. Typically, no project risk plan exists.

- Intermediate: some project management practitioners undertake certain project risk management activities. Neither these activities nor the systems and applications used to support risk management are standardised. The organisation does not gain the full benefit of implementing these risk management activities.
- Standardised: risk management is seen as part of core business processes, and risk responses and their effectiveness are reviewed in most projects. Systems and applications supporting risk management are accessible, and lessons learned are established to improve the overall risk management process.
- Corporate: the entire organisation recognises and values risk management, which is integrated into other processes. Executives actively audit and support risk owners. Multi-user risk databases are widely available and used as part of continuous improvement programs.

Maturity stage /Risk dimensions	Rudimentary	Intermediate	Standardised	Corporate
Risk Identification				
Risk Assessment				
Risk Allocation				
Risk Appetite				

Figure 8: Initial maturity model structure with stages (columns 2 – 5) and process areas (rows 2 – 5) for effectively assessing risk management capability (developed for this thesis)

2.3 Risk dimensions and centricity

The research used the centricity concept to act as a stimulus for discussion and debate in the interview process. This involved the graphic depiction in grid format of

risk identification set alongside each of the other three dimensions, with centricity as a key variable. These simple grid charts (see example in Figure 9) were used as ice-breakers and to promote discussion around good and bad risk management practice; and to familiarise interviewees with the four dimensions of risk, as well as the centricity concept. Centricity as a concept remained as a point of discussion in the second round of interviews and was evident in some of the findings embodied in the maturity model.

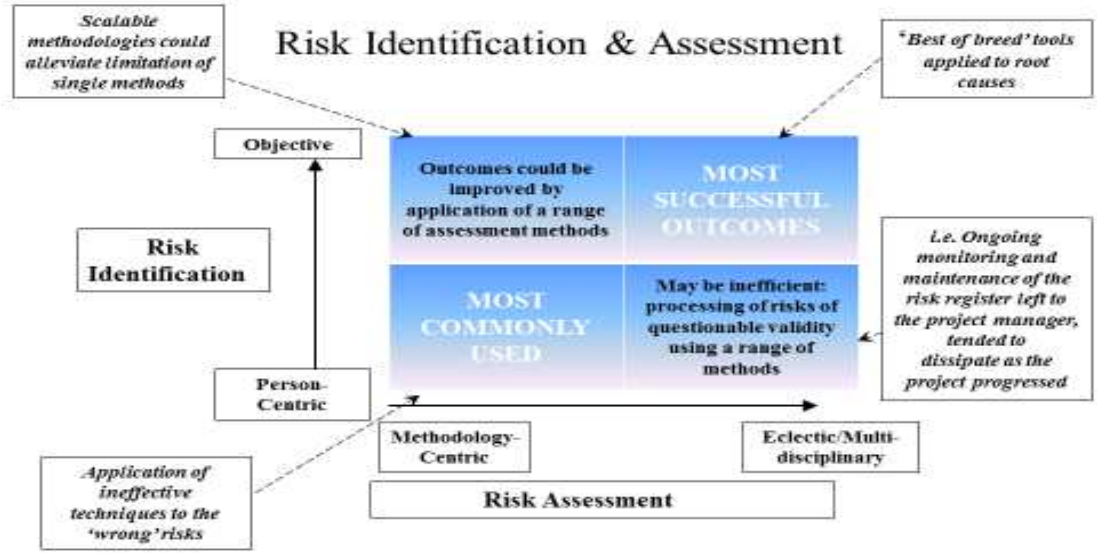


Figure 9: Example of Centricity Grid used in Interview process

3 Research methodology and design

3.1 Introduction

This chapter outlines how the research project was conducted to develop a project risk maturity model in the automotive industry. This chapter aims to demonstrate that the methods chosen for this research are the most appropriate to answer the research questions, considering the study philosophy within the case study.

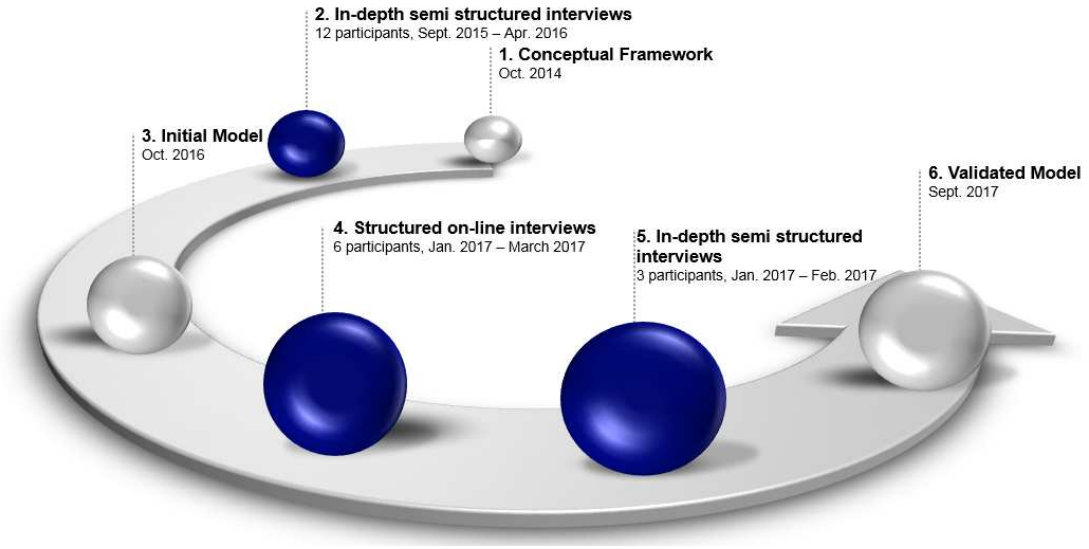


Figure 10: Research design, model development and validation process

Figure 10 shows the overall research process following the literature review, which consists of 6 main steps, with the two sets of interviews subsequent to the initial model conducted partly in parallel but independent from each other.

This chapter starts with an introduction which provides the chapter structure. The next section discusses the research design which aligns the research paradigm, research questions and objectives, methodologies and methods as well as the selected verification strategies and validation procedures. Then the research paradigm is considered in more detail. This part of the thesis reflects on the post-positivistic philosophical grounding of the research, stressing the importance of the context when analysing risk management in the automotive industry. It also describes the interpretivist alternative and the reasons for not adopting it for this thesis. The next section provides justification for using a case study method, the choice of a qualitative approach and the time horizon selected. Section 4.5 follows with a justification of the

data gathering procedures applied. The subsequent section provides an explanation of the data analysis procedures employed for the initial maturity model conception, namely continual synthesis of the data, thematic analysis, data reduction and coding. This section then illustrates the data analysis procedures used for validating and enhancing the maturity model. Finally, the conclusions are presented.

3.2 Research design

The research design represents the structure that guides the appropriate research method's execution for data collection and the subsequent analysis of data. This study centres on a single company case study. The case study has several advantages when compared with other research design alternatives, such as experiment, grounded theory, survey or actions research. The single company case study offers the possibility of focusing on a bounded situation such as the management of risks in projects. Case studies also enable the intensive examination of the setting related to the subject matter, in this case the management of project risks. Further, the case study provides a vehicle through which several qualitative methods can be combined, avoiding the dependence on one single data collection method (Bryman & Bell, 2011).

This case study entails a "detailed investigation of one or more organisations, or groups within organisations, with a view to providing an analysis of the context and processes which illuminate the theoretical issues being studied" (Hartley, 2004, p. 323). The first batch of interviews undertaken in 2015/2016 involved all 12 participants.

The research design choices are described by Saunders, Lewis, and Thornhill (2009) and are depicted in Figure 11.

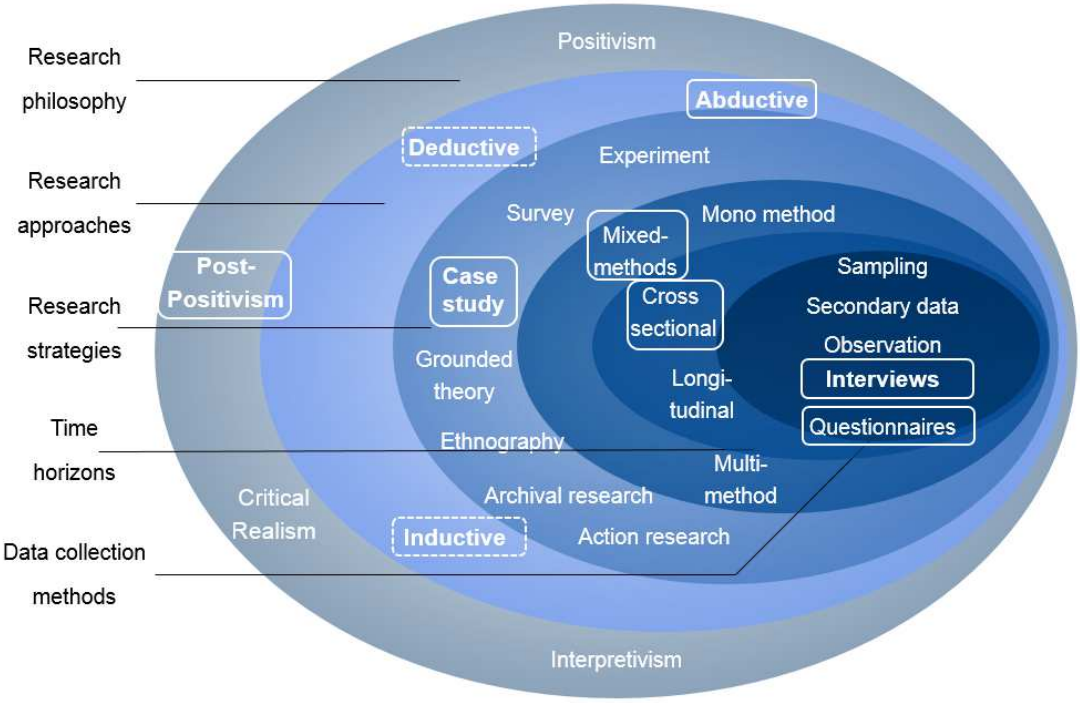


Figure 11: Research design choices, adapted from Saunders et al. (2009)

In this research project, data collection has been conducted through semi-structured interviews, in-depth interviews, surveys, informal discussions, secondary material, and participant observation. Secondary material, project documentation, informal discussions and participant observation were used in addressing RQ1. Semi-structured interviews, in-depth interviews and surveys were undertaken to address RQ2, while in depth interviews were the primary data collection method used in the context of RQ3. The researcher was employed within the company in study, allowing access to both secondary material and interview participants.

Regarding the methodology of this research, a highly structured methodology is required to facilitate replication according to Gill and Johnson (as cited in Saunders, Lewis, and Thornhill, 2009). The exploratory research questions suggest that a qualitative approach is appropriate. The three principal ways of conducting exploratory research according to Saunders et al. (2009) are a search of the literature, interviewing 'experts' in the subject and conducting focus group interviews. The literature review and secondary material were analysed to answer RQ1. Input from project risk experts collected through semi-structured and in-depth interviews and surveys contributed to address RQ2 and RQ3. The semi-structured interviews and surveys followed predetermined questionnaires, while the in-depth interviews followed the same structure with all the interviewees.

The research approach is inductive, that is, it builds explanations of risk management in practice from the ground up and is based on what was discovered from the interviews, observations and analysis of available documentation. RQ1, which is a purely explorative question, can initially only be addressed through the study of existing literature and business documentation. To answer RQ2, project risk maturity features were identified through analysis of the risk experts' experience, which was evidenced in semi-structured interviews with experienced practitioners. A similar approach was adopted to address RQ3, through the conduct of in-depth and structured interviews deemed appropriate to operationally validate the model, requesting the experts for either confirmation of the findings or the need for refinement of certain aspects of the model. This research takes an inductive approach as it involves the development of a maturity model as result of the observation of empirical data. The aim is to build a maturity model that is adequately grounded in the collected data. It can be argued the research approach is based on abduction in the sense that the author hopes to find a rule-governed and replicable production of new and valid knowledge (Flick, Kardorff & Steinke, 2004). Abduction helps social research, or rather social researchers, to make new discoveries in a logically and methodologically ordered way. As a first step of scientific discovery, the conceptual framework was developed from the literature as an initial proposition for the analysis of risk identification and the other three dimensions of risk, risk assessment, risk allocation and risk treatment by means of abduction. Following Pierce's next step of three stage of discovery, through deduction, a 'derivation of prediction' is developed in the form of the three grid figures by viewing risk identification against the three other categories applying the centricity concept (Irizar & Wynn, 2015). The third step, which is induction, consists of the 'search for facts' which will verify the assumptions. Pierce's generic 'scientific enquiry' process is shown in Figure 12 below

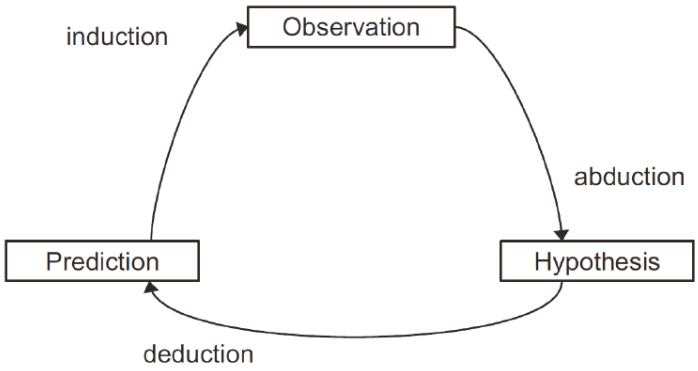


Figure 12: The process of 'scientific enquiry' as outlined by C.S. Peirce (Pauwels, Jonckheere, De Meyer, & Van Campenhout, 2011).

In most cases, the collection of data has been made with semi-structured interviews. The interview is an important source for collecting data, and the interview may take several forms (Yin, 2012). Obviously, in order to achieve quality in data collection, interviews must be carefully planned.

3.3 Research paradigm

This research takes place within the automotive industry, one of the leading manufacturing industries worldwide. The scientific method has an undeniable influence on manufacturing industry development (Myers, 2011). Operational research and systems engineering are two of the basic academic disciplines that provide the basis for process improvements in this industry. The underlying theoretical perspective of these disciplines is positivism (Taylor, 1911). The concept of separating planning from doing (Taylor, 1911) is reflected in the emphasis on planning and control in modern project management. Furthermore, rationality, universality, objectivity, value-free decision making and the possibility of generating law-like predictions in knowledge are basic assumptions of modern project management (Gauthier & Ika, 2012). Traditional project management paradigm has been described as ‘rational’, ‘normative’, ‘positivist’ and ‘reductionist’ (Harvett, 2013).

The post-positivist perspective rejects the positivist epistemology and ontology and their stance on both the objective nature of reality and the ability of science to discern that reality (Given, 2008). The study coincides with recent academic research from authors such as Harvett (2013), Niebecker (2009) or Olsson (2006) all of which explicitly characterise their work on project risk management in practice as post-positivist. It is to be noted that both Niebecker and Olsson developed their research in the manufacturing industry, Niebecker in the automotive industry. These authors criticise the prescriptive guides and methodologies as putting forward a too mechanistic and simplistic view of the risk management process. In this same line, although addressing different questions, this study puts in context bare prescriptions from guides and methodologies with the use of a qualitative research approach. In the positivist tradition of risk management, risk management is recognised as having an instrumental effect on project success through risk mitigating actions. However, de Bakker et al. (2012) argue that the positive effect goes beyond this instrumental effect.

Individual risk management activities generate communicative effects which contribute to the effectiveness of instrumental actions and thus to project success. This communicative effect, not considered by the positivist tradition is a significant component of the post-positivist view. The communicative effect is the one that creates the context which influences the setting. Setting is an integral component of activity and as such, cannot be ignored. This research accepts Kutsch and Hall (2009) post-positivist opinion that objectivity in regards to risk remains a 'regulatory ideal' (Guba & Lincoln, 1994). As Kutsch and Hall (2009) argue there are obviously several obstacles concerning risk objectivity, not least the nature of uncertainty, which by definition remains hidden until it materialises. This study does not adhere to the positivistic view that reality and therefore the risk phenomenon can be considered only from an objective perspective. Rather it takes the post-positivist view of the world as open to interpretation in line with the observations of Krane, Olsson, and Rolstadås (2012) of different perspectives of risk between project teams and project owners. The understanding of risk also in the automotive project environment can be enhanced by the project stakeholders' subjective explanation of the phenomenon. This broader view of risk helps to better deal with threats and therefore to improve projects outcomes.

Authors mentioned previously posit risk phenomena to be not only objective. These authors subsequently argue current prescriptive project and project risk management guides based in positivism to be mechanistic. They complement, and so does this study, the understanding of risk with the contextualization and collected emic viewpoints or the risk phenomena.

The characteristics of positivist and phenomenological paradigms are considered to arrive at a preferred research philosophy, which is post-positivist. Project management systems recognise the basic assumption of positivism as the ontological realism (Gauthier & Ika, 2012). However, there is currently considerable debate in the literature regarding the ontological scope of project management. The fundamental disputed question is whether project management is execution management, or should the domain be broader. In other words, should project management include other disciplines as business analysis, development management, engineering or procurement? This postmodern or hypermodern concept of project management recognises the context-specific or contingent considerations, which links with the post-positivist acknowledgement of context and contingency. In this perspective, "projects

are ad hoc, context-specific, or contingent organisations, information-processing systems, value creation instruments; human and social issues; and the front-ends of projects, and the interplay between them and portfolios, programs and the strategic direction of the organisation" (Winter, Smith, Morris, & Cicmil, 2006).

The management of risk recognises the dynamic nature of projects (Thamhain, 2013). Furthermore, risk is an intrinsically dynamic and unstable phenomenon (Macgill & Siu, 2005). The project management methodologies do not provide single solutions; nor do they pretend the existence of the best solution. These adopt the post-positivist view to open up alternative possibilities to accomplish project tasks depending on the context (O'Leary, 2007). Finally, in the post-positivist tradition this research objective is about understanding both the nature of risk and the project risk management process in practice. This objective is further constrained by acknowledgement of context and contingency. In line with the post-positivist paradigm, the researcher's role as interpreter of data is fully acknowledged, as is the importance of reflexivity in research practice (Given, 2008).

Several arguments and indications suggest that traditional project and project risk management take an implicit positivist position. This study focuses on finding new data and explanations on the state and trends of project risk management. The research attempts to integrate the RaaSC, and 'centricity' concepts into a maturity model for effectively assess risk management capability in organisations. If the author were to take the positivist position, he would not be interested in such attempts. The essence of the post-positivist platform is that it problematises certain taken-for-granted aspects in the research of risk management and their impact on project performance, while also trying to provide solutions and suggestions for a more appropriate measurement of these processes, as well as new possibilities of assessment through a maturity model (Adam, 2014). As an incremental progression, the post-positivist approach is likely to be more readily accessible, and acceptable, to manager/researchers than an introduction to the methodologies and assumptions of critical theorists and constructivists.

But, why not interpretivist? Interpretivism, as an alternative to the positivist orthodoxy, assumes there is no absolute truth, but multiple realities and is based on subjectivity (Biedenbach & Müller, 2011). This research is developed under the assumption there is an answer to the questions posed. However, the answer is not easy

to find; the researcher seeks for consensus of the practitioners to validate what is known. For the interpretivist, all meaning is believed to be subjective, based on subjective perceptions and experiences with external environmental factors. As post-positivist, the author seeks for an objective, singular truth, which differentiates from the interpretive paradigm (Phoenix et al., 2013). It is also to notice that the interpretive paradigm seeks to reveal the idiosyncrasies of people on their everyday lives, in the context of this research these are their activities as project participants, what is not scope of the study. This research intends to provide the answer how to improve project risk management irrespective of gender, class, age or physical (dis)ability. Other than in the interpretivist approach, the research finding is understood to be the result of minor interaction between researcher and researched with no influence of power relationships. This research utilises qualitative methods complemented with quantitative methods and certain measurement instead of meaning oriented methods (Gephart, 1999). There are nevertheless some commonalities with interpretivism. Post-positivism, other than interpretivism, follows realism in the ontology. However, the epistemology of post-positivism is interpretivist in nature, has in common the intent of understanding. The most obvious is part of the analytical process which will be discussed later. Certain passages from conversations are selected and treated as representative of many similar examples, what is described as expansion analysis of one display often generalised to many cases which the study uncovered (Gephart, 1999). Recognising this feature, which is common to qualitative approaches, the research is built under the assumption that variable relations of facts are probabilistic. One paramount example is the analysis of risk, which under an interpretivist approach would be observed as socially constructed and not as objectively existent. Post-positivism and interpretivism both acknowledge the importance of context to understand reality. This research is an effort to derive laws or prescriptions for the project risk management practice based on nomothetic theory and not an ideographic descriptive theory to understand the meaning of contingent, unique, subjective phenomena (Biedenbach & Müller, 2011), as it would be under an interpretivist paradigm.

3.4 Research methodology

This section provides justification for using a case study. Subsequently, the choice of a qualitative approach is discussed as well as the choice of the time horizon. Lastly, alternative approaches are considered.

3.4.1 Case study

The strategy for the research is based on a case study. The case study's main advantage is the opportunity to gain a rich understanding of the context and processes enacted in project risk management in the automotive industry (Morris & Wood, 1991). The research utilises an international automotive company organisation as single case study. The case study was developed by analysing projects, both in the information systems and research and development areas. The projects which serve as context for the case study are the launch preparation for serial production of new driver assistance systems for international car makers and implementations of Enterprise Resource Planning (ERP) systems in several manufacturing facilities in Europe. The unit of analysis is the entire organisation. Following Yin's distinctions of designs for case studies, the one chosen in this research is holistic as opposed to embedded, in which more than one unit of the organisation are units of analysis (Saunders et al., 2009).

As a first stage, the researcher analysed three major project risk registers and associated records in which he had had some involvement working with the project managers, facilitating and documenting the project risk management as part of their regular duties.

The case study has been selected because it can generate new thinking, the validity of which does not completely depend on this concrete case. The model developed in this research can be compared with and judged against other models of project risk management. Furthermore, this case study can be transposed to other organisations. Project management practitioners in other industry sectors may be able to recognise the sort of situations described in this study. Furthermore, and in line with the post-positivist approach explained previously, the maturity model establishes a provisional truth, in a Popperian sense (Hodkinson & Hodkinson, 2001), at least until contradictory findings or better theorising has been developed. Yin (2017) enumerates five rationales for choosing the single case study: a) when the case represents a critical

test of the existing theory b) an extreme or unusual circumstance c) a common case, or where the case serves a d) revelatory or e) longitudinal purpose. This research chooses the single case study as a common case where the objective is to capture the circumstances and conditions of managing risk in the global automotive supplier industry within projects and the lessons it might provide to develop a project risk management maturity model.

Single case studies are particularly valuable when the case organisation is an important source of information in a new study context and can provide detailed information and critique of the results. In this research, a single case company, which is a leading global supplier in the automotive industry, is investigated. This enables the understanding and consideration of the company's project risk management procedures and project context, which is essential to understand the study's relevance and managerial value for the case company and for the interpretation of the study's findings (Trautrims, MacCarthy, & Okade, 2017). For obtaining a general understanding of project risk management, project managers from the R&D departments and also from the Information Technology departments were interviewed and their projects analysed.

The selection of the organisation chosen for the case study takes into consideration its regional presence, customer mix and product catalogue. These characteristics make of it a fair example of a global automotive supplier organisation. The company with over 135.000 employees, around 200 production facilities in some 40 countries, sales of €35.2 billion in 2016 and a yearly investment on Research and Development (R&D) of about € 2 billion is highly dependent on its new projects' success and smooth launch of serial production for global customers. Project risk management is a fundamental aspect of project management and is applied globally. Project risks are documented, evaluated, and risks controls are applied. The risk management process is regularly reviewed to adapt it to the market challenges. As a result of its relatively high in-house R&D activities, it believes that it is more reliant than its competitors on acquiring innovation from its own R&D initiatives and thus the success of project launches in collaboration with automakers.

A paramount example of the criticality of project risk management in the global supplier automotive industry has been the failure applying risks controls by one Volkswagen AG suppliers with the result of a recent production halt at six VW plants

and cutting hours of nearly 28.000 workers. U.S. light-vehicle recalls set an all-time record in 2016 and experts predict they will remain elevated in coming years, so parts suppliers should get their houses in order to overcome potentially costly penalties and litigation (Amend, 2017).

The case study has also actively looked for data about rival explanations. It has been actively searched for "discrepant evidence", and generally, a certain level of scepticism about the data collected was desired. A case study database has been created where the data is compiled. This formal case study database is the source of the case study evidence (Yin, 2012). The execution of the case study follows three steps: definition, the actual conduct of the field study, and the analysis and conclusion. The case study chosen meets all major requirements specified by Thies and Volland (2010):

- The selected organisation and the customers it serves are truly global, and thus they constitute a suitable case for the study of project risk management in the global automotive industry.
- A single case has been selected because it allows the analysis of several types of projects in the organisation and because of the resources available to the researcher.
- Biases are avoided by using multiple sources of evidence (source triangulation between interviews transcripts, project records and surveys).
- In the conclusion, the findings are reflected upon in light of existing theory.

3.4.2 Reasons for using a qualitative approach

This research is concerned with the context of managing project risk in the automotive industry. Project management success is complex, messy, and involves a range of stakeholders with different concerns and perceptions (Skinner, Tagg, & Holloway, 2000). Qualitative research is particularly valuable for research that seeks to explore real organisational goals, linkages and processes in organisations; to understand the failure of policies and practices. The contribution of the study may influence policy and improve project risk management practice or may just illuminate the lived experiences of interested parties by providing rich description and to foster taking action (Marshall & Rossman, 2014).

There is limited empirical research focused primarily on the RaaSC and centricity in project risk management concepts. The literature on the research topic has required a qualitative examination or re-examination to document the project risk management phenomenon in relation to the two concepts - RaaSC and centricity - and explore perceptions and causal mechanisms. Research on a more established phenomenon would have more likely demanded the calibration and generalizability that come from deductive quantitative research (Bluhm, Harman, Lee, & Mitchell, 2011). The research questions can be better addressed using qualitative research, as the research seeks understanding and extrapolation to similar situations (Golafshani, 2003).

The qualitative approach provides support for interpretation of the results and answers to the research questions. To that purpose, qualitative research and an inductive approach appear to fit best. A qualitative strategy and an inductive position allow the generation of alternative hypothesis and development of theory useful for organisations. Moreover, analytic, inductive, qualitative case studies offer a flexible structure that permits changes to the research emphasis as the research progresses (Saunders et al., 2009).

3.4.3 Time horizon

This research entails the collection of data on one single case but from several groups in the organisation. The research phase was conducted over an eighteen-month period, and the three series of interviews were all taken in two sub-periods of four months each. The results can be considered as having been obtained in a single point in time (Bryman & Bell, 2011) and does not focus on showing changes over time (Rübesam, 2015). It is only a ‘snapshot’ of the current situation of project risk management in the organisation (Brautsch & Wynn, 2013).

3.5 Data gathering procedures

In this project, data collection was undertaken using different techniques. The main data source for addressing RQ1 was the literature review discussed in section 2.6 and elaborated upon further in chapter 8. The first data source used for informing RQ2 was the semi-structured interviews conducted with the 12 participants listed in Table 6. The researcher used the questionnaire presented in Table 7 as script for the discussions.

For validating the data extracted out of the 12 primary interviews, six secondary structured on-line interviews were undertaken. The six participants' roles and experience are listed in Table 8. Four of those were part of the initial group of 12 interviewees of the semi-structured interviews. In parallel, the researcher conducted three structured interviews. These three participants were first requested to self-assess their project teams' risk capability in all four dimensions using the maturity model's four stages. They were then requested to select a few labels which best characterised the teams' dimensions. Finally, project documentation out of two major projects, concerning product development and an ERP implementation, was analysed to support the application of the maturity model as response to RQ3.

Research on RaaSC and centricity applied to risk identification, assessment, allocation and treatment is about exploring the positions between extremes, examining apparent contradictions, and understanding the key risk items, and requires in-depth interviewing. Both RaaSC and centricity are new concepts, and qualitative interviewing research will suggest new ways of understanding the problem of identifying and dealing with risks and open up possibilities for new solutions.

De Bruin et al. (2005) recommend exploratory research methods such as the Delphi technique, Nominal Group technique, case study interviews and focus groups to be considered when developing maturity assessment models. Case study interviews with practitioners have been selected based on the stakeholders involved in the model development and the resources available to the researcher. It had been almost impossible to bring the interviewees to one single location and agree for a time to carry out either the Delphi or Nominal Group techniques or working with focus groups. For this reason, the interviews were conducted individually. One of the data sources of the case studies are the interviews with key project stakeholders. The main objective is to create knowledge in the interaction between researcher and interviewee. The interviews using open-end questions allows the researcher to determine the topic of the interchange. Such interviews allowed the interviewee to elaborate opinions. There has been a growth in the use of qualitative research interviews due to technical, epistemological and cultural reasons (Kvale, 2007).

Data was also collected through participant observations in addition to interviews. Participant observation has been aimed at gaining an inside view, mostly during meetings. Meetings were attended at various levels from top management

meetings to the single engineering, or functional, meeting. Here, the data collection was focused on the more hermeneutic view, i.e. with the aim of finding more complex relations and behavioural aspects from within. One additional method of collecting data has been the distribution of surveys used to evaluate preliminary data findings. The statements assignment to a defined maturity stage out of the interviews are compared to the survey responses.

Qualitative researchers have the habit of using multiple methods. (Stake, 2010) The primary reason for mixing the methods in this research is to improve the quality of the evidence. The research questions need multiple sources of evidence, and the multiple methods are used to triangulate key findings. Writing up mixed methods inquiry is considered to be challenging whereas different methodological traditions involve different communication traditions associated with different technical, rhetorical and aesthetic criteria, and norms (Greene, 2008). Mixed methods are required for theory-driven evaluation (Chen, 2006). Theory-driven evaluations include both the clarification or facilitation of the program theory to the stakeholders and the program assessment. Definition and conceptual framework outline are best understood using qualitative methods while the maturity model development and validation benefits of complementary semi-structured interviews and surveys. This allows cross-validating an observed phenomenon. According to Chen's strategies of applying mixed-methods, this research uses a triangulation assessment strategy:

- qualitative methods for the program theory clarification and
- mixed methods for different elements of components for the program assessment

Qualitative and quantitative methods are based on different epistemological positions with different views on how knowledge can be best collected and documented. The use of a mixed methods approach enables a more rounded and complete picture to be drawn.

The research approach to quality considers criteria such as 'fairness' or emerging criteria with a balance of stakeholder views (Guba & Lincoln, 1994). Further adheres to Lincoln (1995) three new commitments: to emergent relations with respondents, to a set of stances – professional, personal, and political – towards the

uses of inquiry and towards its ability to foster action; and to a vision of research that enables and promotes social justice, community, diversity, civic discourse, and caring.

The use of mixed methods enables triangulation of the evidence, and iterative reviews of data collection are executed. There are two major goals in this research in the use of triangulation: data triangulation and methods triangulation (Hoepfl, 1997). Data triangulation encompassing points of interest in other interviews and/or analysis of documentation available was applied wherever it appeared appropriate. The results are confirmations, or the data offers further meanings to be unpacked (Stake, 2010). Data triangulation contributes to data saturation and helps to strengthen the validity of the data. Mixed methods triangulation was conducted by comparing the survey results with semi-structured interviews data used to assess maturity stage assessments.

The aim of the research is to understand how to inform and improve theory and practice in the context of project risk management by considering both RaaSC and centricity. The approach is based on finding out this information from project management practitioners with experience in leading risk management activities. Also, other contributors to the risk management process such as project team members, project sponsors, project owners or steering committee members have been interviewed. Interviews were done in person when possible. Otherwise, video conferences were used; all of them were recorded, and transcripts are available. Both concepts - RaaSC and centricity - with regard to risk identification, risk assessment, risk allocation and risk treatment were presented to the practitioners as introduction to the individual interviews.

According to Saunders et al. (2009), the research purpose can be classified as exploratory, descriptive and explanatory. As this research has more than one purpose, the classification is not unique. The expectation is for the result to be an exploratory endeavour, trying to answer the question what is going on the project risk field. Secondly, the study is as well descriptive, a portrayal of how risk assessment is performed in this particular industry. Finally, it is not just description, but explanation is provided as of why certain patterns of risk identification and handling occur, and even causal relationships between variables, risks identified to a later project stage and their severity, and the objectivity/subjectivity nature of the risks. It was also understood during the entire research process that these purposes could change with the course of the research itself.

Project management practitioners may choose different techniques or may apply available project risk methods differently in different situations. The context of the project risk management activities is relevant to understand what is done, how and why. The subjectivity aspect in complex processes such as identifying and assessing potential risks in projects can best be explored and understood through in-depth interviews (Rubin & Rubin, 2012). Interviews can help to challenge long-held assumptions regarding the use of risk management methods or the project practitioner's attitude towards techniques and tools. In depth-interviewing is the tool of choice for exploring personal and sensitive issues or ambiguous choices. The project risk management process is nearly invisible with the exception of the risk register which only provides a limited amount of information.

An initial semi-structured interview took place with each manager in which their previous experience in regard to project risk management and their understanding of the risk management approaches was explored (both educational and work-based). The centricity grids and the conceptual framework was then used as a stimulus for discussion in semi-structured interviews with 12 personnel involved in major projects in the company (Table 6).

1. ***Program Manager:*** *8 years experience as Project Manager – published articles on project risk management, PMP*
2. ***European ERP Manager:*** *12 years experience in IT and project management as project manager and Steering Committee member, PhD in IT, PMP*
3. ***VP Program Management Global:*** *25 years experience in Project Management, responsible for the Project and Project Risk Management methodology, training, templates and business process methods defined/deployed through the global organisation, PMP*
4. ***Global ERP Manager:*** *20 years experience, responsible for ERP competency center, responsible for several ERP rollouts worldwide, PMP*
5. ***Director, Global Program Management of business unit:*** *20 years experience, responsible for the global business unit programs, manager of 15 program managers, experience with Project Risk management quantitative methods such as Montecarlo, PMP*
6. ***Chief Engineer, PMO lead:*** *15 years experience, responsible for the PMO, engineering programs methodologies and systems, PMP*
7. ***PMO / Program Systems Coordinator:*** *10 years experience, responsible for standard program management training and Program management systems development, PMP*
8. ***Senior Program Manager:*** *15 years experience – responsible for major programs, PMP*
9. ***Senior Program Manager:*** *15 years experience – responsible for major programs, PMP*
10. ***Director, Global Program Management business unit:*** *10 years experience, responsible for the global Engineered Fasteners & Components programs, manager of 10 program managers, PMP*
11. ***Applications Engineer and Project Manager:*** *5 years experience, Project Risk management expert, co-author of the internal project risk management procedures.*
12. ***Senior Vice President, business unit:*** *15 years experience - ultimate responsibility for 12 sites in 9 countries, acting as Sponsor and/or senior Steering Committee member on major customer programs.*

Table 6: Project management stakeholder's roles and experience, interviewed to develop the initial risk management maturity model

This interview material, allied to the empirical data from the risk registers, is used to answer the research questions. As suggested by Hickson, Wilson, and Miller (2003) these interviews, coupled with open-ended exchanges with senior managers, and documentary evidence are analysed to identify the intricacies of risk management in projects.

Introduction

1. Have you recently experienced projects which failed to meet their due dates, exceeded budget, did not deliver to specification, missed quality standards or fell short of customer expectations?
2. Could you please tell what the problems were, what went wrong?
3. Why do you think the project risk management process did not prevent such events happening?
4. Do you think project risk management could avoid these problems?
5. Which of the 5 phases / major activities do you think is most critical?
6. Which of the 5 phases / major activities, if any, do you think was not given sufficient focus and attention?

Risk Identification

7. Do you think such competing and contradictory demands lead to mistaken risk item identification? Can you think of any examples in practice?
8. How objective / subjective are the risk items collected in the risk register?
9. To what extent do you see a subjective aspect in the identified risk items (subjective perception, fear, operations vs strategy, short vs long term, defence of own area of responsibility…)
10. How objective / subjective are the risk items collected in the risk register?
11. "Is the 'Risk as a Subjective Concept (RaasC)' a valid concept from your experience?

Risk Assessment

12. Are you aware of the in-house prescribed risk assessment methodology?
13. Do you think is there a good knowledge of this methodology among our project management practitioners?
14. Are you aware of other PM methodologies or guides such as PRINCE2, Agile..?
15. Our in-house methodology is exclusively based on PMI / PMBoK - PMI is said to be suitable for routine/easily planned/usual situations; would the company benefit from combining/adding other techniques?
16. Our in-house risk registers and lessons learned logs – do you think available data could support the development of a decision tool and/or visual aids to improve the assessment of risks.
17. Do you think project outcomes would benefit from more flexible risk assessment methods?

Risk Ownership/Allocation

18. Do you think that risk ownership / allocation is well understood by our practitioners?
19. Do you think the risk ownership / allocation is well deployed by the practitioners in practice?
20. Are there particular issues when allocating risks to third parties / vendors?
21. Are there particular issues when allocating or sharing risks with customers?
22. Can you think of groups within the project / program that proactively identify and assign the risk?
23. Do you consider such events positive? - can autonomous identification and assignment of risk items contribute to project performance?
24. If yes, how can effective participation be encouraged in project risk management?
25. How could sub-project team leads be empowered to handle risk items better?

Risk Appetite/Treatment

26. What is your understanding of reward in the context of risk?
27. Could you provide an example of reward, e.g. new technology, new functionalities introduced/implemented with adequate attention to risks?
28. Do you think there is potential for education, training or exposure to risk?
29. If so, how do you think this could happen?
30. What do you think could be the benefits (financial, process related) of a balanced attitude towards risk?

31. Are there any other relevant aspects to the subject you would like to raise?

Table 7: Questionnaire used with the first 12 interviewees to develop the initial risk management maturity model

Responsive interviewing assumes that people interpret events and construct their own understanding of what happened and that the researcher's job is to listen, balance, and analyse these constructions in order to understand how people see their world. Different to an ordinary conversation the responsive interviewing seeks detail, depth, vividness, nuance and richness. Responsive interviewing is an appropriate model to the research topic because it encourages the researcher to adapt to new information and change directions if necessary to get greater depth on unanticipated insights.

The questions are grouped according to the sequential project risk management phases, which enables the information collected to be systematically analysed to ensure the appropriate level of detail and completeness over the entire project risk management process. This ensures all major activities are discussed. Questions prepared to the interviewees were also assigned to the research question, which guaranteed all research questions were addressed; finally, the research questions are also allocated to the project categories, to ensure context of the different dimensions is adequately considered (Rubin & Rubin, 2011).

The responsive interview is built around main questions, follow-ups and probes. The main questions begin the discussion about each separate research question. Follow up questions seek detail about concepts, themes or events the researcher introduces. Finally, probes help to keep the focus on the topic, asking for examples or clarifications and signalling the desired level of depth. As this research involves testing theories suggested in the academic literature, first the researcher elaborated on what the theory means for the matter; then a set of main questions was prepared to ask about concrete illustrations that are implied by the separate parts of the theory I am testing (Rubin & Rubin, 2011). To balance the main questions, follow-up questions and probes the researcher chose the interviewing patterns presented by Rubin and Rubin (2011) called 'Main Branches of a Tree'. Basically, this consists in dividing the research problem into roughly equal parts and plan to cover each part with a main question. This approach is about breath, to assure each subtopic, in our case risk dimensions, is covered.

Their major individual projects were discussed to gain an understanding of their risk management aspects and the manager's perceptions of the shortcomings of methods they had considered so far. The 12 interviewees are a sample representing the future recipients of the assessment. Following the approach suggested by Maier et al. (2012) the viewpoints of these interviewees will be subsequently synthesised to formulate the text descriptions in each of the cells in the maturity model.

Kvale (2007) lists twelve aspects of the interview form from a phenomenological perspective. Among these following four characteristics are particularly relevant to this research:

- Qualified naïveté: The interviewer sets up the interview with a lack of presuppositions and critical awareness of her own presuppositions. He shows openness to new and unexpected aspects of the subject treated in the discussion

- Focus: The semi-structured interviews need to be directed to the subjects, in this case, the risk phenomena in projects, the interviewee leads the subject toward certain themes, but not to specific opinions about these themes.

- Ambiguity: The task of the interviewer is to clarify whether ambiguities and contradictions are due to failure of communication. In some cases, it may be recognised that contradictory statements may reflect objective contradictions in the project risk management world.

- Positive experience: Consider and facilitate the interview to be an enriching experience for the subject, that may obtain further insights into his/her life situation.

The other eight aspects of the qualitative interview which are appropriate for this research are:

- Quality of precision in the description of the risks examples and stringency in the meaning of the organisation’s capacities
- Nuanced description of the processes such as risk identification and assessment
- Specificity in explaining certain details such as risk root causes

- Openness to change directions and attitudes during the interview process when the interviewee moves into other aspects of the process or proposes completely new approaches in the discussion
- Interviewee's sensitivity towards the treated phenomenon, understanding her emotions when she is referring to the 'others', either from upper management or other functions
- Interviewer awareness of the interpersonal situation during the interview, who is possibly perceived also in his condition as colleague or peer
- Interview as privileged access to people's life world
- Relationship between factual and meaning levels of the statements, sometimes there several meanings behind a factual description or statement.

Following Kwale's (2007) recommendation of thoroughly interview preparation for a higher quality of the knowledge produced in the interview interaction the seven stages of an interview inquiry were a good help in order to design the methodology:

1. Thematising: The purpose of the investigation is to develop a maturity model for effectively assessing risk management capability in organisations, taking account of RaaSC and centricity concepts. There is a general consensus in the literature, amongst practitioners, and also among those working in the organisation regarding the potential high benefit for project success by increasing attention on risks. There is a need to enhance the project risk management process to improve project outcomes.

a. Formulation of proposition about how project risk management theory and practice can be informed or improved by the RaaSC concept. The RaaS concept is confirmed in the organisation, and examples of conflicting risks are documented

b. Develop a framework for integrating different risk thinking in the context of project management. Using the centricity concept in project risk management such a framework as shown in figure 12, which is also presented to the 12 interviewees as introduction to the questions outlined above, has been developed.

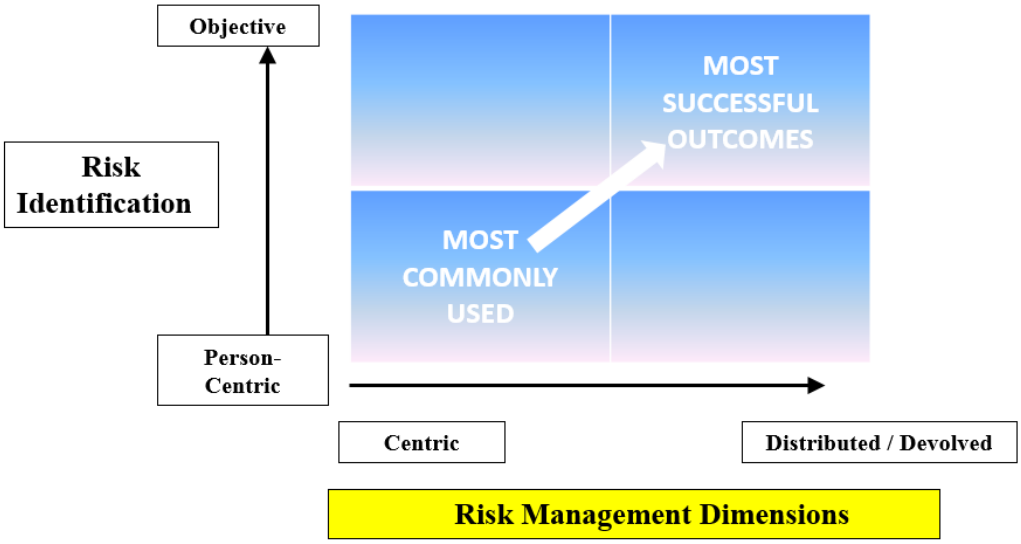


Figure 13: Centricity and risk identification against other risk management dimensions: basic model.

The questions have a precise structure, covering the four risk dimensions one after the other - addressing and trying to discover subjectivity and centricity related issues within these dimensions. Subject matter knowledge and familiarity with the subject of study are ensured with the interviewer 18 years' project management experience within the organisation and 18 months' intensive involvement on the project risk management of a significant mechanical steering system development for an international car maker. The endpoint was kept in sight from the start of the investigation. The interviewees were all well aware of the interview's purpose

2. Designing: Plan the interviews with 12 relevant project stakeholders. This number is a compromise between obtaining a representative sample and the resources available for the study. After identifying the 15 potentially accessible best-suited candidates, 12 of them accepted the invitation. Due to the three months' period in which the interview took place, and the fact that certain transcripts were analysed prior to complete all of the 12 interviews, experience from the initial interviews after reviewing the scripts provided valuable feedback on how to probe and reiterate questions when these had sometimes not been specifically responded in subsequent interviews. The basic questions structure remained the same through all 12 interviews although with interviewees of higher management level or less detailed involvement on the day-to-day activities more freedom was left to them to elaborate on their thought about the risk dimensions in relation to subjectivity and centricity.

