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**UNDERSTANDING THE RISK IN SOUTH AFRICAN
CONSTRUCTION PROJECTS –
A CASE OF THE WESTERN CAPE**

by

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RWLEST001

A minor dissertation presented to the Department of Construction Economics and
Management in partial fulfilment of the requirements for the degree MSc in
Project Management

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Dedication

Dearly beloved, this one is for all of you.



Acknowledgments

I thank the Lord God Almighty who made this opportunity imaginable.

A heartfelt thank you goes to Dr. Nien-Tsu Tuan, my supervisor, for his patience, tremendous support and positivity during my thesis research. I really appreciate all the early mornings and weekends that you have sacrificed to meet with me for a discussion and all your implausible generosity and confidence in patiently guiding me through, I cannot thank you enough.

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Abstract

Purpose – The purpose of this dissertation is to understand the risk in South African construction projects that affect the achievement of objectives, with respect to time, cost and quality.

Design/methodology/approach – A comprehensive review of Risk management and construction risks in South Africa and abroad was conducted. This was followed by a review of construction risks in the Western Cape from a contractor’s perspective, using the Repertory Grid Analysis Technique (RGT) methodology. The results of the RGT were then analysed against the preceding literature to draw inferences and conclusions.

Findings – This study has provided insight to the risks that hinder the realisation of project objectives in the Western Cape, through the Triad and Elicitation process of the Repertory Grid Technique. The identified risks were categorized in groups based on their similarity and the groups ranked in order of frequency and importance as follows: labour, material, selected subcontractor, programme and scheduling and client.

Originality/Value – The research represents one of the few attempts to understand construction risks utilising the RGT, thus forming a valued contribution to the project management database.

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Chapter 1: Introduction

The construction industry is an essential contributor to employment and growth in South Africa but it suffers from poor performance and poor execution of contracts. These shortfalls are exacerbated by the skills shortage in an already competitive market. With the increased pressure on corporations to deliver successful projects within limited resources, there is a call for the implementation and monitoring of project management procedures and policies over the life cycle of projects and the assignment of accountability in mitigating the risks that hinder successful project execution (PWC,2013).

PWC (2013) strongly emphasises that the implementation of project management processes is imperative in the management of construction risk to prevent poor execution of contracts. Which often result in margin erosion, losses and an increase in the risk of poor quality control on site, which leads to rework, enlarged costs and delayed delivery of contracts.

Managing risk or otherwise referred to as the management of uncertainty in construction projects. Implies searching for and exploiting numerous opportunities to enhance project performance and project delivery (Rafindadi *et al.*, 2014).

The research in this dissertation touches on the founding principles of risk management and its contribution to project success but focuses on understanding the risks in the South African construction industry that inhibit successful project delivery.

This dissertation is organised into six chapters as follows:

Chapter One: Provides a brief overview of the shortfalls that plague construction projects and touches on the role that risk management plays in contributing to project success.

Chapter Two: The background to the study is elaborated upon and the problem statement is defined. The research question, objectives and limitations are introduced.

Chapter Three: An extensive literature review is covered in this chapter, where the definition of risk is discussed and defined. Risk management and risk identification tools are reviewed in detail, with an analysis on the global perspective of construction project risks.

Chapter Four: Discusses the research strategy utilised in this study and provides insight into why specific methodologies were chosen and how they were best suited to answer the research question.

Chapter Five: Contains a summary of the data collected and an analysis of the results obtained.

Chapter Six: Concludes the research based on the empirical data and provides recommendations for further research.



Chapter 2: Background to Research

2.1 Overview of Construction Risk

Today's society requires that all projects should be successful and has become less tolerant of failure (Bowen *et al.*, 2012). Pressure is exerted on project managers to minimize the likelihood of project failure. This increasing need for successful project delivery, suggests that it is paramount for everyone involved in a project to be concerned with the associated risks and how they can be effectively managed, to increase the probability of project success.

Zhi (1995) posits that every construction activity attracts risk, therefore an effective risk management method is essential in understanding what kind of risks are being faced and how to manage these risks at the different stages of the project life cycle. Dainty *et al.* (2002) further emphasise the need for risk to be considered as a critical factor, since it affects the cost benefit analysis, demand, production costs, execution time and financial variables during project execution.

Sanchez *et al.* (2008) suggests that if risks are not identified, success cannot be achieved because the magnitude of uncertainty will be far too great for the team to have any chance of meeting the project objectives. However, if risk can be documented, allocated and costed, there is a greater probability of project success.

2.2 Construction Project Risk in South Africa

As global construction projects increase in scope, complexity and technology. There are an increasing number of risks that threaten the existence of many corporations and impend the stability of countries that approach these projects unprepared (Miller and Lessard, 2000). The recent international boom in the construction industry has required that certain steps be taken to ensure projects are successfully delivered, to meet the projects objectives with respect to time, quality, and cost.