3. Interviewing: A detailed guide has been used for the individual interviews, each of which lasted over an hour and was tape-recorded.

Setting the interview stage: The interview was introduced by a briefing, using a power point presentation with seven slides. Only the first four slides were discussed in detail during the introduction, the rest were discussed in combination with the questions. The participant consent form and the project information sheet were sent in advance together with an interview agenda and questionnaire. In some cases, a link to recently published articles by the author was sent to encourage some reading in advance of the interviewees.

Each of the interviews was finished with a debriefing, requesting whether anything else could be relevant to the questions discussed, any aspect that should be mentioned or any question needing further elaboration.

4. Transcribing. All 12 stakeholder interviews were transcribed verbatim, resulting in 135 pages of transcripts.

5. Analysing. The 12 stakeholder interviews were categorised with respect to different forms of grading risk. The interviews with the stakeholders were also subjected to more extensive qualitative interpretations.

6. Verifying. Reliability and validity checks have been attempted throughout the research, including interviewer reliability, and validity of interpretations.

7. Reporting. The results are reported in the next chapter and conference proceedings and journal articles.

Out of the seven phases of an interview inquiry, the first two ones, thematising and designing, are the two most critical ones. Clarity about the why the investigation is taking place and what is being investigated are critical in moving forward into the next steps. Establishment of an interview design considering all seven stages before starting the interviews provides a particularly valuable baseline for the interview endeavour.

3.5.1 Conducting in-depth semi-structured interviews

The potential interviewees were contacted face-to-face or by telephone. Once they agreed verbally to be interviewed they received:

- Participant consent form
- Project information sheet
- Interview agenda
- Questionnaire

The interviews were performed between September 2015 and April 2016. 14 potential research participants were invited, 12 of them accepted the invitation. These business leads were chosen because collectively they represented project managers of major projects with high impact to the organisations. The role of the researcher was that of participant observer as described by Waddingion (2004) in that a relationship developed with the informants. To varying extents, the researcher participated in the activities which took place and attempted to be completely open about the purpose of doing so.

3.5.2 Conducting structured on-line interviews

Once the model was built with the data collected through the 12 in-depth interviews, the next step is to test this for validity and relevance (Maier et al., 2012). There is evidence of considerable differences among individual estimations of maturity within organisations (Brookes et al., 2014). Surowiecki (2005) introduced the term ‘Wisdom of Crowds’ by which groups of people are smarter than an elite few, no matter how brilliant— better at solving problems or coming to wise decisions. Characteristics required by wise crowds are knowledge of the individuals on the subject, their ability to draw on local knowledge, no influence by those around and the existence of a method of aggregation (Brookes et al., 2014). All these conditions are fulfilled by the selection of the respondents, who sum up over 80 years of relevant experience and could draw upon their knowledge of project risk maturity. A method is established for aggregating the responses.

The researcher selected a group of experts concerned with the project risk management development. At first, the model concept was presented to six experts. The experts were contacted by phone. The maturity model and the aim of the online

interview was presented. The responders were requested to assign each of the 151 statements which were listed in an aleatory order to one of the four maturity stages. Subsequently, the survey was distributed using google forms. Google forms is a simple tool used to create and distribute questionnaires. The respondents did answer the survey on their own with no influence from the researcher, and the responses were collected on a repository. The design of the survey avoided any possible problem of group effects, such as group conformity or uncritical thinking. Each participant answered the questions for themselves with no influence either from other respondents or the researcher. Out of the six experts who were approached to participate in the online interviews, all of them responded the survey. Four of these experts had already participated previous 12 in-depth semi-structured interviews conducted to develop the initial risk management maturity model.

1. ***Program Manager:*** *8 years' experience as Project Manager – published articles on project risk management, PMP*
2. ***Global ERP Manager****: 20 years' experience, responsible for the ERP competency centre, responsible for several ERP rollouts worldwide, PMP*
3. ***PMO / Program Systems Coordinator:*** *10 years' experience, responsible for standard program management training and Program management systems development, PMP*
4. ***Applications Engineer and Project Manager:*** *5 years' experience, Project Risk management expert, co-author of the internal project risk management procedures.*
5. ***Senior Program Manager:*** *25 years' experience – responsible for major programs, PMP*
6. ***Applications Engineer and Project Manager:*** *8 years' experience as engineer project lead.*

Table 8: Project management stakeholder's roles and experience, interviewed to refine the initial risk management maturity model

These interviews were conducted between January and March 2017.

3.5.3 Conducting structured interviews

Subsequently, three additional structured interviews were carried out with 3 of the 12 participants in the first interviews. These interviews were aimed at testing the validity of the populated maturity model. The interviewees received:

- The labels grouped by dimension with no indication to which stage these belong in the original model
- Form for them to self-assess their maturity stage in the four dimensions as well as an assessment of their overall risk management maturity stage

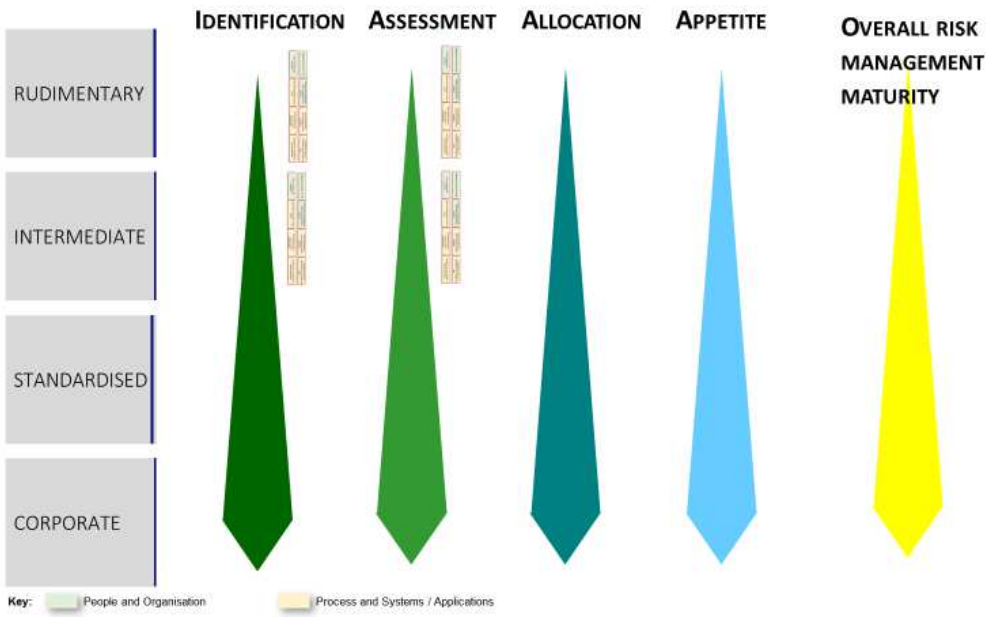


Figure 14: Form distributed to the three interviewees for collecting their risk management dimensions and overall risk management maturity self-assessment.

The interviewees were requested:

- to select few labels within each of the dimensions which best characterise their projects
- to self-assess their dimension by selecting one of the four stages

These three interviewees responded the structured online interviews as well. The model was validated by comparing the labels selected within each dimension against the correspondent dimension's self-assessment. The interviews were conducted in January and February 2017.

3.6 Data analysis procedures

Data analysis in this project centred first on content analysis of the 12 initial interviews. Some of the techniques applied to the transcripts were continual synthesis of the data, thematic analysis, data reduction and coding. This resulted in the 155 labels distributed through the four dimensions and assigned to one of the four maturity stages. The responses from the six participants in the online survey were translated into values according to the stage assigned to the labels, the lowest being '1' for rudimentary and the highest '4' for corporate. Significant divergences between the participant responses and the initial model were analysed and if applicable the labels were reassigned to a different maturity stage. The responses of the three in depth semi-

structured interviews were translated into values in the same manner as the survey responses. The average values by dimension were then compared against their self-assessment, and where significant inconsistencies were detected, labels were allocated to another maturity stage.

Also aligned with the post-positivist approach of the research, triangulation is a substantial component of the case study methodology. The observation of projects risk assessment has been combined with the analysis of answered questionnaires and collection of interviews to ensure consistency between data provided and data providers understanding of the given data.

As a post-positivist influenced research project, the methodology employed has been primarily empirical. The term empiricism as described by Bryman and Bell (2011) refers to knowledge gained through experience.

3.6.1 Data analysis maturity model conception

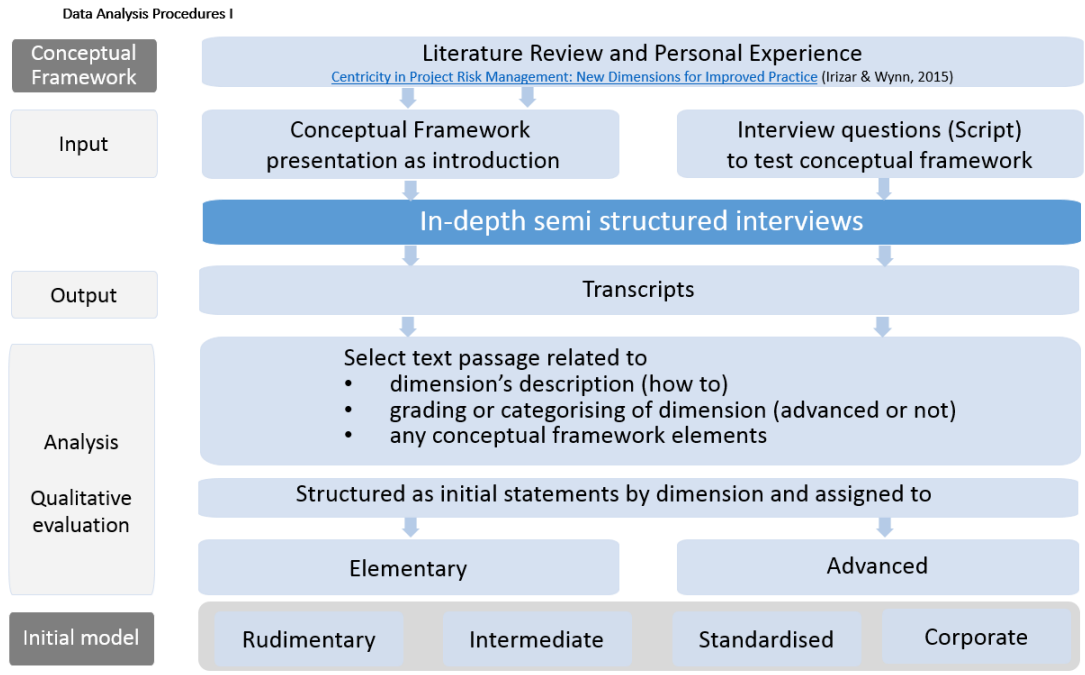


Figure 15: Data analysis procedures for development of the initial project risk maturity initial model.

The qualitative analysis in the first part of this study through which the author arrives at the initial model follows the ideas of Hopkinson (2012) and approach of Maier et al. (2012) on how to develop maturity grids based on organisational capabilities assessments. The semi-structured interviews included narrative histories of risk management, open-ended follow-up questions, and supplement ratings to

affirm and clarify meaning, interviewing several informants per program or group of projects and restricting interviews to top executives who were involved in the project risk management policy reinforcement and execution (Bluhm et al., 2011).

The data collected through interviews with practitioners and executives were analysed based on Creswell (2007) three steps recommendation: Preparing and organising the data in transcripts, reducing the data into themes through coding and condensing the codes, and finally representing the data in figures, tables, or discussion as presented in the next chapter. Continual synthesis of the data, thematic analysis, data reduction and coding were the basis for the data analysis. The researcher started the coding with following initial categories:

1. Dimensions:
    a. Risk identification: Process in which the project team detects prospective events which might affect the project and documents their characteristics (Holzmann, 2012)
    b. Risk assessment: Stage at which the identified risk is assessed for its probability (likelihood) of occurrence and its impact, in terms of time, cost and quality (Patterson & Neailey, 2002)
    c. Risk allocation: Assignment of the responsibility for managing project uncertainty to appropriate project parties (Harvett, 2013)
    d. Risk appetite: Individual or organisational behavioural tendency upon how to take reasonable risks (Aloini et al., 2012b)
2. Lessons learned: Documented and structured key project experiences which have a certain general business relevance for future projects (Schindler & Eppler, 2003)
3. Risk register: Tool which enables the risks within a project to be documented and maintained irrespective of geographical location, and provides the platform for the reduction and mitigation plans to be developed for the high level risks within the project (Patterson & Neailey, 2002)
4. Procedure
    a. Qualitative: Assessments which assign interval scales, e.g. Likert-scales, to both probability and business impact of an outcome
    b. Quantitative: Assessments which assign fixed numerical values to both probability and business impact of an outcome

5. Communication: Process by which project relevant information is exchanged between individuals through a common system of symbols, signs, or behaviour
6. Training: Organised activities aimed at imparting information and/or instruction for improving the recipient's performance or to help him or her attain a required level of knowledge or skill.
7. Subjectivity: Characteristic of or belonging to reality as perceived rather than as independent of mind
8. Centricity: Mindset or attitude that characterises the managers or organisation's outlook and motivation in the relationship to others (Olsen & Roper, 1998; Perlmutter, 1969).
9. Maturity stage: Rudimentary, intermediate, standardised and corporate
10. Systems: Any application which supports project management such as databases or reporting systems
11. People: Human beings linked by any means to the project

This study follows content analysis as choice of qualitative data analysis. Content analysis is a procedure to describe selected text meanings, in this case, the interviews transcripts. This description is carried out by defining relevant meanings as categories of a content analytic category system and then assigning passages to that category. The information in each cell synthesises the viewpoints from a sample representing the future recipients of the assessment. The definition of the cells is descriptive in nature. Individual text descriptions for the cells in each selected process area to be assessed are deduced from the underlying rationale and formulated accordingly.

Reliability understood as credibility, transferability and validity in qualitative research; this is the examination of trustworthiness is crucial. Reliability as the extent to which results are consistent over time has been ensured by using specific interview techniques, confirming a degree of confidence from the interviewees with their responses and collecting interviewee's agreement with the researcher's interpretation of the data. Reliability in this research has been attempted as the researcher's inner dialogue confronted with the external audience: there has permanently an imaginative effort to enter potential critics in the literature review and interviews' responses (Seale, 1999). Data consistency is achieved through the verification of the interview

transcripts or raw data, the coded data or data reductions products, and the researcher's process notes (Golafshani, 2003).

The researcher has attempted to apply certain data reduction techniques without deemphasising the importance of the context and richness of the data themselves (Namey, Guest, Thairu, & Johnson, 2008). In order to consider context which is considered key in this research, the author has chosen thematic analysis. This has the advantage that allows to capture and determine nuances that will apply to the goal of developing a staged model with four levels. The transcripts were carefully read looking for keywords, trends, themes, or ideas in the data that will help outline the analysis before the analysis takes place. As suggested by Namey et al. (2008) the analysis objective in all of the data reduction is based on certain research questions, namely on the two first ones, RQ1 and RQ2. The structured coding used was based on four domains of enquiry, risk dimension analysed, identification, assessment, allocation and appetite. Information refers mostly to retrospective data and events. As in any qualitative research, this raises unavoidable concerns about reliability of recall and subjective bias among interviewees. Out of the transcripts, on a first step focus was set on information with any direct relation to grading or categorising any of the four-project risk dimension. Using the categories initially within each of the four domains of enquiry the data was structurally coded. In the next step, the structurally coded data, mostly in the form of statements, were assigned to one of two extremes, either elementary (left) or advanced (right), example below:

Risk Ownership	
Recognition project centric as opposite to devolved is not efficient	Use team's expertise
Barrier – managements reticence to receive input	Ensure all groups get involved, participate 'the product engineer or the designer who is more focused on their portion of work, is not really sensitive with risks'

Figure 16: Example of coded data assigned to elementary (left) or advanced (right) categories

Then, the two extreme categories, elementary and advanced were extended to four categories or stages: rudimentary, intermediate, standardised and corporate. The data was assigned to the four stages by comparing the statements with the literature and quotes from the transcripts. The data was processed from the table formatting into a mind map, what enables to easily cluster the elements within the domains of enquiry. These elements were grouped into four types: people, organisation, process and

systems. Finally, these elements were structured into a matrix form which build the maturity model. In order to simplify the number of element types, these were reduced to two: 'People and organisation' and 'process and systems'.

S1 25:03	Crucial?
S2 25:03	Yeah, because for example, for me, my application engineer was before a program manager, so he's really experienced and he's really planning-orientated, but some of the other team members, not really. And then when you try to push to get something, they don't really see the final target and it's difficult. The same with risk management, not everybody knows about risks.
S1 41:38	Anything else with identification, is there anything that you would like to mention? I'm thinking maybe on the model that we've seen before.
S2 41:52	As we said before, I don't think we or the company is really doing their risk management in a very methodical way. I really think that somehow identification is done or it's part of the daily basis of a program I really think that at the end, in the program team meetings, I think people mentioned, "We have this action," and so on, and at the end, the identification of the risk is somehow there.

Figure 17: Example of a transcript, selection of a sentence while discussing risk identification which will initiate coding.

In a second step, those portions of the interviewee contribution either representing categorisation of any of the dimensions or describing any relevant aspect of these dimensions have been placed as cells on an initial structure. Each of these is just a paragraph or sentence sometimes highlighting certain words with particular relevance for the research questions; for example, when the interviewee confirms the conceptual framework regarding risk ownership and centricity: '*lack of efficiency when the project manager is the only one allocating risks'* was selected.

3.6.2 Data analysis maturity model validation and enhancement

The model validation process is depicted in Figure 18. As noted above, the initial maturity model was subject to assessment and validation in two stages – via an online form circulated to six participants (the expert focus group in Figure 18) and then with three follow-up in-depth interviews.

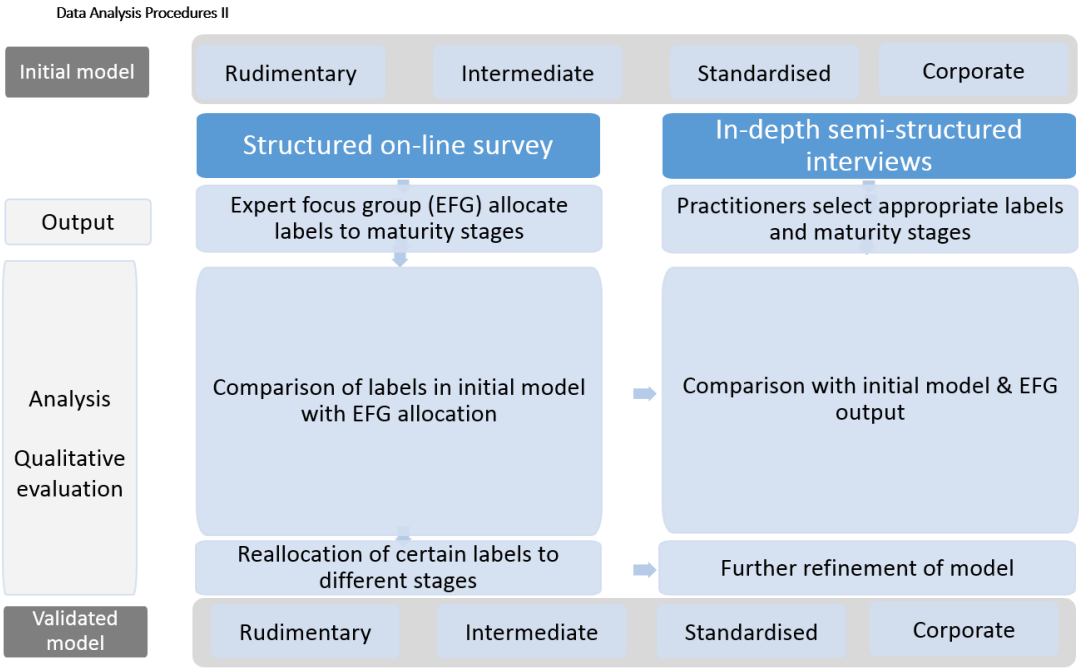


Figure 18: Data analysis procedures for validation and amendment of the initial project risk maturity model.

Structured online interviews

The feedback from the six participants in the online survey was analysed to identify coincidences and divergences between the original model's label positioning and the experts' allocation of the labels. To this end, the responses of the 6 participants were collected in Google forms (Figure 19). As a next step, the responses and the labels' initial model allocation were translated into values (Table 9 and Table 10). If there was a divergence between the initial model and survey participants' view of 0.7 to 1.7 in the four-stage model, then the label was moved one stage in the model. A divergence higher than 1.7 suggested a move of two stages was justified.

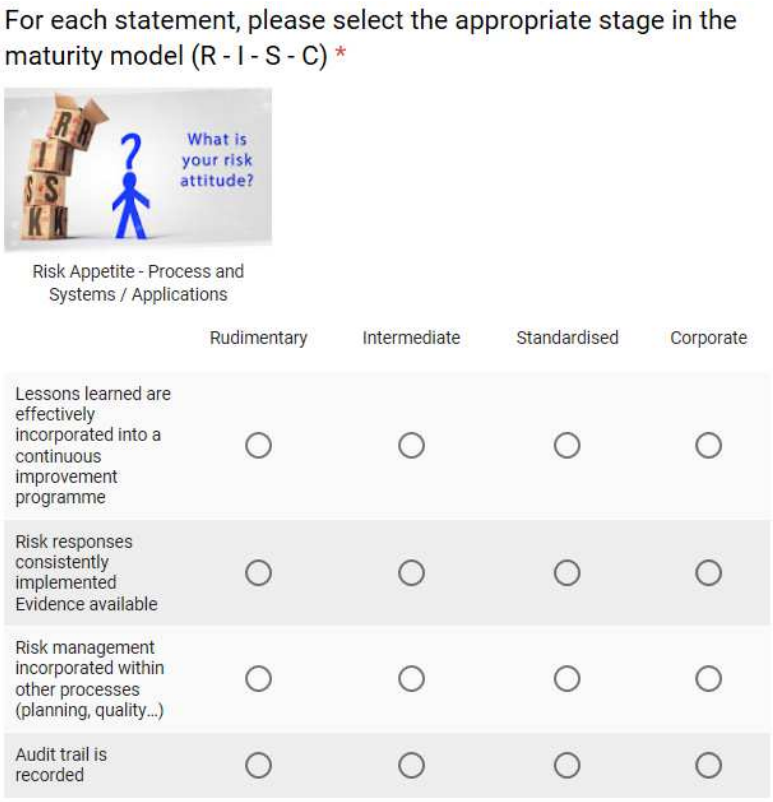


Figure 19: Section of the survey distributed to the experts for these to assign the statements to one of the 4 maturity stages.

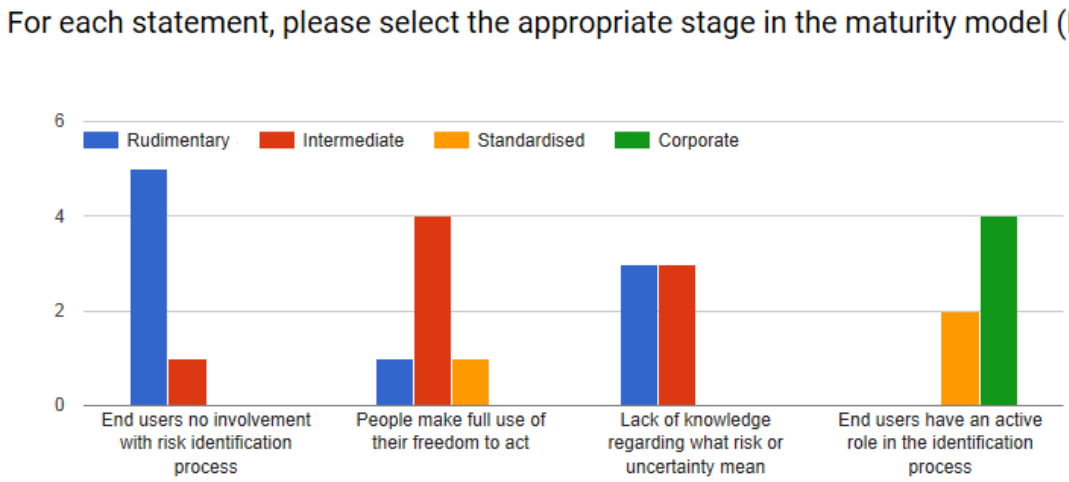


Figure 20: Survey responses collected with Google forms

Label	Value
Rudimentary	1
Intermediate	2
Standardised	3
Corporate	4

Table 9: Label's values used for the model validation

Labels / Responses	End users no involvement with risk identification process	People make full use of their freedom to act	Lack of knowledge regarding what risk or uncertainty mean	End users have an active role in the identification process
Interview 1	1	1	2	4
Interview 2	2	2	2	3
Interview 3	1	3	1	4
Interview 4	1	2	1	4
Interview 5	1	2	1	4
Interview 6	1	2	2	3
Average	1,2	2,0	1,5	3,7
Initial model	1	4	2	3
Difference	0,17	-2,00	-0,50	0,67

Table 10: Extract from the survey responses collected with Google forms

The logic for moving the labels either one or two stages to a higher or a lower stage is depicted in Table 11 below. The survey responses also serve as triangulation to the initial data collected during the initial in-depth semi-structured interviews.

Difference Average - Initial model	Stages variation
-2,5 ; -1,7	-2
-1,69 ; -0,7	-1
-0,69 ; -0,51	?
-0,50 ; 0,50	-
0,51 ; 0,69	?
0,7 ; 1,69	1
1,7 ; 2,5	2

Table 11: Logic for moving labels from the initial model stage allocation

In-depth semi-structured interviews

The three in-depth semi-structured interviews provided more material for refining the model. The responses allow the comparison of the interviewee's four dimensions' self-assessment against their selected labels. Having the interviewees selected the labels which best characterised their projects for each dimension and calculating the label's average, this value was compared with the interviewees' self-assessment of each dimension in their project. Adjustments were made to the model if divergences supported this, using the same divergence bands as in the online survey.

A coincidence between the average value of the selected labels and the self-assessment of the dimension confirms the model's validity. Considerable divergences between the average value of the selected labels and the self-assessment of the

dimension may indicate that some of the label stages may need to be adjusted or there is just a disconnect between the interviewee's self-assessment and the selected label average value in the maturity model. A further refinement of the model was made by evaluating the divergences emanating from both sources, and where there were small differences, a qualitative judgement was made, based on a wider review of interview material in the original transcripts.

3.7 The role of researcher values

Regarding ethics, it has been considered the fact of collecting confidential data from employees in the organisation. Also, data that eventually reflect their adherence to business processes or policies. For that reason, details as names and departments have been anonymised. When using research interviews, ethic issues, primarily respect to the integrity of the interview subject needs to be balanced with the interviewer's concern of pursuing interesting knowledge. The use of a parallel ethical protocol that can be anticipated in projects which success or failure may have direct considerable organisational and financial effects will help to identify critical and sensitive issues that may turn up during the enquiry. Superiors consent, confidentiality, access to data, consequences for the subjects and many other aspects are to be considered prior to initiating the interviews (Kvale, 2007).

3.8 Conclusion

This chapter presented the research strategy and research methodology utilised in this thesis. Chapter four has demonstrated the suitability of the methods chosen to answer the research questions and its alignment with the researcher's underlying philosophy.

The possible research design has been discussed, and the suitable research techniques have been presented. The research approach, namely abduction has been explained with justification on how it fits in the process of 'scientific enquiry'. The rationale for the research paradigm, post-positivism has been elaborated with the subsequent discussion of potential alternative choices, interpretivism and reasons for its rejection. Next, the strategy for the research, the case study has been reviewed followed by answering why to use a qualitative approach. Further, insight on how data has to be gathered, coded and consideration on how validity and reliability can be ensured have been reviewed. Reliability and validity data strategies were developed

during the preparation and conduction of the interviews; data validation was achieved through the comparison of interviews, documentation, observation and survey results; interpretation validity through the transcripts analysis. Further, the logic for the refining of the labels assignment to the maturity stages has been illustrated.

4 Research findings

4.1 Introduction

The results of the initial 12 in-depth interviews were summarised and incorporated into an assessment tool, namely a project risk management maturity model. This model can be used in project-oriented organisations to assess and understand their risk maturity stage, and develop strategies to improve their risk management practice (Zou et al., 2009). The model is built on four stages of capability maturity, namely rudimentary, intermediate, standardised and corporate. The model takes on change management and continuous improvement perspective addressing and analysing issues in 4 project risk management dimensions: risk identification, risk assessment, risk allocation and risk appetite.

The initial manifestation of the maturity model is as follows:

- 40 labels in the identification dimension with ten labels in each of the four maturity stages
- 38 labels in the assessment dimension with eight labels in the rudimentary stage and ten labels in each of the other three maturity stages
- 36 labels in the allocation dimension with six labels in the rudimentary stage, ten labels in the intermediate and standardised stages and nine labels in the corporate stage
- 41 labels in the appetite dimension with ten labels in the rudimentary, intermediate and standardised stages and 11 labels in the corporate stage.

The labels are grouped within the stages and dimensions into two types: ‘People and organisation’ and ‘process and systems’.

4.2 Risk Identification

4.2.1 Risk Identification: Rudimentary stage

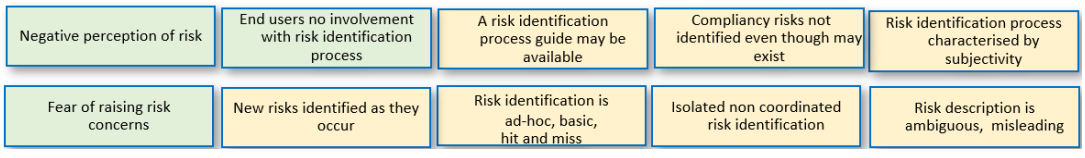


Figure 21: Risk management maturity model labels: risk identification - rudimentary stage.

Process and System Aspects:

Many or most organisations where risk identification stays at rudimentary stage may have adopted some standard guide or developed documentation to support project risk identification. The process may not be known by all stakeholders or implemented by the project management practitioners with due rigour. Risks are identified in an ad hoc manner, and the process may be driven by one single group or individual thus missing the opportunity to consider other groups' views and enhancements. The narrow source of risk identification raises the threat of this being subjective. The activity may be a single action, without clarity on how to review the validity of identified risks periodically, conduct new identification sessions, monitor risk amelioration plans and communicate identified risks to all relevant stakeholders. Potentially high risks such as compliance-related risks may remain unaddressed as the process of identification is eventually subsumed within other project initiatives, and risk logs are not systematically updated during the project life cycle.

The documented risk item descriptions may be ambiguous, in many cases describing potential events instead of the root cause that originates the risk. Impact-oriented risk descriptions with no insight into how risk could be managed proactively are typical at this stage. Often the risks are identified as they occur, leaving inadequate time to address them effectively.

Organisational and People aspects:

The individuals involved in the project may well share a negative perception of risk and may be reluctant to bring these risks forward for discussion and review. End users who may have experience of the environment in which the project product is designed are not involved in the risk identification process.

4.2.2 Risk Identification: Intermediate stage

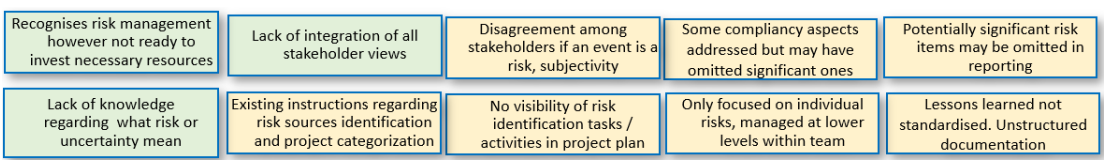


Figure 22: Risk management maturity model labels: risk identification - intermediate stage.

Process and System Aspects:

Practitioners follow specific project and risk management guidelines and instructions – these may provide a methodology to categorise the project's complexity based on several dimensions such as business impact, project team size or project schedule. The project categorisation determines the level of management attention and project risk detail. Typically, the prescriptive risk identification procedure may be more comprehensive in projects categorised as complex than in those categorised as less complex. The risk management instructions provide a framework to outline the individual risk description, source(s) of uncertainty and the effect or risk occurrence.

Although instructions are available, the project plan does not show any specific work package or activities for project risk identification. Project records are maintained, but central documentation such as lessons learned is not standardised. The documentation is unstructured, and data searches on project history are cumbersome. Risk management tends to focus on individual risks managed at lower levels within the team. Some compliance aspects are addressed, but the risk identification process may have failed to recognise some significant risks. In some cases, there is strong disagreement on whether an event is a risk or not. Potentially significant risk items may be omitted in reporting.

Organisational and People aspects:

Many project team members recognise the benefit of investing resources in systematic risk identification at this stage, but the organisation is not ready to invest the necessary resources. There is a lack of knowledge of the meaning and significance of risk and uncertainty which, together with the lack of involvement of certain stakeholders, increases the subjectivity of how potential events are documented as risks for the project. Several stakeholders and groups with significant involvement in the project do not contribute to risk identification.

4.2.3 Risk Identification: Standardised stage

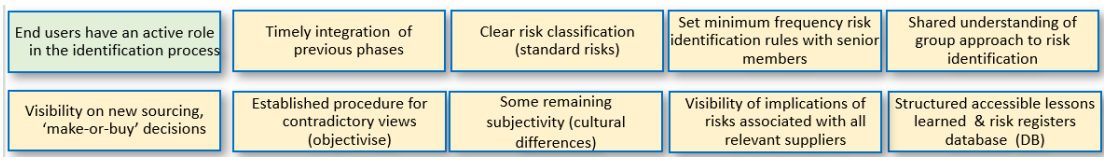


Figure 23: Risk management maturity model labels: risk identification – standardised stage.

Process and System Aspects:

Groups still not active in the project at that point in time, but which will be required subsequently to contribute to risk identification, are encouraged to participate. The project manager is aware well in advance of significant changes, such as the introduction of new suppliers or significant design modifications. The risk register template provides clear risk classifications which can be mapped to established standard risks. The risk identification procedure proposes guidelines on how to document events which represent contradictory perspectives on risk. For example, the sourcing function may want to introduce a new supplier with a certain saving for a new part. The sourcing function may see a savings opportunity in working with the new supplier, but the new supplier's lack of expertise can be conversely perceived as a risk by the quality group. A holistic view of the project is required in order to properly identify risks. Risk identification is performed at a group level, encouraging and integrating all stakeholders' views. There is visibility of implications of risks associated with all relevant suppliers. Still, some subjectivity may remain at this stage, e.g. cultural differences among project team members.

Project categorisation establishes minimum frequency rules to perform risk identification. The project team adheres to these rules, and evidence regarding risk identification is documented, and senior members are involved in the process. Regarding documentation, such as lessons learned logs and risk registers, these are standardised to a certain level and regularly maintained. Records are accessible by all project team members.

Organisational and People aspects:

Organisations performing risk identification at a standardised stage promote an active role of the end users. These are permanently informed about project progress, and they are actively involved in the testing and validation process.

4.2.4 Risk Identification: Corporate stage

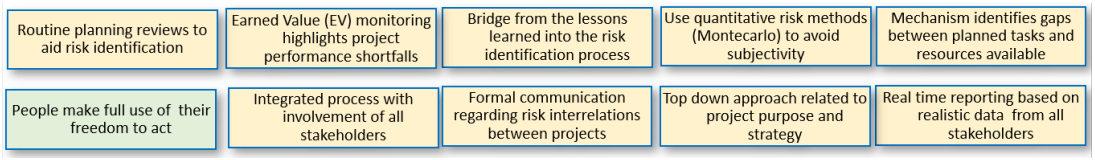


Figure 24: Risk management maturity model labels: risk identification – corporate stage.

Process and System Aspects:

Project planning and risk management are fully integrated. Routine planning reviews consistently use lessons learned logs as well as risk registers databases to aid risk identification. All stakeholders contribute to the process whereby their input and their views are considered. Project team members are knowledgeable and use quantitative data and methods such as Monte Carlo simulation when required. The project team ensures formal communication about the identified risk items within the organisation while keeping an overview of the interrelationship or impact of other projects risks. Capacity resource issues may represent schedule risks. Resource bottlenecks are determined by capacity risk identification, which is a mechanism that recognises any difference between the available and the required amount and quality of resources and skills for business activities. Use and monitoring of earned value (EV) management support the identification of potential risk areas.

A high maturity in risk identification allows focussing on the key risks. The risk identification process is driven by an initial iterative top-down approach based on the project's purpose and strategy. The risk prioritisation is based on the project's strategic goals. The risk analysis must make sure that it analysis the right question, the fundamental purpose of the project. In other words, the big picture needs to be understood from the beginning instead of adding risk effects from different parts. Less mature organisations add up risk effects from different parts and try to establish a detailed risk register using a single-pass. Doing so, they often fail to account for significant sources of uncertainty (Hopkinson, 2012).

Finally, there is good evidence that risk data emerging from all stakeholders, including suppliers is reported and documented in a timely manner. Systems supporting risk management are available to all stakeholders, and these enable real-time reporting.

Organisational and People aspects:

People involved in the project understand and use the defined scope in which they may act. Stakeholders are trained, there is an understanding through the entire organisation about the benefit of proactively identifying risks, risk identification activities are integrated into the project planning, visible in the project plan, and there is evidence of its results.

4.3 Risk Assessment

4.3.1 Risk Assessment: Rudimentary stage

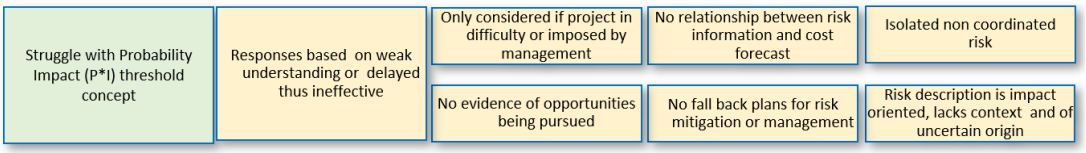


Figure 25: Risk management maturity model labels: risk assessment – rudimentary stage.

Process and System Aspects:

Risk assessment performed at the rudimentary stage is not regularly maintained. Changes in the project which could influence the impact or the likelihood of the event are not considered. As results are not reviewed regularly, risk information may become stale. The approach can be described as static as opposed to an active style. Risk description tends to be impact-oriented and often lacks context and identification of relevant sources of uncertainty. The assessment results are not reflected in the cost forecast. Risk assessment tends to be considered only when the project is in difficulty, or senior management imposes it. Risk responses are often based on rapid decisions reflecting a poor understanding of the alternative courses of action. Sometimes there is a delay between risk identification and responses implementation which results in its ineffectiveness. The organisation focuses exclusively on treat management when addressing uncertainty and does not consider opportunity management. Typically, no fall-back plans are developed.

Organisational and People aspects:

Individuals required to participate in risk assessment do not entirely understand how to assign the likelihood and the impact (P*I) of the potential risks. They struggle with how to rate the risk statements against prescribed risk tolerance thresholds. There is a lack of knowledge of the risk concept and its potential effect on the project outcomes.

4.3.2 Risk Assessment: Intermediate stage

Figure 26: Risk management maturity model labels: risk assessment – intermediate stage.

Process and System Aspects:

The project teams are capable and sufficiently knowledgeable to undertake risk assessment deploying quantitative quality methods such as FMEA, 6 σ or poka-yoke, used mainly in specific processes, for example, the product design phase. The risks are updated, and specific risk categorisation is assigned with the utilisation of risk register templates. Risk descriptions provide some indication of the source of risks. However, the probability estimation is weak. Quantitative schedule analysis is not generally executed. There are clear minimum frequency rules on when to perform risk assessments. Action response plans to the identified risks are regularly reviewed.

The project team deploys mainly qualitative assessments, e.g. a probability and impact matrix. Also, existing expertise from previous projects is used as an input for these assessments. The lack of standards to estimate impacts and the difficulty in quantifying likelihood increases the subjectivity of the risk assessment results, and therefore any subsequent risk prioritisation.

Organisational and People aspects:

The organisation and management would rather deal with issues than with risks - it is embedded in the culture; resource constraints and a focus on problem-solving make it difficult to undertake an adequate risk assessment.

4.3.3 Risk Assessment: Standardised stage

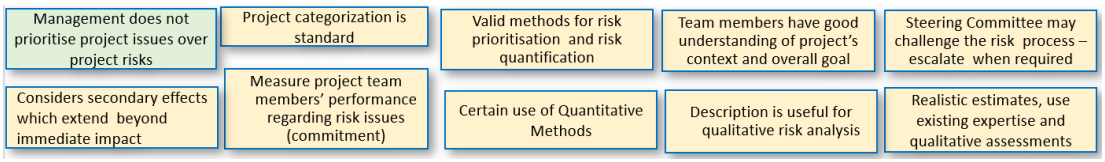


Figure 27: Risk management maturity model labels: risk assessment – standardised stage.

Process and System Aspects:

Project categorisation is performed. This categorisation is based on several dimensions and reflects the project complexity. The higher the complexity, the higher is the level of management attention and risk assessment detail. There is a precise method to estimate the Overall Risk Priority Rating, which determines the threshold for taking a particular risk into the risk response plan or not. The description of the risks documented in the risk register is useful for qualitative risk analysis. Project managers and core team members utilise realistic estimates, are trained in quantitative risk assessment methods and use some of these.

Experts' commitment and availability are valued as the major risk factor in several projects. A method is designed for the project manager to measure team members' commitment by means of their performance. Steering Committees challenge the assessment process and initiate appropriate escalation when required. Team members understand the overall project, its context, and their potential contribution to the organisation's success. That understanding allows them to act in difficult situations focusing on the overall project goal. This understanding is critical to successful project outcomes. Some risk effects may extend beyond the immediate risk impact. These effects could also exacerbate other existing risks. Such secondary risks are considered in the assessment.

Organisational and People aspects:

Management does not prioritise project issues over project risks. Management reviews of open issue lists and issues resolution share the same importance for management as risk assessments.

4.3.4 Risk Assessment: Corporate stage

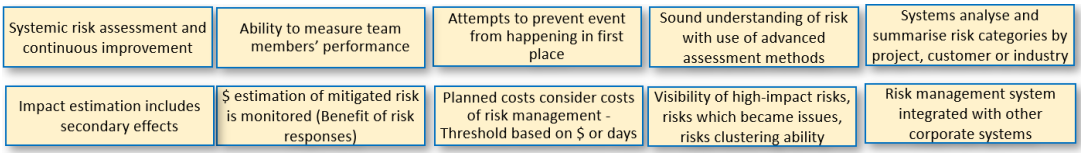


Figure 28: Risk management maturity model labels: risk assessment – corporate stage.

Process and System Aspects:

At corporate level, the organisation assesses systemic risks based on past projects; this assessment can be part of a continuous improvement initiative. This initiative evaluates those risks in more detail and determines how to mitigate or change procedures or ways of working to minimise, if not eliminate, the potential impact on the project. Risk assessment includes the quantification of mitigated risks, the benefit of risk responses and secondary effects. The project budget contains appropriate funding for overall cost risk.

The project managers measure and monitor the project team members' performance against project deliverables. The threshold for taking events into the risk register's response plan is based on estimated costs or project delays in case of the event happening. Risk assessment is reviewed against the likelihood of any risk happening – a risk assessment at corporate level is one that aims at preventing the events from happening in the first place.

The use of quantitative risk assessment methods such as Monte Carlo, decision trees or Bayesian belief networks is underpinned by a sound understanding of risk with significant thought put into identifying relevant sources of uncertainty. Project reporting supports management with visibility of the high impact risks, with clustering and prioritisation functionalities. Systems provide risk aggregation by customers, groups of programs or project portfolios. The risk register lists are the result of all stakeholders' and functions' inputs into an integrated system.

4.4 Risk Allocation

4.4.1 Risk Allocation: Rudimentary stage

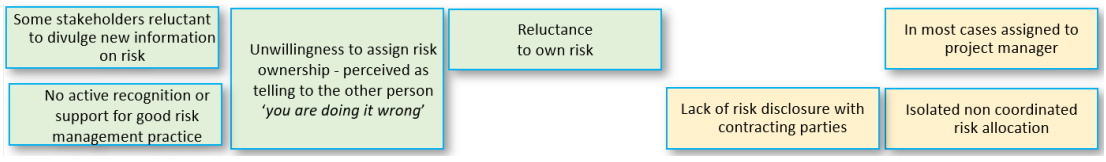


Figure 29: Risk management maturity model labels: risk allocation – rudimentary stage.

Process and System Aspects:

Organisations assign risks in most cases to the project manager. Risk ownership is not reviewed and remains assigned to the same individual during the

different project phases. In most cases, the risk allocation is hindered by the lack of risk disclosure with the contracting parties, e.g., suppliers or external customer.

Organisational and People aspects:

Team members are mostly reluctant to own the risks. There is the general impression that assigning somebody a risk item equates to telling them they are doing something wrong. The reluctance of certain stakeholders', in particular suppliers, to divulge new information on risk prevents risks to be effectively allocated to individuals or groups.

The organisation does not actively recognise the support of good risk management practice.