Project risk management is one such step towards this attainment. It is a fundamental process that is required and more needs to be done towards understanding its advantage in identifying and managing the risks that impact on a project's ability to meet its objectives (Thompson and Perry, 1992). Chihuri and Pretorius (2011) concur with Thompson and Perry (1992) adding that project performance could be improved considerably through the use of risk management, because 70% to 90% of the problems encountered on projects are foreseeable and avoidable.

Serpella *et al.* (2014) argue that without an effective project risk management function to combat the risks and uncertainty that any project presents, there will always be continued delays, high costs and contractual disputes. It is thus paramount that project risk management becomes an integrative process which can be implemented in a systematic manner throughout the lifecycle of a construction project leading to project success (Banaitiene and Banaitis, 2012).

Serpella *et al.* (2014) emphasise that the way in which project teams' account for risk needs to be addressed. Many projects handle risk through the application of contingencies or floats that are not based on a thorough analysis of the risks that can affect a project. Consequently, it is insufficient to cover the magnitude of risks that do occur during project realization, resulting in projects with high cost and schedule overruns (Kishkak and Ukaga, 2008).

This perception is tantamount to a survey done by Makombo (2011), wherein only 16% of professionals and firms surveyed in South Africa could demonstrate the implementation of risk management in their projects. While, 42% said they had no planned risk management activities during their project lifecycle because they handled risk issues at the end of their project. According to Makombo (2011) the absence of risk management is evident of the fact that professionals handle risks as they appear, it can thus be assumed that professionals have a reactive as opposed to a proactive management stance on risk (Visser and Joubert 2008).



Makombo (2011) argues that risk management is perceived to be a waste of time by many professionals. Only 16% of respondents have a systematic approach to risk management, 46% do not have any risk management activities and 38% have some risk management system in its initial stages. He further argues that some professionals handling projects have no formal risk or project management training and experience at all. This eventually has a negative impact on the project, as some risks are because of poor knowledge and poor skills in project and risk management.

Chihuri and Pretorius (2011) maintain that the lack of risk management implementation in corporations is not a blanket notion that can be applied unanimously, as some organizations embrace the principles of project risk management. However, the failure lies in the inability to apply the principles throughout the project life cycle. Seemingly, there is a lack of appreciation as to the benefits of a structured project risk management methodology; as many respondents are not clear as to how risk management could contribute to the overall success of projects in South Africa. This lack of understanding, is evident from current empirical data that reflects the inability of 65% of mega projects in meeting their project objectives.

A few South African projects that are reflective of this data are the Transnet multipurpose product pipeline, the Medupi Power Station and the Gautrain project (Chihuri and Pretorius, 2011). The Transnet new multipurpose product pipeline (NMPP) originally budgeted at R12.7 billion had a final cost of R23.4 billion and was three years behind schedule. In the case of the Medupi Power Station there were huge cost escalations linked to project scope definition and specifications. Resulting in a project that ended up being R56 billion rand more than the initial estimate (Donnelly, 2012). The Gautrain project was completed two years after schedule and had a cost overrun of R14 billion. According to a report published by the PICC (2012) all of these projects have succumbed to numerous unforeseen risks that have had a significant implication on cost over-runs and completion dates (PICC, 2012).



These failed projects highlight the need between the establishment of risk management policies, procedures and the usage, understanding and enforcement thereof. In order to allow for collaborative risk management on projects and to enable project participants to think creatively (Visser and Joubert, 2008).

According to Chihuri and Pretorius (2011) in cases where risk is an active part of the execution process, the rigor devoted to this area is negligible. Too often than not, problems are addressed reactively, causing schedules and budgets to be exceeded, resulting in schedule slippage, budget overruns and excessive staff overtime and burnout (Oracle, 2010).

PWC (2013) coincides with Oracle (2010) highlighting that risk management has become a vital component of effective management in the construction industry. Companies have realized the need to integrate risk and performance management and the need to evolve risk management to be more predictive, in order to anticipate and plan for negative potential events.

PWC (2013) emphasises that an effective risk management process is critical in ensuring that project managers monitor risks and assess when they need to put a mitigation plan in place. However modern project management theory makes provision for risk management but the existing method fails to identify many of the risks.

2.3 Problem Statement and Research Question

Many practitioners have not yet grasped the significance of risk management in successful project delivery (Smith *et al.*, 2006). They battle to comprehend that through risk management, projects become more transparent and numerous problems can be avoided from the outset. With proactive action that permeates all areas, functions and processes of the project, success can be realised (Schieg, 2010).

Zou *et al.* (2007) concur with Schieg (2010) adding that the construction industry is subjected to higher levels of risk when compared to other industries. Due to the unique nature construction activities - such as long periods, intricate processes, volatile environments, financial constraints and dynamic organizational structures. Consequently, the use of effective risk management techniques to manage the risks associated with these variable construction activities is important for the successful delivery of a project.