4.4.2 Risk Allocation: Intermediate stage

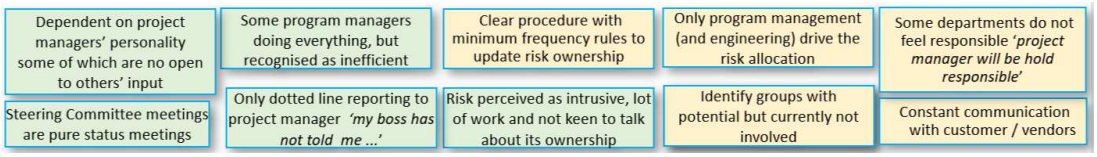


Figure 30: Risk management maturity model labels: risk allocation – intermediate stage.

Process and System Aspects:

There is a clear procedure to assign risks in the risk register. Clear instructions exist suggesting at what point in time these assignments are to be documented or reviewed, typically at the end of any given project phase. Project managers maintain constant communication with third parties and customers to agree on risk accountability.

However, there are groups with a critical role in the project who have little or no involvement in the risk allocation process. Individuals from different functions involved in the project do not feel responsible for the program - it is the project manager that will be associated with the result - and therefore those functions do not feel responsible for the risk which remains with the project manager. Central risk allocation is carried out only by the project manager with most risks remaining with the project manager. These are characteristics of risk ownership centricity.

Organisational and People aspects:

Some project managers recognise the inefficiency of this centric approach, but sometimes they are reluctant to receive input from other team members or functions. This seems to be dependent on the personal attitude of the project manager. Some of them do everything, from assigning the risk, maintaining the risk registers, and even owning most of the actions documented in the risk response plan. Individuals involved in the project perceive risks as intrusive. Being owners of a risk item represents for them an additional burden. In most cases, they do not feel motivated to talk about risk and the associated problems of risk ownership.

Steering committees are more status boards; in their meetings, risk allocation is not reviewed. The fact that the individuals working on the project only report dotted line to the project manager and direct line to their functions negatively influences risk ownership and therefore the allocation. This lack of willingness to own risk by the project team members is best represented with the expression '*my boss has not told me to do that*'.

4.4.3 Risk Allocation: Standardised stage

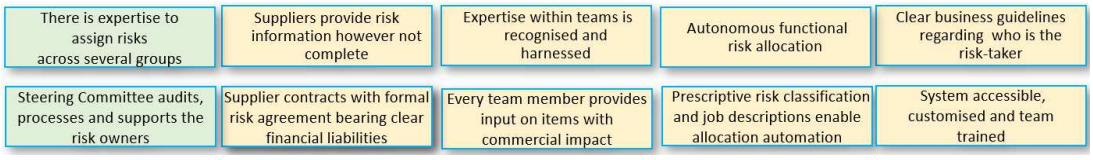


Figure 31: Risk management maturity model labels: risk allocation – standardised stage.

Process and System Aspects:

Organisations review and assess team members' expertise to assign risk items to the appropriate person. In some projects, every member regularly provides their input to items which may have a commercial impact and every item has a risk owner. Suppliers provide risk information; however, this is sometimes not complete. When the suppliers' performance is critical, risk allocation takes into consideration vendor risk ownership. In some cases, risk ownership is documented in the contracts awarded to these suppliers. The contracts contain formal risk agreements with clear financial liabilities for bearing risk. The contract may be designed in a form that specifies traceability requirements in the components delivered by the supplier. Another approach is to formally agree on penalties in case certain contract specifications are not fulfilled. The limited financial resources of small suppliers sometimes make it

difficult to adopt penalties which align with the product's potential warranty implications. Collaboration and risk sharing are required between partners of different size.

The organisation has established guidelines to clearly identify and specify the risk taker, be it the project sponsor, the project manager, or the stream lead, e.g. the engineering or purchasing representative. The introduction of prescribed risk classification and job descriptions in the project provides the opportunity to introduce some automation in the risk allocation process, e.g. risks with a main category of 'technical' and subcategory of 'complexity and interfaces' can be automatically assigned to the 'software development lead'.

Regarding systems, risk registers are accessible and used by all members and functions. All team members are trained in the use of these systems.

Organisational and People aspects:

For the project manager to assign risks across several groups, a certain level of expertise is required. Project managers have acquired this expertise through experience and training, but the project manager is not the only person responsible for the risk allocation. Functional groups involved in the project can assign the identified risks internally without much involvement from the project manager. By doing so, the project manager is released from risk allocation activity, allowing him/her to concentrate on other critical activities. His/her involvement will be limited to verifying the names assigned by the stream leads or sub-project managers in the risk register or otherwise. Steering committees audit the risk allocation process. Moreover, the steering committee members actively support the risk owners and their mitigation actions.

4.4.4 Risk Allocation: Corporate stage

Figure 32: Risk management maturity model labels: risk allocation – corporate stage.

Process and System Aspects:

All identified risks have a risk owner with authority and skills to undertake the required actions from the response plan and who accept responsibility. One major characteristic is the transparency of the escalation procedure of risk allocation for project team members. These procedures answer the following questions, for example: Who is the next person the risk is allocated to when I am not able to cope with the risk? Who needs to take a decision when the actions described in the risk response plan are well above my responsibility?

Risk sharing promotes risk disclosure; it is also a mean of engaging the customer in the process. When included within relevant formal agreements, these reduce the overall project risk. All stakeholders are open in their disclosure of all risk information. Suppliers operate risk management processes which are complementary to the ones used in the project. In term of systems, the risk database is consistently maintained and enables multi-user concurrent access.

Organisational and People aspects:

Risk project team members know enough about the ultimate project goal and align their actions accordingly. If team members at the standardised stage identify responses to risk associated with a pre-existing project plan they support choices about the project solution – their risk capability includes an understanding of risk from the project strategy perspective (Hopkinson, 2012). There is evidence that all people working on the project use the risk management plan. Management actively rewards good risk management practice (Hopkinson, 2012). There is evidence that all people working on the project use the risk management plan. Management actively rewards good risk management practice.

4.5 Risk Appetite

4.5.1 Risk Appetite: Rudimentary stage

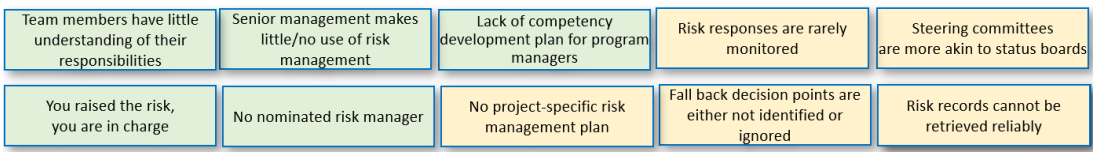


Figure 33: Risk management maturity model labels: risk appetite – rudimentary stage.

Process and System Aspects:

There is no project-specific risk management plan. The risk is not at the top of the executives' agenda. Risk responses are rarely monitored. Fall back decision points are either not identified or ignored. (The fall-back decision point is the date or the point in the project's schedule at which a decision on implementing the fall back should be taken). Steering committees are typically status boards; the risk is discussed only during phase exits or program reviews. Risk records cannot be retrieved reliably.

Organisational and People aspects:

Senior management makes little or no use of risk management. Team members have little understanding of their responsibilities. In some cases, there is no nominated risk manager. People avoid raising risk items. Team members are afraid that if they bring up their concerns, they may end up being made responsible for the potential risk. In other words, 'you raised the risk, you take charge of it'.

Competency development is a crucial strategic management tool in the industry. An established competency development policy is a central part of human resources practice. The result of the organisation failing to offer competency development plans for program managers is a misalignment of employee competencies to the organisational strategy. Competency development plans include specific training, on-the-job learning and career management (De Vos, De Hauw, & Willemse, 2015). This lack of potential development does most likely negatively affect the project management performance from the risk management perspective.

4.5.2 Risk Appetite: Intermediate stage

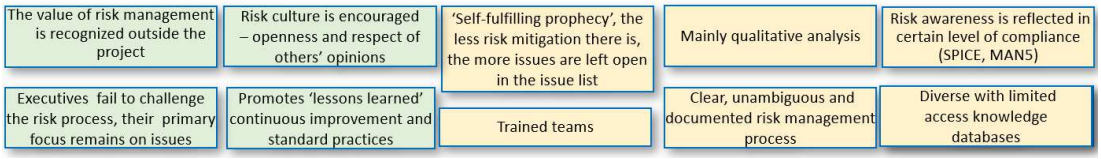


Figure 34: Risk management maturity model labels: risk appetite – intermediate stage.

Process and System Aspects:

Project team members start doing some risk identification and assessments. As the project moves forward, the project manager and team members typically come

under time pressure and risk management falls increasingly behind. This development is sometimes described as a ‘self-fulfilling prophecy’. As the team is not able to cope with the execution of the planned risk mitigation actions, more issues are raised in the open issue list. As resources are assigned to address the issues, less time and resources are available for risk management.

However, management only adopts qualitative risk analysis. Project management is supported with guidelines and methods containing clear, unambiguous process descriptions. Companies train staff in project management specific to their industry, let their risk management process be assessed by OEM’s or auditors, and follow risk management process reference models such as MAN.5, part of the Software Process Improvement and Capability dEtermination (SPICE). The organisation’s executives sanction the risk management methodology, and its adoption is generally ‘top-down’.

There are systems designed to document risks, but these are not common to all functions and may not be accessible to all project stakeholders.

Organisational and People aspects:

The organisation supports and promotes lessons learned regarding how risk management is handled. Management works to ensure common practice also in the risk management area. In some cases, these lessons learned and best practice efforts are part of continuous improvement initiatives.

Risk management’s value is recognised beyond projects, and risk is an area of attention within the organisation. Some organisations introduce compliance programs, business continuity management and Enterprise Risk Management (ERM) which includes methods and processes to manage risks and seize opportunities related to the organisation’s objectives. At this stage, executives fail to challenge the documented project risks, as they feel uncertain as to how to deal with risks, and their comfort area remains on how to address issues. The organisation starts to develop a risk culture and individuals raising risk concerns are treated with respect.

4.5.3 Risk Appetite: Standardised stage

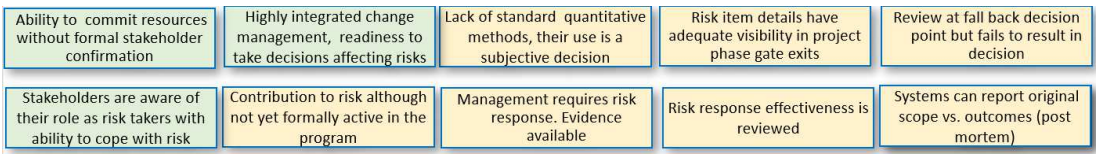


Figure 35: Risk management maturity model labels: risk appetite – standardised stage.

Process and System Aspects:

Some quantitative methods are used, such as FMEA. Nevertheless, there are not formalised standard quantitative methods - the use of these may vary from project to project, and the decision to use quantitative methods is left to the project manager or subject matter expert. Functions still not active in the project at a particular point in time are requested to contribute with their risk assessment to consider potential future implications of current project developments or status.

Risk items have adequate visibility at project phase exits and review. Executives request evidence for risk mitigation actions and dictate compliance with specific risk management activities. Importantly, risk response effectiveness is reviewed. In line with good project governance, steering committee members are keen to make decisions. However, sometimes a fall-back decision point fails to result in a decision. The risk management applications enable ‘post-mortem’ analysis which compares historical original project scope and outcomes.

Organisational and People aspects:

The project team has established a highly integrated project change management process to implement recommended preventive actions. Steering committee members, project manager(s) and functional leads are aware of their responsibilities as risk takers. They explicitly validate their capability to cope with the documented risks. As a result of this, activities which require significant resource allocation may be authorised without formal confirmation from certain key stakeholders – for example, the customer in a new customer-specific product design.

4.5.4 Risk Appetite: Corporate stage

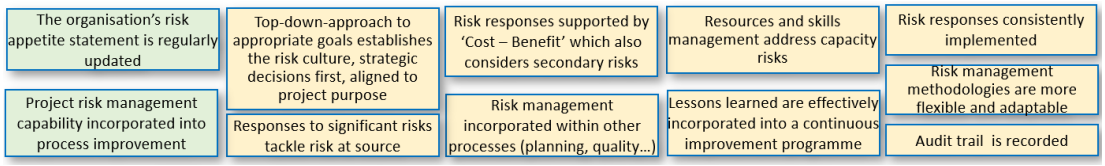


Figure 36: Risk management maturity model labels: risk appetite – corporate stage.

Process and System Aspects:

Risk management is integrated into project planning. The project plan considers routine activities are used to aids project identification and assessment. Cost of risk responses is considered. Otherwise, risk management becomes an isolated activity with no impact on other project management processes. The risk management methodology is used flexibly, adapted this to project particularities. This flexibility allows focussing on certain risk management activities in certain phases or the omission of other activities when not required. Risk responses are consistently implemented. These are supported by cost-benefit analysis which also considers secondary risks. Responses to significant risks tackle risk at the source.

Competency development is a crucial strategic management tool in the industry. An established competency development policy is a central part of human resources practice. The project managers follow a well-defined competency plant enables them to best support the project risk management. Competency development plans include presentation and communication techniques and quantitative risk assessment training as well as career management. Project management practitioners within the organisation have stressed the importance of project governance, clarity of roles and responsibilities, authority, and competency. Capacity risks can be easily identified and addressed when authority and responsibilities match, and skills and resources fit together. What is more important, management has the ability to quantify the risks associated with capacity shortcomings. Project governance and project human resource management are integrated into the overall project plan.

Executives and steering committees provide leadership in risk management. Executives request evidence of risk activities and challenge the risk management process. They support an iterative top-down approach to risk management which supports key strategy decisions first. The first cycle is based on a simple holistic

understanding of how uncertainty could affect the project's purposes. By doing so, high-level insights into the project are considered, and all major sources of uncertainty that affect most or all the elements of the project are determined. Project risk management applications enable audit trail functions.

Organisational and People aspects:

The organisation regularly updates its risk appetite statement. Organisations have at their disposal all elements needed to perform continuous improvement initiatives in risk management:

- Project history with risk registers
- Risk items with detail whether events occurred or not
- The result of mitigation actions
- Systems that support queries/aggregation.

The project risk management capability is assessed. As a result, process improvements in risk management are implemented.

4.6 Summary

This chapter presents the initial maturity model developed with the input of 12 in-depth interviews conducted with project management experts. This is drawn in two parts:

a) 155 short statements in the form of labels assigned to the four-risk dimension and four maturity stages configure the model.
b) These different aspects of risk identification, assessment, allocation and appetite about a) risk management process and systems and b) organisation and people involved are elaborated in a narrative form, providing the opportunity to the reader to assess whether her organisation risk maturity stage coincides with any of the stages described or otherwise.

Several of the descriptions suggest actions to improve the risk management process or address critical organisational gaps, such as the roles of steering committees and their duties. Subjectivity and risk centricity are a constituent part of several of these descriptions – ability to perform specific project management techniques define

the risk maturity evolution in all four risk dimensions. Some of these techniques or process aspects, like SPICE or traceability-related requirements, may be industry-specific and only applicable to the manufacturing or automotive industries. Collaboration between parties and functioning escalation procedures within the organisation are relevant features of risk maturity. Both aspects require effective change management in place.

5 Model validation and amendment

5.1 Introduction

This chapter describes how the initial model was validated. The aim is, based on the data analysis described in section 4.6.2, to outline the labels which need to be reallocated to a different stage in the maturity model as well as to explain the reasons supporting the amendment. As this is qualitative research based on interviews, the key concern at this stage relates to precision, credibility, and transferability. The validation intends to facilitate illumination, understanding, and more importantly, extrapolation to similar situations (Hoepfl, 1997). This validation aims to test confirmability, applicability and transferability. It is about testing and increasing the validity of trustworthiness of the research. Once populated the initial model it must be tested for validity and relevance. Evidence needs to be given for correspondence between the researcher's findings and the understandings of the participants of the assessments.

A degree of agreement is required as to what elements need to be included or excluded, justifying the use of the theoretical framework underlying the selection of process areas.

- Are all four dimensions, identification, assessment, allocation, and appetite to be included?
- Are the two major aspects, a) People and Organisation and b) Process and Applications identified within the dimension?

It is essential to test input into the maturity model (choices made during the planning and development phases) for validity and the results acquired by applying the model in practice for correctness—in particular as in this research when the objective is to develop benchmarking which requires generalizability. However, the generalizability is one of the criteria for quality case studies depending on the case selected and studied. That is, the generalizability can be understood as the ability to deploy the maturity model to wider groups and circumstances within the organisation (Golafshani, 2003). Evaluations may be continued until a saturation point is reached, i.e., until no more significant changes are being suggested by participants and/or until evaluation results are satisfactory. The first applications of the assessment should ideally be treated as a final stage of evaluation (Golafshani, 2003).

The maturity model has been validated in terms of usability and usefulness. Usability mainly addresses the degree to which users understand the language and concepts used. Usefulness could be seen in terms of companies' perceptions of whether they found the assessment helpful in stimulating learning or in leading to effective plans for improving a certain situation.

Section 5.3 discusses how the online survey responses provided by the six experts suggest confirming or refining the labels allocation in the maturity model. The results of these fully structured short interviews have been used to analyse whether the means of measurement are accurate and whether they actually measure what they are intended to measure (Golafshani, 2003). In an attempt to further assess and iteratively refine the maturity model, additional feedback was gained through three in-depth semi-structured interviews, the results of which are presented in the next section 5.4. The use of triangulation by collecting the data through different methods is a significant consideration for the model validation. Then, after a summary of the amendments is presented, section 5.5 describes the entire validated and amended maturity model. To conclude, section 5.6 provides a summary of the validation process and its results.

5.2 The model validation process

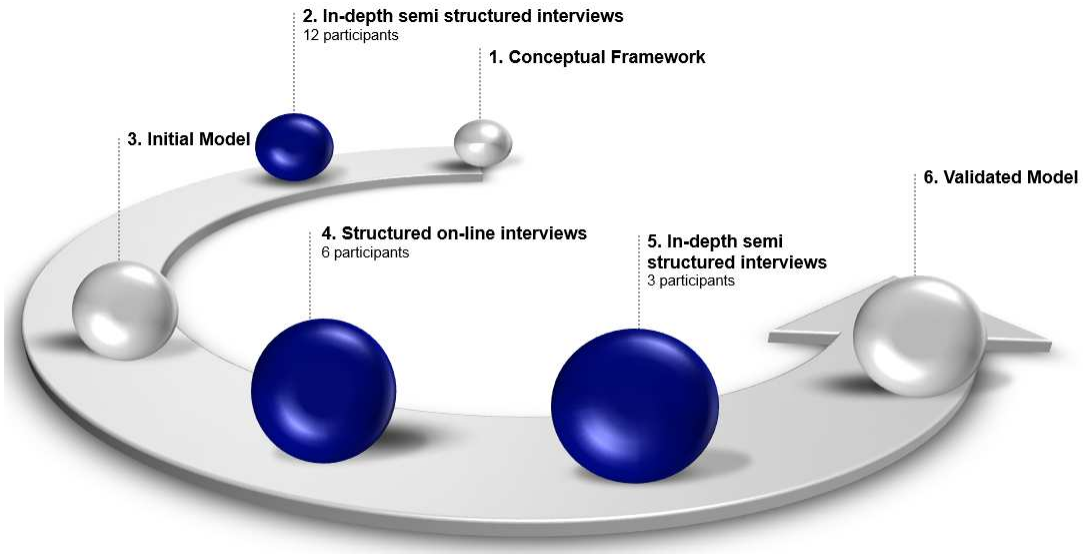


Figure 37: Research design, model development and validation process

Taking the initial maturity model created out of the input from the 12 in-depth semi-structured interviews, the initial maturity model was assessed and validated in

two steps. To this end, as shown above, six participants responded an online form, and then three follow up in-depth interviews were conducted.

5.3 Structured online interview analysis

In this section, responses showing a considerable divergence between the respondents' label allocation and the initial maturity model in each of the four dimensions are highlighted. Subsequently, suggestions for adjusting their stage or otherwise are discussed.

5.3.1 Identification

Listed below in Table 12 are the 13 labels with a considerable divergence between the survey response and the initial label stage assignments. These are the primary candidates for changing their stage in the validated model.

Maturity model label stage adjustment - Identification			
Label	**From**	**To**	**Difference Initial model - Survey average**
A risk identification process guide may be available	Rudimentary	Standardised	2,33
Risk identification process characterised by subjectivity*	Rudimentary	Intermediate	0,83
New risks identified as they occur	Rudimentary	Intermediate	1,17
Isolated non-coordinated risk identification	Rudimentary	Intermediate	0,83
Risk description is ambiguous, misleading	Rudimentary	Intermediate	0,83
Recognises risk management but not ready to invest resources	Intermediate	Standardised	1,17
Instructions with project categorization / risk sources identification	Intermediate	Standardised	1,00
Some remaining subjectivity (cultural differences)	Standardised	Intermediate	0,83
Routine planning reviews to aid risk identification	Corporate	Standardised	1,50

Bridge from the lessons learned into the risk identification process	Corporate	Standardised	1,17
Use quantitative risk methods to avoid subjectivity (Montecarlo)	Corporate	Standardised	0,83
Mechanism identifies gaps between planned tasks and resources available	Corporate	Standardised	1,17
People make full use of their freedom to act	Corporate	Intermediate	2,00

Table 12: List of labels with a considerable divergence between the survey responses and the initial label stage assignments

Next, the survey responses to these 13 labels were analysed.

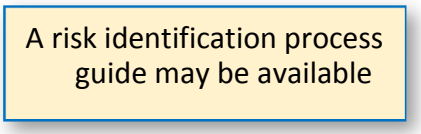


Figure 38: Label moved two stages higher, from rudimentary to standardised stage

'A risk identification process guide may be available' initially positioned at the rudimentary stage, received an average value of 3,3 which suggests moving the label two stages higher, to the standardised stage. Four of the survey respondents assigned the label to the standardised stage; the two other participants assigned the label to the corporate stage. These responses confirm moving the label to the standardised stage.

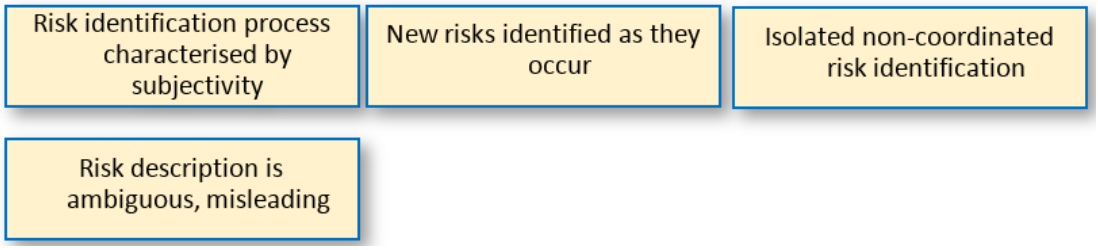


Figure 39: Labels potentially moved one stage higher, from rudimentary to intermediate stage

'Risk identification process characterised by subjectivity' is placed at the rudimentary stage in the original model and has been selected by two of the participants in the in-depth interviews. Their self-assessments of the risk identification dimension were: one between intermediate and standardised and the second one rudimentary. Five out of the six respondents of the online interview selected the intermediate stage and only one the rudimentary. 'New risks identified as they occur' was allocated to the intermediate stage by three respondents, two selected the standard

and one the rudimentary stages. Three respondents assigned 'Isolated non-coordinated risk identification' to the intermediate stage, one to the corporate and one to the rudimentary stages. 'Risk description is ambiguous, misleading' was allocated to the intermediate stage by five respondents, only one selected the Rudimentary stage.

The responses of the six experts in the survey suggest moving these four labels one stage higher to the intermediate stage.

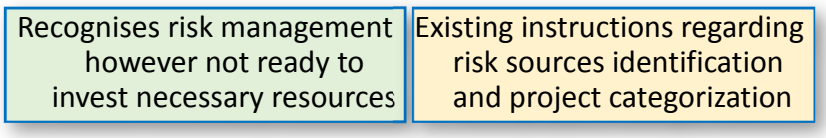


Figure 40: Labels potentially moved one stage higher, from intermediate to standardised stage

'Recognises risk management however not ready to invest necessary resources' and 'Existing instructions regarding risk sources identification and project categorisation' are allocated to the intermediate stage in the initial maturity model. Three respondents assigned 'Recognises risk management however not ready to invest necessary resources' to the corporate stage, one the standardised and two the intermediate stages. 'Existing instructions regarding risk sources identification and project categorisation' was allocated to the Corporate stage by two participants, three selected the standardised and one the intermediate stages.

Responses to both labels initially located at the intermediate stage suggest moving these to the next higher stage, standardised.

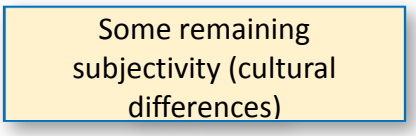


Figure 41: Label potentially moved one stage lower, from standardised to intermediate stage

Five responses to 'Some remaining subjectivity (cultural differences)' are intermediate and only one standardised. These responses strongly suggest moving the label from the standardised to the intermediate stage.

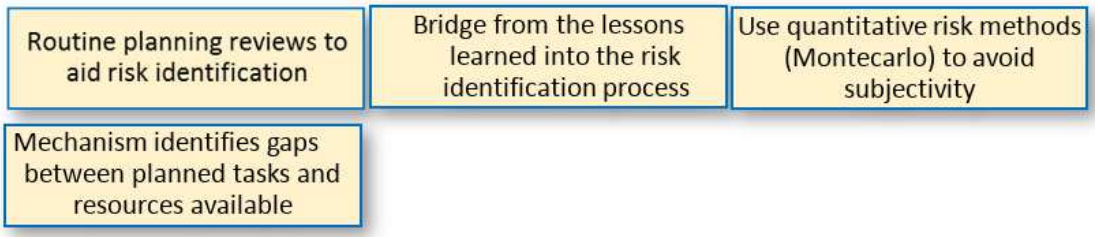


Figure 42: Labels potentially moved one stage lower, from corporate to standardised stage

The next four labels were initially assigned to the corporate stage. Two respondents assigned 'Routine planning reviews to aid risk identification' the standardised and Intermediate stages. One selected the corporate and one the rudimentary stages. 'Bridge from the lessons learned into the risk identification process' was assigned to the corporate and standardised stages by two respondents; one chose the intermediate and one the rudimentary stages. 'Use quantitative risk methods to avoid subjectivity (Montecarlo)' allocations were five to the standardised and one to the corporate stages. 'Mechanism identifies gaps between planned tasks and resources available' was assigned to the corporate stages by two respondents; three chose the intermediate and one the standardised stages.

The survey responses on these four labels suggest lowering these from the corporate stage to the standardised stage.

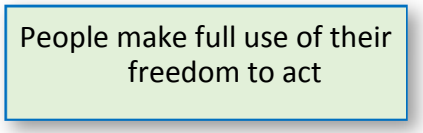


Figure 43: Label potentially moved one stage lower, from corporate to intermediate stage

Finally, 'People make full use of their freedom to act', initially allocated to the corporate stage, was assigned by four respondents to the Intermediate stage, one participant chose the rudimentary and the standardised stages each. This result suggests a lowering of the label stage from the corporate to the Intermediate stages.

Based on the survey responses all 13 labels may be adjusted as outlined in Table 12.

5.3.2 Assessment

Table 13 below lists ten labels with a considerable divergence between the survey response and the initial label stage assignments. These are the preliminary candidates for changing their stage in the validated model.

Maturity model label stage adjustment - Assessment			
Label	**From**	**To**	**Difference Initial model - Survey average**
Risk description is impact-oriented, lacks context and of uncertain origin	Rudimentary	Intermediate	0,83

Clear procedure, minimum frequency to assess risk event - (Evidence-based)	Intermediate	Standardised	1,50
FMEA, 6s, poke yoke used for quality management (in product design) *	Intermediate	Standardised	1,00
Management does not prioritise project issues over project risks	Standardised	Intermediate	0,83
Attempts to prevent the event from happening in the first place*	Corporate	Standardised	1,33
Sound understanding of risk combined with the use of Monte Carlo, decision tree	Corporate	Standardised	1,00
Systems analyse and summarise risk categories by project, customer or industry	Corporate	Standardised	1,17
Impact estimation includes secondary effects	Corporate	Standardised	1,17
Planned costs consider risk management - Threshold based on $ or days	Corporate	Standardised	1,17
Visibility of high-impact risks, risks which became significant issues, risks clustering ability*	Corporate	Standardised	1,00

Table 13: List of labels with a considerable divergence between the survey responses and the initial label's stages assignment

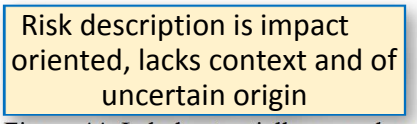


Figure 44: Label potentially moved one stage higher, from rudimentary to intermediate stage

'Risk description is impact-oriented, lacks context and of uncertain origin', initially located at the rudimentary stage, received three responses with the assignment intermediate, one standardised and only one rudimentary. These responses suggest moving the label to the intermediate stage.

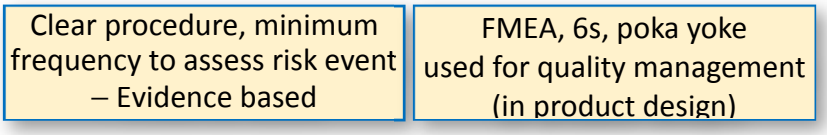


Figure 45: Labels potentially moved one and two stages higher respectively, from intermediate to standardised and corporate stage

'Clear procedure, minimum frequency to assess risk event - Evidence-based' was allocated to the corporate stage by four of the respondents, to the standardised and the intermediate by one each. These results suggest the label should be moved two

stages higher, to the corporate stage. Regarding 'FMEA, 6s, poke yoke used for quality management (in product design)' most of the online interview participants, three chose the standardised and two the corporate stages. One selected the rudimentary stage. The survey results of these two labels initially positioned at the intermediate stage suggest moving the first one to the corporate stage and the second one to the standardised stage.

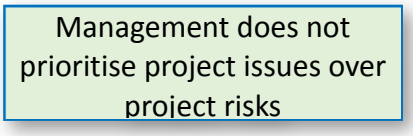


Figure 46: Label potentially moved one stage lower, from standardised to intermediate stage

'Management does not prioritise project issues over project risks' initially positioned at the standardised stage received four responses with an assignment to the Intermediate stage, one to the corporate and one to the rudimentary stages. These responses suggest lowering the stage from standardised to intermediate.

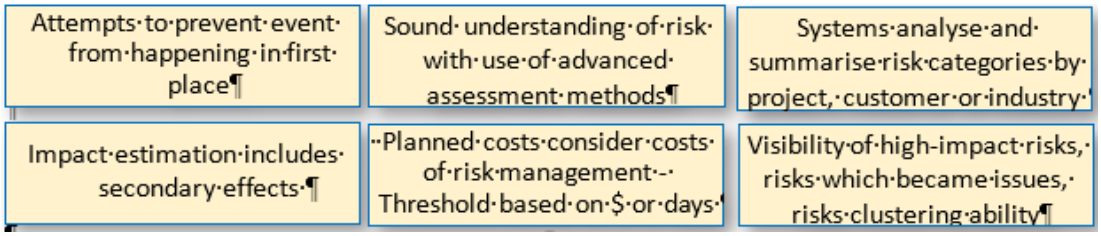


Figure 47: Labels potentially moved one stage lower, from corporate to standardised stage

'Attempts to prevent the event from happening in the first place' has been only chosen by one participant of the in-depth interviews. Her self-assessment of the risk assessment dimension is between intermediate and standardised. Only one of the six respondents of the online interview agree with the initial model, and three chose the standardised stage. One selected the intermediate and one the rudimentary stage. 'Sound understanding of risk with use of advanced assessment methods' allocation on the survey model received two respondents each to the stages standardised, intermediate and corporate. The assignments of 'Systems analyse and summarise risk categories by project, customer or industry' were three Standardised, two intermediate and one corporate. Respondents allocations for 'Impact estimation includes secondary effects' were only one corporate stage, four standardised and one rudimentary. Five of the respondents selected the standardised stage to 'Planned costs consider risk management - Threshold based on $ or days' and one intermediate. Only one participant of the in-depth interviews has chosen 'Visibility of high-impact risks, risks

which became issues, risks clustering ability'. Her self-assessment of the risk assessment dimension is between intermediate and standardised. Only one of the six respondents of the online interview agree with the initial model, and four chose the standardised stage. One selected the intermediate stage.

The responses to the six labels initially positioned at the Corporate suggest moving all six one stage lower to the Standardised stage. Based on the survey responses all nine out for the ten labels will be adjusted as outlined in Table 13, 'Clear procedure, minimum frequency to assess risk event - Evidence-based' will be moved two stages higher from the Intermediate to the Corporate stage.

5.3.3 Allocation

Table 14 below lists ten labels with a considerable divergence between the survey response and the initial label stage assignments. These are the primary candidates for changing their stage in the validated model.

Maturity model label stage adjustment - Allocation			
Label	**From**	**To**	**Difference Initial model - survey average**
In most cases, items are allocated to project manager*	Rudimentary	Intermediate	0,83
Clear procedure with minimum frequency rules to update risk ownership	Intermediate	Standardised	1,17
Suppliers provide risk information however not complete*	Standardised	Intermediate	1,00
Team members' actions are aligned with achieving overall project objectives*	Corporate	Standardised	1,17
Good risk management practice, management audits the process and supports the risk owners*	Corporate	Standardised	0,83
Formal agreements with risk-sharing arrangements	Corporate	Standardised	1,33
Suppliers undertake complementary risk management	Corporate	Standardised	0,83
All stakeholders are open in their disclosure of all risk information	Corporate	Standardised	1,00

All people working on the project actually use the risk management plan	Corporate	Standardised	1,17
All risks have a risk owner with authority and who accepts responsibility	Corporate	Standardised	1,33

Table 14: List of labels with a considerable divergence between the survey response and the initial label's stages assignment

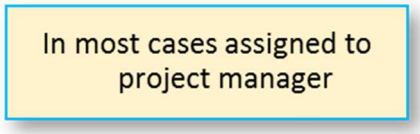


Figure 48: Label potentially moved one stage higher, from rudimentary to intermediate stage

'In most cases, items are allocated to project manager' is assigned to the rudimentary stage in the initial model. One participant has chosen the label in the in-depth interview. Her self-assessment of the risk allocation dimension is intermediate. Two participants of the online interview coincide with the initial model; three chose the next higher stage, Intermediate and one selects the Standardised stage. These responses suggest moving the label to the next higher stage, intermediate.

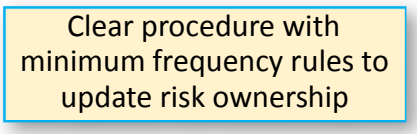


Figure 49: Label potentially moved one stage higher, from intermediate to standardised stage

'Clear procedure with minimum frequency rules to update risk ownership' was assigned to the standardised stage by five of the survey respondents and the corporate stage by one. These responses suggest moving the label to the next higher stage, standardised.

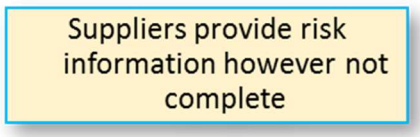


Figure 50: Labels potentially moved one stage lower, from standardised to intermediate stage

'Suppliers provide risk information however not complete' manager' is assigned to the standardised stage in the initial model. One participant has chosen the label in the in-depth interview. Her self-assessment of the risk allocation dimension is

intermediate. All six respondents select the intermediate stage. These responses suggest moving the label to the next lower stage, intermediate.

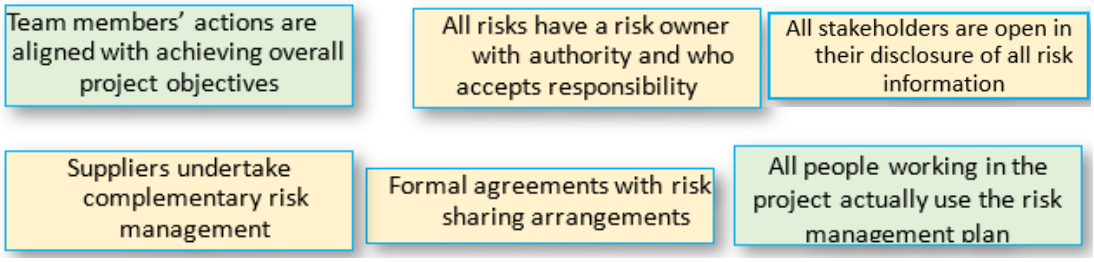


Figure 51: Labels potentially moved one stage lower, from corporate to standardised stage

'Team members' actions are aligned with achieving overall project objectives' only selected in one of the in-depth interviews; the participant self-assessed her risk allocation as rudimentary is placed at the corporate stage in the initial model. Five out of the six respondents of the online interview have selected one lower stage, standardised. The one remaining respondent chose even two steps lower, intermediate. These results point out a strong recommendation to lower the label's stage in the initial model. 'Formal agreements with risk-sharing arrangements' was assigned to the standardised stage by four of the respondents; the other 2 chose the Intermediate stage. These responses suggest lowering the initial label allocation one stage. 'Suppliers undertake complementary risk management' was assigned to the standardised stage by three of the survey respondents, 2 selected the corporate and one the intermediate stage. 'All stakeholders are open in their disclosure of all risk information' was allocated to the Corporate, Standardised and Intermediate by two respondents each. 'All people working on the project actually use the risk management plan' was assigned to the corporate and standardised stages by two respondents each, one selected the Intermediate and one the rudimentary. 'All risks have a risk owner with authority and who accepts responsibility' was assigned to the standardised stage by four of the survey respondents, the other two selected the intermediate stage.

The responses to these six labels initially positioned at the Corporate suggest to move these one stage lower to the standardised stage.

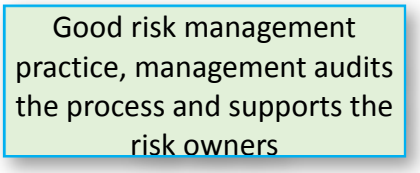


Figure 52: Label remaining at corporate stage

'Good risk management practice, management audits the process and supports the risk owners' is allocated to the corporate stage in the initial model. One participant has chosen the label in the in-depth interview. Her self-assessment of the risk allocation dimension is intermediate. Half of the respondents of the online interview coincides with the initial model allocation, one chose the lower stage, standardised and 2 chose the intermediate stage. These responses do not suggest changing the initial label allocation.

Based on the survey responses, nine out for the ten labels will be adjusted as outlined in Table 14, 'Good risk management practice, management audits the process and supports the risk owners' will remain assigned to the corporate stage.

5.3.4 Appetite

Table 15 below lists 19 labels with a considerable divergence between the survey response and the initial label stage assignments. These are the preliminary candidates for changing their stage in the validated model.

Maturity model label stage adjustment - Appetite			
Label	**From**	**To**	**Difference Initial model - Survey average**
Steering committees are more akin to status boards	Rudimentary	Intermediate	1,50
No project-specific risk management plan*	Rudimentary	Intermediate	0,83
The value of Risk Management is recognised outside the project	Intermediate	Standardised	1,33
Risk culture is encouraged – openness and respect for others' opinions	Intermediate	Standardised	1,67
Risk awareness is reflected in certain level of compliance (SPICE, MAN5)	Intermediate	Standardised	1,50
Promotes lessons learned, continuous improvement and standard practices*	Intermediate	Standardised	1,50
Clear and unambiguous and documented risk management process*	Intermediate	Standardised	1,00

Lack of standard quantitative methods, their use is a subjective decision	Standardised	Intermediate	1,33
Review at fall back decision point but fails to result in a decision	Standardised	Intermediate	1,00
Contribution to risk although not yet formally active in the program*	Standardised	Intermediate	0,83
The organisation's risk appetite statement is regularly updated	Corporate	Standardised	1,17
Top-down approach to appropriate goals establishes the risk culture, strategic decisions first, aligned to project purpose	Corporate	Standardised	1,00
Risk responses consistently implemented Evidence available	Corporate	Standardised	1,17
Risk responses supported by 'Cost-Benefit' analysis which also considers secondary risks*	Corporate	Standardised	0,83
Capacity / resource/skills management in place to address capacity risks	Corporate	Standardised	1,00
Responses to significant risks tackle risk at source*	Corporate	Standardised	1,67
Lessons learned are effectively incorporated into a continuous improvement programme	Corporate	Standardised	0,83
Risk management methodologies are more flexible and adaptable	Corporate	Standardised	0,83
Audit trail is recorded	Corporate	Standardised	1,17

Table 15: List of labels with a considerable divergence between the survey responses and the initial label's stages assignment

Steering committees are more akin to status boards

Figure 53: Label potentially moved one stage higher, from rudimentary to intermediate stage

'Steering committees are more akin to status boards' was assigned to the intermediate and standardised stages by two respondents each. One respondent selected the rudimentary and one the corporate stages. These responses suggest moving the label to the Intermediate stage.

No project-specific risk management plan

Figure 54: Label remaining at rudimentary stage

Half of the respondents assigned 'No project-specific risk management plan' to the rudimentary stage. Two respondents chose the intermediate stage on one the corporate one. These answers do not suggest to change the initial label allocation.

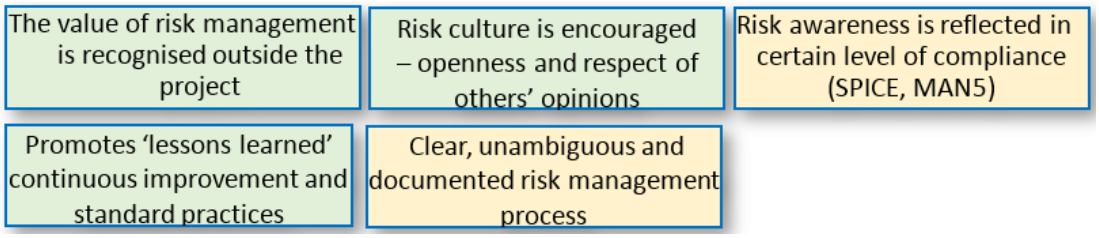


Figure 55: Labels potentially moved one stage higher, from intermediate to standardised stage

'The value of Risk Management is recognised outside the project' was allocated to the Corporate stage by three respondents, two selected the standardised and one the Intermediate the stages. 'Risk culture is encouraged – openness and respect of others' opinions' was assigned by two respondents to the standardised stage, one participant chose the intermediate and three the corporate stages. 'Risk awareness is reflected in certain level of compliance (SPICE, MAN5)' and 'Promotes lessons learned, continuous improvement and standard practices' were both allocated to the stages standardised and corporate by three respondents each. 'Clear and unambiguous and documented risk management process' has been selected by of the interviewees in the in-depth interviews. Her risk appetite self-assessment was intermediate. Half of the six respondents in the online interview chose the standardised stage, two the corporate and one the rudimentary.

The responses to these five labels initially positioned at the intermediate stage suggest moving these one stage higher to the standardised stage.

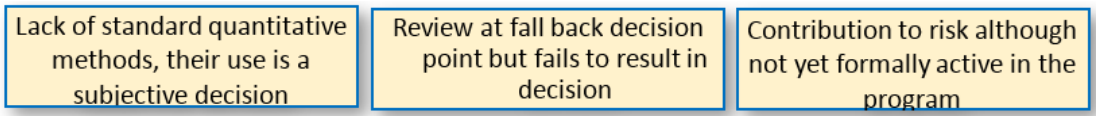


Figure 56: Labels potentially moved one stage lower, from standardised to intermediate stage

Four respondents allocated 'Lack of standard quantitative methods, their use is a subjective decision' to the Intermediate stage, the two others selected the Rudimentary stage. All six respondents assigned 'Review at fall back decision point but fails to result in decision' to the Intermediate stage. 'Contribution to risk although not yet formally active in the program' has been selected by two interviewees of the in-depth interviews which risk appetite self-assessment were rudimentary and intermediate. The label is initially allocated to the standardised stage. Of the six respondents of the online interviews, only two coincide with the model's initial allocation. Three select the intermediate stage and one rudimentary.

The responses to these three labels initially positioned at the standardised stage suggest moving these one stage lower to the intermediate stage.

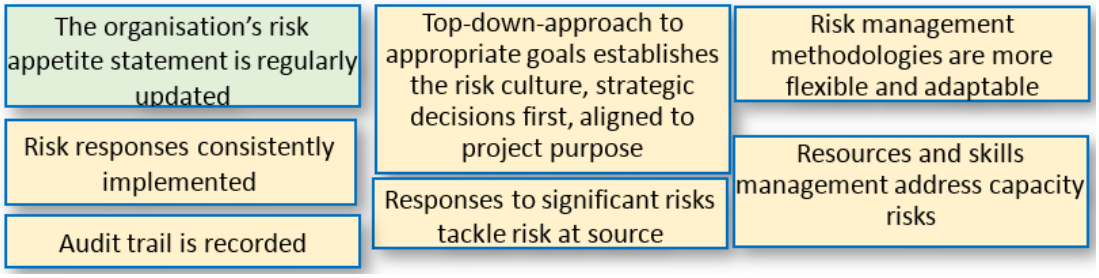


Figure 57: Labels potentially moved one stage lower, from corporate to standardised stage

'The organisation's risk appetite statement is regularly updated' was assigned to the standardised stage by three respondents, 2 chose the intermediate and one the corporate stages. This received the same response as 'Resources and skills management address capacity risks'. Four participants selected the standardised stage, one corporate the stage and one the intermediate stages to the label 'Top-down approach to appropriate goals establishes the risk culture, strategic decisions first, aligned to project purpose'. 'Risk responses consistently implemented Evidence available', and 'Audit trail is recorded' were both allocated to the corporate and standardised stages by two respondents each. One participant selected the intermediate and rudimentary stages each. Two respondents allocated 'Risk management methodologies are more flexible, and adaptable' to the corporate stage, three to the standardised and one to the intermediate stage. Half of the six respondents in the online interview chose the standardised stage to 'Responses to significant risks tackle risk at source', two the intermediate and one the rudimentary. These responses suggest moving the seven labels allocation to the next lower stage, standardised.

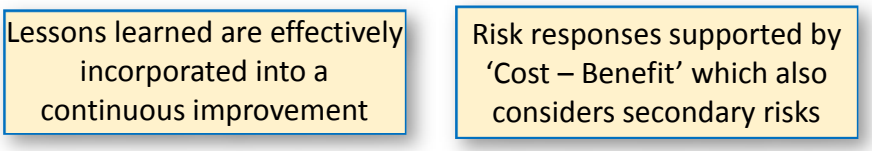


Figure 58: Label potentially remaining at corporate stage

'Lessons learned are effectively incorporated into a continuous improvement programme' and 'Risk responses supported by 'Cost-Benefit' received the same responses. Half of the six respondents in the online interview coincide with the initial model and allocate the label to the corporate stage. Two other assign the label to the standardised stage, and one selects the rudimentary stage. These responses suggest maintaining these two labels assigned to the corporate stage.

Based on the survey responses 16 out for the 19 labels will be adjusted as outlined in Table 14. 'No project-specific risk management plan' will remain assigned to the rudimentary stage; 'Lessons learned are effectively incorporated into a continuous improvement programme' and 'Risk responses supported by 'Cost-Benefit' remain at the Corporate stage.

5.4 In-depth interviewee feedback – interviewee's self-assessment in each of four risk dimensions against the interviewee's average value of selected labels

In this section, the labels selected by all three interviewees to best characterise their projects are analysed based both on the interviewees' self-assessment to the correspondent dimension and the responses received in the survey. Major deviations between the three interviewees' maturity self-assessment of the dimensions and the results obtained by the labels selected in the survey are discussed. Based on this analysis specific labels stage assignment may be adjusted; also for labels not identified for refinement out of the survey data, a qualitative judgement is made, and the adjustments suggested by the survey data are confirmed or otherwise.

The fact that one or more of the selected labels are allocated to a different stage than the interviewee's dimension's self-assessment is likely in projects and organisations. The dimension picture is not homogeneous. Thus individual label stage discrepancies against the interviewee's dimension's self-assessment are not indication enough of the need to reallocating these labels. When several labels selected to describe a dimension point a consistently either higher or a lower stage this may

suggest that any of these labels should be reallocated in the model. Conversely, it could be that the interviewee's self-assessment of the dimension is biased.

5.4.1 Interview 1

Interview 1 Identification

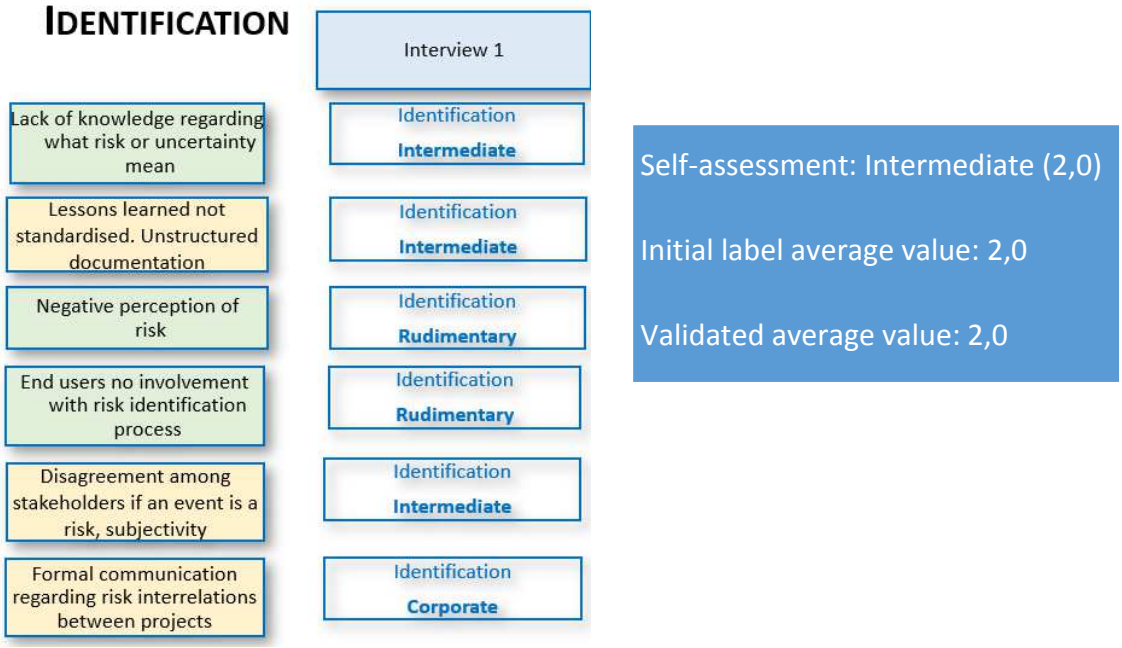


Figure 59: Risk identification labels selected by interviewee 1 – overall risk identification self-assessment against labels initial and post validated average value

Interviewee 1 assesses her project risk identification capability as intermediate. She selected six labels to best describe her projects' current risk identification maturity stage. Three of these labels are assigned to the Intermediate stage, two to the rudimentary and one to the corporate stage in the original project risk management maturity model. The average value of the selected labels shows coincidence between interviewee's self-assessment and the average value of selected labels.

The survey results of all these six labels show coincidence with the label stage in the initial model. Further detailed analyse of the survey responses, and the interviewees' self-assessment of the dimension identification does not provide any suggestion for changing the label stage. This is in line with the interviewee self-assessment.

Interview 1 Assessment

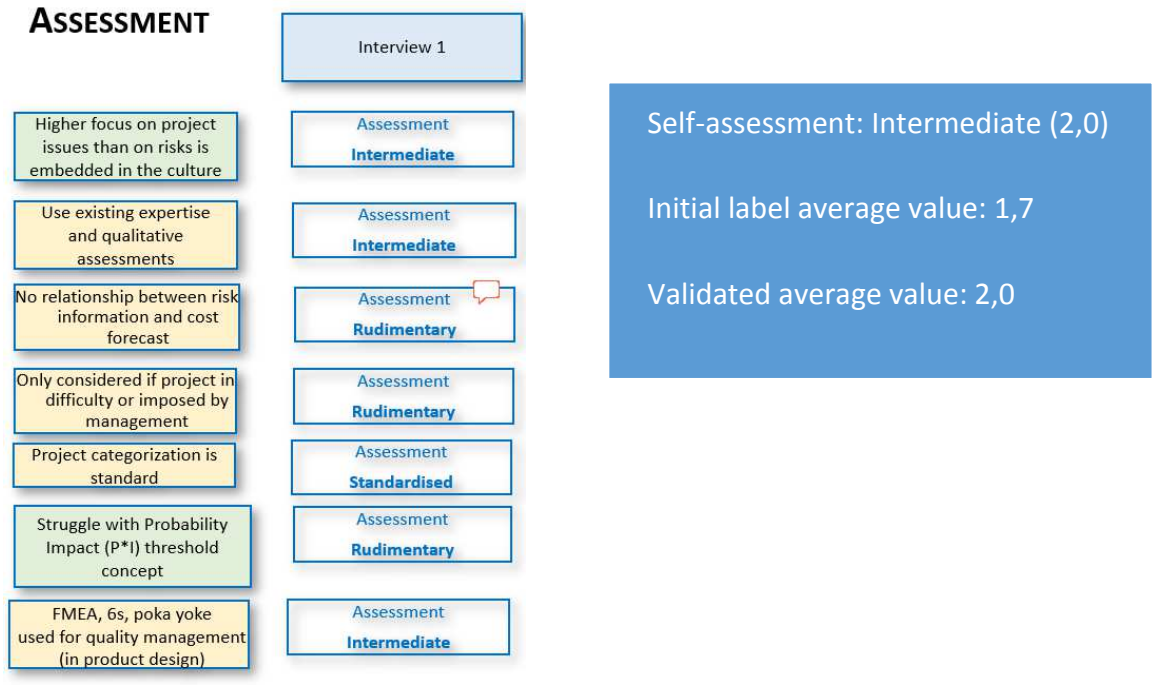


Figure 60: Labels selected by interviewee 1 – overall risk assessment self-assessment against labels initial and post validated average value

Interviewee 1 assesses her project risk assessment capability as intermediate. She selected seven labels to best describe her projects' current risk assessment maturity stage. Three of these labels are assigned to the intermediate stage in the original project risk management maturity model. The average value of the selected labels shows coincidence between interviewee's self-assessment and the average value of selected labels.

Suggested changes:

The survey analysis suggested moving 'FMEA, 6s, poka-yoke used for quality management (in product design)' to the standardised stage. This change is in line with the interviewee's self-assessment.

Responses to 'Struggle with Probability Impact (P*I) threshold concept' suggest moving the label to the Intermediate stage what is in line with the interviewee's self-assessment. Four out of six respondents in the online interview selected the intermediate stage, and the rest selected the rudimentary stage. The difference between survey results average and the label's stage value is 0,67 < 0,7, and it had therefore

not been initially considered for moving its stage. This change is also in line with the self-assessment.

These two changes are both in line with the self-assessment. After the change, the average value of the labels moves from 1,7 to 2,0 which coincides with the self-assessment.

Regarding the other selected labels in interview 1 for the dimension assessment, there are no suggestions for amending any of these. This is in line with the interviewee self-assessment.

Interview 1 Allocation

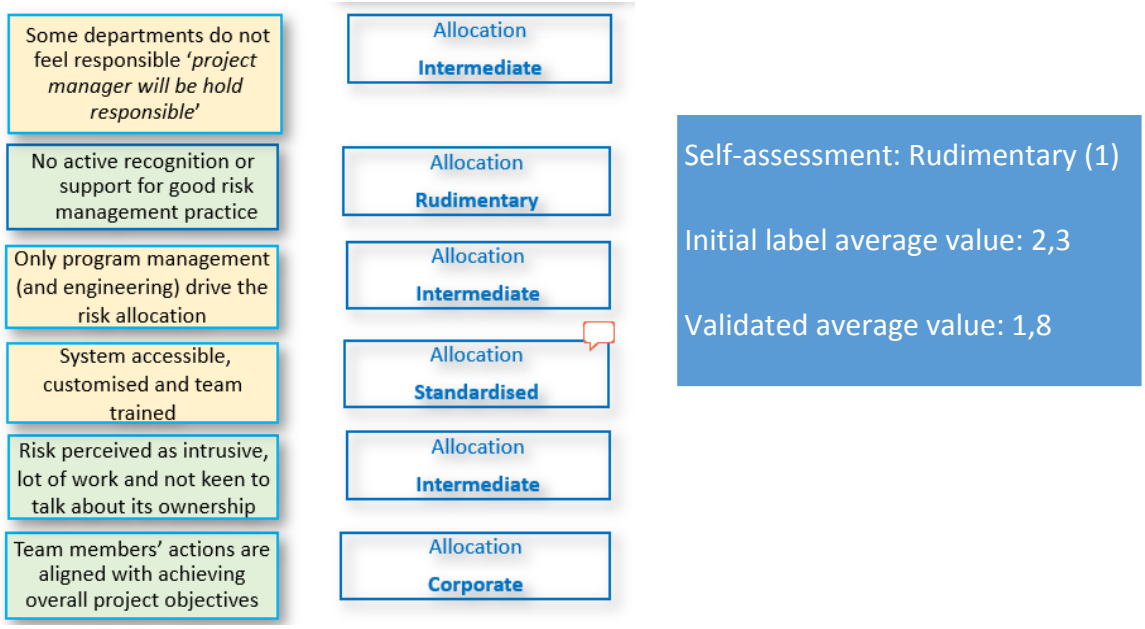


Figure 61: Labels selected by interviewee 1 – overall risk allocation self-assessment against labels initial and post validated average value

Project risk allocation is assessed as rudimentary by Interviewee 1. She selected six labels to best describe her projects' current risk allocation maturity stage. Only one of these labels is assigned to the rudimentary stage in the original project risk management maturity model. Three of the selected labels belong to the intermediate stage, and the average value of the selected labels corresponds to the intermediate stage. Some of the discrepancies between interviewee's self-assessment and the average value of selected labels may be explained (rebalanced) by adjusting the stage of one or more of the labels.

Suggested changes:

The survey analysis suggested moving 'Team members' actions are aligned with achieving overall project objectives' to the standardised stage. This change is in line with the interviewee's self-assessment.

'Risk perceived as intrusive, lot of work and not keen to talk about its ownership' which is located at the intermediate stage in the original maturity model has only been chosen by one of the respondents of the in-depth interviews. His self-assessment of the risk allocation dimension was rudimentary. Five out of the six respondents of the online interview selected the rudimentary stage, and the only one deviation was one respondent who selected the standardised stage. These results suggest that the stage of this label may be changed to the lower stage, rudimentary. The difference between survey results average and the label's stage value is 0,5 < 0,7, and it had not been therefore considered for moving its stage. This change is also in line with the self-assessment.

'Some departments do not feel responsible '*project manager will be held responsible''* placed in the intermediate stage in the initial model has been selected by all three respondents of the in-depth interviews to describe their risk allocation stage. Their self-assessment of the allocation dimension is intermediate in 2 of them and rudimentary in the 3rd one. The majority of the participants, four of the online interviews have selected the label for the rudimentary stage, one for the intermediate and one for the standardised. These results suggest moving the label to the next lower stage, rudimentary. The difference between survey results average and the label's stage value is 0,5 < 0,7, and it had not been therefore considered for moving its stage. This change is also in line with the self-assessment.

All these three changes together are in line with the self-assessment. These changes move the label's average value to 1,8 what is closer to the self-assessment.

Regarding the other selected labels in interview 1 for the dimension allocation, there are no suggestions for amending any of these. This is in line with the interviewee self-assessment.

Interview 1 Appetite

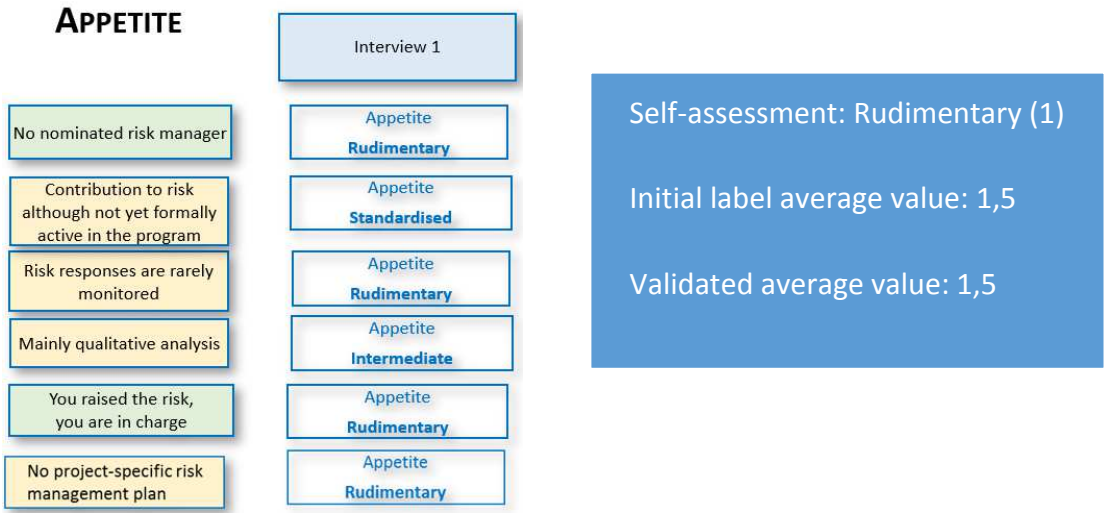


Figure 62: Labels selected by interviewee 1 – overall risk appetite self-assessment against labels initial and post validated average value

Interviewee 1 assesses her project risk appetite as rudimentary. Four out of the six labels she selected to describe best her projects' current appetite stage are assigned to the rudimentary stage in the original project risk management maturity model. The average value of the selected labels shows coincidence between interviewee's self-assessment and the average value of selected labels.

Suggested changes:

> The results of the survey suggested moving 'Contribution to risk although not yet formally active in the program' from the Standardised to the Intermediate stage. This label had been allocated to the Intermediate stage by three participants. Two chose the Standardised and one the rudimentary stages. This change is in line with the dimension's self-assessment.
>
> 'No project-specific risk management plan' was initially allocated to the rudimentary stage and selected in only one of the in-depth interviews. The participant's risk appetite self-assessment was also rudimentary, and half of the respondents have assigned the label been to the rudimentary stage. 2 respondents chose the intermediate stage on one the corporate one. These answers do not suggest changing the initial label allocation. The difference between survey results

average and the label's stage value is 0,83 > 0,7 but the qualitative judgement done in 6.3.4 was not to adjust the label assignment. Not changing the label's stage is also in line with the self-assessment.

'Risk responses are rarely monitored' initially allocated to the rudimentary stage has been selected by two participants of the in-depth interviews. One self-assessment of the appetite dimension is rudimentary and the second one intermediate. The majority of the six online interview respondents, four selected the intermediate and two the rudimentary stage. These results suggest to possibly move the label one stage higher to the intermediate stage. This is not in line with the self-assessment.

The result of applying both changes, 'Contribution to risk although not yet formally active in the program' and 'Risk responses are rarely monitored' to the Intermediate stage is neutral for the label average value. Regarding the other selected labels in interview 1 for the dimension appetite, there are no suggestions for amending any of these. This is in line with the interviewee self-assessment.

5.4.2 Interview 2

Interview 2 Identification

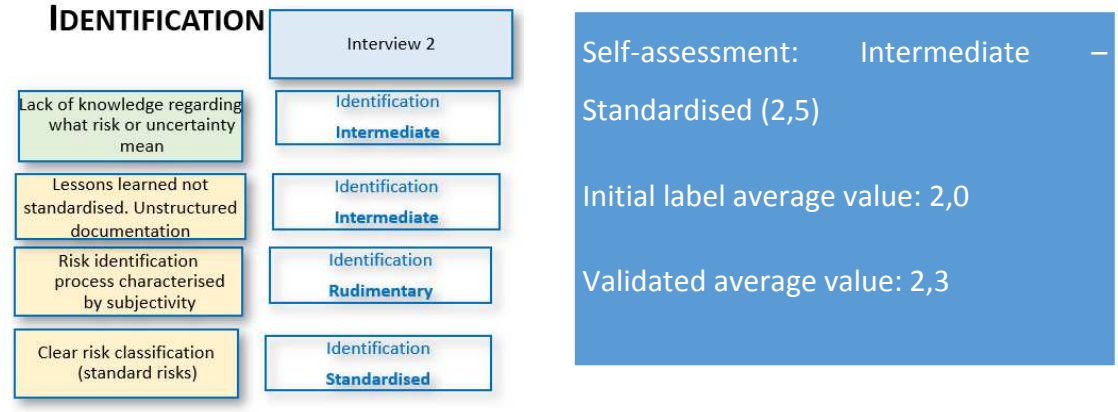


Figure 63: Labels selected by interviewee 2 – overall risk identification self-assessment against labels initial and post validated average value

Interviewee 2 assesses her project risk identification capability as between intermediate and standardised. She selected four labels to best describe her projects' current risk identification maturity stage. Two of these labels are assigned to the

intermediate, one to the standardised and one to the rudimentary stages of the initial project risk management maturity model. The average value of the selected labels shows coincidence between interviewee's self-assessment and the average value of selected labels.

Suggested changes:

The results of the survey suggested moving 'Risk identification process characterised by subjectivity' to the intermediate stage. It is placed at the rudimentary stage in the original model and has been selected by two of the participants in the in depth-interviews. Their self-assessments of the risk identification dimension were one between intermediate and standardised and the second one rudimentary. Five out of the six respondents of the online interview selected the intermediate stage and only one the rudimentary. These responses suggest moving the label one stage higher to the intermediate stage. This is in line with the self-assessment.

The average value of the selected labels moves from 2,0 to 2,3, value which is closer to the value of the self-assessment 2,5.

The responses to the other three labels coincide to a great degree with the values assigned to these in the initial model, what suggests to keep these in the same stages as in the initial model.

Interview 2 Assessment

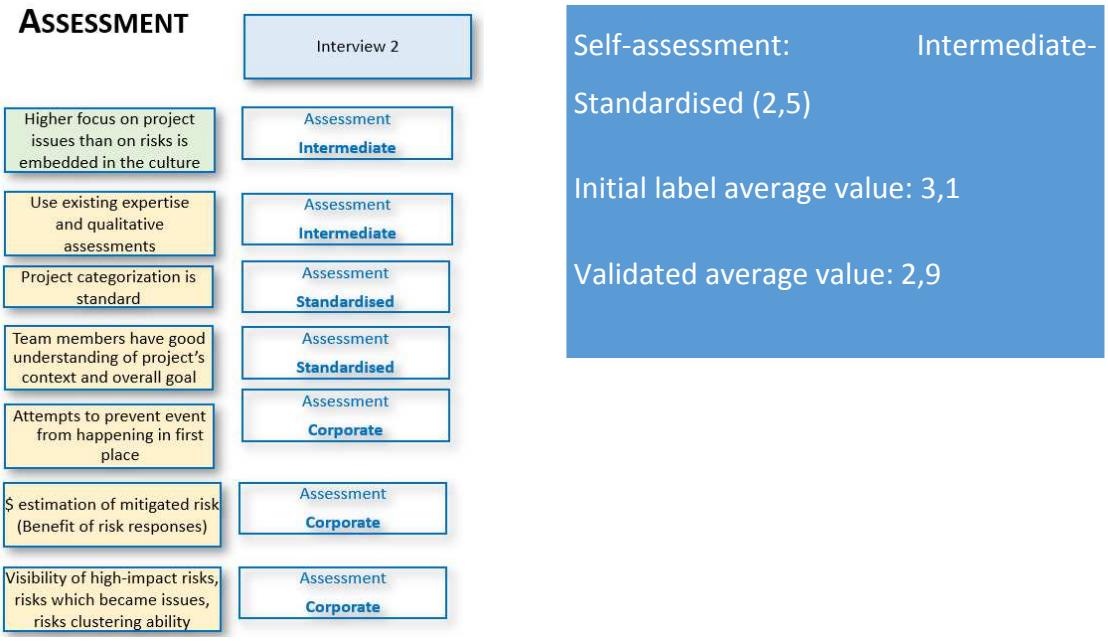


Figure 64: Labels selected by interviewee 2 – overall risk assessment self-assessment against labels initial and post validated average value

Interviewee 2 assesses her project risk assessment capability as between intermediate and standardised. She selected seven labels to best describe her projects' current assessment maturity stage. Two of these labels are assigned to the intermediate stage, two to the standardised stage and three to the Corporate stage in the original project risk management maturity model. The majority of the selected label stages match the interviewee's project risk assessment self-assessment.

Suggested changes:

'The results of the survey to 'Visibility of high-impact risks, risks which became significant issues, risk clustering ability' and 'Attempts to prevent event from happening in first place' suggested to move these labels one stage lower to the Standardised label what is in line with the interviewee's self-assessment, between Intermediate and Standardised.

The average value of the selected labels moves from 3,1 to 2,9, value which is closer to the value of the self-assessment 2,5.

The results of the survey to 'Higher focus on project issues than on risks is embedded in the culture', 'Use existing expertise and qualitative assessments', 'Project categorization is standard', 'Team members have good understanding of project's context and overall goal' and '$ estimation of mitigated risk (Benefit of risk responses)' show a high degree of coincidence with the labels' values in the initial model.

Interview 2 Allocation

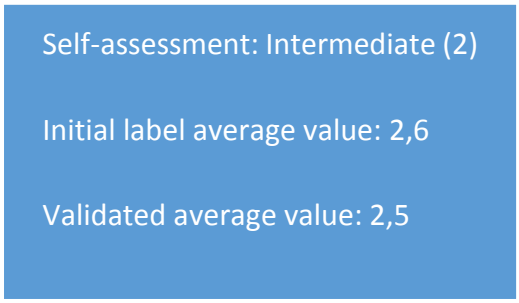


Figure 65: Labels selected by interviewee 2 – overall risk allocation self-assessment against labels initial and post validated average value

Project risk allocation is assessed as intermediate by Interviewee 2. She selected ten labels to best describe her projects' current risk allocation maturity stage. The highest score in the original project risk management maturity model goes to the intermediate stage with four labels. Three of the selected labels belong to the standardised stage, two to the corporate stage and only one to the rudimentary stage.

Suggested changes:

Results from the survey suggest raising 'In most cases, items are allocated to project manager' in one stage to intermediate and lowering 'Suppliers provide risk information however not complete' to the Intermediate stage what is in line with the interviewee's self-assessment.

'Some departments do not feel responsible '*project manager will be held responsible*' placed in the intermediate stage in the initial model has been selected by all three respondents of the in-depth interviews to describe their risk allocation stage. Their self-assessment of the allocation dimension is intermediate in two of them and rudimentary in the 3rd one. The majority of the participants of the online interviews, four have selected the label for the rudimentary stage, one for the intermediate and one for the standardised. These results suggest moving the label to the next lower stage, rudimentary. This

decision is relevant because the difference between the initial model and the survey average value is 0,5, lower than 0,7.

'Constant communication with customer/vendors' is assigned to the intermediate stage in the initial model. One participant has chosen the label in the in-depth interview. Her self-assessment of the risk allocation dimension is intermediate. Four of the six respondents of the online interviews chose the standardised stage and the rest of these, two respondents chose the intermediate stage. These responses suggest moving the label to the next higher stage. However, the recommendation also considering the dimension self-assessment is not strong enough to do the change without receiving responses from additional respondents. This decision is relevant because the difference between the initial model and the survey average value is 0,67, lower than 0,7.

These changes which are in line with the self-assessment move the average value of selected labels to 2,5, what is closer to the self-assessment value of 2,0.

'Good risk management practice, management audits the process and supports the risk owners' although fitting the criterion in the previous validation stage for being adjusted, the qualitative judgement resulted in keeping it at the corporate level.

The responses from the survey to 'System accessible, customised and team trained', 'Some program managers doing everything, but recognised as inefficient', 'Only dotted line reporting to project manager *'my boss has not told me ...''*, 'Steering Committee audits, processes and supports the risk owners' inefficient' all coincide to a high degree with the labels' value in the initial model.

Interview 2 Appetite

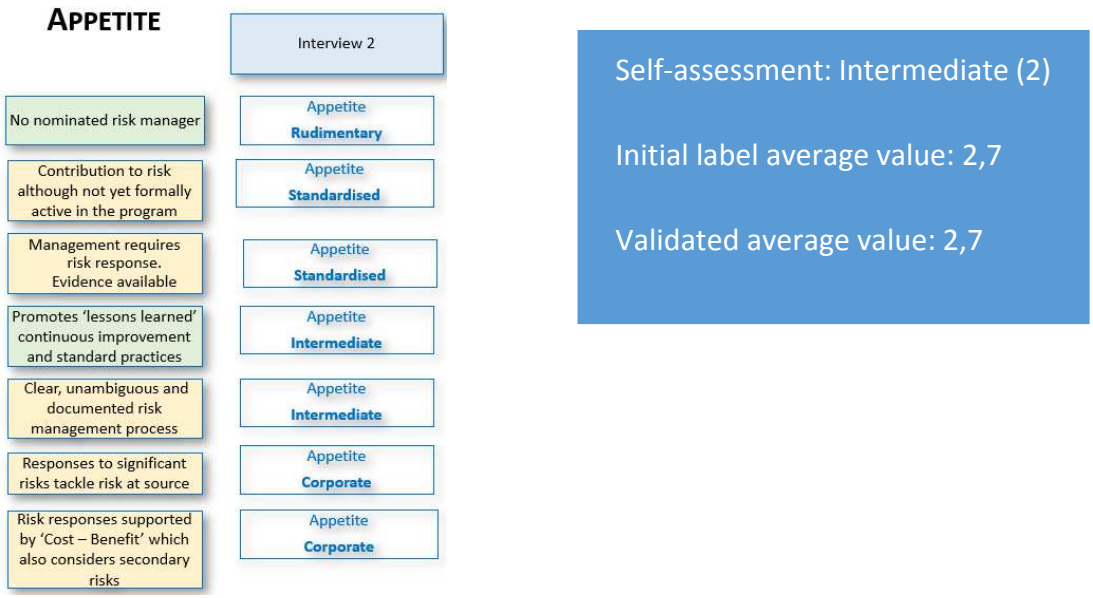


Figure 66: Labels selected by interviewee 2 – overall risk appetite self-assessment against labels initial and post validated average value

Interviewee 2 assesses her project risk appetite as intermediate. She selects two labels each from the intermediate, standardised and corporate stages in the original project risk management maturity model and only one from the rudimentary stage. There is not a significant divergence between the average value of the selected labels and the interviewee's self-assessment. However, whether any of the labels should be adjusted to a lower stage in the maturity model will be reviewed in this section.

Suggested changes:

The results from the survey suggest moving both 'Contribution to risk although not yet formally active in the program' and 'Responses to significant risk tackle risk at risk source' to the Intermediate stage and the Standardised stage. These two adjustments are in line with the interviewee's self-assessment. Conversely, the survey suggests raising both 'Promotes 'lessons learned' continuous improvement and standard practices' and 'Clear and unambiguous and documented risk management process' to the standardised stage. These four changes are neutral for the average value of selected labels in the validated model.

The survey results to 'No nominated risk manager', 'Management requires risk response. Evidence available', and 'Risk responses supported by 'Cost-Benefit'

analysis which also considers secondary risks' suggest maintaining the label stage as in the initial model.

5.4.3 Interview 3

Interview 3 Identification

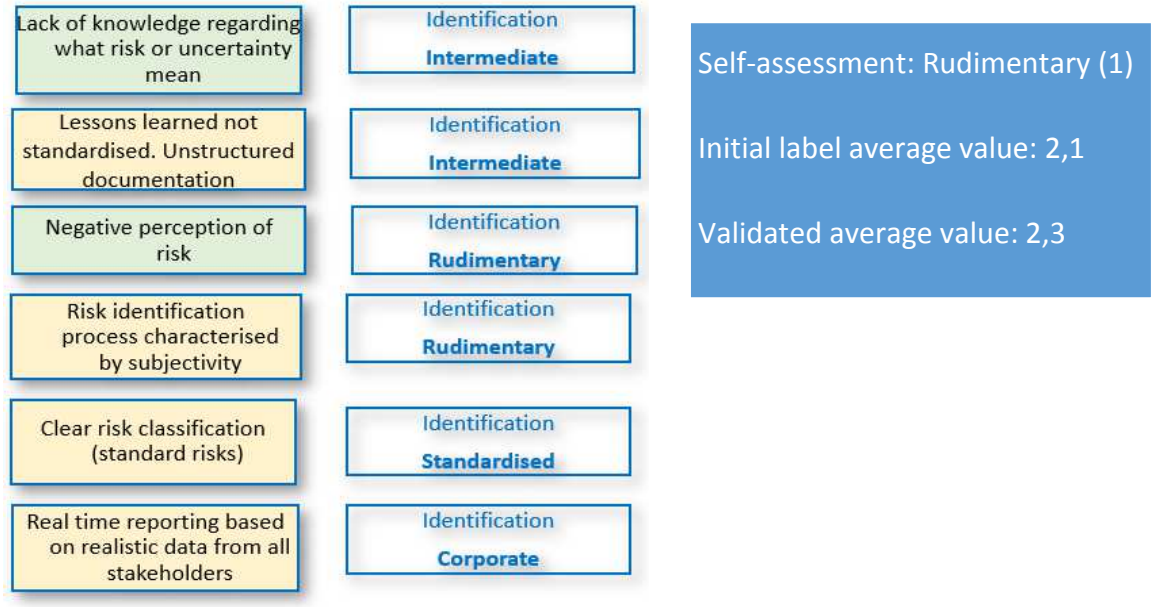


Figure 67: Labels selected by interviewee 3 – overall risk identification self-assessment against labels initial and post validated average value

Project risk identification is assessed as rudimentary by Interviewee 3. He selected six labels in order to best describe his projects' current risk identification maturity stage.

Two of these labels are assigned to the rudimentary stage in the original project risk management maturity model. Two other selected labels belong to the intermediate stage, and one has been selected from the standardised and corporate stages each. Part of the discrepancy between interviewee's self-assessment and the stage of selected labels in the original maturity model may be explained (rebalanced) by adjusting the stage of one or more of the labels. The question raised out of the data is, do belong any of the selected labels to a lower maturity stage? The responses of the six full structured short interviews which will be discussed in this section may suggest adjustments in the stage allocation of any of these labels.

Suggested changes:

'Risk identification process characterised by subjectivity' is placed at the rudimentary stage in the original model and has been selected by two of the participants in the in depth-interviews. Their self-assessments of the risk identification dimension were one between intermediate and standardised and the second one rudimentary. Five out of the six respondents of the online interview selected the intermediate stage and only one the rudimentary. These responses suggest moving the label one stage higher to the intermediate stage. This is not in line with the interviewee's self-assessment. The result of this change moves the label average value from 2,1 to 2,3, what is farther to the self-assessment value, rudimentary.

The survey results regarding 'Lack of knowledge regarding what risk or uncertainty mean', 'Lessons learned not standardised. Unstructured documentation', 'Negative perception of risk', 'Clear risk classification (standard risks)' and 'Real-time reporting based on realistic data from all stakeholders' suggest maintaining these labels at the same stage as in the initial model.

Interview 3 Assessment

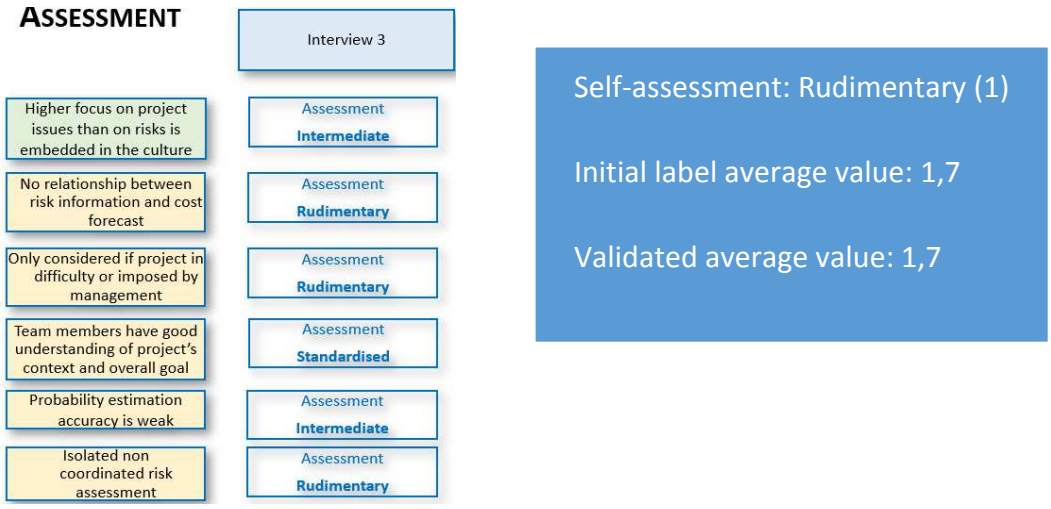


Figure 68: Labels selected by interviewee 3 – overall risk assessment self-assessment against labels initial and post validated average value

Interviewee 3 assesses his project risk assessment capability as rudimentary. He selected six labels in order to best describe his projects' current risk assessment maturity stage. Three of these labels are assigned to the rudimentary stage in the original project risk management maturity model. The average value of the selected labels shows some coincidence between interviewee's self-assessment and the average

value of selected labels. However, the results of the surveys may suggest moving some of the labels to a different stage.

The results of the survey do not suggest to move the stage of any of the six labels: 'Higher focus on project issues than on risks is embedded in the culture', 'No relationship between risk information and cost forecast', 'Only considered if project in difficulty or imposed by management', 'Team members have good understanding of project's context and overall goal', 'Probability estimation accuracy is weak' and 'Isolated non coordinated risk assessment' in the maturity model. As there are no changes in the validated model, the average label value, 1,7 stays the same.

Interview 3 Allocation

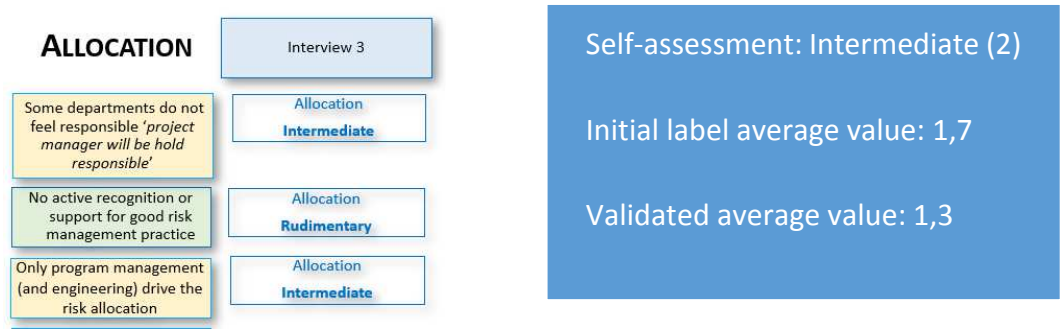


Figure 69: Labels selected by interviewee 3 – overall risk allocation self-assessment against labels initial and post validated average value

Project risk allocation is assessed as intermediate by Interviewee 3. Two out of the three labels he selected are assigned to the intermediate stage. This suggests a coincidence between the interviewee's risk appetite self-assessment and the label stage assignment in the original project risk management maturity model.

Suggested changes:

'Some departments do not feel responsible '*project manager will be held responsible*' placed in the intermediate stage in the initial model has been selected by all three respondents of the in-depth interviews to describe their risk allocation stage. Their self-assessment of the allocation dimension is intermediate in two of them and rudimentary in the third one. The majority of the participants of the online interviews have selected the label for the rudimentary stage, one for the intermediate and one for the standardised. These results suggest moving the label to the next lower stage, rudimentary. This

change is not in line with the self-assessment, and the selected label average value moves from 1,7 to 1,3 which is farther from the self-assessment Intermediate.

The results from the survey do not suggest moving the stage in the maturity model of any of the other two labels: 'No active recognition or support for good risk management practice' and 'Only program management (and engineering) drive the risk allocation'.

Interview 3 Appetite

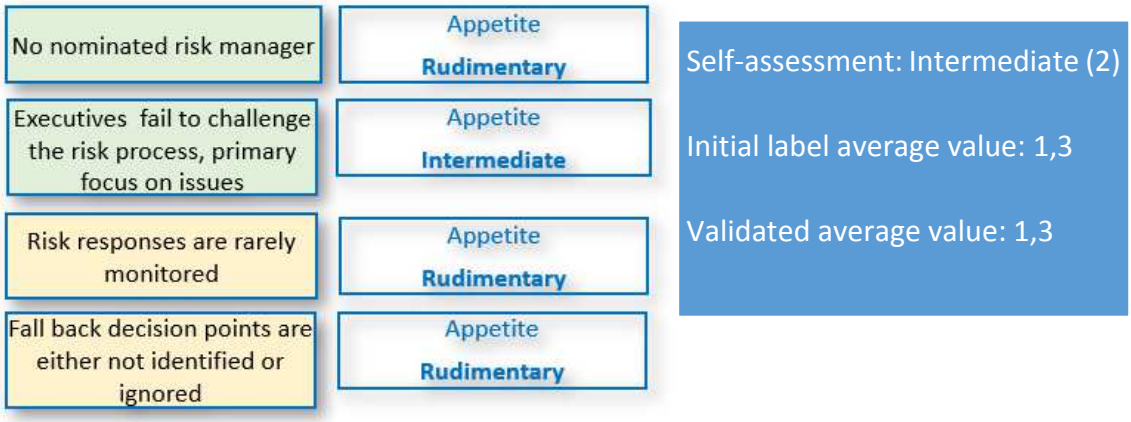


Figure 70: Labels selected by interviewee 3 – overall risk appetite self-assessment against labels initial and post validated average value

Project risk appetite is assessed as intermediate by Interviewee 3. He selected four labels to characterise his projects' current risk appetite maturity stage. Only 1 of these labels is assigned to the intermediate stage in the (original project risk management) maturity model. The other three selected labels belong to the rudimentary stage. Some of the discrepancies between interviewee's self-assessment and the selected label stage may be explained (rebalanced) by adjusting the stage of one or more of the labels. The question raised out of the data is, do belong any of the selected labels to a higher maturity stage? The responses of the six-full structured short interviews which will be now discussed in this section and may suggest adjustments in the stage allocation of any of these four labels.

Suggested changes:

'Executives fail to challenge risk process, primary focus on issues': four respondents have selected the label for the rudimentary stage, two for the

intermediate. These results suggest moving the label to the next lower stage, rudimentary. This change is not in line with the self-assessment.

'Risk responses are rarely monitored' initially allocated to the rudimentary stage has been selected by two participants of the in-depth interviews. One self-assessment of the appetite dimension is rudimentary and the second one intermediate. The majority of the six online interview respondents, four selected the intermediate and two the rudimentary stage. These results suggest to possibly move the label one stage higher to the intermediate stage. This change is in line with the self-assessment.

These two changes are neutral to the average value of the selected labels.

The survey results of 'No nominated risk manager' and ''Fall back decision points are either not identified or ignored' do not suggest moving the label's stage.

5.4.4 Summary of possible amendments to the model

Labels	**Identification**		**Assessment**		**Allocation**		**Appetite**		**Total**	
Total	40		38		36		41		155	
Adjustments	13	33%	11	29%	11	31%	18	44%	**53**	34%
Higher	7	18%	4	11%	2	6%	7	17%	20	13%
R to I	*4*		*2*		*1*		*2*		*9*	
R to S	*1*								*1*	
I to S	*2*		*1*		*1*		*5*		*9*	
I to C			*1*						*1*	
Lower	6	15%	7	18%	9	25%	11	27%	33	21%
C to S	*5*		*6*		*6*		*7*		*24*	
C to I	*1*								*1*	
S to I			*1*		*1*		*3*		*5*	
I to R					*2*		*1*		*3*	

Table 16: Table showing the suggested label adjustments

The model validation combining the survey results and the three in-depth interviews suggests changing the maturity stage of 34% of the labels or 53 labels out of a total of 155 labels in the maturity model. 20 of these changes are to a higher stage and 33 to a lower stage. The model refinement increases the coincidence between the participants risk self-assessment and the labels stage allocation.

Structured Online Interview Analysis:

The survey responses resulted in 52 potential adjustments or 34% of the total 155 labels_based on the difference between the initial model label's value and the survey average values. The percentage of adjusted labels after the qualitative judgement has been reduced from 52 (34%) to 48 (31%).

Identification: The survey suggested 13 adjustments of which all 13 were validated after detailed analysis of the responses.

The changes of labels moved to a higher level are:

- 4 from the rudimentary to the Intermediate stage
- 1 from the rudimentary to the Standardised stage
- 2 from the Intermediate to the Standardised stages

The movements to a lower stage are:

- 5 from the Corporate to the Standardised stage
- 1 from the Corporate to the Intermediate stage

Assessment: The qualitative judgement of the_survey suggested adjusting the stage of ten labels. Once analysed the responses to the ten labels, nine out of the ten labels will be adjusted as outlined in Table 13, 'Clear procedure, minimum frequency to assess risk event - Evidence-based' will be moved two stages higher from the Intermediate to the Corporate stage.

The changes of labels moved to a higher level are:

- 1 from the rudimentary to the Intermediate stage
- 1 from the Intermediate to the Standardised stage
- 1 from the Intermediate to the Corporate stage

The movements to a lower stage are:

- 1 from the Standardised to the Intermediate stage
- 6 from the Corporate to the Standardised stage

Allocation: The survey suggested ten adjustments. Based on the survey responses nine out of the ten labels will be adjusted as outlined in Table 14, 'Good risk

management practice, management audits the process and supports the risk owners' will remain assigned to the Corporate stage.

The changes of labels moved to a higher level are:

- 1 from the rudimentary to the intermediate stage
- 1 from intermediate to the standardised stage

The movements to a lower stage are:

- 1 from the standardised to the intermediate stage
- 6 from the corporate to the standardised stage

Appetite: The survey suggested 19 adjustments. Based on the survey responses 16 out for the 19 labels will be adjusted as outlined in Table 14. 'No project-specific risk management plan' will remain assigned to the rudimentary stage; 'Lessons learned are effectively incorporated into a continuous improvement programme' and 'Risk responses supported by 'Cost-Benefit' remain at the Corporate stage.

The changes of labels moved to a higher level are:

- 1 from the rudimentary to the Intermediate stage
- 5 from intermediate to the standardised stage

The movements to a lower stage are:

- 3 from standardised to the intermediate stage
- 7 from the Corporate to the Standardised stage

3 in-depth interviews

The three participants in the structured in-depth interviews selected 52 or 34% out of the 155 labels to describe their risk capability. Their analysis results in adjusting the maturity stage of another five labels, one in the assessment dimension and two each in the allocation and appetite dimensions. The effect of the validation conducted through the 3 in-depth interviews is the adjustment of less than 10% of the labels analysed.