According to the PICC (2012) 65% of mega projects in South Africa have failed to meet their project objectives. Subsequently, it is vital that more research is conducted to address the correlation between effective risk management and project success, through the identification of risks and their adverse impact.

This leads to the research question:

What are the risks governing South African construction projects that affect the success of the project in meeting its objectives with respect to time, cost and quality?

The focus of this dissertation is to review the risks that are contributing to the problematic management of South African construction projects from the contractor's viewpoint. This will be achieved through a case study review of specific projects that organisations have been involved with and the problems that they have encountered that have affected project delivery.



2.4 Research Objective

This dissertation contributes to the theory of risk management in South Africa by investigating what are the prevalent risks that are inherent in South African construction projects and how are they managed, through the following objectives:

1. To investigate the tools commonly used to identify risks on projects.
2. To examine the risks that construction contractors in South Africa are exposed to.
3. To examine whether the construction risks proposed in existing literature are relevant to South African projects.

2.5 Expected Contribution

According to the Project Management Institute (PMI) (2008), project risk management is one of the nine critical parts of project management. It is described as a process that complements all the phases in the project life cycle, from project definition through to project closure. The concept of risk management is therefore central to all aspects of a project. This indicates that there is a strong association between risk management and project success. Potts (2008) describes risk management as the most challenging area within construction management, adding that its application is encouraged in all projects to avoid negative consequences.

The aim of this research is to further add to the knowledge base of project management in general and in the built environment, specifically focusing on South Africa.

2.6 Limitations of The Research

The scope of the thesis is overtly related to the project management discipline and construction projects. Public projects are out-of-scope for this study; rather the concentration is on private projects as they are highly influenced by external and internal sources. Consequently, my research is focussed on private projects within the construction sector.



Chapter 3: Literature Review

Construction projects are one-off endeavors with high levels of organizational and technological complexities that generate enormous risks (Zou *et al.*, 2007). Regardless of this, clients continue to have an increasing expectation for the project team to deliver high quality products and services on tighter time scales and at lower costs. This increases the pressure on the management of the risks that have a huge impact on the projects objectives (Flanagan and Norman, 1993).

According to Abd El-Karim *et al.* (2015) these objectives are the key success indicators of construction management systems. They include the completion of the project within cost, time, planned budget, duration and within the required quality, safety and environmental restrictions. The achievement of these project objectives is regarded as the successful completion of a construction project (Williams 1995).

Numerous projects within the construction industry fail to meet their projects objectives, Laryea *et al.* (2008) postulates that this failure is attributed to the industries poor reputation in risk analyzation as compared to other industries. Latham (1994) concurs with Laryea *et al.* (2008) adding that this failure is an indicator that no construction project is risk free. Risks must be managed, minimized, shared, transferred or accepted but not ignored. Latham (1994) further posits that because risk cannot be ignored, effective management of risk through early identification and assessment increases the probability of successful projects.

These steps are part and parcel of the Risk management process which builds to an understanding of what risks are being encountered and what should be done to warrant success (Zou *et al.*, 2007). It is therefore fundamental that risk management is emphasized in all construction projects, irrespective of their size or monetary value, to ensure the achievement of the project's objectives (Hwang *et al.*, 2013).

Contractors in developing countries often bear most of the construction risks, unfortunately, many of them are unfamiliar with these risk factors and do not have the experience and knowledge to manage them effectively (Tadayon *et al.*, 2012). Consequently, conflicts, poor quality of work, late completion, poor cost performance and business failures result. This highlights the need for contractors to have a clear perspective and understanding of risk. To grasp the fundamental uses of the risk management process, this begins with defining risk (Tadayon *et al.*, 2012).

3.1 Risk

Risk is the probability of a detrimental event occurring to the project (Baloi and Price, 2003). Risk is a combination of threat and vulnerability that occurs when two conditions interconnect, the impact of risk from threat and the frequency of occurrence of risk from vulnerability determines the level of exposure to risk (Birch and McEvoy, 1992). Jaafari (2001) defines risk as the probability of occurrence of loss or gain multiplied by its respective magnitude.

Risk can also be defined as a characteristic of a situation, action or event, in which numerous outcomes are possible. One that will occur is uncertain and at least one of the possibilities is undesirable (Yoe, 2000). PMBOK (2008) refers to risk in the future, as an uncertain event or condition that creates the possibility of negative or positive outcomes and if it occurs, affects at least one of the projects objectives.

Since risks are assessed by their potential effect on the objectives of the project (Baloi and Price, 2003). There is a direct relationship between effective risk management and project success. Consequently, as projects become more complex and competition progressively tougher, risk management becomes a critical tool for successful project management (Baloi and Price, 2003).