Identification: The interviewees selected nine different labels to describe their project risk identification practice. The data analysed from the in-depth interviews confirmed the suggestion from the survey data for maintaining the maturity stage for eight of the selected labels. The data from the in-depth interviews also confirmed the suggestion from the survey for adjusting one label. Two interviewees selected this label, the change is consistent with one of the interviewee's self-assessment and contradictory with the second one.

Assessment: The interviewees selected 14 different labels to describe their project risk assessment practice. The data analysed from the in-depth interviews confirmed the suggestions from the survey data for maintaining the maturity stage for ten of the selected labels and adjusting the other three. This data suggested adjusting one additional label not considered for adjustment by the survey. This change is consistent with the interviewee self-assessment.

Allocation: The interviewees selected 14 different labels to describe their project risk allocation practice. The data analysed from the in-depth interviews confirmed the suggestions from the survey data for maintaining the maturity stage for eight of the selected labels and adjusting three others. One adjustment suggested by the survey had been rejected as part of the qualitative judgement. Two labels not considered for adjustment in the survey were added to the changes. One of these changes is coherent with the interviewee's self-assessment that selected the label; the other change is coherent with two of the three interviewee's self-assessment and contradictory with the third one.

Appetite: The interviewees selected 15 different labels to describe their project risk appetite practice. The data analysed from the in-depth interviews confirmed the suggestions from the survey data for maintaining the maturity stage for nine of the selected labels and adjusting four others. The result of the qualitative judgement of the remaining two labels was to adjust them although these were no candidates for refinement out of the survey results. One of the adjustments was non-consistent with the participant self-assessment while the second one was consistent with one of the participants' self-assessment and contradictory with the second one.

Dimension	Identification			Assessement			Allocation			Appetite		
	Initial Value	Self-Ass't	Val'd Model	Initial Value	Self-Ass't	Val'd Model	Initial Value	Self-Ass't	Val'd Model	Initial Value	Self-Ass't	Val'd Model
Interview 1	2	2	2	1,7	2	2	2,3	1	1,8	1	1,5	1,5
Interview 2	2	2,5	2,3	3,1	2,5	2,9	2,6	2	2,5	2,7	2	2,7
Interview 3	2,1	1	2,3	1,7	1	1,7	1,7	2	1,3	1,3	2	1,3

Table 17: Table showing the positive (green) or negative (yellow) effect of the amendments in bringing closer the dimension self-assessment and the validated model selected labels in the in-depth interviews

As reflected above in Table 17, the effect of the model validation is a higher coincidence between the participants' self-assessment and the selected labels average value above. The model validation brings the participant risk self-assessment and the selected labels average value closer together in most cases. One example is Interviewee 1's risk allocation. The interviewee describes her allocation as rudimentary, with a value assigned of 1. There is a significant difference with the average of the initial value of the selected labels which is 2,3. The model validation suggests adjusting the maturity stage of three of the six labels selected. These adjustments reduce the labels' average value bringing the risk allocation self - assessment, 1, and the average value of the selected labels, 1,8 closer.

48 of the adjustments or 91% of the refinements are result of the survey. Only 5 changes are result of the in-depth interviews. The adjustments are in line with the self-assessments in most of the cases. There are only two exceptions, identification and allocation in Interview 3.

It could be argued that a third stage of validation is required for further refinement of the model. The validation process is reiterative, and it needs to be seen from a cost-benefit point of view. Additional validation stages would require the use of considerable additional resources and may only add minor or negligible improvements. These improvements would likely add only marginally to the correlation between the label stages and the experts' perception.

5.5 Model after adjustments and refinements

5.5.1 Risk Identification

IDENTIFICATION	RUDIMENTARY	Negative perception of risk	End users no involvement with risk identification process	Fear of raising risk concerns	Compliancy risks not identified even though may exist	Risk identification is ad-hoc, basic, hit and miss
	INTERMEDIATE	People make full use of their freedom to act	Lack of integration of all stakeholder views	Disagreement among stakeholders if an event is a risk, subjectivity	Some compliancy aspects addressed but may have omitted significant ones	Potentially significant risk items may be omitted in reporting
		Lack of knowledge regarding what risk or uncertainty mean	Risk identification process characterised by subjectivity	No visibility of risk identification tasks / activities in project plan	Isolated non coordinated risk identification	Risk description is ambiguous, misleading
			New risks identified as they occur	Some remaining subjectivity (cultural differences)	Only focused on individual risks, managed at lower levels within team	Lessons learned not standardised. Unstructured documentation
	STANDARDISED	End users have an active role in the identification process	Timely integration of previous phases	Clear risk classification (standard risks)	Set minimum frequency risk identification rules with senior members	Shared understanding of group approach to risk identification
		Recognises risk management but not ready to invest resources	Instructions with project categorization / risk sources identification	Routine planning reviews to aid risk identification	Bridge from the lessons learned into the risk identification process	Mechanism identifies gaps between planned tasks and resources available
		Use quantitative risk methods (Montecarlo) to avoid subjectivity	Established procedure for contradictory views (objectivise)	A risk identification process guide may be available	Visibility of implications of risks associated with all relevant suppliers	Structured accessible lessons learned & risk registers database (DB)
				Visibility on new sourcing, 'make-or-buy' decisions		
	CORPORATE	Earned Value (EV) monitoring highlights project performance shortfalls	Integrated process with involvement of all stakeholders	Formal communication regarding risk interrelations between projects	Top down approach related to project purpose and strategy	Real time reporting based on realistic data from all stakeholders

Figure 71: Validated and amended model – risk identification.

5.5.1.1 Risk Identification: Rudimentary stage

Negative perception of risk	End users no involvement with risk identification process	Fear of raising risk concerns	Compliancy risks not identified even though may exist	Risk identification is ad-hoc, basic, hit and miss

Figure 72: Risk management maturity model validated labels: risk identification rudimentary stage.

Process and System Aspects:

Risks are identified in an ad hoc manner, and the process may be driven by one single group or individual thus missing the opportunity to consider other groups' views and enhancements. Potentially high risks such as compliance related risks may remain unaddressed as the process of identification is eventually subsumed within other project initiatives, and risk logs are not systematically updated during the project life cycle.

Organisational and People aspects:

The individuals involved in the project may well share a negative perception of risk and may be reluctant to bring these risks forward for discussion and review.

End users who may have experience of the environment in which the project product is designed have no involvement in the risk identification process.

5.5.1.2 Risk Identification: Intermediate stage

People make full use of their freedom to act	Lack of integration of all stakeholder views	Disagreement among stakeholders if an event is a risk, subjectivity	Some compliancy aspects addressed but may have omitted significant ones	Potentially significant risk items may be omitted in reporting
Lack of knowledge regarding what risk or uncertainty mean	Risk identification process characterised by subjectivity	No visibility of risk identification tasks / activities in project plan	Isolated non coordinated risk identification	Risk description is ambiguous, misleading
	New risks identified as they occur	Some remaining subjectivity (cultural differences)	Only focused on individual risks, managed at lower levels within team	Lessons learned not standardised. Unstructured documentation

Figure 73: Risk management maturity model validated labels: risk identification intermediate stage.

Process and System Aspects:

The project plan does not show any specific work package or activities for project risk identification. Project records are maintained, but central documentation such as lessons learned is not standardised. The documentation is unstructured, and data searches on project history are cumbersome.

Risk management tends to focus on individual risks managed at lower levels within the team. The activity may be a single action, without clarity on how to periodically review the validity of identified risks, conduct new identification sessions, monitor risk amelioration plans and communicate identified risks to all relevant stakeholders. The narrow source of risk identification raises the threat of this being subjective. Some subjectivity may remain at this stage, e.g. cultural differences among project team members. Often the risks are identified as they occur, leaving inadequate time to address them effectively.

The documented risk item descriptions may be ambiguous, in many cases describing potential events instead of the root cause that originates the risk. Impact-oriented risk descriptions with no insight into how to manage risks proactively are typical at this stage.

Some compliance aspects are addressed, but the risk identification process may have failed to recognise some significant risks. In some cases, there is strong disagreement on whether an event is a risk or not. Potentially significant risk items may be omitted in reporting.

Organisational and People aspects:

There is a lack of knowledge of the meaning and significance of risk and uncertainty which, together with the lack of involvement of specific stakeholders, increases the subjectivity of how potential events are documented as risks for the project.

Several stakeholders and groups with significant involvement in the project do not contribute to risk identification. However, those people involved actively in the project understand and use the defined scope in which they may act.

5.5.1.3 Risk Identification: Standardised stage

End users have an active role in the identification process	Timely integration of previous phases	Clear risk classification (standard risks)	Set minimum frequency risk identification rules with senior members	Shared understanding of group approach to risk identification
Recognises risk management but not ready to invest resources	Existing instructions regarding risk sources identification and project categorization	Routine planning reviews to aid risk identification	Bridge from the lessons learned into the risk identification process	Mechanism identifies gaps between planned tasks and resources available
Use quantitative risk methods (Montecarlo) to avoid subjectivity	Established procedure for contradictory views (objectivise)	A risk identification process guide may be available Visibility on new sourcing, 'make-or-buy' decisions	Visibility of implications of risks associated with all relevant suppliers	Structured accessible lessons learned & risk registers database (DB)

Figure 74: Risk management maturity model validated labels: risk identification standardised stage.

Process and System Aspects:

Many or most organisations where risk identification stays at standardised stage may have adopted some standard guide or developed documentation to support project risk identification. The process may not be known by all stakeholders or implemented by the project management practitioners with due rigour.

Practitioners follow specific project and risk management guidelines and instructions – these may provide a methodology to categorise the project's complexity based on several dimensions such as business impact, project team size or project schedule. The project categorisation determines the level of management attention and project risk detail. Typically, the prescriptive risk identification procedure may be more comprehensive in projects categorised as complex than in those categorised as less complex. The risk management instructions provide a framework to outline the individual risk description, source(s) of uncertainty and the effect or risk occurrence. Project planning and risk management are fully integrated. Routine planning reviews consistently use lessons learned logs as well as risk registers databases to aid risk

identification. All stakeholders contribute to the process whereby their input and their views are considered.

The risk register template provides clear risk classifications which can be mapped to established standard risks. Groups still not active in the project at that point in time, but which will be required subsequently to contribute to risk identification, are encouraged to participate. The project manager is aware well in advance of significant changes, such as the introduction of new suppliers or significant design modifications. Project categorisation establishes minimum frequency rules to perform risk identification. The project team adheres to these rules, and evidence regarding risk identification is documented, and senior members are involved in the process.

The risk identification procedure proposes guidelines on how to document events which represent contradictory perspectives on risk. For example, the sourcing function may want to introduce a new supplier with a certain saving for a new part. The sourcing function may see a savings opportunity in working with the new supplier, but the new supplier's lack of expertise can be conversely perceived as a risk by the quality group. A holistic view of the project is required in order to properly identify risks. Risk identification is performed at a group level, encouraging and integrating all stakeholders' views. There is visibility of implications of risks associated with all relevant suppliers.

Resource bottlenecks are determined by capacity risk identification, which is a mechanism that recognises any difference between the available and the required amount and quality of resources and skills for business activities. Project team members are knowledgeable and use quantitative data and methods such as Monte Carlo simulation when required. In terms of documentation, such as lessons learned logs and risk registers, these are standardised to a certain level and regularly maintained. Records are accessible by all project team members.

Organisational and People aspects:

Organisations performing risk identification at a standardised stage promote an active role of the end users. These are permanently informed about project progress, and they are actively involved in the testing and validation process. Many project team members recognise the benefit of investing resources in systematic risk identification at this stage, but the organisation is not ready to invest the necessary resources. There

is a lack of knowledge of the meaning and significance of risk and uncertainty which, together with the lack of involvement of certain stakeholders, increases the subjectivity of how potential events are documented as risks for the project.

5.5.1.4 Risk Identification: Corporate stage

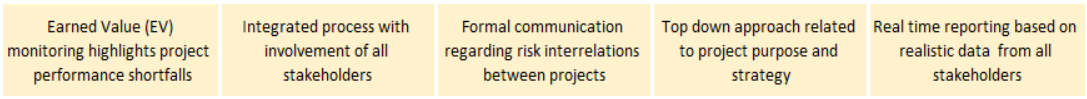


Figure 75: Risk management maturity model validated labels: risk identification corporate stage.

Process and System Aspects:

Use and monitoring of earned value (EV) management supports the identification of potential risk areas. A high maturity in risk identification allows focussing on the key risks. The risk identification process is driven by an initial iterative top-down approach based on the project's purpose and strategy. The risk prioritisation is based on the project's strategic goals. The risk analysis must make sure that it analysis the right question, the fundamental purpose of the project. In other words, the big picture needs to be understood from the beginning instead of adding risk effects from different parts. Less mature organisations add up risk effects from different parts and try to establish a detailed risk register using a single-pass. Doing so they often fail to account for major sources of uncertainty (Hopkinson, 2012). The project team ensures formal communication about the identified risk items within the organisation while keeping an overview of the interrelationship or impact of other projects risks.

Finally, there is good evidence that risk data emerging from all stakeholders, including suppliers is reported and documented in a timely manner. Systems supporting risk management are available to all stakeholders, and these enable real time reporting.

5.5.2 Risk Assessment

ASSESSMENT	RUDIMENTARY	No relationship between risk information and cost forecast	Responses based on weak understanding or delayed thus ineffective	Isolated non coordinated risk No evidence of opportunities being pursued	No fall back plans for risk mitigation or management	Only considered if project in difficulty or imposed by management
	INTERMEDIATE	Higher focus on project issues than on risks is embedded in the culture Management does not prioritise project issues over project risks	Description includes an indication about the source of risk Quantitative schedule analysis is not used	Lacks standard impact & probability estimate methodologies. This increases 'subjectivity' Struggle with Probability Impact (P*I) threshold concept	Probability estimation accuracy is weak Formal risk register maintenance Prescribed risk categorisation	Risk description is impact oriented, lacks context and of uncertain origin Use existing expertise and qualitative assessments
	STANDARDISED	FMEA, 6s, poka yoke used for quality management (in product design) Planned costs consider risk management - Threshold based on $ or days Considers secondary effects which extend beyond immediate impact	Clear procedure, minimum frequency to assess risk event - Evidence based Visibility of high-impact risks, risks which became issues, risks clustering ability Measure project team members' performance regarding risk issues (commitment)	Realistic estimates, use existing expertise and qualitative assessments Valid methods for risk prioritisation and risk quantification Steering Committee may challenge the risk process – escalate when required	Sound understanding of risk combined with use of Monte Carlo, decision tree Team members have good understanding of project's context and overall goal Systems analyse and summarise risk categories by project, customer or industry	Description is useful for qualitative risk analysis Impact estimation includes secondary effects Certain use of Quantitative Methods Project categorization is standard Attempts to prevent event from happening in first place
	CORPORATE	Systemic risk assessment and continuous improvement	Ability to measure team members' performance	$ estimation of mitigated risk (Benefit of risk responses)	Risk management system integrated with other corporate systems	

Figure 76: Validated and amended model – risk assessment.

5.5.2.1 Risk Assessment: Rudimentary stage

No relationship between risk information and cost forecast	Responses based on weak understanding or delayed thus ineffective	Isolated non coordinated risk No evidence of opportunities being pursued	No fall back plans for risk mitigation or management	Only considered if project in difficulty or imposed by management

Figure 77: Risk management maturity model validated labels: risk assessment rudimentary stage.

Process and System Aspects:

Risk assessment performed at the rudimentary stage is not regularly maintained. Changes in the project which could influence the impact or the likelihood of the event are not considered. As results are not reviewed regularly, risk information may become stale. The approach can be described as static as opposed to an active style.

Risk assessment tends to be considered only when the project is in difficulty, or it is imposed by senior management. Risk responses are often based on rapid decisions reflecting a poor understanding of the alternative courses of action. Sometimes there is a delay between risk identification and responses implementation which results in its ineffectiveness. The organisation focuses exclusively on treat management when addressing uncertainty and does not consider opportunity management.

The assessment results are not reflected in the cost forecast. Typically, no fall-back plans are developed.

5.5.2.2 Risk Assessment: Intermediate stage

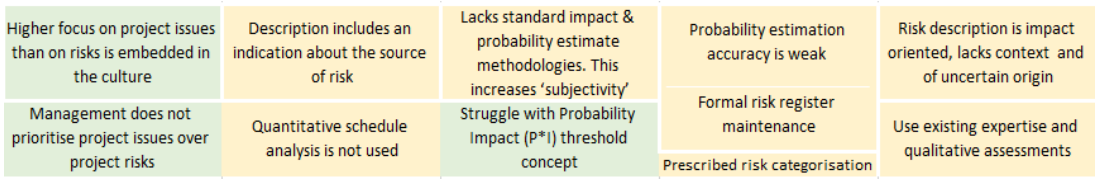


Figure 78: Risk management maturity model validated labels: risk assessment intermediate stage.

Process and System Aspects:

The risks are updated, and certain risk categorisation is assigned with the utilisation of risk register templates. Risk description tends to be impact-oriented and often lacks context and identification of relevant sources of uncertainty. Sometimes the risk descriptions provide some indication about the source of risks. However, the probability estimation is weak.

The project team deploys mainly qualitative assessments, e.g. a probability and impact matrix. Quantitative schedule analysis is not generally executed. In addition, existing expertise from previous projects is used as an input for these assessments. The lack of standards to estimate impacts and the difficulty in quantifying likelihood increases the subjectivity of the risk assessment results, and therefore any subsequent risk prioritisation.

Organisational and People aspects:

Individuals required to participate in risk assessment do not completely understand how to assign the likelihood and the impact (P*I) of the potential risks. They struggle with how to rate the risk statements against prescribed risk tolerance thresholds. There is a lack of knowledge of the risk concept and its potential effect on the project outcomes.

The organisation and management would rather deal with issues than with risks - it is embedded in the culture; resource constraints and a focus on problem-solving make it difficult to undertake an adequate risk assessment. Management does not prioritise project issues over project risks. Reviews of open issue lists and issues resolution share the same importance for management as risk assessments.

5.5.2.3 Risk Assessment: Standardised stage

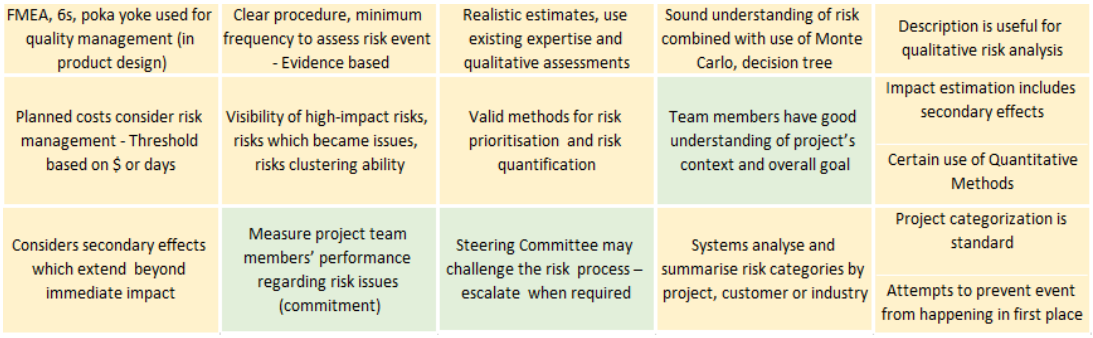


Figure 79: Risk management maturity model validated labels: risk assessment standardised stage.

Process and System Aspects:

Project categorisation is performed. This categorisation is based on several dimensions and reflects the project complexity. The higher the complexity, the higher is the level of management attention and risk assessment detail.

The project teams are capable and sufficiently knowledgeable to undertake risk assessment deploying quantitative quality methods such as FMEA, 6 σ or poka-yoke, used mainly in specific processes, for example, the product design phase. Although not consistently, the team uses certain risk analysis quantitative methods. The use of quantitative risk assessment methods such as Monte Carlo, decision trees or Bayesian belief networks is underpinned by a sound understanding of risk with significant thought put into identifying relevant sources of uncertainty.

There are clear minimum frequency rules on when to perform risk assessments. Project managers and core team members utilise realistic estimates, are trained in quantitative risk assessment methods and use some of these. Action response plans to the identified risks are regularly reviewed.

The description of the risks documented in the risk register is useful for qualitative risk analysis. Some risk effects may extend beyond the immediate risk impact. These effects could also exacerbate other existing risks. Such secondary risks are considered in the assessment. There is a clear method to estimate the Overall Risk Priority Rating, which determines the threshold for taking a certain risk into the risk response plan or not.

The threshold for taking events into the risk register's response plan is based on estimated costs or project delays in case of the event happening. Risk assessment is reviewed against the likelihood of any risk happening – a risk assessment at standardised level is one that aims at preventing the events from happening in the first place.

Project reporting supports management with visibility of the high impact risks, with clustering and prioritisation functionalities. Systems provide risk aggregation by customers, groups of programs or project portfolios.

Organisational and People aspects:

Team members understand the overall project, its context, and their potential contribution to the organisation's success. That understanding allows them to act in difficult situations focusing on the overall goal of the project. This understanding is seen as critical to successful project outcomes. Steering Committees challenge the assessment process and initiate appropriate escalation when required. Experts' commitment and availability is valued as the major risk factor in several projects. A method is designed for the project manager to measure team members' commitment by means of their performance.

5.5.2.4 Risk Assessment: Corporate stage

Systemic risk assessment and continuous improvement	Ability to measure team members' performance	$ estimation of mitigated risk (Benefit of risk responses)	Risk management system integrated with other corporate systems

Figure 80: Risk management maturity model validated labels: risk assessment corporate stage.

Process and System Aspects:

At corporate level the organisation assesses systemic risks based on past projects; this assessment can be part of a continuous improvement initiative. This initiative evaluates those risks in more detail and determines how to mitigate or change procedures or ways of working to minimise, if not eliminate, the potential impact on the project. Risk assessment includes the quantification of mitigated risks, benefit of risk responses and secondary effects. The project budget contains appropriate funding for overall cost risk.

The project managers measure and monitor the project team members' performance against project deliverables. The risk register lists are the result of all stakeholders' and functions' inputs into an integrated system.

5.5.3 Risk Allocation

ALLOCATION						
	RUDIMENTARY	Some stakeholders reluctant to divulge new information on risk	Unwillingness to assign risk ownership - perceived as telling to the other person 'you are doing it wrong'	Reluctance to own risk	Isolated non coordinated risk allocation	Some departments do not feel responsible 'project manager will be hold responsible'
		No active recognition or support for good risk management practice		Risk perceived as intrusive, lot of work and not keen to talk about its ownership	Lack of risk disclosure with contracting parties	
	INTERMEDIATE	Dependent on project managers' personality some of which are no open to others' input	Some program managers doing everything, but recognised as inefficient	Steering Committee meetings are pure status meetings	Only program management (and engineering) drive the risk allocation	In most cases assigned to project manager
			Only dotted line reporting to project manager 'my boss has not told me ...'	Suppliers provide risk information however not complete	Identify groups with potential but currently not involved	Constant communication with customer / vendors
	STANDARDISED	There is expertise to assign risks across several groups	Team members' actions are aligned with achieving overall project objectives	Expertise within teams is recognised and harnessed	Formal agreements with risk sharing arrangements	Clear business guidelines regarding who is the risk-taker
		All people working in the project actually use the risk management plan	Autonomous functional risk allocation	All risks have a risk owner with authority and who accepts responsibility	Clear procedure with minimum frequency rules to update risk ownership	Suppliers undertake complementary risk management
			System accessible, customised and team trained			
		Steering Committee audits, processes and supports the risk owners	Contracts with formal risk agreement bearing clear financial liabilities	Every team member provides input on items with commercial impact	Prescriptive risk classification and job descriptions enable allocation automation	All stakeholders are open in their disclosure of all risk information
	CORPORATE	Good risk management practice, management audits the process and supports the risk owners		Escalation powers and procedures are in place	Consistently maintained multi-user concurrent access risk database is in place	

Figure 81: Validated and amended model – risk allocation.

5.5.3.1 Risk Allocation: Rudimentary stage

Some stakeholders reluctant to divulge new information on risk	Unwillingness to assign risk ownership - perceived as telling to the other person 'you are doing it wrong'	Reluctance to own risk	Isolated non coordinated risk allocation	Some departments do not feel responsible 'project manager will be hold responsible'
No active recognition or support for good risk management practice		Risk perceived as intrusive, lot of work and not keen to talk about its ownership	Lack of risk disclosure with contracting parties	

Figure 82: Risk management maturity model validated labels: risk allocation rudimentary stage.

Process and System Aspects:

Risk ownership is not reviewed and remains assigned to the same individual during the different project phases. In most cases, the risk allocation is hindered by the lack of risk disclosure with the contracting parties, e.g., suppliers or external customer. Individuals from different functions involved in the project do not feel responsible for the program - it is the project manager that will be associated with the result - and

therefore those functions do not feel responsible for the risk which remains with the project manager.

Organisational and People aspects:

Team members are mostly reluctant to own the risks. There is the general impression that assigning somebody a risk item equates to telling them they are doing something wrong. The reluctance of certain stakeholders', in particular suppliers, to divulge new information on risk prevents risks to be effectively allocated to individuals or groups. Individuals involved in the project perceive risks as intrusive. Being owners of a risk item represents for them an additional burden. In most cases, they do not feel motivated to talk about risk and the associated problems of risk ownership. The organisation does not actively recognise the support of good risk management practice.

5.5.3.2 Risk Allocation: Intermediate stage

Dependent on project managers' personality some of which are no open to others' input	Some program managers doing everything, but recognised as inefficient	Steering Committee meetings are pure status meetings	Only program management (and engineering) drive the risk allocation	In most cases assigned to project manager
	Only dotted line reporting to project manager 'my boss has not told me ...'	Suppliers provide risk information however not complete	Identify groups with potential but currently not involved	Constant communication with customer / vendors

Figure 83: Risk management maturity model labels: risk allocation intermediate stage.

Process and System Aspects:

Central risk allocation is carried out only by the project manager with most risks remaining with the project manager. These are characteristics of risk ownership centricity. Project managers maintain constant communication with third parties and customers to agree on risk accountability. However, there are groups with a critical role in the project who have little or no involvement in the risk allocation process. Suppliers provide risk information; nevertheless, this is sometimes not complete.

Organisational and People aspects:

Some project managers recognise the inefficiency of this centric approach, but sometimes they are reluctant to receive input from other team members or functions. This seems to be dependent on the personal attitude of the project manager. Some of them do everything, from assigning the risk, maintaining the risk registers, and even owning most of the actions documented in the risk response plan.

Steering committees are more status boards; in their meetings, risk allocation is not reviewed. The fact that the individuals working on the project only report dotted line to the project manager and direct line to their functions negatively influences risk ownership and therefore the allocation. This lack of willingness to own risk by the project team members is best represented with the expression '*my boss has not told me to do that*'.

5.5.3.3 Risk Allocation: Standardised stage

There is expertise to assign risks across several groups	Team members' actions are aligned with achieving overall project objectives	Expertise within teams is recognised and harnessed	Formal agreements with risk sharing arrangements	Clear business guidelines regarding who is the risk-taker
All people working in the project actually use the risk management plan	Autonomous functional risk allocation System accessible, customised and team trained	All risks have a risk owner with authority and who accepts responsibility	Clear procedure with minimum frequency rules to update risk ownership	Suppliers undertake complementary risk management
Steering Committee audits, processes and supports the risk owners	Contracts with formal risk agreement bearing clear financial liabilities	Every team member provides input on items with commercial impact	Prescriptive risk classification and job descriptions enable allocation automation	All stakeholders are open in their disclosure of all risk information

Figure 84: Risk management maturity model validated labels: risk allocation standardised stage.

Process and System Aspects:

There is a clear procedure to assign risks in the risk register. Clear instructions exist suggesting at what point in time these assignments are to be documented or reviewed, typically at the end of any given project phase.

Organisations review and assess team members' expertise to assign risk items to the appropriate person. Functional groups involved in the project are able to assign the identified risks internally without much involvement from the project manager. By doing so, the project manager is released from risk allocation activity, allowing him/her to concentrate on other critical activities. His/her involvement will be limited to verifying the names assigned by the stream leads or sub-project managers in the risk register or otherwise.

In some projects, every member regularly provides her input to items which may have a commercial impact and every item has a risk owner. The organisation has established guidelines to clearly identify and specify the risk taker, be it the project sponsor, the project manager, or the stream lead, e.g. the engineering or purchasing representative. The introduction of prescribed risk classification and job descriptions in the project provides the opportunity to introduce some automation in the risk

allocation process, e.g. risks with the main category of ‘technical’ and subcategory of ‘complexity and interfaces’ can be automatically assigned to the ‘software development lead’.

All identified risks have a risk owner with authority and skills to undertake the required actions from the response plan and who accept responsibility. The organisation has established guidelines to clearly identify and specify the risk taker, be it the project sponsor, the project manager, or the stream lead, e.g. the engineering or purchasing representative. When the suppliers’ performance is critical, risk allocation takes into consideration vendor risk ownership. In some cases, risk ownership is documented in the contracts awarded to these suppliers. The contracts contain formal risk agreements with clear financial liabilities for bearing risk. The contract may be designed in a form that specifies traceability requirements in the components delivered by the supplier. Another approach is to formally agree on penalties in case certain contract specifications are not fulfilled. The limited financial resources of small suppliers sometimes make it difficult to adopt penalties which align with the product’s potential warranty implications. Collaboration and risk sharing are required between partners of different size.

Risk sharing promotes risk disclosure; it is also a mean of engaging the customer in the process. When included within relevant formal agreements, these reduce the overall project risk. All stakeholders are open in their disclosure of all risk information. Suppliers operate risk management processes which are complementary to the ones used in the project. In terms of systems, risk registers are accessible and used by all members and functions. All team members are trained in the use of these systems.

Organisational and People aspects:

For the project manager to assign risks across several groups, a certain level of expertise is required. Project managers have acquired this expertise through experience and training, but the project manager is not the only person responsible for the risk allocation. Steering committees audit the risk allocation process. Moreover, the steering committee members actively support the risk owners and their mitigation actions.

There is evidence that all people working on the project use the risk management plan. Risk project team members know enough about the ultimate project goal and align their actions accordingly. If team members at the standardised stage identify responses to risk associated to a pre-existing project plan they support choices about the project solution – their risk capability includes an understanding of risk from the project strategy perspective (Hopkinson, 2012).

5.5.3.4 Risk Allocation: Corporate stage

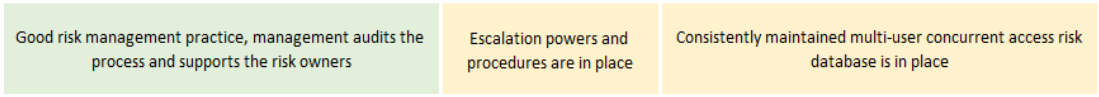


Figure 85: Risk management maturity model validated labels: risk allocation corporate stage.

Process and System Aspects:

One major characteristic is the transparency of the escalation procedure of risk allocation for project team members. These procedures answer the following questions, for example: Who is the next person the risk is allocated to when I am not able to cope with the risk? Who needs to take a decision when the actions described in the risk response plan are well above my responsibility?

In term of systems, the risk database is consistently maintained and enables multi-user concurrent access.

Organisational and People aspects:

Management actively rewards good risk management practice and supports the risk owners as contributors to project success. Good risk management practice is the one that continuously monitors and tries to improve the risk management processes, sets comprehensive and stretching targets, and promotes high-performing employees and fixes underperforming employees in regards of risk management (Bloom, Genakos, Sadun, & Van Reenen, 2012).

5.5.4 Risk Appetite

RUDIMENTARY	Team members have little understanding of their responsibilities	Senior management makes little/no use of risk management	Lack of competency development plan for program managers	Executives fail to challenge the risk process, primary focus on issues	No project-specific risk management plan
	You raised the risk, you are in charge	No nominated risk manager		Fall back decision points are either not identified or ignored	Risk records cannot be retrieved reliably
INTERMEDIATE	Lack of standard quantitative methods, their use is a subjective decision	Review at fall back decision point but fails to result in decision	'Self-fulfilling prophecy', the less risk mitigation there is, the more issues are left open in the issue list	Mainly qualitative analysis	Steering committees are more akin to status boards
	Contribution to risk although not yet formally active in the program	Risk responses are rarely monitored		Trained teams	Diverse with limited access knowledge databases
STANDARDISED	Ability to commit resources without formal stakeholder confirmation	Highly integrated change management, readiness to take decisions	Clear, unambiguous and documented risk management process	Risk item details have adequate visibility in project phase gate exits	Top-down-approach to appropriate goals establishes the risk culture, strategic decisions first, aligned to project purpose
	The organisation's risk appetite statement is regularly updated	Promotes 'lessons learned' continuous improvement and standard practices	Responses to significant risks tackle risk at source	Resources and skills management address capacity risks	Risk responses consistently implemented Evidence available
	The value of risk management is recognized outside the project	Risk culture is encouraged – openness and respect of others' opinions	Risk awareness is reflected in certain level of compliance (SPICE, MAN5)	Audit trail is recorded	Risk management methodologies are more flexible and adaptable
	Stakeholders are aware of their role as risk takers with ability to cope with risk		Management requires risk response. Evidence available	Risk response effectiveness is reviewed	Systems can report original scope vs. outcomes (post mortem)
CORPORATE	Project risk management capability incorporated into process improvement	Risk management incorporated within other processes (planning, quality…)	Risk responses supported by 'Cost – Benefit' which also considers secondary risks	Lessons learned are effectively incorporated into a continuous improvement programme	

Figure 86: Validated and amended model – risk appetite.

5.5.4.1 Risk Appetite: Rudimentary stage

Team members have little understanding of their responsibilities	Senior management makes little/no use of risk management	Lack of competency development plan for program managers	Executives fail to challenge the risk process, primary focus on issues	No project-specific risk management plan
You raised the risk, you are in charge	No nominated risk manager		Fall back decision points are either not identified or ignored	Risk records cannot be retrieved reliably

Figure 87: Risk management maturity model validated labels: risk appetite rudimentary stage.

Process and System Aspects:

There is no project-specific risk management plan. Fall back decision points, these are a date, or the point in the project's schedule at which a decision on implementing the fall back should be taken are either not identified or ignored. Risk records cannot be retrieved reliably.

Organisational and People aspects:

Senior management makes little or no use of risk management. At this stage, executives fail to challenge the documented project risks, as they feel uncertain as to how to deal with risks, and their comfort area remains on how to address issues. Team

members have little understanding of their responsibilities. In some cases, there is no nominated risk manager. People avoid raising risk items. Team members are afraid that if they bring up their concerns, they may end up being made responsible for the potential risk. In other words, 'you raised the risk, you take charge of it'.

Competency development is a crucial strategic management tool in the industry. An established competency development policy is a central part of human resources practice. The result of the organisation failing to offer competency development plans for program managers is a misalignment of employee competencies to the organisational strategy. Competency development plans include specific training, on-the-job learning and career management (De Vos et al., 2015). This lack of potential development does most likely negatively affect the project management performance from the risk management perspective.

5.5.4.2 Risk Appetite: Intermediate stage

Lack of standard quantitative methods, their use is a subjective decision	Review at fall back decision point but fails to result in decision	'Self-fulfilling prophecy', the less risk mitigation there is, the more issues are left open in the issue list	Mainly qualitative analysis	Steering committees are more akin to status boards
Contribution to risk although not yet formally active in the program	Risk responses are rarely monitored		Trained teams	Diverse with limited access knowledge databases

Figure 88: Risk management maturity model validated labels: risk appetite intermediate stage.

Process and System Aspects:

Risk is not at the top of the executives' agenda. Risk responses are rarely monitored. Steering committees are typically status boards; risk is discussed only during phase exits or program reviews. However, management only adopts mainly qualitative risk analysis. Some quantitative methods are used, such as FMEA. Nevertheless, there are not formalised standard quantitative methods - the use of these may vary from project to project, and the decision to use quantitative methods is left to the project manager or subject matter expert. Sometimes a fall-back decision point fails to result in a decision.

Teams are typically trained in project risk management. Project team members start doing some risk identification and assessments. As the project moves forward, the project manager and team members typically come under time pressure and risk management falls increasingly behind. This development is sometimes described as a 'self-fulfilling prophecy'. As the team is not able to cope with the execution of the

planned risk mitigation actions, more issues are raised in the open issue list. As resources are assigned to address the issues, less time and resources are available for risk management. Functions still not active in the project at a certain point in time are requested to contribute with their risk assessment to consider potential future implications of current project developments or status.

There are systems designed to document risks, but these are not common to all functions and may not be accessible to all project stakeholders.

5.5.4.3 Risk Appetite: Standardised stage

Ability to commit resources without formal stakeholder confirmation	Highly integrated change management, readiness to take decisions	Clear, unambiguous and documented risk management process	Risk item details have adequate visibility in project phase gate exits	Top-down-approach to appropriate goals establishes the risk culture, strategic decisions first, aligned to project purpose
The organisation's risk appetite statement is regularly updated	Promotes 'lessons learned' continuous improvement and standard practices	Responses to significant risks tackle risk at source	Resources and skills management address capacity risks	Risk responses consistently implemented Evidence available
The value of risk management is recognized outside the project	Risk culture is encouraged – openness and respect of others' opinions	Risk awareness is reflected in certain level of compliance (SPICE, MAN5)	Audit trail is recorded	Risk management methodologies are more flexible and adaptable
Stakeholders are aware of their role as risk takers with ability to cope with risk		Management requires risk response. Evidence available	Risk response effectiveness is reviewed	Systems can report original scope vs. outcomes (post mortem)

Figure 89: Risk management maturity model labels: risk appetite standardised stage.

Process and System Aspects:

Project management is supported with guidelines and methods containing clear, unambiguous process descriptions. Companies train staff in project management specific to their industry, let their risk management process be assessed by OEM's or auditors, and follow risk management process reference models such as MAN.5, part of the Software Process Improvement and Capability dEtermination (SPICE). The risk management methodology is sanctioned by the organisation's executives and its adoption is generally 'top-down'. Risk items have adequate visibility at project phase exits and review. Executives request evidence for risk mitigation actions and dictate compliance with certain risk management activities. Responses to significant risks tackle risk at source. Importantly, risk response effectiveness is reviewed. Risk responses are consistently implemented.

Executives and steering committees provide leadership in risk management. Executives request evidence of risk activities and challenge the risk management process. They support an iterative top-down approach to risk management which

supports key strategy decisions first. The first cycle is based on a simple holistic understanding of how uncertainty could affect the project's purposes. Doing so, high-level insights into the project are considered, and all major sources of uncertainty that affect most or all the elements of the project are determined. The risk management methodology is used flexibly, adapted this to project particularities. This flexibility allows focussing on certain risk management activities in certain phases or the omission of other activities when not required.

Project management practitioners within the organisation have stressed the importance of project governance, clarity of roles and responsibilities, authority, and competency. Capacity risks can be easily identified and addressed when authority and responsibilities match, and skills and resources fit together. What is more important, management has the ability to quantify the risks associated with capacity shortcomings. Project governance and project human resource management are integrated into the overall project plan.

The risk management applications enable 'post-mortem' analysis which compares historical original project scope and outcomes. Project risk management applications enable audit trail functions.

Organisational and People aspects:

The organisation starts to develop a risk culture and individuals raising risk concerns are treated with respect. Risk management's value is recognised beyond projects, and risk is an area of attention within the organisation. Some organisations introduce compliance programs, business continuity management and Enterprise Risk Management (ERM) which includes methods and processes to manage risks and seize opportunities related to the organisation's objectives. The project team has established a highly-integrated project change management process to implement recommended preventive actions.

Steering committee members, project manager(s) and functional leads are aware of their responsibilities as risk takers. They explicitly validate their capability to cope with the documented risks. As a result of this, activities which require considerable resource allocation may be authorised without formal confirmation from certain key stakeholders – for example, the customer in a new customer-specific product design.

The organisation regularly updates its risk appetite statement. The organisation supports and promotes lessons learned regarding how risk management is handled. Management works to ensure common practice also in the risk management area. In some cases, these lessons learned and best practice efforts are part of continuous improvement initiatives.

5.5.4.4 Risk Appetite: Corporate stage

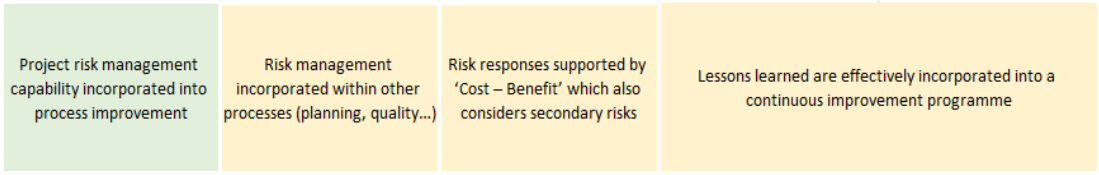


Figure 90: Risk management maturity model labels: risk appetite corporate stage.

Process and System Aspects:

Risk management is integrated into project planning. The project plan considers routine activities are used to aids project identification and assessment. Cost of risk responses is considered. Otherwise, risk management becomes an isolated activity with no impact on other project management processes.

Risk responses which are consistently implemented are supported by cost-benefit analysis which also considers secondary risks. Lessons learned are effectively incorporated into a continuous improvement programme

Organisational and People aspects:

Organisations have at their disposal all elements needed to perform continuous improvement initiatives in risk management:

- Project history with risk registers
- Risk items with detail whether events occurred or not
- Result of mitigation actions
- Systems that support queries/aggregation.

The project risk management capability is assessed. As a result, process improvements in risk management are implemented.

5.6 Summary

This chapter presents the validated risk maturity model after providing insight on the model validation and the principles applied for refinement of the labels stage allocation. The validation process starts analysing those labels which present considerable divergence between the survey response and the label assignment in the initial model. The initial criteria to select candidates for refinement is as follows: If there was a divergence between the initial model and survey participants' view of 0.7 to 1.7 in the four-stage model, then the label is considered to be moved one stage in the model. A divergence higher than 1.7 suggested a move of two stages may be justified. 52 labels out of 156 fit into the criteria as candidates for refinement. The individual responses to the survey were then compared to the labels stage in the initial model, and a qualitative judgement was made.

The qualitative judgement results in five adjustments. Four labels remain at the initial model maturity stage, three of these labels remain at the corporate stage, and one remains at the rudimentary stage. The last one was moved two stages higher to the corporate stage instead of only one stage. All these adjustments, which represent less than 10% of the amendments suggested by the original criteria offset the tendency to position most of the labels in the two central stages, intermediated and standardised.

On the second validation stage, the 52 labels selected by the three interviewees to best characterise their projects were analysed based both on the interviewees' self-assessment to the correspondent dimension and the responses received in the survey. As result of the analysis, a qualitative judgement was made. Several of the labels analysed at this stage had not been candidates for refinement in the previous validation stage and therefore had not been scrutinised earlier. The outcome of the qualitative judgement was to adjust five of the labels, or less than 5% of the total scrutinised labels which had not been considered for refinement in the previous validation stage. Again, three of these changes which move the labels from the intermediate to the rudimentary stage offset the tendency to place the labels in the two central stages.

6 Model application

6.1 Introduction: how the maturity model can be used

Management of risk is not limited to avoiding hazards but about increasing the likelihood and extent of reward (Antonucci, 2016). Assessing project risk management effectiveness is to evaluate 'doing the right things' in terms of the project risk management capabilities, and this includes the desired project risk management outputs-to-outcomes. An organisation adopting a project risk management maturity model does it to improve their project performance in terms of costs, schedule and quality. The primary purpose of the assessment is to enable the identification of priorities for improvements in the risk management process. This helps to gain self-assurance about process effectiveness. (Hopkinson, 2012). This chapter discusses the application of the risk maturity model developed in this research to two projects currently in operation within the organisation. These projects were the product development and production launch of a motor vehicle power-steering system and the introduction of an ERP system in three sites (two production sites and an engineering centre).

An initial assessment of each project can be viewed as a starting point or 'baseline' for subsequent self-improvement within agreed timescales. This may take the form of a roadmap or action plan for uprating risk management capabilities. A corollary benefit of such activity is building a risk-aware culture within the organisation via project risk management committees and other teams or individuals involved in informed risk decision-making (Antonucci, 2016).

Risk maturity is not only about managing progression, but also regression and stasis in some cases (Antonucci, 2016). This is important because future process improvements need to be planned carefully to overcome different barriers. As an example, organisations at the rudimentary stage in the model which may not have formal risk management in place, it is likely that at least one project or business process is in crisis at any certain time originating from lack of resources and time available to be dedicated to a new process (Hillson, 1997). The higher the level of project risk management maturity, the higher the level of confidence stakeholders enjoy that the organisation manages its risks effectively. It is also probable that the higher the level of project risk management maturity, the greater will be the success of the

organisation, which increases its competitive advantage in terms of revenue growth and earnings (Antonucci, 2016).

Hopkinson (2012) discusses the three major different approaches used to gather evidence for project risk maturity assessments:

1. Self-assessment
2. Risk management audit, and
3. Project team workshops.

Each of these approaches is appropriate for different purposes and dependent on the projects involved. Different projects and departments often show different levels of risk management practice (Hopkinson, 2012). Reasons include project managers being more supportive than others, and internal and external scrutiny are factors that influence the vigour of risk management. Project self-assessment is probably the most frequently used assessment approach, but a recognised shortfall is the tendency to exaggerate the level of performance (Hopkinson, 2012). The researcher's external position in the projects analysed lessens any propensity to embellish the projects' performance. Independent assessors are crucial for project risk management audits and project team workshops which are alternatives to self-assessment. The maturity model developed in this research could also be used in these contexts, but they were not chosen due to practical and resource reasons. It needs to be noted, that the assessment of the two projects conducted in the following sections 7.2 and 7.3 ends with the presentation of the researcher's suggested action plan for improving the organisation's project risk capability. The project self-assessments performed by the researcher are based on his business role within these two projects and does not include any feedback from other project stakeholders.

Some interviewees have call attention to the potential benefit of risk management expert teams in the organisation. These experts could actively support the project teams in the project identification process. One significant benefits of the expert team would be the enablement of project risk comparison and identification of (systemic) endogenous risks. However, other interviewees argue the activity of such groups could be perceived as extra work and inefficient overhead. The expert group's recommendation could be seen as a danger for the project team members in the sense that their proposals could be turned around and used to blame them. Project risk

management experts such as Hopkinson (2012) recommend the maintenance of centralised resources to provide best practice guidance as mean of risk assessment improvements. These individuals could play a key role to assess the organisation's capability as well as providing training and defining and monitoring improvement plans.

The steps shown below in Figure 91 can be used in the application of the model.

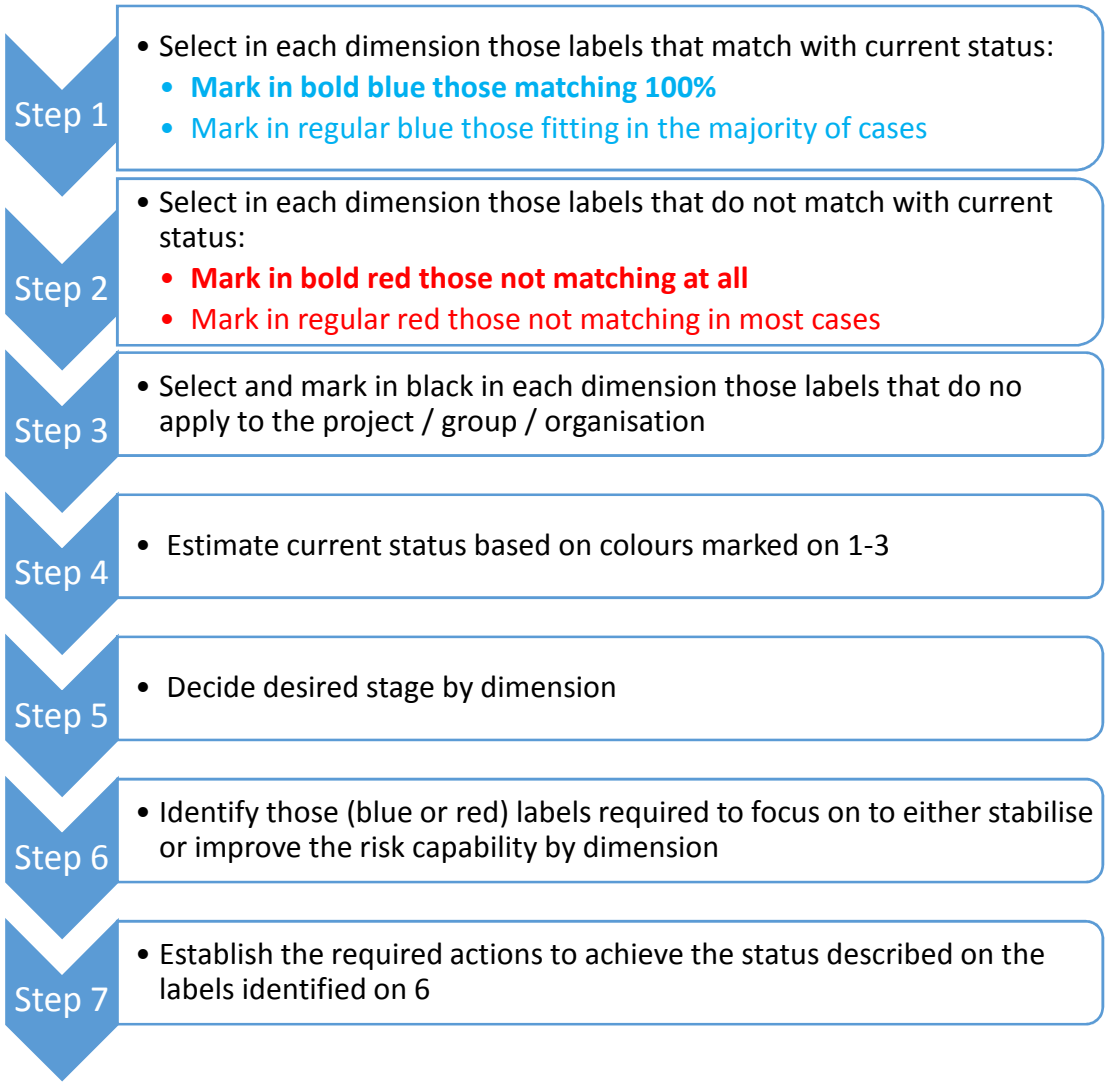


Figure 91: Guide for maturity model application

This guide will be followed in the next two sections in the application of the maturity model. Explanation will be given on how the seven steps are undertaken in the two selected projects.

6.2 Model application in the new product development project

This project entails the product development of a mechanical steering gear product for an international automotive Original Equipment Manufacturer (OEM) and encompasses formal customer confirmation of product technical and quality requirements, the initial contractual forecast of volumes in a multi-years-period, and engineering product development through the start-of-production. As the steering system will finally be assembled in different countries with specific requirements and technical specifications such as UK or Russia, several product variations needed to be validated.

The team consists of about 20 individuals with representatives of all functions with involvement in the project: Program Management, Sales, Engineering, Purchasing, Finance, Manufacturing and Logistics. The project follows a formal Development and Product Introduction Management process, which includes risk management. The program manager reports directly to the Program Management Director while the rest of the team members report to their departmental managers with only a dotted line into the project manager.

Risk Identification

IDENTIFICATION	RUDIMENTARY	Negative perception of risk	End users no involvement with risk identification process	Fear of raising risk concerns	Compliancy risks not identified even though may exist	Risk identification is ad-hoc, basic, hit and miss
	INTERMEDIATE	People make full use of their freedom to act	Lack of integration of all stakeholder views	Disagreement among stakeholders if an event is a risk, subjectivity	Some compliancy aspects addressed but may have omitted significant ones	Potentially significant risk items may be omitted in reporting
		Lack of knowledge regarding what risk or uncertainty mean	Risk identification process characterised by subjectivity	No visibility of risk identification tasks / activities in project plan	Isolated non coordinated risk identification	Risk description is ambiguous, misleading
			New risks identified as they occur	Some remaining subjectivity (cultural differences)	Only focused on individual risks, managed at lower levels within team	Lessons learned not standardised. Unstructured documentation
	STANDARDISED	End users have an active role in the identification process	Timely integration of previous phases	Clear risk classification (standard risks)	Set minimum frequency risk identification rules with senior members	Shared understanding of group approach to risk identification
		Recognises risk management but not ready to invest resources	Instructions with project categorization / risk sources identification	Routine planning reviews to aid risk identification	Bridge from the lessons learned into the risk identification process	Mechanism identifies gaps between planned tasks and resources available
		Use quantitative risk methods (Montecarlo) to avoid subjectivity	Established procedure for contradictory views (objectivise)	A risk identification process guide may be available Visibility on new sourcing, 'make-or-buy' decisions	Visibility of implications of risks associated with all relevant suppliers	Structured accessible lessons learned & risk registers database (DB)
	CORPORATE	Earned Value (EV) monitoring highlights project performance shortfalls	Integrated process with involvement of all stakeholders	Formal communication regarding risk interrelations between projects	Top down approach related to project purpose and strategy	Real time reporting based on realistic data from all stakeholders

Figure 92: Risk identification capability assessment new product development project (blue labels match current project status; red labels are relevant but do not apply to current project status; black labels are not relevant to the particular project environment)

Model application: Steps 1- 3 Select labels which apply and match or not with project status

Most of the project team members have several years' experience in project management, several of them are formally trained in project management, in which however only basic notions of risk management are discussed. This is basically providing instructions on how to use the risk register and fill in risk required information during the project phase exits. Mainly due to their professional experience, team members feel comfortable reviewing or discussing risks. When requested, they contribute openly with their input. Only the project manager has been specifically trained in project risk management. Management recognises the value of project risk management, but advanced training in risk management is not considered.

Risk descriptions are clear and address risk root causes in most cases. The documented risks in the risk register are generally well understood by the involved parties, e.g. regarding a risk associated with a new non-validated required technical solution the two involved functions - sourcing and sales support - coordinate the required risk response plan. This ensures the integration of all stakeholder views. End users, in this case, the OEM, are informed about certain existing risks.

There is evidence in the risk register that a majority of risks have been identified and documented far in advance of their potential occurrence. Risk registers and phase exit required documentation require risk classification. Risk items are regularly updated and discussed with senior management as part of the phase exits. Lessons learned are supported by standard processes. Risk management is hardly ever object of review in lessons learned exercises or continuous improvement initiatives. Lessons learned documentation is not easily analysed, and no specific risk management lessons learned are in place. Formal communication on risk interrelations among project responsible is missing.

Risk identification remains subjective in certain cases. One reason for this is the cultural differences which are accentuated by the virtual character or the team, with groups in dispersed geographical locations and infrequent face to face meetings. Analysis of the project's risk register shows five risk documented items which could be adjudged as subjective or subjectively identified. Four out of these five risks can be classified as "project schedule risks" (where timescale is a major uncertainty), and the

fifth one can be classified as a "specification risk", (where completeness of specification is at risk). A lack of collective, objective assessment is indicated by the fact that, in the risk register, the risk type or risk category was not adequately maintained or updated by the project manager or any other team member during the project life cycle; and once the countermeasures agreed to mitigate the risk items were completed, these risks were then eliminated from the register without adequate consideration. From the risk register, examples of "project schedule risks" include "risk of delay in design verification due to component prototype timing" and "potential misalignment between supplier key product characteristics matrices". In the first example, once the manufacturing team had confirmed the prototype timing was not an issue for design verification, the risk item was closed. In a similar manner, for the second item, after the engineering representatives confirmed that there was no misalignment between the two lists with the responsible suppliers, the risk item was closed, the result of this confirmation being risk elimination. Project risk identification is not supported by use of any causal decision method, quantitative risk method or earned value monitoring.

The computer applications supporting project management documentation are very limited in providing project risk management data. There are no intelligent systems which could enable querying and analysis of project risk management data in available project documentation. The risk identification involvement of certain stakeholders is suboptimal. Finally, the identification process is not primary lead by the project overall purpose and strategy but focused on individual risks.

Steps 4&5: Estimate current status and decide desired stage

The overall assessment regarding risk identification indicates the project is at the intermediate stage but with several characteristics of the standardised stage. The project outcomes would highly benefit in terms of cost and duration when the organisation's risk identification capability could reach the standardised stage.

Steps 6&7: Identify labels required to focus on to reach the standardised stage and establish the required actions to achieve desired stage

To fully reach the standardised stage, the model indicates a number of possible initiatives relevant to this project context and environment: first, increasing knowledge and usage of quantitative risk methods; second, improved usage and availability of

lessons learned; and third, visibility of planned tasks against committed resources. Applying, for example, a first pass approach to estimate and evaluate uncertainties using the net present value (NPV) and Monte Carlo simulation is a simple and effective way to establish a simple risk model. Assessing and applying available lessons learned data and developing a reporting tool would also provide immediate benefit and require relatively little additional resource

Risk Assessment

ASSESSMENT						
	RUDIMENTARY	No relationship between risk information and cost forecast	Responses based on weak understanding or delayed thus ineffective	Isolated non coordinated risk assessment No evidence of opportunities being pursued	No fall back plans for risk mitigation or management	Only considered if project in difficulty or imposed by management
	INTERMEDIATE	Higher focus on project issues than on risks is embedded in the culture Management does not prioritise project issues over project risks	Description includes an indication about the source of risk Quantitative schedule analysis is not used	Lacks standard impact & probability estimate methodologies. This increases 'subjectivity' Struggle with Probability Impact (P*I) threshold concept	Probability estimation accuracy is weak Formal risk register maintenance Prescribed risk categorisation	Risk description is impact oriented, lacks context and of uncertain origin Use existing expertise and qualitative assessments
	STANDARDISED	FMEA, 6s, poka yoke used for quality management (in product design) Planned costs consider risk management - Threshold based on $ or days Considers secondary effects which extend beyond immediate impact	Clear procedure, minimum frequency to assess risk event - Evidence based Visibility of high-impact risks, risks which became issues, risks clustering ability Measure project team members' performance regarding risk issues (commitment)	Realistic estimates, use existing expertise and qualitative assessments Valid methods for risk prioritisation and risk quantification Steering Committee may challenge the risk process – escalate when required	Sound understanding of risk combined with use of Monte Carlo, decision tree Team members have good understanding of project's context and overall goal Systems analyse and summarise risk categories by project, customer or industry	Description is useful for qualitative risk analysis Impact estimation includes secondary effects Certain use of Quantitative Methods Project categorization is standard Attempts to prevent event from happening in first
	CORPORATE	Systemic risk assessment and continuous improvement	Ability to measure team members' performance	$ estimation of mitigated risk (Benefit of risk responses)	Risk management system integrated with other corporate systems	

Figure 93: Risk assessment capability assessment new product development project (blue labels match current project status; red labels are relevant but do not apply to current project status; black labels are not relevant to the particular project environment)

Steps 1- 3 Select labels which apply and match or not with project status

The project risk management plan and risk register instructions exclusively consider risk items with negative impact but not potential positive risks or opportunities. A higher focus on project issues than on risk is reflected in considerably higher time and resources dedicated to manage open item lists rather than on assessing and updating risks. The documented risk descriptions provide an indication of the source of risk, and these are useful for qualitative risk analysis. Schedule analysis considers the documented risks using solely qualitative analysis. There is evidence of risk register maintenance. As a result, the identified risks are allocated to prescribed risk categories. Experts assess risk using mainly qualitative methods. Few quantitative

methods are used in quality management in the product design phase. Probability estimation is weak, the lack of standard impact and estimation methodologies increases the risk estimation subjectivity. There are shortcomings in the methods used for risk prioritisation and quantification. The secondary effects of risks are not considered. Data on risk (e.g. items which became issues or risk items clustering) is not easily available, and the existing applications do not support data intelligence and queries.

There is a clear procedure which establishes a minimum frequency for reviewing the risk assessments. Evidence of the risk assessments is available. The project risk management plan is adapted to the project complexity, defined by the project categorisation.

Steps 4&5: Estimate status and decide desired stage

As regards project risk assessment, the project exhibits most characteristics at the intermediate stage with few others also at the standardised and rudimentary stages.

Steps 6&7: Identify labels required to focus on to reach the standardised stage and establish the required actions to achieve desired stage

To advance the risk management process and move to a consistently standardised stage for risk assessment, the model suggests several initiatives. First, improve risk analysis with the use of risk quantification and quantitative analysis. This would allow better integration risk management and costs planning. Secondly, the risk assessment would improve with a better understanding of the identified secondary risk effects, e.g. potential delays in new parts development may retain resources planned for next planned tasks and exacerbate other identified risks. Another opportunity would be to improve the risk management data structure and its reporting ability.

Risk Allocation

Figure 94: Risk allocation capability assessment new product development project (blue labels match current project status; red labels are relevant but do not apply to current project status; black labels are not relevant to the particular project environment)

Steps 1- 3 Select labels which apply and match or not with project status

Risk allocation is equitably distributed among the business streams active in the project with participation of the purchasing, engineering, sales and manufacturing functions. The risk allocation process is led by the project manager who is open to others' inputs. The project manager demonstrates the ability to identify groups not involved in the risk allocation and has experience in assigning risks across several groups. Project management and engineering are the drivers of the risk allocation.

Expertise within teams is recognised and harnessed. Some functional representatives with dotted line reporting to the project manager limit and affect their level of involvement in the risk management activities negatively. All risks have a risk owner with authority who accepts responsibility. Existing prescriptive risk classification of the documented items in the risk register does not enable allocation automation to existing job roles. There is evidence that risk item allocation is systematically reviewed according to the risk management plan. Fluid communication between customers and vendors characterises the project. The contractual agreements specify financial liabilities for all parties, supplier with OEM and sub-supplier with the supplier. However, this is mainly about transferring risks from customer to vendors

instead of developing risk-sharing arrangements. The suppliers provide risk information, sometimes late or incomplete though.

Steps 4&5: Estimate status and decide desired stage

The model indicates that risk allocation resides between the intermediate and the standardised stages, and near to being solidly aligned to the standardised stage.

Steps 6&7: Identify labels required to focus on to reach the standardised stage and establish the required actions to achieve desired stage

To achieve a consistent standardised stage, the maturity model indicates a number of possible beneficial initiatives. First, uprate the overall organisation attitude towards risk management. This is clearly reflected in the low recognition or support for good risk management practice during steering committee meetings or the very loose collaboration with suppliers to undertake complementary risk management. Further, within the project team, not all people working in the project actually use the risk management plan. With the exception of the engineering and project management team members, there is no evidence of autonomous risk allocation within the other groups. Project risk management training plan including the entire project team would ensure the proper use of the project risk management plan. Executives and senior management could better ensure the use of risk management after having been formally trained in project risk management. There are no existing business guidelines regarding who the risk taker is.

Risk appetite

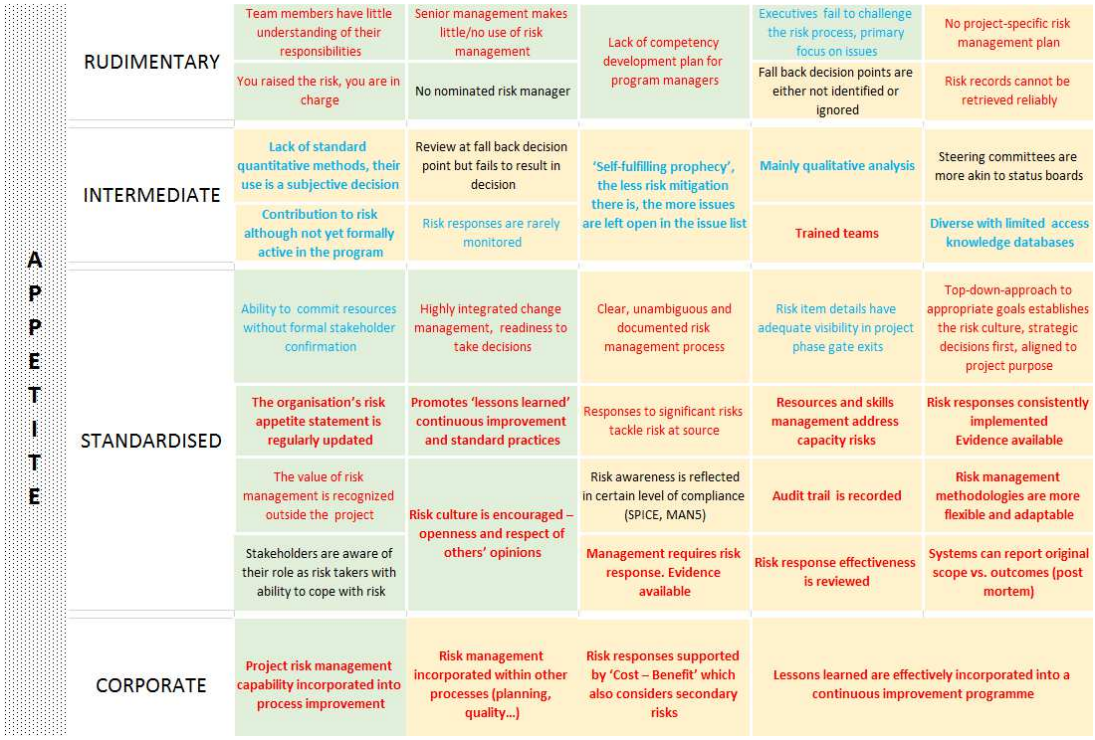


Figure 95: Risk appetite capability assessment new product development project (blue labels match current project status, red labels are relevant but do not apply to current project status; black labels are not relevant to the particular project environment)

Steps 1- 3 Select labels which apply and match or not with project status

Executives responsible for the project fail to challenge the risk management process, do not review risk details or their prioritisation. The risk management knowledge in the team only allows it to perform simple qualitative risk analysis. There are no standard quantitative methods available, and their use is dependent on the project manager's knowledge and decision making. Not all project team members are trained in risk management. The risk responses and risk mitigation activities are not properly monitored and controlled. As a consequence, the number of issues increases which require increased management attention, reducing further time and resources dedicated to project risk management. This situation has been depicted as a 'self-fulfilling prophecy'.

There were some characteristics of the standardised stage that were evident in the project. Identified risk items had adequate visibility during the formal project phase exits, and certain team members had shown their ability to commit resources prior to receiving customer order confirmation. On the other hand, there was no formal risk

appetite statement at the organisational level. Risk data was available on diverse non-integrated systems with limited access to limited team members.

Risk mitigation activities with impact on cost, schedule, quality or regulatory compliance are not considered as part of change management, and the integration of risk management and change management is weak. Lessons learned sessions are not formally documented and data is not easily available. Historical valuable information for risk analysis such as original scope vs outcomes in previous projects is also not available. Decisions relating to risk management are sometimes not considered in a timely manner in the change management process.

Steps 4&5: Estimate current status and decide desired stage

As regards risk appetite, the project exhibits mainly characteristics of the intermediate stage, but also some of the standardised stages. A higher stage of risk appetite capability will improve the risk mitigation and reduce project costs.

Steps 6&7: Identify labels required to focus on to reach the standardised stage and establish the required actions to achieve desired stage

A comprehensive programme of risk management training for all the project team members is required as a first step to move risk appetite to a consistently standardised stage in the maturity model.

Table 18 below lists a summary of recommended actions for the new product development project

Action plan by project / dimension	New product developement project	
	Current / next stage	Suggested next steps
IDENTIFICATION	Intermediate / Standardised	• Increase knowledge and usage of quantitative risk methods • Improve usage and availability of lessons learned • Provide visibility of planned tasks against committed resources
ASSESSMENT	Intermediate / Standardised	• Expand the use of risk quantification and quantitative analysis • Train project team members on advanced risk analysis (e. g. consider secondary risk effects) • Develop risk management reporting
ALLOCATION	Intermediate / Standardised	• Train executives and senior management about the responsibilities of Steering Committee Members • Enforce usage of project risk management plan by all project team members
APPETITE	Intermediate / Standardised	• Ensure project risk management training for all project stakeholders including Steering Committee members

Table 18: A coordinated plan of actions for improvement for the new product development project.

6.3 Model application in the ERP system implementation project

The second project is an ERP system implementation in two production sites and one engineering centre of the global automotive supplier in a European country. The sites employ 2000 individuals and achieve a yearly turnover of around € 500 Million. The sites serve several OEMs in Europe, North America and Asia with Steering Systems and prototypes. The new systems implementation replaces several legacy systems in the logistics, production planning and finance functions and includes interfaces with EDI. The implementation timeline is 12 months from kick-off until go-live. The project team includes four external consultants, seven business analysts and ten subject-matter-experts who validate the systems results. The team is organised in functional streams: finance and control, inbound logistics, outbound logistics, materials management and warehouse management, production planning and plant maintenance.

Risk Identification

IDENTIFICATION						
	RUDIMENTARY	Negative perception of risk	End users no involvement with risk identification process	Fear of raising risk concerns	Compliancy risks not identified even though may exist	Risk identification is ad-hoc, basic, hit and miss
	INTERMEDIATE	People make full use of their freedom to act	Lack of integration of all stakeholder views	Disagreement among stakeholders if an event is a risk, subjectivity	Some compliancy aspects addressed but may have omitted significant ones	Potentially significant risk items may be omitted in reporting
		Lack of knowledge regarding what risk or uncertainty mean	Risk identification process characterised by subjectivity	No visibility of risk identification tasks / activities in project plan	Isolated non coordinated risk identification	Risk description is ambiguous, misleading
			New risks identified as they occur	Some remaining subjectivity (cultural differences)	Only focused on individual risks, managed at lower levels within team	Lessons learned not standardised. Unstructured documentation
	STANDARDISED	End users have an active role in the identification process	Timely integration of previous phases	Clear risk classification (standard risks)	Set minimum frequency risk identification rules with senior members	Shared understanding of group approach to risk identification
		Recognises risk management but not ready to invest resources	Instructions with project categorization / risk sources identification	Routine planning reviews to aid risk identification	Bridge from the lessons learned into the risk identification process	Mechanism identifies gaps between planned tasks and resources available
		Use quantitative risk methods (Montecarlo) to avoid subjectivity	Established procedure for contradictory views (objectivise)	A risk identification process guide may be available	Visibility of implications of risks associated with all relevant suppliers	Structured accessible lessons learned & risk registers database (DB)
				Visibility on new sourcing, 'make-or-buy' decisions		
	CORPORATE	Earned Value (EV) monitoring highlights project performance shortfalls	Integrated process with involvement of all stakeholders	Formal communication regarding risk interrelations between projects	Top down approach related to project purpose and strategy	Real time reporting based on realistic data from all stakeholders

Figure 96: Risk identification capability assessment ERP project (blue labels match current project status, red labels are relevant but do not apply to current project status; black labels are not relevant to the particular project environment)

Steps 1- 3 Select labels which apply and match or not with project status

Risk identification is not done consistently and is more of an ad-hoc activity left to the project manager's discretion. The project team is keen to identify and review risks, and end-user representatives are included in this exercise when this occurs. However, risk identification is not formalised, thus not necessarily all stakeholders participate. Further, knowledge regarding what risk or uncertainty mean is missing in some groups. In addition, the majority of the risk items in the risk register are assigned to the project manager, an indication of potential subjectivity in the risk identification process. There is a lack of integration of all stakeholder views.

Lessons learned, although part of the project management plan, are not always pursued effectively. Project documentation from previous initiatives is not readily available and extracting risk information or comparing projects is difficult. The project manager makes very limited use of the risk management documentation available from other projects or existing lessons learned.

The project manager follows the corporate procedure and completes the documentation regarding project categorisation and risk sources identification. However, the risk identification activities are not planned or visible in the project plan and do not have continuity. The planning sessions do not include risk identification. Although the reviews with senior management consider risk identification, these are generally neither discussed nor challenged. Practitioners and management recognise the value of project risk management, but they are not ready to invest the required resources.

Steps 4&5: Estimate current status and decide desired stage

As regards risk identification, the project exhibits characteristics of both the intermediate and the standardised stages. The organisation recognises that an enhanced risk identification capability at the standardised stage will improve considerably the projects outcome and the customer satisfaction.

Steps 6&7: Identify labels required to focus on to reach the standardised stage and establish the required actions to achieve desired stage

Major actions required to move to the standardised stage are to firstly incorporate risk identification into the planning process. To this end, a process guide for risk identification is needed. Secondly, it is necessary to agree, structure and

document formal lessons learned concerning risk management. The result of this should include a database with accessible risk related data. Finally, an expansion of the use of quantitative risk methods would be beneficial in reducing uncertainty.

Risk Assessment

ASSESSMENT	RUDIMENTARY	No relationship between risk information and cost forecast	Responses based on weak understanding or delayed thus ineffective	Isolated non coordinated risk assessment No evidence of opportunities being pursued	No fall back plans for risk mitigation or management	Only considered if project in difficulty or imposed by management
	INTERMEDIATE	Higher focus on project issues than on risks is embedded in the culture Management does not prioritise project issues over project risks	Description includes an indication about the source of risk Quantitative schedule analysis is not used	Lacks standard impact & probability estimate methodologies. This increases 'subjectivity' Struggle with Probability Impact (P*I) threshold concept	Probability estimation accuracy is weak Formal risk register maintenance Prescribed risk categorisation	Risk description is impact oriented, lacks context and of uncertain origin Use existing expertise and qualitative assessments
	STANDARDISED	FMEA, 6s, poka yoke used for quality management (in product design) Planned costs consider risk management - Threshold based on $ or days Considers secondary effects which extend beyond immediate impact	Clear procedure, minimum frequency to assess risk event - Evidence based Visibility of high-impact risks, risks which became issues, risks clustering ability Measure project team members' performance regarding risk issues (commitment)	Realistic estimates, use existing expertise and qualitative assessments Valid methods for risk prioritisation and risk quantification Steering Committee may challenge the risk process – escalate when required	Sound understanding of risk combined with use of Monte Carlo, decision tree Team members have good understanding of project's context and overall goal Systems analyse and summarise risk categories by project, customer or industry	Description is useful for qualitative risk analysis Impact estimation includes secondary effects Certain use of Quantitative Methods Project categorization is standard Attempts to prevent event from happening in first place
	CORPORATE	Systemic risk assessment and continuous improvement	Ability to measure team members' performance	$ estimation of mitigated risk (Benefit of risk responses)	Risk management system integrated with other corporate systems	

Figure 97: Risk assessment capability assessment ERP project (blue labels match current project status, red labels are relevant but do not apply to current project status; black labels are not relevant to the particular project environment)

Steps 1- 3 Select labels which apply and match or not with project status

Although few of the risk items in the risk register specify a significant impact on the project costs, the cost forecast is not updated based on this risk information. The project risk management plan and risk register instructions identify the potential existence of risk items with positive and negative impact. The risk register documents risk items with exclusively negative impact on cost, time, scope or quality. Currently, the project is running under budget

The project managers focus resources and time more on risk issues resolution than on risk items. The risk descriptions refer to the source of risk in many items, but only a small portion of these is impact-oriented ('interface problems', 'change in scope', 'no final solutions for new process'). The risk register supports the

categorisation of risks. The team utilises qualitative assessment. However, the risk impact and risk likelihood estimations are based on experts' subjective judgement and not on standard estimate methodologies.

The regular steering committee meetings review the documented major risks, but the process fails to quantify and to rationally prioritise these risks. Secondary effects are not consistently considered. Intelligent risk data from previous projects is not easily available.

Steps 4&5: Estimate current status and decide desired stage

In terms of risk assessment, the project shows mainly characteristics aligned to the intermediate stage. The project outcomes and deliverables would benefit of a higher risk assessment capability, the organisation may look for moving to the standardised stage.

Steps 6&7: Identify labels required to focus on to reach the standardised stage and establish the required actions to achieve desired stage

Integrating risk information and cost forecast is required to move forwards the next maturity stage. Secondly, a formalised procedure to review the risk assessments could help to adjust the estimates, making these gradually more realistic. Identifying opportunities could be the next step for the project organisation to move towards the next maturity stage. It is noticeable that although the project has successfully been completed in time and is under budget, the risk estimation has not been adjusted during the project. These three wo suggestions together with an improvement in the knowledge of risk management and usage of quantitative methods could move risk management maturity from the intermediate to the standardised stage as regards this dimension.

Risk Allocation

Figure 98: Risk allocation capability assessment ERP project (blue labels match current project status, red labels are relevant but do not apply to current project status; black labels are not relevant to the particular project environment)

Steps 1- 3 Select labels which apply and match or not with project status

Currently, there is no active recognition or support for good risk management practice in the project. This is reflected in the steering committees in which the risks are reviewed without questioning the risk assessment and the risk owners' allocation. In some departments, the business managers do not feel responsible for risk management, and they expect that the project manager will be held responsible for project outcomes. Some team members are not trained in project risk management. Risk management is undertaken by the project manager with the very limited participation of several groups active in the project. Nine out of the 15 items documented in the risk register are assigned to the project managers. There are no business guidelines available regarding who the risk taker is. The project is however characterised by constant formal and informal communication between the IT personnel responsible for the implementation and the internal customer, represented by the functional leads in the business.

Not all people working on the project use the risk management plan, and therefore these individuals are not open in their disclosure of all risk information. Non-specific risk owners such as 'each team' or 'finance/logistics' show that not all risks have a risk owner with authority and who accepts responsibility. The project streams

or groups do not perform risk allocation autonomously, and it is the project manager who assigns all risks in the risk register. The risk management documentation is not readily available, and most of the project team except for the project manager is not trained in using the risk management procedures.

Steps 4&5: Estimate current status and decide desired stage

The overall assessment of the project regarding risk allocation is intermediate with a few elements belonging to the rudimentary stage. It appears as if the organisation needs to work to stabilise the intermediate stage for this dimension.

Steps 6&7: Identify labels required to focus on to reach the standardised stage and establish the required actions to achieve desired stage

As a first action, project sponsors and senior management need to reinforce the standing of risk management in the project. Specific risk management training for both senior management and team members is required for meeting the intermediate stage criteria.

Risk Appetite

APPETITE	RUDIMENTARY	Team members have little understanding of their responsibilities	Senior management makes little/no use of risk management	Lack of competency development plan for program managers	Executives fail to challenge the risk process, primary focus on issues	No project-specific risk management plan
		You raised the risk, you are in charge	No nominated risk manager		Fall back decision points are either not identified or ignored	Risk records cannot be retrieved reliably
	INTERMEDIATE	Lack of standard quantitative methods, their use is a subjective decision	Review at fall back decision point but fails to result in decision	'Self-fulfilling prophecy', the less risk mitigation there is, the more issues are left open in the issue list	Mainly qualitative analysis	Steering committees are more akin to status boards
		Contribution to risk although not yet formally active in the program	Risk responses are rarely monitored		Trained teams	Diverse with limited access knowledge databases
	STANDARDISED	Ability to commit resources without formal stakeholder confirmation	Highly integrated change management, readiness to take decisions	Clear, unambiguous and documented risk management process	Risk item details have adequate visibility in project phase gate exits	Top-down-approach to appropriate goals establishes the risk culture, strategic decisions first, aligned to project purpose
		The organisation's risk appetite statement is regularly updated	Promotes 'lessons learned' continuous improvement and standard practices	Responses to significant risks tackle risk at source	Resources and skills management address capacity risks	Risk responses consistently implemented Evidence available
		The value of risk management is recognized outside the project	Risk culture is encouraged – openness and respect of others' opinions	Risk awareness is reflected in certain level of compliance (SPICE, MAN5)	Audit trail is recorded	Risk management methodologies are more flexible and adaptable
		Stakeholders are aware of their role as risk takers with ability to cope with risk		Management requires risk response. Evidence available	Risk response effectiveness is reviewed	Systems can report original scope vs. outcomes (post mortem)
	CORPORATE	Project risk management capability incorporated into process improvement	Risk management incorporated within other processes (planning, quality…)	Risk responses supported by 'Cost – Benefit' which also considers secondary risks	Lessons learned are effectively incorporated into a continuous improvement programme	

Figure 99: Risk Appetite capability assessment ERP project ((blue labels match current project status, red labels are relevant but do not apply to current project status; black labels are not relevant to the particular project environment)

Steps 1- 3 Select labels which apply and match or not with project status

Project sponsors and senior management's role in project risk management may need to be clarified. Other issues in need of clarification are project team training, the relevance of risk management and how the monitoring of risk responses should work.

Although there is a specific risk management plan, senior management does not make full use of risk management while it is more focused on the management of open issues. Risk item details are collected and prepared for the project phase gates; however, these are not analysed or challenged during the steering committees. Interestingly, the organisation offers professional development plans for the project managers and also in the IT area. The risk management process is partially documented, certain documentation is available, but information is sometimes not updated or specific enough. Evidence of risk responses being consistently implemented is missing. Lessons learned sessions had been initiated, but entire teams do not provide input. The results were properly published, but the risk data is not easily comparable to other similar or related projects.

Risk responses were not formally reviewed. However, the approach when documenting risks is aligned with the company's strategy and key decisions such as go-live, training or validation dates are taken after due consideration of the local and corporate business circumstances. The documented risk assessment is only qualitative, the project team has no experience of using quantitative risk assessment methods, possibly because no standard quantitative methods are established. Risk information about other projects is limited and accessing related information and data is cumbersome. Senior management does not encourage risk management and risk management is not generally recognised outside the project. Risk culture is not the subject of much discussion in the organisation in which the implementation takes place, and risk appetite is not a subject that is regularly reviewed. Resources and skills management are not used to identify potential capacity risks or bottlenecks during the project. The fact that some team members maintain a dual role as systems maintenance and development for other locations causes conflicts between daily systems operations activities and project performance.

Steps 4&5: Estimate current status and decide desired stage

The overall assessment of the project regarding risk appetite is intermediate with a few elements belonging to the rudimentary stage. Here, there are similarities with the risk allocation dimension in that considerable work is still required to consolidate risk appetite maturity at the intermediate stage.

Steps 6&7: Identify labels required to focus on to reach the standardised stage and establish the required actions to achieve desired stage

The first required action to stabilise risk appetite capability is to review with senior management whether the current risk management operations could be improved or not. Formal training for senior management and team members is also required. It is also necessary to consistently review the evidence of risk responses. The computer applications supporting the project management documentation need to be enhanced.

Table 19 below lists a summary of recommended actions for the ERP system implementation.

Action plan by project / dimension	ERP system Implementation	
	Current / next stage	Suggested next steps
IDENTIFICATION	Intermediate /Standardised	• Integrate risk identification into the planning process. • Develop and apply a risk identification guide • Improve usage and availability of lessons learned
ASSESSMENT	Intermediate /Standardised	• Integrate risk assessent into the project cost planning • Expand opportunity management to risk management • Train project team members on advanced risk analysis
ALLOCATION	Intermediate / Intermediate	• Reinforce usage of project risk management • Train executives and senior management on project risk management for Steering Committee Members • Train project team members on advanced risk analysis
APPETITE	Intermediate/Intermediate	• Train executives and senior management on project risk management for Steering Committee Members • Train project team members on advanced risk analysis • Develop risk management reporting (to ensure risk responses monitoring)

Table 19: A coordinated action plan for improvement for the ERP system implementation project.

6.4 Summary

The two projects assessed show similar maturity stages, but maturity is slightly higher in the product development project, particularly in the allocation and appetite dimensions of risk management. This might be the result of a higher adherence to the project management methodology in the product development area than in the information technology groups.

The areas for improvement in both projects can be summarised in four items:

a) Training: Training in risk management is an essential part of the action plan for both projects as it is part of the required improvements in all four risk dimensions in the new product development project and three of the dimensions in the ERP system implementation.

b) Wider application of existing risk management methodology: in the new product development project, this is noticeable in need for enforcing the usage of the plan by all project team members. In the ERP system implementation, this is evident in need for integrating risk identification into the planning process, again in the assessment dimension improving cost and opportunity management and in the allocation dimension with the need for reinforcing usage of project risk management.

c) Lessons learned and use of risk identification guides: Both projects show the need for improvement in the identification dimension regarding utilising lessons learned. Other improvements in the identification dimension are better visibility of required resources against the tasks planned in the product development project, and the use of a risk identification guide in the ERP project.

d) Computer applications: Better systems with improved reporting capabilities are part of the suggested action plan for both projects.

Action plan by project / dimension	New product developement project		ERP system Implementation	
	Current / next stage	Suggested next steps	Current / next stage	Suggested next steps
IDENTIFICATION	Intermediate / Standardised	● Increase knowledge and usage of quantitative risk methods ● Improve usage and availability of lessons learned ● Provide visibility of planned tasks against committed resources	Intermediate /Standardised	● Integrate risk identification into the planning process. ● Develop and apply a risk identification guide ● Improve usage and availability of lessons learned
ASSESSMENT	Intermediate / Standardised	● Expand the use of risk quantification and quantitative analysis ● Train project team members on advanced risk analysis (e. g. consider secondary risk effects) ● Develop risk management reporting	Intermediate /Standardised	● Integrate risk assessent into the project cost planning ● Expand opportunity management to risk management ● Train project team members on advanced risk analysis
ALLOCATION	Intermediate / Standardised	● Train executives and senior management on project risk management for Steering Committee Members ● Enforce usage of project risk management plan by all project team members	Intermediate / Intermediate	● Reinforce usage of project risk management ● Train executives and senior management on project risk management for Steering Committee Members ● Train project team members on advanced risk analysis
APPETITE	Intermediate / Standardised	● Ensure project risk management training for all project stakeholders including Steering Committee members	Intermediate /Intermediate	● Train project team members on advanced risk analysis ● Train executives and senior management on project risk management for Steering Committee Members ● Develop risk management reporting (to ensure risk responses monitoring)

Table 20: A coordinated plan of actions for improvement in both projects.

7 Discussion

7.1 Introduction

This chapter discusses the application of the centricity concept to some key elements of risk management and links the findings to the literature review. Centricity in the specific context of project risk management is defined as the integration of risk management activities in the overall project management process as opposed to a specialist activity, perceived as alien to the project stakeholders._This discussion highlights some of the shortcomings of current project risk management practices and suggests alternative ways forward. More important, this chapter addresses RQ1 'Can the centricity concept be usefully harnessed to further our understanding of risk management?' by applying the centricity concept to the four risk dimensions which have been considered in previous chapters to develop the risk maturity model. The contribution of the centricity concept to improved risk management is a new way of looking at management that can add value to the overall process. The centricity concept applied to risk identification, assessment, allocation and appetite in the context of projects, suggests a series of features in relation to the risk maturity of the organisation which are illustrated in the following sub-sections.

At this juncture the merits and limitations of the maturity model are discussed, the RISC model viability compared to other maturity risk models presented by Hillson, Zou, Yeo or Hopkinson. This chapter continues with a review of the model's applicability, transferability and how data saturation in the model development was achieved. The final section deals with the researcher's reflections on the research process. The chapter content is then summarised.

7.2 Centricity in project risk management

The identification of risk as a subjective phenomenon coincides with its creation – the risk exists only once the stakeholder has identified it. This is particularly noticeable for risks linked to an organisation's own qualities and deficiencies (Irizar & Wynn, 2013). This subjective or person-centric risk identification can often produce inefficiencies in the management of risk that may impact detrimentally on project cost and overall project success. The analysis of risks associated with different information systems (IS) by Ward and Griffiths (1996) uses a strategic grid depiction of risk

categories (Figure 100) Figure 1that can be used in the application of the centricity concept for project risk management.

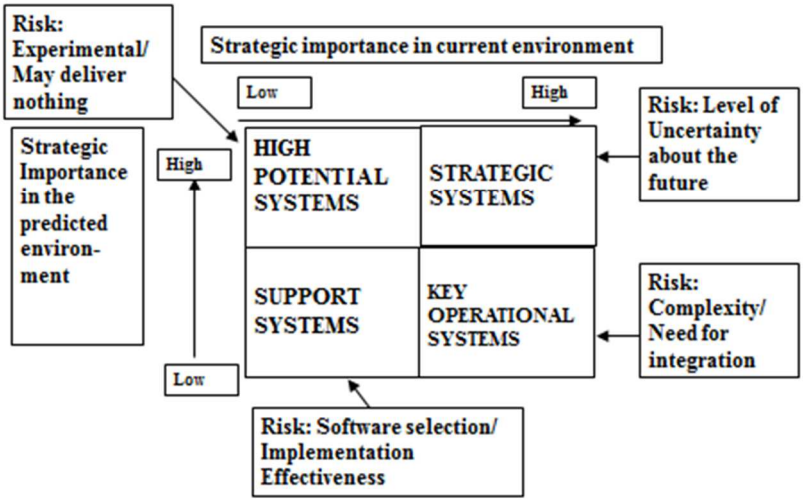


Figure 100: Quadrant grid depiction of IS risk categories (Ward & Griffiths, 1996).

If we view risk identification against risk assessment in grid format, many projects - arguably the majority - adopt a person-centric approach to risk identification and a methodology centric approach to risk assessment. Yet, as suggested by Emblemsvåg and Kjølstad (2006) and Zayed et al. (2008), from an initial standpoint, a combination of objective risk identification and eclectic risk assessment is likely to produce the most successful project outcomes (Figure 101). The higher degree of subjectivity in risk identification has been shown particularly in projects with teams with lower risk maturity (Irizar & Wynn, 2015).

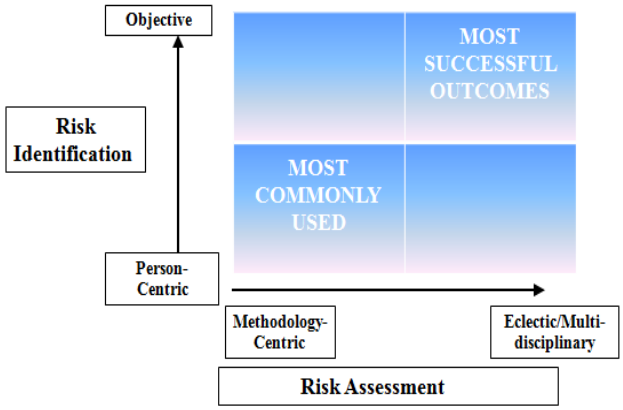


Figure 101: Risk identification and risk assessment: basic model.

Risk identification centricity

Centricity applied to risk identification is the integration of all project stakeholders in the risk identification activities. The risk identification style in the rudimentary stage lacks consistent group input and participation. The absence of involvement of significant part of the project stakeholders in the risk identification process, and therefore lack of risk discussion among them prevents the positive influence of risk discussion in objective and perceived project success. On the other hand, organizations or projects at the corporate stage ensure formal communication about the identified risk items within the organisation while maintaining an overview of the interrelationship or impact of other projects risks. This is in line with the findings of de Bakker, Boonstra, and Wortmann (2014b) regarding the significance of communication between project members during risk identification in providing a positive influence on objective and perceived project success.

NASA (2005) can be cited as a paramount example of a mature organization in terms of risk identification. NASA advocate a risk-centric view of their project design when they note that it is "essential to identify the architecture-discriminating issues that would drive the risk of the program" or their programs focus on "identifying differences that made a difference in architectural risk". Their risk identification process incorporates many sources of information, such as intensive reviews of heritage information, past risk assessments, and interaction with vehicle designers and operations experts performed by experienced analysts. Once identified, these risk drivers were combined into models for the specifics of each mission implementation. The goal is to arrive at reasonable estimates that can be used to identify "differences that make the difference" in programs such as the International Space Station (ISS) and lunar missions.

Another illustration of a lead organisation in the manned spacecraft programs with an embedded risk-centric oriented decision-making approach is the Jet Propulsion Laboratory (JPL). Their risk identification process is characterised by correlating the identified risk items to the strategic program objectives. In addition the risk identification activities are performed as a team outcome, with a particular attention on effect and impact of the identified items (Feather et al., 2004). Another promoter of a risk-centric approach, Clayton (2009), ensures a broad participation and number of contributors on the risk identification process by passing down the goals through all

organization's departments. His maturity model considers formal accountability dissemination of key objectives, which ensures awareness of key risks to meeting these objectives. The focus on management control maturity narrows organisational vulnerabilities to objective risk items, directly correlated to operational and strategic objectives.

Risk assessment centricity

As regards risk assessment, the choice of a particular industry prescribed project management methodology can have a major impact on how risks are assessed, and on overall project outcomes. Eclectic, multidisciplinary risk assessment is likely to produce the most successful project outcomes.

The use of risk matrices for risk assessment illustrates this well. Their apparent simplicity and transparency are reasons for their popularity; however, they potentially entail serious mathematical defects and inconsistencies. Different risk assessors may assign greatly different ratings to the same risk exposure (Ball & Watt, 2013). Such different ratings are due to fundamentally different worldviews, beliefs, and other psychosocial factors, the consequences of which are not significantly changed through reflection and learning.

There are a number of evident shortcomings in the use of these matrices. These include instability resulting from categorisation differences, and the lie factor, which suggest that they can obscure rather than enlighten communication. The rankings produced have been shown to be unduly influenced by the matrix design, which is ultimately arbitrary. It is suggested that other means of assessing risk based on decision-analytical methods could produce improved outcomes (Wall, 2011).

An example of a decision-making tool applicable to new product development (NPD), designed to help the project manager choose the best way to improve project success rates while controlling the level of risks, is presented by Marmier, Gourc, and Laarz (2013). Other authors combine content analysis with cluster analysis of existing historical data, to develop the Risk Breakdown Structure which can be used to build risk management guidelines (Holzmann, 2012). These scientific decision analysis tools could be an alternative to the popular but inefficient use of risk matrices for risk prioritisation. The establishment of systematically maintained lessons learned datasets

could also provide reliable quantitative data to estimate the likelihood of potential events.

A comprehensive combination of risk assessment methodologies is presented by NASA (2005). The methodologies applied a blend of quantitative risk assessments including simple tree events, with each pivotal event assigned a success probability, Monte Carlo simulations, but also qualitative assessments such as expert opinion until more information about the design was quantified, and detail models were produced. In addition to these techniques, an intensive review of heritage information back to Apollo and past risk assessments are performed. Employing these techniques into the design process allowed NASA arrive to a solution that effectively blended performance and risk management within time and budget constrains (NASA, 2005). The NASA well documented case conforms empirical results in which practitioners in large, international, complex, innovative context use more risk management techniques.

Expertise and application in quantitative methods such as Defect Detection and Prevention (DDP) with well estimated costs improve designs with savings that far exceed these expenses. The results for decision making based on the deployment of these quantitative techniques beat conventional risk grids as the risk matrices which eventually may produce misleading assessment results, also called pathological examples (Feather et al., 2004).

Therefore, it can be concluded that risk assessment centricity can be viewed as reliance on one specific methodology and its inherent tools in the assessment of risk. This may entail, for example, the use of exclusively qualitative risk assessment such as the use of risk impact matrix or subjective expert's estimations.

Risk ownership centricity

The different approaches to the risk management process often appear as a conflict between centralised project risk management and the empowerment of sub-project teams (Williams, 1997). The complexity of certain projects makes it difficult to understand the consequences of central decisions for the team members. The project manager alone will struggle to comprehend the details of all potential risks, oversee these and control their management. Yet most projects are project-centric in terms of risk management process and person-centric as regards risk identification. The

ongoing monitoring and maintenance of the risk register in which project risks are listed tend to be controlled by the central project manager (Bannerman, 2008). It is suggested that overall project outcomes would be improved by appropriately combining centralised and decentralised risk management activities, especially in complex projects (Harvett, 2013). Risk ownership centricity is viewed as an overdependence on centralised control and allocation of risks, and their subsequent management and resolution.

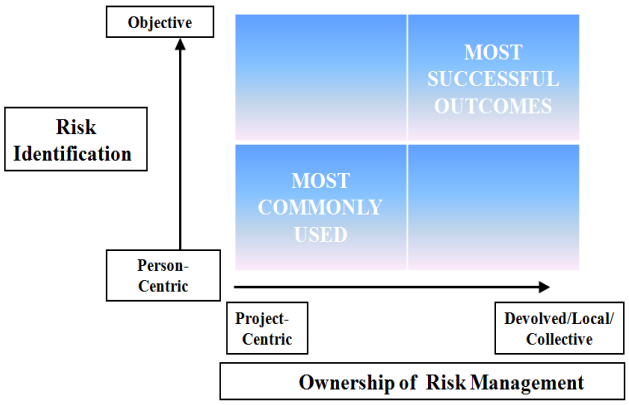


Figure 102: Risk identification and risk ownership: basic model.

There are some similarities in an initial assessment of risk identification and risk ownership using the centricity concept (see Figure 102). Kaplan and Mikes (2012) provides insight into how JPL, an organisation which applies a risk-centric perspective for spacecraft technology decision making effectively involves relevant functions in the risk management allocation and assigns risk ownership of the most critical risks. JPL established a risk review board with independent technical experts who challenged the project engineers' design, risk assessment, and risk-mitigation decisions. This regular and intense reviews allow the project manager and key stakeholders to collectively analyse their work from another perspective.

A devolved and collective risk ownership offsets biased estimations resulting from unnecessary centralised risk management. A centric risk ownership approach addresses human tendency to overconfidence about forecasts, far to narrow risk assessment of the range of outcomes that may occur and estimates anchoring (Kahneman, 2011; Kaplan & Mikes, 2012). The formal definition of the risk function in the organisation has a great influence on the risk allocation. Functional or project

managers may suffer of overconfidence about their strategies or projects. This can be addressed in different ways by the organisation. Some of these choose the introduction of an 'independent facilitator'. One of his major activities is influencing risk-based resource allocation. An alternative approach is the creation of a 'business partner role' such as the one introduced by JPL (Kaplan & Mikes, 2016). Any of these approaches will:

- reduce the reluctance to divulge new information on risks
- increase the active recognition or support for good risk management practice
- change the perception of risk from intrusive to allowing organisations to take on riskier projects and strategies
- release and support project managers and steering committees during the risk allocation procedure
- ensure all people working on the project use the risk management plan
- improve the risk expertise to assign risks across groups
- contribute to transparency of the escalation procedure or risk allocation

More particularly, project management practitioners in industries which require intense collaboration - such as automotive product development - complain about the insufficient development of risk management methods and processes not being integrated and synchronised. Lack of collaborative risk management, together with poor communication, is the main reason for project failure in the automotive industry (Niebecker, 2009).

Similarly, in major IS projects, the IT function has traditionally owned and led information risk management and security operations. However, the move to user ownership of systems requirements, process improvement issues, data access and maintenance, have changed the risk and security paradigm. Business managers, systems users and the IT function are now required to understand and learn others risk-reward trade-offs. The IT function must now share ownership of the risk management process and transfer accountability for some key areas of risk to business partners (Chobanova, 2014).

Risk appetite and centricity

The final dimension considered here is risk appetite, again juxtapositioned against the central theme of risk identification (Figure 103). As noted above, centricity in the specific context of project risk management could be understood as the integration of risk management activities in the overall project management process as opposed to a specialist activity, perceived as alien to the project stakeholders. Risk-averse organisations may even avoid managing risks or limit resources available for risk management activities, which will work against effective risk management making these organisations, paradoxically, more vulnerable to risk (Bannerman, 2015).

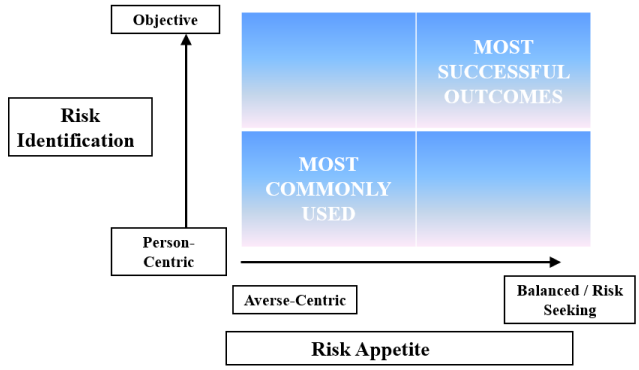


Figure 103: Risk identification and risk appetite: basic model.

Limited awareness of risk engenders occasional applications of informal risk management techniques to specific projects and problems are dealt with only when they occur. Understanding the full relevance of risk, however, will encourage the proactive management of uncertainty (Hopkinson 2012). Companies with a low maturity degree only perform risk identification or qualitative risk analysis, while organisations with a high level of maturity deal with all the stages of the risk management process (Cagliano, Grimaldi, & Rafele, 2015).

Risk-centric organisations other than averse-centric ones can aggregate risk exposure against its risk appetite. A balanced risk treatment enables management to consciously understand which risks can be accepted and left unattended, and what risks need immediate attention and action. The risk appetite is not defined in a sentence but reflected in organisation's behaviour based upon their underlying value priorities in truly testing situations under circumstances that force them to make trade-offs among their multiple stakeholders (Kaplan & Mikes, 2016).

The organisation's risk appetite needs to be reviewed regularly. This requires good command of quantitative methods to draw the official position of the firm on risk tolerance (Hubbard, 2009). Managers can select appropriate risk responses based on the organisation's risk appetite (Clayton, 2009; Business Objects, 2009).

Academically, this study offers, for the first time, a conceptualization of centricity applied to risk management. The centricity concept applied to the four risk dimensions, identification, assessment, ownership and appetite is a new way of looking at risk management that adds value to the overall process. The contribution to theory is reflected in how the various dimensions of risk management matched against different aspects of the project – project focus, duration, budget, resourcing, ownership, expectation, and secondary effects for example – as well as with project outcomes enable the identification of criteria relevant to the development of the maturity model.

7.3 Merits and limitations of the maturity model

One major merit of the proposed maturity model is its applicability within project-oriented organisations, and for global automotive suppliers in particular.

The applicability of maturity models can be assessed based on:

- their practicability
- complexity of the assessment and
- the model support or availability

Applicability Criteria \Model	Hillson	Zou et al	Yeo	Hopkinson	Irizar (RISC)
Practicality	General recommendations	General recommendations	Specific improvement activities	Specific improvement activities	Specific improvement activities
Model Assessment					
Assessment Method Described	Yes	No	No	Yes	Yes
Assessment Cost	?	No	No	No	No
Continous Assessment	No	No	Yes	No	Yes
Improvement Opportunities Prioritization	No	No	No	Yes	Yes
Model Support / Accessibility	Free	Free	Free	Free	Free

Figure 104: Applicability of risk maturity models adapted from Proença and Borbinha (2016)

The practicability of models outlines whether the recommendations are problem-specific or general in nature. The assessment to calculate the maturity

stages can be done by following a self-assessment questionnaire or by following a fully-fledged maturity assessment method. So, for example certain maturity models include an associated assessment method while others do not. A relevant aspect of the applicability of the RISC maturity model is how it supports its use. The two examples of the model application presented in chapter 7 illustrate a suitable method of use of the model (Lacerda & von Wangenheim, 2018). The application of the model is easy and intuitive. Basically, it requires a good understanding of the model structure and meaning of the labels. These can be allocated to three categories based on how well they match with the project or group, either they match, do not match or they are just not relevant for the environment being analysed. The relative difficulty of the training to perform the assessment depends on the project management experience and existing risk management knowledge of the individuals being trained. However, the training required by project management professionals to assess their projects or organisation using the RISC model can be estimated as relatively low. The model practicability is characterised by its ability to prioritise improvement opportunities, which is only offered by Hopkinson and the RISC models. The result of the assessment are specific weaknesses which can be addressed with the coordinated plan of actions outlined at the end of sections 7.1 and 7.2. The outcome of the model deployment is a list of prioritised improvement opportunities.

The assessment costs may vary with different degrees of expenditure of an assessment project. The assessment costs for deploying the RISC model are dependent on the approach used. Obviously, a formal audit with external resources may require higher expenditure than self-assessments or project team workshops. Furthermore, the maturity model may be linked to continuous improvement initiatives. The RISC maturity model is the only one of the risk maturity models that specifically relates to the continuous improvement process and it can ~~be~~ possibly easily applied in organisation adopting a philosophy of continuous improvement (Proença & Borbinha, 2016).

Finally, a last criterion to assess the practicality is the model support and its availability. The RISC model will be freely available on the web.

As outlined in chapter 7, the risk maturity assessment method focuses on highly complex and specialised tasks being performed by competent assessors in an organisational context. Due to the complexity of these methods, the maturity assessment becomes an expensive and burdensome activity for organisations. As such, an example of future work is the enhancement of methods and techniques used in the RISC model to automate certain aspects of the assessment such as the maturity stage determination or the labels stage reassignment. Such an automation could be done by developing some simple visual basic applications in Microsoft Excel, for example.

Although the results of the research may be relevant and similar to prior and future studies, the researcher does not claim that these findings are generalisable to other sectors of industry. Considering the small sample, it cannot be claimed that the research is generalisable to all global automotive suppliers. However, on the other hand it is reasonable to assume that the descriptions provided about the context and the industry environment related to this research may be useful to understand whether the findings are transferable to another milieu (Bryman & Bell, 2011; Rastrelli & Ricca, 2015).

Several techniques have been used to achieve data saturation. One method suggested by Creswell (2007) to move toward saturation is to use discriminating sampling, in which the researcher gathered additional information from individuals similar to those people initially interviewed to determine if the theory holds true for these additional participants. This was done by adding two participants to the structured interviews who had not been part of the initial 12 contributors to the initial model. Concerning the sample, several approaches were applied to ensure data saturation. In the first place, the researcher used an interview protocol to ensure all the research participants were asked the same question. Further, purposely sampling was used, which is a technique suggested to facilitate saturation (Creswell, 2007). Finally, triangulation was used as a mean of saturation. The responses from the three in depth interviews were cross-verified with the ones from the initial 12 interviews, confirming that additional data provided few, if any new insight (Saunders et al., 2009).

The present research contributes to the maturity model literature by documenting the development of a maturity model in the automotive industry. It provides a starting point for the application of maturity models in other sectors. The model adds to existing literature of risk management maturity models and is unique in being specific to the automotive industry. It can be used by risk and project managers, and can also be adapted to other industry sectors. It contributes to reduce the gap between theory and practice.

7.4 Reflections on the research process

As mentioned previously, the researcher has extensive experience in project management in the automotive industry, mainly in the IT area, and has had the opportunity to act in the roles of project manager, sponsor, steering committee member, user and team member. Due to the long practice years of service with the organisation there is always the possibility for the researcher to exhibit researcher bias. Although the researcher recognises the impossibility of being totally free of bias, the three phases of bracketing as suggested by Gearing (2004) were utilised to remove possible preconceptions. The first phase of the bracketing technique was the justification of the research paradigm as post positivist in section 4.3. Next, for the data gathering procedures, the interviews were designed purposely setting aside any presuppositions and rendering explicit the management of risks in projects. To ensure any internal or external suppositions were bracketed, the researcher reviewed the questionnaires and interview excerpts with the interviewees after the interviews. Finally, the collected information in the form of statements was reintegrated in the structured maturity model. This procedure has been outlined in sub-section 4.6.1. (Data Analysis Maturity Model Conception).

There was a challenge in sharing and substantiating the findings for fear of the participants' rejection and disagreement. However, there was a common consensus of agreement to the initial findings, as confirmed by the results of the subsequent interviews and surveys. Although not yet formally deployed, there is a high interest within the organisation to apply the maturity model in different groups and units.

Overall, the personal experience throughout the doctoral journey was positive and has contributed to the researcher's growth as an organisational leader. Several challenges were encountered along the way, including numerous evolutions of the subject of the research. The research started initially as 'An approach to Risk Analysis in Project Management – development of a frame to integrate subjective project risk'. Originally launched as a way of integrating different risk thinking and viewpoints towards developing a more scientific and comprehensive framework in project risk management, the researcher introduced the centricity concept in relation to several risk management aspects. The centricity concept has been a linking concept to integrate the two major schools of thought in risk management, risk as an objective fact and RaaSC. Finally, and possibly influenced by the organisational environment in which the research was developed, which is very much characterised by the continuous improvement philosophy, the researcher elected to develop a risk maturity model as a project management tool that could be deployed in the global automotive industry to bring together all the elements mentioned previously.

7.5 Summary

In this chapter, the contribution of the centricity concept to enhancing risk management was discussed. Centricity as the integration of risk management activities in the overall project management process as opposed to a specialist activity, perceived as alien to the project stakeholders, was examined in a number of contexts.

Centricity applied to risk identification engenders the integration of all project stakeholders in the risk identification activities. The organisations presented in section 8.2 illustrate well how they actively integrate all stakeholders in the risk identification process and how the result is a high level of maturity in risk identification. Certain authors discussed in the literature review outlined how organisations that apply a comprehensive and adequate combination of risk management methodologies can produce excellent assessment results. These companies also avoid misleading estimations or risk prioritisation that could be result of using one single assessment procedure. Organisations which learnt to apply devolved and collective ownership, offset biased estimations result from

overcentralised risk management. To this end, organisations can choose between introducing 'independent facilitators' who facilitate and support the process or 'business partners' as part of the decision-making authority. Irrespective of which these approaches organisations choose, the organisation's risk appetite needs to be reviewed regularly. Finally, those organisations with a balanced risk treatment are capable of understanding which risks can be accepted against the expected reward.

The centricity concept has for the first time been academically applied to project risk management. The theoretical contribution is the conceptual framework which combines centricity with the four risk management dimensions. It has greatly contributed to the discussions of good risk management with the practitioners unveiling several insights on how to improve the management of risk identification, assessment, allocation and balancing risk appetite in organisations.

The major theoretical contribution of this research is the development of a risk maturity model in the automotive industry, which adds to existing maturity models. The merits and limitations of the maturity model were outlined. The major merit of the maturity model compared with existing ones is its applicability. The model's applicability has been assessed against its practicability, complexity and description of the proposed method assessment as well as the accessibility of the different models. The aspect of transferability of the proposed model has also been explained. One major limitation of the maturity model is the focus on manual collection of evidence to substantiate the maturity stage calculation. The development of automated methods and techniques could be an area of subsequent research to further develop the maturity model.

Finally, some personal insights into the research journey of the researcher were discussed. In particular, this encompassed the procedures applied to avoid or reduce as much as possible potential bias, and the personal experience of progressing with the research while professionally working as a project professional within the research environment.

8 Conclusion

8.1 Introduction

In this chapter, conclusions for this research are presented, starting with an introduction integrating and synthesising the various issues raised in the discussion sections. This is followed by a summary of answers to the RQs, after which the contribution of this thesis to theory and practice and an analysis of its limitations and future research opportunities are discussed.

Projects are risky propositions, and in certain industries, these are closely linked together with product innovation. The automotive industry is one of the major contributors to the economies of industrialised countries. The success of organisations working in this industry is very much dependent on its level of innovation. These innovation initiatives often materialise in projects, the outcomes of which often have a critical impact on the organisation's results. Risk management has been one of the areas of significant attention in modern project management. Despite the establishment of professional project management standards and practices, a high percentage of projects continue to fail. The practitioners consider poor risk management as one of the top contributing factors to these project failures (PMI, 2017).

The literature review revealed some key findings:

- subjectivity is a major barrier in dealing with risks in projects, particularly in regards to risk identification
- risk identification is the activity in the project risk management process with the highest impact on the project outcome
- no scientific and complete framework integrates different thinking and views for analysing and managing project risks (Zhang, 2011)

The centricity concept can be applied to some key aspects of project risk management to aid understanding, develop alternative perspectives and assess subjectivity with regard to risk identification. On the other hand, maturity models enable the deployment of structured assessments. These assessments can provide an approach to performance improvement in many areas of business, e.g. can be used for both the profiling of project risk management capability and as a tool for on-going

monitoring and improvement. Taking the generic risk management model as a point of reference, and with the centricity concept as a stimulus for discussion and debate, the researcher has developed a maturity model. A major criticism from academics of the existing project management guides and maturity models has been their lack of consideration of context and contingencies. This research has addressed this issue through the research design choice, based on a multi-project case study and the qualitative approach using several sources of data and different stakeholder perspectives.

This research has also applied the validated risk maturity model operationally in two project organisations. After presenting the results of the risk maturity model assessment, the desired maturity stages in the different risk management dimensions were set, and finally, a coordinated plan has been developed to either stabilise the current maturity stages or to move these to a higher level.

8.2 Conclusions regarding the research questions

RQ1. Can the centricity concept be usefully harnessed to further our understanding of risk management?

This research presents a theoretical framework applying the centricity concept to four major project risk management dimensions namely, risk identification, risk assessment, risk allocation and risk appetite. Centricity, understood in our context as the mindset or attitude that characterises the manager's or organisation's outlook and motivation in the relationship to others, helps to explain the practice of project risk identification, assessment, allocation and the project risk appetite of organisations. In this research, centricity is understood as a tendency to centralise risk management activity, authority and decision-making generally to the detriment of overall project outcomes. The researcher's contention is that devolution of responsibility, workload, and objective setting relating to risk is likely to be beneficial. Similarly, in regards to assessment and appetite, this research proposition favours multidisciplinary/eclectic methodologies and balanced risk treatment over methodology centric and averse-centric treatment. Interviews and discussions with business leads responsible for major projects in the organisation studied in the research supported the model assumptions

and its validity. The participants in the initial interviews understood well the model, appraised it in some cases as a 'good model', and were able to easily position their project risk management policy within the model with comments like 'the system we have is facilitating this model'.

The centricity concept applied to the four risk dimensions of the maturity model was crucial to develop several of the labels which refer to subjectivity such as:

- Disagreement among stakeholders if an event is a risk, subjectivity
- Risk identification process characterised by subjectivity
- Some remaining subjectivity (cultural differences)
- Use quantitative risk methods (Montecarlo) to avoid subjectivity
- Lacks standard impact & probability estimate methodologies. This increases 'subjectivity'
- Lack of standard quantitative methods, their use is a subjective decision

However, also, other labels were the direct result of discussions on the conceptual framework:

- End users lack involvement with risk identification process
- Only focused on individual risks, managed at lower levels within the team
- Established a procedure for merging contradictory views (objectivise)
- Suppliers provide risk information however not complete

Several labels were derived from the discussion around good and bad risk management practice using the simple grid charts representing the centricity concept. The fact that according to the interviees some of these labels are the ones that best describe their projects demonstrates how fruitful the concept is. Some of these labels are: 'End users no involvement with risk identification process', 'Disagreement among stakeholders if an event is a risk, subjectivity', 'Risk identification process characterised by subjectivity', 'In most cases assigned to project manager', 'Some departments do not feel responsible "project manager will be held responsible"', 'Risk identification process characterised by subjectivity', 'Probability estimation accuracy is weak', 'Only program management (and engineering) drive the risk allocation'.

Evidence of subjectivity in the identification of individual risks combined with weak risk estimation probability and lack of estimation methodologies in one of the projects analysed suggest person-centric risk identification and methodology-centric risk assessment. Conversely, several of the labels identified to create the coordinated plan of actions out of the model assessment are strongly related to the centricity concept.. Example of actions aiming to objectivise risk identification is the improvement in the usage of lessons learned or growing the knowledge and use of quantitative risk methods. Thus, centricity has been used explicitly to develop the maturity model labels and implicitly to amend the maturity stages of certain labels which build the model, to apply the maturity model and finally to develop the coordinated plan of actions for improvement.

RQ2. Can a maturity model be developed for effectively assessing risk management capability in organisations?

A project risk management maturity model which assesses project-oriented organisations has been introduced and applied in this study. The model with its four stages of maturity can be used to assess and understand the organisation's current project risk management capability and subsequently develop strategies to improve their risk management practice. The maturity model assesses four fundamental dimensions of project risk management, namely risk identification, assessment, allocation and appetite. There are 156 labels allocated to one of the four risk dimensions and one of the four stages in the model.

This research adopted a qualitative approach based on a case study strategy to develop the project risk maturity model. The organisation selected with its truly international presence, broad suite of technological products, customers and related development projects is illustrative of the global automotive component business. The labels are in the form of summary statements, which describe the organisation's maturity stage in each of the risk dimensions; these have been shaped by capturing business leads' and project management experts' inputs related to major projects. As a means of facilitating the organisation capability assessment, the labels have been classified into two label types:" process and systems" and "organisational and people". The initial maturity model was validated in two stages. The first one being a survey distributed to six experts with the aim of confirming the labels assignment in the

maturity model. The second validation was completed through the conduct of structured interviews. These allowed a comparison of the labels selected to best characterise the projects maturity against the self-assessment for each risk dimension The outcome of the validation is a refined model. The label stage assignment after the validation shows a significantly higher alignment with the interviewees self-assessment.

The maturity model presented in this research is different to other maturity models firstly because it is specific to the automotive industry. A significant difference to other models is its focus on the application of the primary activities in the risk management process. This enables a detailed analysis of several aspects of these activities as preparation for subsequent improvement plans. The maturity model has been applied to two project teams of the organisation chosen for the case study, and the results have been presented in sections 7.2 and 7.3 in this research. The risk management capability assessment in these two groups analysing two real projects identified a series of deficiencies affecting project performance. Some of the recommendations included risk management training for the stakeholders, increased attention on activities such as risk identification within the project planning and reinforcing the development of lessons learned.

RQ3. Can this model be applied operationally to enhance the overall risk management process?

Chapter 8 demonstrates how the model was applied to two major in-company projects. It also presents the output of the model deployment with the establishment of a coordinated plan of action for improvement of these two projects.

The model can be used in practice in a variety of ways and contexts and for different purposes. Company project practitioners may select the appropriate labels from each dimension to assess their risk management capability. Senior management and project practitioners may agree the desired maturity stage, identify gaps in their capabilities with the help of the label descriptors, and develop the list of actions required to reach the chosen stage. In a training or workshop session, the model can also be “deconstructed”, removing the allocation of labels to specific maturity stages, and asking project participants to select labels that appear most appropriate to the

environment in which they work. Ensuring debate can then suggest the current maturity level for that particular project risk management environment.

The maturity matrix can also be viewed as a means of achieving improved communication within and across a project team. This communicative effect occurs when stakeholders deliberately use risk management to convey messages to others, with the aim of influencing their behaviour, synchronising their perception, and making them aware of the context and their responsibilities. It stimulates action and increases the effectiveness of the action, helps to synchronise stakeholders' actions and perceptions making the situation more predictable leading to less uncertainty (de Bakker et al., 2014a).

The maturity model can be seen in the context of what Voetsch et al. (2004) termed 'operational monitoring' and 'controlling of issues' that may be used to manage and monitor risk. They confirmed the direct relationship between risk management practice and project success and called attention to the need for general control activities not identified as risk practices per se. The model application understood as part of continuous improvement programs, may lead to the implementation of a coordinated plan of actions similar to the ones described in the previous chapter and ultimately to an improved risk management process.

This maturity model ensures the integration of risk in several project management processes such as project human resource management, project cost management, project communication management, project procurement management and project stakeholder management. It also supports adding responsibility for risk management to functional managers as well as it enables the discussion of risks with relevant team members and project stakeholders. Integration of risk with other project management processes, adding responsibility for risk to functional managers and an open discussion of risk with team members and stakeholders are the principles suggested by Zwikael and Ahn (2011) to increase the levels of uncertainty avoidance and the project management maturity as means of mitigating risks and enhancing value.

This research provides practical recommendations for advancing the maturity stage with the use of quantitative methods. Some of these are the rational prioritisation of risks presented by Aloini, Dulmin, and Mininno (2012a), the reduction of the

subjectivity factor when using FMEA offered by Alam et al. (2014) or the Monte Carlo simulation. All these techniques should be assessed for suitability by the project management experts in the organisation.

8.3 Contribution of this research

Contribution to theory

The main contribution of this research is the new maturity model for assessing risk management capability. The four risk dimensions encompassed by the model ensure that all relevant organisational capabilities required to assess the organisation's risk management performance in projects are considered. Equally crucial for the validity of the maturity model are the insights on individual skills, abilities and expertise provided by a representative sample of experts. Finally, the process and steps applied to develop this maturity model provide a path for researchers on how to select dimensions, shape and framework concepts relevant for their area of interest and ultimately generate other maturity models. The development process could potentially be applied in other industries but also in other managerial disciplines.

The next significant contribution is the development of centricity as means of looking at risk management dimensions. By developing the centricity concept, this thesis provides new knowledge on how to integrate multiple rationalities of risk management coexisting in a project with the objective to support rational and consistent decisions in projects. Information collected through the maturity model assessment represents a two-way mode of risk communication, which involves understanding and incorporating the viewpoints, perspectives, and logic of different people to improve the organisation's risk model and methods. The maturity model introduced in this research supports the standpoint put forward by (Zhang, 2011) that final risk decisions are actually the outcomes of communication coordination and negotiation among multiple stakeholders. Centricity acts as a catalyst for looking at risk management in a new way while adding value to the overall process.

Several authors have noted maturity models struggle to account for the idiosyncrasies of the problem spaces in which the users work (Buckle, 2017). The approach followed in this research for developing the maturity model capturing primarily practitioners input ensures unique processes, peculiarities and specifics of

the automotive global supplier industry are appropriately considered. Other researchers or policy makers can replicate this approach in other sectors or industries.

Contribution to practice

The automotive industry, one of the major contributors to the global economy and paramount example of a project-oriented industry, is currently suffering dramatic disruptions. Project complexity, new technologies, suppliers' dependencies and legal and normative changes conceal very significant risks that could threaten the very existence of the organisations involved in these initiatives. Standard methodologies identify and evaluate individual risks without considering RaaSC, human ramifications of each risk, or how to ensure adequate risk allocation or the project and organisational contexts in which the risks are analysed. This is the case particularly for complex projects (Williams, 2017). If one looks at project risk registers, risks belonging to the RaaSC type do not appear at all, although these may be critical for the project. The researcher followed the recommendations of Maier et al. (2012) for developing maturity models, adopting a change management and continuous improvement perspective. The maturity model presented in this research can be used for assessing the organisation's project risk maturity level and identifying weaknesses in all four risk dimensions. The entire organisation can apply the assessment; it can also be used for comparing differences in practice within the same organisation, e.g. different business units or division within bigger organisations. This approach can be useful for the development of roadmaps for achieving project risk management harmonisation through the entire organisation. An example of action timelines is shown below:

Action plan by project/dimension	Target stage	ACTION	RESPONSIBLE	Due date
IDENTIFICATION	Standardised	Establishment and implementation lessons learned process	Engineering VP/Project Management Director	01 – 09 - 2019
ASSESSMENT	Standardised	EVM and MonteCarlo certification for project managers	PMO/Project Management Director	01 – 12 – 2019

ALLOCATION	Standardised	Formal project risk management for Senior /functional managers	HR Director/Project Management Director	01 – 09 - 2019
APPETITE	Standardised	Develop risk management reporting	Project Management Director/IT Director	01 – 12 – 2019

Table 21: Example of action timeline resulting from the project risk maturity assessment

The use of the model in these ways can provide the basis for a coordinated plan of actions for improvement of the group's project risk management. The execution of such an action plan can enhance project risk managemnt in practice and lead to more successful projects and a more profitable organisation.

Another beneficial approach can be the deployment of the maturity model within two or more organisations aiming to cooperate in joint projects, for these organisations to agree on a standard project risk management approach. Process assessment in the manufacturing industry and the supply chain context in the automotive industry, in particular, is a critical aspect of collaboration. Risk management capability audits are in many cases part of the contractual agreements between OEMs and tier-1 suppliers. The customer typically requires management of project and technical risks. Project management should consider risks for the project scope, feasibility, estimates, skills etc. Thus, the project has to identify, mitigate and manage project risks at project management level and technical risks on requirements and architecture level. The Automotive SPICE process assessment model (QMC, 2017) is one of the typically considered scenarios in such audits. The audit assesses several process capabilities, among others project management and project risk management. These are noted in this process assessment model as MAN.3 Project Management and MAN.5 Risk Management. The process capabilities are assessed against certain base practices (BP). One representative scenario is described below:

- Assessment purpose "process-related product risk", in which the purpose of the assessment shall give evidence of process risk impacting on the quality of a specific product release.

The most important criterion is, whether a given set of top-level requirements has been processed correctly and entirely in the chain of all assessed processes, thus resulting in a product which is "ready for delivery". Specific aspect that the auditor

will assess is whether impact analysis and risk assessment for changes or changing technology have been performed. Lack of risk management integration in the project, e.g. an agile project, will lead to downrate of SPICE base practices such as:

MAN.3.BP5: Define, monitor and adjust project estimates and resources. Define, monitor and adjust project estimates of effort and resources based on project's goals, project risks, motivation and boundaries.

Now, using the maturity model, following labels could be selected to address the base practice mentioned above:

- Identification, standardised stage: ‘Mechanism identifies gaps between planned tasks and resources available’; ‘Routine planning reviews to aid risk identification’ and ‘Visibility of implications of risks associated with all relevant suppliers’.
- Assessment, standardise stage: ‘Clear procedure, minimum frequency to assess risk event - Evidence-based’; ‘Planned costs consider risk management - Threshold based on $ or days’ and ‘Impact estimation includes secondary effects’.
- Appetite, standardised stage: ‘Resources and skills management address capacity risks’.

MAN.5.BP1: Establish risk management scope. Determine the scope of risk management to be performed for the project, in accordance with organisational risk management policies.

For compliance with this base practice these are the labels that could be considered:

- Identification, standardised stage: ‘Clear risk classification (standard risks)’ and ‘A risk identification process guide may be available.’
- Assessment, standardised stage: ‘Clear procedure, minimum frequency to assess risk event - Evidence-based’ and ‘Project categorisation is standard.’
- Allocation, standardised stage: ‘Contracts with formal risk agreement bearing clear financial liabilities’.

- Appetite, standardised stage: ‘Clear, unambiguous and documented risk management process.’

The use of the maturity model is an opportunity for organisations to close the gap described by Bannerman (2008) between the state of risk management research in the literature and its application. The maturity model labels relate to several effective ways to improve the risk management effectivity in projects. Bannerman found a significant lack of application in practice of the state of risk management research being one of his examples the lonely project manager informally updating the risk register before each steering committee meeting. This apparent deficiency points to a rudimentary or intermediate stages for the risk identification dimension. This deficit is reflected in labels such as ‘End users no involvement with risk identification process’, or ‘No visibility of risk identification tasks/activities in project plan’. More advanced stages address the issue with labels such as ‘End users have an active role in the identification process’, ‘Routine planning reviews to aid risk identification’ or at corporate stage, ‘Integrated process with the involvement of all stakeholders’. The same deficiency is also identified again in the risk allocation dimension. At the rudimentary or intermediate stages labels like ‘Some departments do not feel responsible “project manager will be held responsible”’ or ‘only program management drive the risk allocation’ and ‘Some program managers doing everything, but recognised as inefficient’ reflect the issue. This is addressed in the standardised stage with ‘Every team member provides input on items with commercial impact’.

Regarding developing project risk management maturity, certain organisations may find it beneficial to establish risk management expert teams responsible of regularly assessing the organisation’s capability, providing training and monitoring the improvement plans or merely working side by side with the project managers.

Previous research (see section 2.5) and this research found that the centricity concept can be used to improve the project risk management process. Centricity applied to risk identification in projects can deliver crucial information to reduce subjectivity in the risk management process and improve the project's output. When looking forward, there are different directions where this research could be extended. If organisations were able to identify subjective risks in their risk registers and define the risk concept in a subjective sense, the risk process could be adjusted based on more

objective data. With more objective risk identification, project responsible teams may adopt alternative risk mitigation responses.

The maturity model may positively influence the project risk management practice by addressing the major barriers to its use. One of the significant barriers to the use of project risk management identified in the literature is its cost justification (Kutsch & Hall, 2009). The maturity model can be an excellent aid for estimating the commitment of resources required to reach the agreed maturity stage. The problem of cost justification will be overcome with the perception of management that the benefits of mitigated risks are greater than the cost of carrying out project risk management. Resistance to own risk being a significant block to risk management will be addressed with the execution of the actions agreed during the risk management capability assessment. This assessment will clarify the risk allocation process, and it will reduce the resistance to own risks. Lack of hindsight, claiming the absence of adequate data is addressed with learning out of experience. Actions which could be taken to address the issue are illustrated by labels such as 'Use existing expertise and qualitative assessments' and 'Lessons learned are effectively incorporated into a continuous improvement programme'. Regarding systems, the risk identification assessment considers the availability of relevant data with the label 'Structured, accessible lessons learned & risk registers database (DB)' and within the dimension allocation with the label 'Consistently maintained multi-user concurrent access risk database is in place'.

This work has also provided some practical contributions and discussed possible implications. This work has delivered a simple tool for project-focused organisations (with a similar structure to the one studied here) for evaluating their current project risk management practices and maturity in each of the four risk dimensions. The maturity model could be used as a guideline to identify weaknesses and plan for development. If it only stimulates to use mind and rationality to predict outcomes to any subjective course of actions, it has met the objectives. As Albert Einstein once said, "Intellectuals Solve Problems Geniuses Prevent Them".

8.4 Limitations of the present study and implications for further research

This research study has certain limitations. Outlining the research limitations aids identifying potential weaknesses of the study (Creswell, 2007). Depending on

their context, some limitations are related to the research methodology, to the specific research topic or the research stage (Drašković, 2010).

The research methodology in this research is based on a qualitative approach. In qualitative case studies, and this one being an in-depth single-case study, the researcher depends on the experiences of the involved participants and their perspectives on a specific phenomenon, what can lead to responses biased in one direction. The labels defining the maturity stages are measured by single items and are newly developed. More research is needed to explore the depth of each indicator and test if additional items are needed.

Another limitation, also related to the methodology, is the role of the researcher as an insider in the organisation and as an investigator. In-depth knowledge of the organisation and extensive project management experience can be not only an opportunity, but may also conversely lead to a preconceived and biased presentation of the findings. As already mentioned in section 8.4, the researcher has been aware of this risk during the entire research journey and used the bracketing techniques to avoid preconceptions. Some of the techniques adopted included those suggested by Tufford and Newman (2012) - the use of a reflexive journal, review of the interview excerpts with the participants, engaging in interviews with external resources, and probing the data obtained out of several sources.

The topic chosen for the research has a direct influence on the research limitations as well. The research scope of this thesis was limited to project risk management in the global supplier automotive industry. There is evidence of significant impact of the perceived level of project risk, and the intensity of risk management process from the project context where the project is executed (Zwikael & Ahn, 2011). For this reason, it is not certain the results of this research can be transposed to other industries. Another limitation of this study is the type of projects. These were limited to product development and launch of new automotive components and complex ERP implementations within a global automotive supplier. These were projects with distributed and geographically dispersed project team members that focus simultaneously on processes, people and technology. A further limitation of this research is the number of research participants, which have been interviewed. The data analysed has been collected from input from fourteen participants, and it could be argued that this research could benefit from a more significant number of participants.

However, considering the variety of functions and the interviewed individuals' level of influence on developing project risk management plans, the sample shows a fair representation of the total population involved in project risk management in the case study.

Another limitation is that the research has been developed considering only one participating organisation in the project, the tier-1 global supplier. The model assessment could be extended for joint use with the customer or OEM or in combination with critical tier-2 suppliers.

Finally, this research concluded with the production of the project risk maturity model generated from the case study. The issues of long-term management of the model are outside the scope of this work. The development of a software application which supports the project risk assessments, and the creation of individual roadmaps to improve the organisation's project risk capability could be the subject of future research. Once the organisation has assessed project risk management capability, it may decide to reinforce individual labels of the maturity stages, or to select labels relating to the next stage in the model and prepare to transition to the next stage of risk management maturity. Each stage in the model offers the opportunity of analysing the implementation of new labels selected as tasks. Finally, another possible area for further research is the study of the effect of implementation of new selected labels on project success.

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Appendices

Appendix I Interview documents

Participant consent form and project information sheet received by the 12 research participants in the in-depth semi structured interviews. The consent forms were all signed by the participants and returned to the researcher.

UNIVERSITY OF GLOUCESTERSHIRE
at Cheltenham and Gloucester

Participant Consent Form

Please complete the whole of this sheet after reading the Project Information Sheet and tick YES or NO	YES	NO
1. I have read and understood this information sheet (Please keep a copy for your reference)	☐	☐
2. I have had an opportunity to discuss this study and ask any questions	☐	☐
3. I have had satisfactory answers to all of my questions	☐	☐
4. I have received enough information about the study	☐	☐
5. I understand that interviews will be audio-recorded	☐	☐
6. I understand that details of my participation up to the time of withdrawal will be stored anonymously on file and may be used in the final analysis of data	☐	☐
7. I understand that my participation is voluntary and I am free to withdraw within 15 days after the interview, without giving any reason	☐	☐
8. I understand that sections of any of my study notes may be looked at by responsible individuals from the University of Gloucestershire where it is relevant to my taking part in this research. I give permission for these individuals to access my records that are relevant to this research	☐	☐
9. I have had sufficient time to come to my decision	☐	☐
10. I agree to participate in this study	☐	☐

Participant

Signed .....

Date .....

Name (BLOCK LETTERS) .....

I have explained the study to the above participant and they have indicated their willingness to take part.

Researcher

Signed .....

Date .....

Name (BLOCK LETTERS) .....

Project Information Sheet

Contact:
Jose Irizar
Email: [redacted]
Mobile: [redacted]
The Business School, University of Gloucestershire
The Park
Cheltenham
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Research background

This research concentrates on project risk management in the global automotive supplier industry sector. Two areas in which project management has considerable visibility in the automotive industry are product development and information systems. Contemporary risk management literature can be assigned to two distinct schools of thought, risk as an objective fact and risk as a subjective construction. Both schools provide different definitions of risk, both are based on different ontological and epistemological principles, and both handle risk in a different manner. The aim of this research is

- to inform or improve project risk management theory and practice by the 'risk as a subjective construct' and 'centricity' concepts
- to find out how to use operationally these concepts to enhance project management outcomes
- to develop a conceptual framework to integrate different risk thinking in the context of project management practice

Purpose of the research

The managerial purpose of this research is to enhance the project risk management process in practice by testing and refining a conceptual model using the 'risk as a subjective construct' and the 'centricity' concepts. These two concepts are used to gauge the key elements of risk management. Risk identification may be person-centric, risk assessment methodology-centric and the risk management process project-centric. Finding out how to move away from centricity in these processes will engender the practice and lead to better project outcomes.

Funding

The research is part of a doctoral dissertation. The research is not funded.

Choice of participants

The research seeks a variety of perspectives from business leaders who have managed critical projects in the automotive industry, and you have been identified as a crucial participant.

Expected benefits and risks

This research aims to assist in the development of best practice advice for project risk management in practice in the automotive industry.
It cannot be promised that the study will help you personally but the results created might help improve how organisations manage project risks and project outcomes. You will receive fist hand results of the study in an executive summary presentation, made available to you through electronic means once the study is completed. There are no foreseen risks associated with the involvement in the study.

Audio Recording of Interviews

With your permission, the researcher would like to audio record the interview for better data capture.

Your Involvement

Taking part in the research will involve talking to the researcher from University of Gloucestershire for up to an hour, at a time and location that is convenient to you. All information will remain strictly confidential, and all names will be anonymised.

Voluntary Participation

It is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw your permission within a period of 15 days after the interview. A decision to withdraw, or a decision not to take part, will not result in penalty or judgement.

Confidentiality

The information that you provide is anonymous. The information will be stored using study numbers on a password-protected computer within a locked space. Your name will not be stored with your interview data. No information about any single individual will be made available to any other person. Only group information will be given in any reports of the study with no indication of any participant's identity. When the research is completed and reported, all recording data will be destroyed and all the transcripts will be stored securely for a period 10 years to allow for checking the accuracy of the information if necessary during that period.

Results

The results of this research will be part of the doctoral dissertation. The research will also be published in the form of academic papers in management journals and presented at academic conferences in order to disseminate the research findings.

Researcher and supervisors

Prof Dr. Martin Wynn and Prof Dr. Shujun Zhang (University of Gloucestershire, United Kingdom) are the principal supervisors for the study who will oversee the work of the researcher. Jose Irizar is the researcher on the project, and will be conducting the research for his doctoral dissertation.

Further information

If you have any questions about this research, or require further information, please contact the study researcher indicated above.

Please keep this information sheet for your information; should you agree to participate in the research you will also be given a copy of the signed Informed Consent form for your records.

Thank you for your interest and participation!

Appendix II Interview transcription example

The text below shows part of the transcript of one of the 12 in-depth semi structured interview conducted using the questionnaire shown in section 4.5 'Data gathering procedures', Table 7. All 12-recorded interview were processed by a professional agency which produced the transcripts used for the data analysis. It should be noticed this transcript is not edited and it is presented in raw data as received by the transcript agency. S1 is the interviewee and S2 the interviewer.

00:00:00,000 - 00:00:46,000 Which we have been facing too. That risk for example-- we are not in that part yet, but we are using more rating, probability impact to prioritize risk and the risk being rated by the single engineers were getting higher rating than what the project manager would expect, and that at the beginning. What we try to do is kind of set up objective criteria just to make that easier. But that [isn't?] how a problem that we are facing, and that we will be facing. So subjectivity is a-- S1

00:00:46,000 - 00:00:47,000 Is an issue. S2

00:00:47,000 - 00:00:49,000 Is an issue. Will be an issue. S1

00:00:49,000 - 00:00:56,000 Yes. Yes. Yes. Because something that is a risk for one person may be a protection for the other. I mean, it's very different from [crosstalk]-- S2

00:00:56,000 - 00:00:59,000 Yeah, that's right. That's right. S1

00:00:59,000 - 00:01:31,000 --[from using this?]. Okay. So the idea is to use this operationally, and not develop only for the theory but also for practical-- this was like the start point. This is based on PMI. And you can see, identification is written in white, different to the others. This is because identification is the most important. I mean it seems defined by the literature and-- S2

00:01:31,000 - 00:01:32,000 As the most important phase. S1

00:01:31,000 - 00:02:27,000 --as the most important phase or set of activities, correct. And what I did, I changed the bit-- the terms, so I took identification as the

central item with subjectivity as that makes a difference on how you identify, and how user has influenced also later on on the next steps on the assessment. Then the ownership I thought is really important. And the ownership, I mean, there are here different aspects of ownership. Ownership of course is the allocation -who's getting. And sometimes when you get-- you are the risk owner, it's something like-- it seems like a penalty, or it's something bad: I'm responsible. I don't want to be responsible for that. S2

00:02:27,000 - 00:03:14,000 That is like a bad thing, and it's interesting that-- and also in complex projects like the ones you worked on you have very often-- the project is very complex and you have the supply chain portion, you have the finance, you have the legal part, you have the engineering that is already very complex and in the middle, you have the program manager who's managing all those people. It's difficult for him to understand the risk and to understand also who the best person that could be assigned to it. When I say ownership is the allocation, but also who's responsible to do that allocation, how autonomous the different groups can work. S2

00:03:14,000 - 00:04:43,000 Once I attended risk management training - three days training, a couple of weeks ago, two months ago already - and we were kind of 15 people there from different organizations, different company, and most of them were already-- or were facing the same problem. So difficult to get people identifying risk; difficult to set up the right owners. People actually not wanting to work with that. The only company in the group that was working the right way was-- I don't know the name, but they had a central risk management organization. So this was a team for five, six people who were responsible of putting the teams together, identifying risk. They were working as a central unit for managing all of this. And as far as the risks were identified, assigned to an owner. Then the risk response planning, ownership was set up, and this person outside this risk management organization was in charge of following up, implemented the needed actions and so on. S1

00:04:43,000 - 00:04:44,000 Okay. S2

00:04:44,000 - 00:05:13,000 There was a central risk management organization who was responsible of as a trigger, identifying, assessing the risks as per the central rules, follow up the owners, he has to get updates, and officially closing the risk. So they were responsible of every phase, except what you call ownership, or what we call risk response planning, so setting up the actions for mitigating or avoiding the risk. S1

00:05:13,000 - 00:05:15,000 So were these like some experts in prior risk management? Only for project or was enterprise risk management? S2

00:05:15,000 - 00:05:20,000 Yeah, that's right. Both. S1

00:05:20,000 - 00:05:26,000 Both. So it was not only applied for projects but also in general risks? S2

00:05:26,000 - 00:05:40,000 Yeah, also in general. There were also in charge, as [part of?], [they say?] of, for example, collecting risks from different projects. Trying to find systemic risks that turned into enterprise-- S1

00:05:40,000 - 00:05:42,000 [inaudible] Inherent, yes. S2

00:05:42,000 - 00:06:18,000 So they gave pretty good feedback. So that was a pretty new organization, two years, three years. They were facing the same problems as the rest at the beginning. But the fact that there is five people, five experts working with the teams trying to trigger actions, lead you to a better risk management process [crosstalk]. So that was very good. And in respect to risk identifications, what you have mention that that is the key process, the key phase, or the key activities. S1

00:06:18,000 - 00:06:23,000 Yes. Sub-phase maybe within the process. Yes. S2

00:06:23,000 - 00:07:23,000 Problem number one is try to get information from the teams that might be getting against them in the future, or that might be generating work for them in the future. And most of them prefer-- they prefer not to say anything. I don't want to have a trouble in that. And the second thing and that's - for me, key - the way in which we phrase the risk. For example, one of the problem we might get is rephrasing the risk in the wrong way might lead to wrong interpretations from the organization [crosstalk]. For example, system testing might not be

completed on time, for example. And the first thing you say, "Oh, we have a problem. This isn't testing organization." S1

00:07:23,000 - 00:08:08,000 Either resources are not there or they are not doing things properly and the thing was software testing might not be ready on time causing delay on system testing. That was the main problem. The problem wasn't the software testing organization. And rephrasing the risk in the other way, so rephrasing the risk going directly into the impact, might lead to wrong conclusions [in?] the organization and that was the problem. The system testing organization was saying, "Oh, rephrase the risk automatically" because that's giving the impression that we are not doing things properly, and that is not like that. So we are just facing delays of the software testing organization that are affecting us. S1

00:08:08,000 - 00:08:09,000 Okay. S2

00:08:09,000 - 00:08:25,000 So this phrasing of the risk is in a proper way, focusing on the route cause and not only on the impact, that [really?] key. Just in order to not get wrong [conclusions?]. S1

00:08:25,000 - 00:08:30,000 There are different techniques also to identify a route class like DC cover-- S2

00:08:30,000 - 00:08:31,000 [?]. S1

00:08:31,000 - 00:08:32,000 Yes, and a lot of different-- S2

00:08:32,000 - 00:08:37,000 Yeah. But that's important the way in which we rephrase the words. S1

00:08:37,000 - 00:08:38,000 Rephrase a word. S2

00:08:38,000 - 00:08:39,000 There is the word. S1

00:08:39,000 - 00:08:40,000 The wording. The wording is-- S2

00:08:40,000 - 00:08:41,000 The wording is key. S1

00:08:41,000 - 00:09:11,000 --is key. Yes. Okay. Good. Good. Okay, so identification, we have the assessment and we have the ownership and the ownership is both how to allocate, who's allocating, and then we have the risk-- I'm changing probably the term. I use risk treatment, but it's more about the risk appetite of the organization. S2

00:09:11,000 - 00:09:14,000 You're also calling that risk-response planning. S1

00:09:14,000 - 00:09:16,000 Risk-response planning, yes. S2

00:09:16,000 - 00:09:24,000 Which contains which kind of response plan, abort, mitigate, transfer, accept, and the concrete response plans. S1

00:09:24,000 - 00:10:07,000 Yeah, okay, we would say-- I don't know how clear I am with the terms, but risk treatment is here is about this appetite, is the risk attitude of the organization. Is the organization looking for training, ready to attack the risks? Maybe looking for opportunities and exploit those if possible? Okay, so these [studies?] that I mentioned that I looked, and then we developed a model. I mean, this is what we used to and I think I forwarded you an article that we wrote. S2

00:10:07,000 - 00:10:08,000 Yeah. S1

00:10:07,000 - 00:11:48,000 Yes, and it's based on this, and we used the risk raised from few projects that we've been working on. I mean, the [major?] IS project in the organization, these were the SAB roll-outs that we did in [Overnesto?] and the three sites in [?] in [Suntherland?], but also in [?] here that we did in [?]. But the model you can see-- I mean the risk identification, it can go from person-centric - that is very subjective - to exactly what you were saying, I mean, to something objective. How to identify the objective, and it's probably better. I mean, that's certainly what we're looking for. And then we have the other dimensions that we surveyed: the assessment, the ownership, and the treatment that we will see on the X-axis. And it can be either centric or distribute or [inaudible] who is-- what it means. But important is the centric term, so what I use is centricity for subjectivity, person-centric, or we will see now if I compare for example the assessment-- I mean I can either use one single methodology or if I use for identification I only use one technique, or maybe I

have somebody who has some knowledge or better knowledge and he knows different techniques and then I could use something more on the right. Maybe I use-- S2

00:11:48,000 - 00:11:52,000 I've mentioned that [you from the year?], this company-- S1

00:11:52,000 - 00:11:53,000 Yes. S2

00:11:53,000 - 00:12:03,000 --where three guys on the training were having an organization, it was taking care of mainly identification and assessment. S1

00:12:03,000 - 00:12:07,000 And they may be aware of different techniques, and not only with the techniques that PMI is presenting-- S2

00:12:07,000 - 00:12:08,000 That's right. S1

00:12:08,000 - 00:12:49,000 --but some of them they also not only not the best, but a few of them, they are really not good in terms of assessment, the metrics, [that?] metrics speed with nine-- it's demonstrated that is not really good because even the prioritization that it offers sometimes can be misleading and [inaudible]. This is what it shows is that probably we would be on the quadrant on the top right. We would be better. We would be identifying really objectively, and we would be using different-- in terms of assessment different methodologies. S2

00:12:49,000 - 00:12:52,000 That's all the more expensive. S1

00:12:52,000 - 00:12:53,000 [It is?]. S2

00:12:52,000 - 00:13:03,000 Do you need train organization or a central team leading this activity? Do you the spreading [of?] risk management knowledge throughout the organization? S1

00:13:03,000 - 00:14:02,000 Yes. Need to be balanced of course, because you don't want to spend more than the benefit that you can get out of it. Yeah. This would the model. And I think the question now for us is to think how can we get from the bottom left to the top right, ways to be using risk identification in the most objective

way. How can we improve our risk assessment techniques? How can we make it better? I think we just talked about [it?]. Either you have the subject matter expert. You go back to the project manager from the previous project and you ask him, "How do you think the likelihood of this to happen is?" And he will would say 20%, but if you ask him tomorrow maybe he says 50%. Not very scientific. S2

00:14:02,000 - 00:14:55,000 That's a subjective probability always relied on the moment you are asking that [chuckles], yeah. The ways of [objectifising?] the assessment, it might be-- as you have said, you might be looking on previous projects that are similar to yours. And try to find cases in which the risks are pure. That will be giving you at least real data from the problem on previous projects. But that start from the point that you are having a proper lessons-learned database. S1

00:14:55,000 - 00:14:56,000 You need a post-mortem. S2

00:14:55,000 - 00:16:25,000 That is recording everything you're having on previous project that is able of giving you a summary. "Okay, I'm looking for this kind of risk." Let's have a look if we have had a similar issue in previous projects. So that start from the point that you're having a proper lessons-learned database. No one would be asking you as a project manager. And he's in a risk for the project. He will not be asking ten different people. He has to look for answers. So either we have a proper lessons-learned database where everyone can look for that - I'm talking about technical items - or this probability assessment based on previous projects would never work. And here in Germany, probably, we have a more stable team. People that are working TRW for a long time. For example, in locations like [?], Poland, the people are continuously changing, leaving the company, the new ones are entering. So you lose this know-how, this experience know-how for kind of writing that. Either you have a proper lessons-learned database or in the current changing company [involved?] that we have right now, that would never work. S1

00:16:25,000 - 00:16:27,000 With a turnover in the [crosstalk]-- S2

00:16:27,000 - 00:16:33,000 That's right. That's for me key. A proper lessons-learned database so that you can compare between project and get all data. S1

00:16:33,000 - 00:16:39,000 Yes. Things you look is, have you identified the risk? Yes or not. Has the risk happened? S2

00:16:39,000 - 00:16:41,000 Happened. That's the key. Yeah. S1

00:16:41,000 - 00:16:47,000 That's the key. Has it happened? Which ones happened? Yes. S2

00:16:47,000 - 00:17:08,000 Not only that, you can be looking not only at the risk database in previous project, but also the issue [data in?] previous project. [So I'm?] detecting a risk. Let's have a look if it's-- not only if it has been detected in previous project, but mainly has it occurred in previous project. S1

00:17:08,000 - 00:17:15,000 Occurred. Okay, that's a good-- how would maintain this clarity from your experiences? Is okay? S2

00:17:15,000 - 00:18:25,000 This would be okay. This would be okay, yeah. The good thing [of?] clarity [is?] you have limitations. First one is, the risk management identification or description, risk description, also the issue of description, it is limited to one field, so you have to-- and the other two, you can categorize the description in respect to-- for example, they're talking about technical items. [inaudible] that's mechanical item. That's an electrical item. That's coming from this components, from [inaudible] component. You don't have this possibility in clarity. That's the negative point. Positive point is you can filter-- you have a thousand different filter possibilities so that you can work with that, or you might be able to work with that. But then anyhow, going back lesson learned process, lessons-learned database, and in TRW, we are not going to good at that. S1

00:18:25,000 - 00:18:40,000 Yes. Okay. One interesting thing you mentioned is it's probably nice to have or to adapt the methodology and bring new-- that's expensive. That's does something is expensive. S2

00:18:40,000 - 00:19:46,000 [inaudible] expensive. Did you know-- how to phrase that? Risk management is at the end of the day a [report process?]. Which might be part of the organization, but an organization can live without it. No question, for me, that's beneficial. That should be there, but an organization can live without it. That's

just a [report?] process. And at the end of the day if you don't have-- or even if you have a well-implemented risk management process in the organization, what is usually happening with the people are [saying?] that that's always priority, priority three. And that's making always complicated to-- mainly to have a well-implemented risk identification process in the organization. S1

00:19:46,000 - 00:21:16,000 The point of having a risk management team within the organization, as this company had - so, a team with four, five dedicated people that are leading this activity - would always help to keep this running. That is the first point. And secondly, if you have four or five people in a kind of risk management team - working with every team, trying to identify risk with any team, trying to identify systemic risk, and conducting the assessment for all of them - okay, it's still subjective, but the fact that these four, five people are getting knowledge from different teams - what have been happening, how often do they occur - that turns step-by-step into an objective rating. That is coming for four or five different people, but the fact of these people having a deeper knowledge what is happening or how often do that occur, that gives a kind of objective to that. And that for me, key. In the way I am seeing that, that is the only way in which this can be successfully implemented. S1

00:21:16,000 - 00:21:52,000 Okay, something that I'm interested in now, looking at the model is to say, where are we on what we would call an elementary risk management environment - that could be on the bottom left - or what would be an advanced risk management environment. From what you're saying is in an elementary risk management environment, I do not have dedicated people and you say that probably a good example of an advanced business environment would be you have with the experts. S2

00:21:52,000 - 00:21:55,000 That's right. Yeah. That's right. S1

00:21:55,000 - 00:22:02,000 And that people can be either practitioners, where really they work on projects, or people who only do that or it could be both maybe. S2

00:22:02,000 - 00:22:03,000 That's right. S1

00:22:03,000 - 00:22:10,000 So they are embedded in the organization, in the project management organization, or maybe they are just outside of it and coordinating. S2

00:22:10,000 - 00:22:50,000 It wouldn't be a central-- it does not need to be a central team. You might be having, for example, half-time risk manager in a [good?] project, for example, who is doing also some other stuff. And having risk management or key stakeholder for risk management in every project. In that way, you also might be getting first project benefits. For example, the risk manager responsible for every project are meeting every two weeks. He has to [intercheck?] information. That may be working-- S1

00:22:50,000 - 00:23:04,000 That's something that's probably not happening now at all, or not a lot-- maybe Lee has some visibility or maybe [Teloa?] has some visibility, because he makes the reviews one after the other.S2

00:23:04,000 - 00:23:12,000 That's right, but the single people working on the project are not getting enough visibility of what is happening in all these projects. S1

00:23:12,000 - 00:23:23,000 In the other projects. Let me [inaudible]. Okay. S2

00:23:23,000 - 00:23:42,000 And that's for me key. If an organization really wants to implement a proper risk management process, then you need to pay for that. Either you have people in the project who are in charge of that, or you build up a central team who was in charge of triggering the process. S1

00:23:42,000 - 00:24:19,000 Yes and eventually you also bring new ideas from outside with a consultant company. I mean you have a Richard? What's his name? [Prittor?]. Kyle [Prittor?]. I think he's the-- he was the first one writing in the PMI and the PMP. He was writing the chapter on risk management. I mean this were the names that [Joanne?] wrote for me. Javier, you were the first. And Kyle [Prittor?]. He's the only external. He's not from [inaudible]. S2

00:24:19,000 - 00:24:20,000 Okay. S1

00:24:20,000 - 00:24:39,000 He wrote on the [PM book?] the section on risk management. And apparently he did some training with organizations. But my question here is you talk about risk assessment and which techniques. We have ours but it's maybe good to get input also from-- S2

00:24:39,000 - 00:24:40,000 [Each other?]. Yeah. What we are doing-- S1

00:24:40,000 - 00:24:46,000 Now, what you need-- I mean, go to an external training and listen from-- S2

00:24:46,000 - 00:25:21,000 What we are doing [inaudible] right now is that we are using probability impact ratings, for the impact ratings we are having some criteria, some rules, but it's not based in money. It's more of-- that might be a safety-related topic, we rate it that high. Or that might be impacted SOP, we rate it that high. Or that might need huge reassessment of the business case, we rate it that high. So we have a table-- S1

00:25:21,000 - 00:25:23,000 Compliancy? S2

00:25:23,000 - 00:25:25,000 Yeah, compliancy to regulatory rules, we rate it that high. S1

00:25:25,000 - 00:25:28,000 Customer impact? S2

00:25:28,000 - 00:25:50,000 Yes, so that's the way we are doing that. In the training I was, that was kind of [inaudible]. Hardware were more or less 25% work [just?] in this qualitative ratings, and the 75% were using [SE] money rating. S1

00:25:50,000 - 00:25:52,000 Hard dollars. S2

00:25:52,000 - 00:26:12,000 Hard dollars, yeah. And again that's more expensive, so at least that takes more effort. You have to write that properly, but I think you can gain much more information if you work that way. S1

00:26:12,000 - 00:26:17,000 And when you say information, I mean, having that information you have less uncertainty. S2

00:26:17,000 - 00:26:18,000 That's right, [crosstalk] rating that properly. S1

00:26:18,000 - 00:26:26,000 I mean you have more certainty. You can look at the platform throughout the years and see the profitability of that. Because you're looking on high dollars. S2

00:26:26,000 - 00:26:35,000 Yeah. We're not doing that in that way. But that is for me the optimal solution. That work [they did?] with high dollars. S1

00:26:35,000 - 00:26:41,000 Understanding the profitability of the project through the years. After the SOP. S2

00:26:41,000 - 00:27:27,000 That's right. And the main metric that the people were using as a kind of, let's say-- they are not savings, but hard dollar savings before risk response plan implementation and after. Okay? So let's say we have a risk or an impact of $10,000 or $100,000 on a probability of 20% that is coming from previous projects, for example. After implemented the response plan. You can either reduce the probability or the impact. S1

00:27:27,000 - 00:27:30,000 We will mitigate it [inaudible] less. S2

00:27:30,000 - 00:27:59,000 Or mitigate. Either the impact or the probability. And what most companies were doing is simply multiplying probability, and impact in money before and doing that after, and the difference what they did in savings, to the savings that the risk management process is bringing you, and I think that's the best metric you can be having. S1

00:27:59,000 - 00:28:01,000 So you're working with the receiver risks? S2

00:28:01,000 - 00:28:02,000 Yeah, that's right. S1

00:28:02,000 - 00:28:20,000 So you make an estimation of what the receiver risk and then-- I think it will come later to that, because this is where it's-- putting in front of an organization how risk adverse or what risk taker you are. You take the risk or you may take the actions, reduce the risk and you move forward. S2

00:28:20,000 - 00:28:41,000 That's right, yeah. And that's for me key. Unless in-- and I'm not sure. Unless in [inaudible] part organizations, we are not working in that way.

But we are using, as I said, qualitative [crosstalk] estimation. That might be the best way to work with that. S1

00:28:41,000 - 00:29:18,000 Do you think having a-- personally I'm absolutely with you. I think the quantitative would be the best. You don't discuss things that match; there's no subjectivity behind-- do you think it's more feasible to adopt the quantitative for the engineering portion of the project? Or do you think, can you use also the quantitative on the program management on the next-- prior to the SOP? S2

00:29:18,000 - 00:30:15,000 Let's put it that way. In engineering, money is not the first priority. In the program management organization, that's even more important. We do have prioritizing, financial, sales on the [discussions?]. And that's even more important. For engineering, at the end of the day for example, the [FMEA?], there's a technical risk management. That is approaching the fact that your technical risk in the design is as less as possible. The main focus in engineering is always that. In the program management, I think this quantitative impact estimation, that's even more important. But that's always more difficult-- S1

00:30:15,000 - 00:30:16,000 More difficult. S2

00:30:15,000 - 00:31:21,000 --to implement. And you need also experienced people. So qualitative risk management, you have a table saying you-- that's impacted SOP, and that's impacting the customer's OP, that's impacting TRW's OP, that might be impacting maybe business case. So you might have a table with some criteria just to make this impact right in objective. That's not that complicated. So you can implement that-- okay, that needs some time to create this criteria. But you can implement that easier as a quantitative impact, impact rating, which always means involving more department, have experienced people who can judge that, and that's not always easy. To try to get the impact meaning of technical risk, for example. That's not always easier. S1

00:31:21,000 - 00:31:22,000 To bring it in high dollars again? S2

00:31:22,000 - 00:31:29,000 To bring in high dollar, that's always complicated. And that also relies on experience. S1

00:31:29,000 - 00:31:34,000 Experience and maybe the support working together with the profitability team from finance? S2

00:31:34,000 - 00:31:39,000 That's right. That's right. That means a cross-functional team working together. S1

00:31:39,000 - 00:31:40,000 Somebody from [?] team. S2

00:31:40,000 - 00:31:41,000 Yeah, that's right. S1

00:31:41,000 - 00:32:28,000 [inaudible] Okay. Good. Okay. We're thinking about how to move [in the maturity?] from the very beginners or something we would call elementary to advanced. I think you mentioned so your opinion is working with probabilities, with likelihood is a symptom of maturity. Removing from qualitative to assessment of probabilities. Understanding how to proper analyzing the risk at the source, so you look at the root cause. S2

00:32:28,000 - 00:32:58,000 That's key. That's key. And use that for risk wording. You have to avoid the unnecessary discussions that we've mentioned. And the probability is key. But that relies on a either a good lessons-learned database or an experience-based approach with experienced people that can give-- estimate your ratings. S1

00:32:58,000 - 00:33:11,000 What about as part of the [fiscal?] [?] now, what about the prioritization of the risk events, the items that you list under risk or risk [inaudible]? How do we--? S2

00:33:11,000 - 00:33:35,000 What we are doing is simply probability high, medium, low, one, two, three. So [we do it?] with three, two, one. Impact low, medium, high, two, four, eight. You multiply both and get the risk priority rating, and you concentrate on the high rated one. S1

00:33:35,000 - 00:33:38,000 [Yes, that?]. S2

00:33:38,000 - 00:34:32,000 That is the theoretical approach. You have always the-- that kind of subjective point there. For example you might have a 24 rated risk or high-rated risk that is pretty difficult to solve or to mitigate. You might have a 16 that you can solve in a second. Let's say how easy is to mitigate risk should be considered here, but that the first approach, the theoretical approach that's what we are doing. We are working with probability and impact rating, generate a risk priority rating. [It's?] simple: the higher the faster you need to approach [crosstalk] and try to set up a proper response line. S1

00:34:32,000 - 00:34:56,000 So it could easily happen in a project that you have only three-- let's say at the beginning, you identified three risks and you make it-- using the template that we have, you use likelihood multiplied impact and you get all three in red. I think 24 requires actions-- S2

00:34:56,000 - 00:34:58,000 Yeah, that's right. S1

00:34:58,000 - 00:35:10,000 Response. And you have all three with 24, but something you mentioned is-- you don't consider for-- to prioritize. I mean, all three have the same priority, but you don't consider how much effort is required. S2

00:35:10,000 - 00:35:11,000 That's right. And that's key. S1

00:35:10,000 - 00:35:20,000 That's key. And what about how strategic those risks are? It's something that is not considered-- S2

00:35:20,000 - 00:35:52,000 Strategic risk. Yeah, that's also important. That will be considered. Another thing we also must consider, and that's always there, is the political play. Which internal or external consequences can the risk be having? This political play that we always have. S1

00:35:52,000 - 00:36:07,000 If you have an example, give me, but would it be-- this is our first project with this customer? This is a Japanese customer and is key that we do the project well if we want to include our fit. S2

00:36:07,000 - 00:36:47,000 [Break out?]. For example, or we have been failing in the last three projects for this customer. That's our only chance if we don't want to

lose them, for example. On the other way, for example if you have carry over project for a previous one that is running pretty good, that is already on the streets, that is working pretty good, so you might have then a little bit more flexibilities. If we do make it, we always have this plan B that is on the street and that's working okay. S1

00:36:47,000 - 00:37:18,000 And this was good that you mentioned it. As part of the risk-assessment, it was the thing was I thinking of: having a very basic environment or elementary risk-management environment or moving to a more advanced. I think the elementary one you still don't think of the fall-back plan. In more sophisticated or when you are more mature. S2

00:37:18,000 - 00:37:47,000 That's also important. Perhaps not at the start, so you [don't?] have a risk management organization, so that will not be the first priority. The first thing we need to do is build up the organization so that risks are getting identified, so that we have clear criteria for assessing them, so that the people are using that. And, once that's really well implemented, that's a second step. Because this needs to be considered. I agree that that's key. S1

00:37:47,000 - 00:38:24,000 Okay. So this is the first of the figures. There are three figures in total. This is the second one. And here we are comparing, again. We have the risk identification, and this is now against ownership or allocation. Basically, [I'm in for?] the y-axis is here. Trying to make it as subjective as possible. And I think we mentioned here, trying to reverse-- we can use the lessons learned, and we can see if the risk happened or not. S2

00:38:24,000 - 00:39:32,000 That's a good example. The both ownership risk interdependencies might get lost. Having people just working on a project basis and no central organization and no central team having the whole overview. Let's do a project-specific thinking and the interdependencies between the different project, interaction between the different project, or the identification of systemic risks in the organization - might not be getting identified as [is found out?]. That's key. Coming back again to what this three guys presented in the training. So they were having a central team working on the identification assessment and closure of the risk.

And they were also in charge of setting ownership. And then the owner was in charge, as it should be, of developing the needed actions of closing that. S1

00:39:32,000 - 00:39:36,000 [crosstalk] [responsive?]. S2

00:39:36,000 - 00:40:13,000 This central team - although they were not the action owner, the one doing the real work let's say - they were getting a whole overview of what is happening in every project so that they were able to rule out [great?] systemic risks. Try to compare risk between the different project. Trying to check. Oh, we have identified this risk in a project that might be affecting you. And that only works if you have a central team [crosstalk]. S1

00:40:13,000 - 00:40:15,000 Central team. Yes. S2

00:40:15,000 - 00:40:32,000 Although the owners must be individual because this central team will not have enough knowledge to develop the actions. But they will be getting the general overview that might be helping for that. S1

00:40:32,000 - 00:41:53,000 Yes. This is an observation I had when working on the Nissan project the last three years. An example of project-centric is when the project manager is assigning the people who are responsible. And he has not all the knowledge, and sometimes if you have people who work in the project, they are not the project manager, but they understand what risk is. My observation was that the engineering team that obviously are maybe a bit more project focused than people from finance and people from processing and from other areas. They were able to raise the red flags, say, "This is the risk that we see and this is the person that--" that's what I mean we've evolved or collective. Also they identify the risk they make the proposal who the best owner and also what the best actions are. It's not [inaudible] the project manager because for the project manager, it's in complex, in big projects. It's too difficult for him. He doesn't know about tolerance or noise. Maybe you are--in engineering is the one who knows about noise. S2

00:41:53,000 - 00:41:54,000 No, that's right. S1

00:41:54,000 - 00:41:58,000 Or contamination or that sort of things. S2

00:41:58,000 - 00:42:25,000 Probably the best thing is to have a balance between both of them. He has to get the best thing of the two of them. You have one having a general overview, which is needed, but having the single people working on a project also leaving [crosstalk] management process. That might be the best way to have that kind of balance between both of them. S1

00:42:25,000 - 00:43:12,000 An aspect here with the ownership that... I hear different opinions from some of the program managers that I interviewed. But you might have completely different opinion. When we talk about ownership-- we have suppliers, and we have a customer. I don't think we work a lot with them on the risk with them. Probably not a lot. And another thing I hear sometimes that we are not as good transferring the risk to our suppliers as our customers are transferring it to us. S2

00:43:12,000 - 00:43:20,000 You mean we are not able to put pressure on our suppliers in the same way our customers are doing with us? S1

00:43:20,000 - 00:43:21,000 Sometimes. S2

00:43:21,000 - 00:43:22,000 Yeah, that's right. S1

00:43:22,000 - 00:43:27,000 Maybe it has to do with the contract, or... S2

00:43:27,000 - 00:43:34,000 That's difficult to judge, but it is like that. It is like that for sure. S1

00:43:34,000 - 00:43:43,000 And that's part of the understatement. I mean, the risk you can accept it, but you can also sell. You can pay for it. You can give it to-- S2

00:43:43,000 - 00:43:44,000 Transfer to the supplier. S1

00:43:44,000 - 00:43:47,000 Transfer, yes, to the supplier. [inaudible]. S2

00:43:47,000 - 00:43:57,000 Yeah, that's right. So the ownership topic is not an easy one. I think if you interview different people, they will be giving you different opinions. S1

00:43:57,000 - 00:45:09,000 Yes, I mean one take from senior management here was you never win anything bringing a customer. You never go with your customer to trial. You never take a supplier to trial. Because you break his liquidity or-- typically it's something you avoid. Okay, so this is the [second?]-- and now it's the last one. I'm thinking of changing the term. I mean we have again the [basic?] identification, and then risk treatment, propensity, and you can see risk covers centric. That would be something like organizations that don't use risk. They don't like to talk about raise as something negative. The appetite is [crosstalk]. S2

00:45:09,000 - 00:45:37,000 For me that's a no-brainer. No discussion needed what is the best here. Not talking about the risk, that's not bringing you anything. They will be occurring anyway, and you are not aware of that and you cannot react against that. So from that point of view, that is for me a no-brainer. S1

00:45:37,000 - 00:46:06,000 Yes, the question is, what makes the difference between-- in terms of appetite, what makes the difference between a conversation that is very basic, that is only very elementary risk-management environment or another one that is more advanced. There's standard training for the entire team, not only for the project managers, maybe. S2

00:46:06,000 - 00:47:14,000 Well, good question. First point I come back again: central team working that or experts leading the activity in the project. That would be key. Second one, and that might be related to the first one, is going to that extra training, not only to the project managers but to everyone who might play a role in the risk management process. Third one, clear process description, clear guidelines, as objective as possible so that people can work against that. That's for me in this order the key three players would lead to a better implemented risk management process in the organization. And at the end of the day, the money you spend on implementing a proper risk-management process, you will be getting it back. S1

00:47:14,000 - 00:47:55,000 Because the money you might spend working on issues once they occur will definitely be higher as the money you will spend on implementing a proper risk-management process. So that's bringing you savings that you are not seeing, but that you only see once you don't have it. Then you will

overspend money on an issue-management process - what we are usually doing. The only problem is that you are not seeing that. So the money that risk-management might be saving you, you are not seeing that. S1

00:47:55,000 - 00:48:05,000 In your current projects, do you think you have examples? You don't need to tell which they are. But do you think you have examples you are dealing with issues that you-- S2

00:48:05,000 - 00:48:06,000 For sure. S1

00:48:06,000 - 00:48:07,000 --would have. S2

00:48:07,000 - 00:48:47,000 Yeah, so starting for the point that our risk management process or implementation of it is only halfway through. We are not [advising?] that for sure, but for sure, that's a key problem now. I think we are pretty good on that, taking the [?] without a proper risk management process, with later into the fact, overspending money for things that you have not been able of [prognose?] before the implementation. S1

00:48:47,000 - 00:49:12,000 Do you think is-- are we good at identifying the risks through the faces or do we identify the risk at the beginning and then we leave and we just monitor those risks. Do we identify new risks as we move in the new phases? S2

00:49:12,000 - 00:49:23,000 We're getting better. What we do pretty good is a-- that's technical related [FMEA?]. S1

00:49:23,000 - 00:49:24,000 Yes, yes, that's good. S2

00:49:24,000 - 00:50:15,000 That's very well implemented in [clear?] value. That's focusing on the technical aspect of it, yeah? And that's working pretty good since years. In respect to time and cost risk, so we're getting better in tracking that into tools so that we have [?] on that. Like I said, we are only half through. So we are still on the way of-- steering is working pretty okay, but we still are halfway through the appropriate implementation of risk management. What we did is we're trying to set

minimum frequency rules, so how often do we need to identify risk. He has to set up minimum rules: how often does the team need to get together-- S1

00:50:15,000 - 00:50:16,000 Is he doing that? S2

00:50:16,000 - 00:50:29,000 --to identify new risk, so that's not only a one-point activity, one-time activity, but that is being run throughout the course of the project. But we are only half through that. S1

00:50:29,000 - 00:50:43,000 So that's one of the [nearer?] actions you think we are moving from. Let's say if you put three levels from level two to level three is improving the cadence, how often [crosstalk]. S2

00:50:43,000 - 00:51:08,000 That's right. The cadence, the training of the team, the knowledge, and risk management, and getting the whole organization aware of how important this is. That's also halfway through. And that's key. I think we are step-by-step moving from a being a [?] management orientated organization to a risk management oriented organization. But that takes time. S1

00:51:08,000 - 00:51:30,000 How is it, in your opinion, is the risk management? Is it top down right now? It's enforced by the top management or you think it's in the middle management or the practitioners who say, "I think we need more of the risk management"? S2

00:51:30,000 - 00:51:31,000 As a general approach it's top down. S1

00:51:31,000 - 00:51:32,000 It's top down. S2

00:51:32,000 - 00:52:03,000 In respect to [FMEA?], the case is different. So we are leaving [FMEA?], yeah? But that's part of the whole organization from the smallest engineering to top management. In respect to organizational risk management, that's right now a more top-down approach still than being a leading process throughout the whole organization. S1

00:52:03,000 - 00:52:10,000 Okay. And you think it's too hard? Is it really that management really behind it? They are willing to-- S2

00:52:10,000 - 00:52:11,000 At least some of them, yeah. S1

00:52:11,000 - 00:52:12,000 At least some of them. S2

00:52:12,000 - 00:52:16,000 Yeah. S1

00:52:16,000 - 00:52:47,000 I think we are all set. I mean, unless-- is there anything from what I presented if you think of the organization that needs to move from an average organization to a best-in-class organization in terms of risk management. We talked about identification. We talked about assessment. We talked about ownership and risk appetite or attitude of the organization against risk. Is there anything else you--? S2

00:52:47,000 - 00:52:53,000 The only thing that we are trying to implement that is measure of performance for the risk management process. S1

00:52:53,000 - 00:52:56,000 Yes, measures of perform-- you use it everywhere. S2

00:52:56,000 - 00:53:51,000 On a project-level approach and on an organization-level approach. That means it has to be enabled of tracking the progress, see how it goes, see if that goes in the perfect direction. And if not if we need to put additional resources there and so on. That's what we are trying to implement. The [national?] vision of the process I sent you. So that we can track the progress and how the risk management processes is going. If we are identifying risk only at the beginning but also throughout the course of the project, if we are closing or resolving risk in a proper path, or if we are too slow on that, if we are updating the risk regularly, especially the dates, so that you can allow planning for that. So that's the approach we are following. S1

00:53:51,000 - 00:53:53,000 Yes, you call it measure-- S2

00:53:53,000 - 00:53:55,000 Measure performance in ops. S1

00:53:55,000 - 00:54:02,000 Measure of performance in ops. Yes. And this is something you will be using not only in the engineering, but also in the program, with the people working with you on [inaudible]. S2

00:54:02,000 - 00:54:15,000 Yeah, that's right. Because it might be generated from a clarity project point of view, and in clarity you have program and [engineering?] report. S1

00:54:15,000 - 00:54:19,000 It's completely new. It's a new term. It's a new concept, this measure of performance. S2

00:54:19,000 - 00:54:22,000 It's not a new concept. For the risk management process, it's a new one. S1

00:54:22,000 - 00:54:24,000 For the risk management process it's new, yes. S2

00:54:24,000 - 00:54:28,000 That's right. That's right. S1

00:54:28,000 - 00:54:43,000 Good. Okay. So we can... [foreign]. S2

00:54:43,000 - 00:54:44,270 [foreign]. S1

Appendix III Development of research and example of interview extracts categorisation

Example of first interview extracts categorisation. The table below shows statements or terms assigned to one of the four project dimensions analysed. In this first categorisation the excerpts are assigned to one of the two extremes, elementary or advanced.

Elementary PRM	Advanced PRM
Risk Identification	
	Usage of lessons learned
	Accessible lessons learned
	Meaningful past-risk registers contain occurred / not occurred events / actions taken
Ambiguous risk description	Clear instructions to identify risks
	Established risk register
	Executive Management / Steering Committee members understanding/challenging risk identification process
Static approach to identification – events evolve through time	Clear procedure / cadence to update risk events
	Early involvement also stakeholder not involved yet but in future project phases (opposite interests/views sales or engineering vs. Launch teams)
Risk Assessment	
	Formal risk register maintenance
	Executive Management / Steering Committee members understanding/challenging risk assessment process
Static approach to assessment – action plan may need to be adapted	Clear procedure / cadence to assess risk events
	Formal training
Risk Ownership	
	Executive Management / Steering Committee members understanding/challenging risk allocation process
Static approach to ownership – allocation/responsibility may change with dynamic response plan	Clear procedure / cadence to update risk ownership
	constant communication with customer / vendors

Appendix **III Development of research and example of interview extracts categorisation**

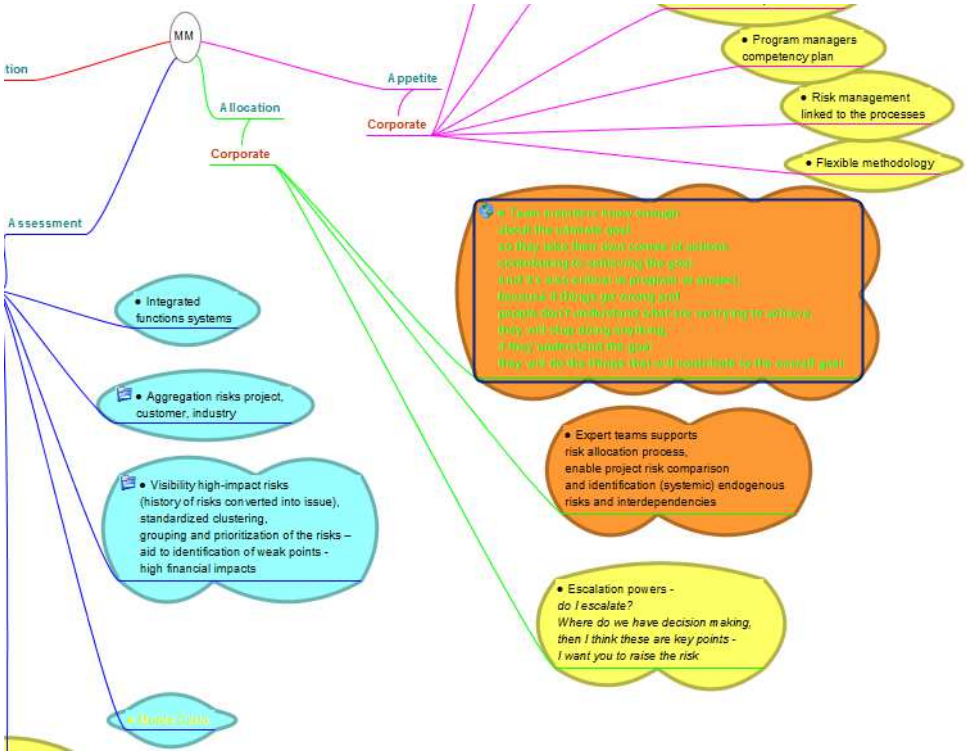
	Adaption to project complexity
Risk Appetite	
	Risk culture goes beyond projects – entire organization
	Organisations priority (Top down approach)
	Top management direction
	Formal, specific, continuous and adaptive training as opposite to standard training
	Flexibility to prescribed methodology when required – away from formalism

Example of the second level of interview extracts categorisation. After having extended the two initial categories to four, rudimentary, intermediate, standardised and corporate, the table below shows how the interview excerpts are placed as cells on an initial structure.

Maturity Level /Risk Dimensions	Rudimentary	Intermediate	Standardised	Corporate
Risk Identification	Process characterised by Subjectivity (which is an issue)	Ability to specifically describe risk root cause (vs. impact description)	Meaningful past-risk registers contain occurred / not occurred events / actions taken	Whole focus around meeting good people and having them there, having them available, has the largest success factor on the project. Now, you can identify it
	Team members' reluctance to contribute to risk identification – perceived as additional work / burden (to come)	Follow existing documented process - inputs coming through from the program team	Executive Management / Steering Committee members understanding/challenging risk identification process	
		Integration w/all stakeholders, purchasing and suppliers in particular when the supplier is new	Understanding opposite views - engineering vs. purchasing or quality – need to objectivise, develop holistic view	
	Documented process description available	This was foreseeable - mentioned to the group, everybody has it. And the business part-- and maybe that's a dimension of this. Who takes it on, who addresses it, who tries to resolve it, and it's	Visibility and influence on any new sourcing, change on' make-or-buy' decision impacting program	This is the effort required to solve that risk." . The risk is a potential scope change. 60% likelihood. What I would like is to say, engineering got a vote, sales got a vote, you got a vote, purchasing got a

Appendix **III Development of research and example of interview extracts categorisation**

Example of the mind map used to cluster elements within the elements of enquiry. The colours represent the four types: people (green), organisation (orange), process (yellow) and systems (blue):



Appendix IV Development of research and example of comparison between initial model label stage and survey responses

As part of the maturity model validation, the results of the online survey circulated to six participants were analysed. The table below shows part of the survey responses to the labels stage assignment. The average value of the responses is compared to the label assignment in the initial model. Divergences higher than 0.7 (or 70%) suggested to move the label stage.

	Identification	Identification	Identification	Identification	Identification	Identification	Identification	Identification	Identification	Identification	Identification	Identification	Identification	Identific
Timestamp	End users no involvement with risk identification process	People make full use of their freedom to act	Lack of knowledge regarding what risk or uncertainty mean	End users have an active role in the identification process	Negative perception of risk	Fear of raising risk concerns	Lack of integration of all stakeholder views	Recognises risk management but not ready to invest resources	New risks identified as they occur	No visibility of risk identification tasks/activities in project plan	Some remaining subjectivity (cultural differences)	Visibility of implications of risks associated with all relevant suppliers	Formal communication regarding risk interrelations between projects	Top dow approach related t project purpose strategy
01.02.2017 15:47	1	1	2	4	1	1	2	4	3	2	2	3	3	
07.02.2017 17:45	2	2	2	3	2	2	2	3	3	1	2	2	3	
13.02.2017 22:09	1	3	1	4	1	2	2	2	2	1	2	3	4	
20.02.2017 10:51	1	2	1	4	1	2	1	4	2	1	2	1	2	
24.02.2017 17:56	1	2	1	4	1	1	2	2	2	2	3	4	4	
09.03.2017 09:14	1	2	2	3	1	2	3	4	1	1	2	3	4	
	1,2	2,0	1,5	3,7	1,2	1,7	2,0	3,2	2,2	1,3	2,2	2,7	3,3	
	1	4	2	3	1	1	2	2	1	2	3	3	4	
Initial model	17%	-200%	-50%	67%	17%	67%	0%	117%	117%	-67%	-83%	-33%	-67%	

Declaration of original content

I declare that the work in this doctoral thesis was carried out in accordance with the regulations of the University of Gloucestershire and is original except where indicated by specific reference in the text. No part of this doctoral thesis has been submitted as part of any other academic award.

Any views expressed in this doctoral thesis are those of the author and in no way represent those of the University.

Signed:

Date: 12/03/2019