These definitions of risk do not cover every description available but they validate that there are three different perspectives of risk. They indicate that risk is negative, risk can be defined neutrally and risk is explicitly described to include both negative and positive outcomes (threats and opportunities).

For this dissertation, the traditional definition of risk is used with emphasis on risk having a negative effect on the project objectives, therefore risk is viewed as a threat.

3.2 Risk Management

Mobey and Parker (2002) postulate, to increase the probabilities of a successful project, one needs to understand risk and systematically and quantitatively assess it, by anticipating possible causes and effects and then choosing appropriate methods of dealing with it. Kishk and Ukaga (2008) concur with Mobey and Parker (2002) adding, to ensure potential risks are managed effectively, the risk process needs to be explicitly built into the decision-making process. Therefore, risk management becomes an important tool to assist in coping with substantial project risks (Kishk and Ukaga,2008).

Tinnirello (2000) propounds the views of Mobey and Parker (2002) and Kishk and Ukaga (2008) and stresses the importance of applying the principles of risk management before project construction to assist in early identification and mitigation of potential risks. According to Tinnirello (2000) this has a significant impact on project cost, quality, schedule and assures the successful completion of the project. Kishk and Ukaga (2008) add, the failure to identify risk at the onset may give rise to serious consequences.

These arguments describe risk management as a systematic way of analyzing the project for areas of risk and consciously determining how each should be treated. According to Othman and Harinarian (1996) the risk management process involves planning, coordinating and

directing risk and the risk financing activities. To protect the organization, its people, assets, and profits against physical and financial consequences (Othman and Harinarian, 1996).

Risk management is a methodical process (see Figure 3.1) which is composed of risk classification, risk identification, risk analysis and risk response (Flanagan and Norman, 1993), these processes are described in detail below.



Figure 3.1: Risk management process (Junior and Carvalho, 2013)

3.2.1 Risk identification

Junior and Carvalho (2013) emphasize the importance of risk identification as being the most influential process in terms of impact, in the achievement of the projects objectives. The risk identification stage takes place during the feasibility and design development phase, at a time whereby any changes made to major decisions have the least impact on the project (Othman

and Harinarian, 1996). Winch (2002) concurs and states that changes made during this stage cause the least disruption. However, it is fundamental that the right decisions are made based on accurate and complete information, which is often not readily available. Consequently, this process is usually reliant on past experience to help establish all possible risks (Winch, 2002).

3.2.2 Risk analysis

The two categories of methods to the analysis of risk identification are qualitative and quantitative. The qualitative approach is common as it is more convenient to describe risks than to quantify them (Winch, 2002). According to Winch (2002) qualitative methods are most applicable when risks can be placed somewhere on a descriptive scale in comparison to quantitative methods which are often used to determine the probability and impact of the risks identified and are based on numeric estimations (Winch, 2002).

Cooper *et al.* (2005) state that risk analysis is used to evaluate risks and ascertain the importance of each risk to the project, based on an assessment of the probability of occurrence and the possible consequence of its occurrence. It assesses both the effects of individual risks and the combined consequences of all risks on the project objectives. Raftery (1994) adds, risk analysis enables decision-makers to improve the quality of their judgments by providing more realistic information on which to base decisions. This is not speculative because the objective of the analysis process is not to avoid risk, but to recognize it, price it and sell it (Raftery, 1994).

3.2.3 Risk response and mitigation

Risk response and mitigation is the action that is required to reduce, eradicate or avoid the potential impact of risks on a project (Flanagan and Norman, 1993). The aim of this strategy is to initiate and implement the appropriate action to prevent risks from occurring, or at minimum, limit the potential damage they may cause to ensure that the overall project objectives of time, cost and quality are not jeopardized.



The general guiding principle of risk response is that the parties to the project should seek a collaborative and mutually beneficial distribution of risk (Raftery, 1994). Risks need to be allocated to the parties best placed to influence both the likelihood of the risk occurring and its potential impact should it occur. The methods used for risk response and mitigation are risk avoidance, risk transfer, risk reduction, risk retention or a combination of two or more (Tweeds, 1996).

3.2.3.1 Avoidance/prevention

According to Potts (2008) it is important to review the project's aim in relation to risk, if risk is classified as bringing negative consequences and has a significant impact on the project. The best solution is to avoid it by changing the scope of the project, or worst-case scenario cancelling it. Darnall and Preston (2010) add, if there are major changes, the application of known and well-developed strategies should take precedent, even if the new ones appear to be more cost efficient. This assists in many risks being avoided and the continuation of the project.

3.2.3.2 Reduction/mitigation

Risk reduction or mitigation is a method of minimizing potential risks by mitigating their likelihood (Thomas, 2009).

Mitigation strategies can, according to Cooper *et al.* (2005) include:

- Contingency planning
- Quality assurance
- Separation or relocation of activities and resources
- Contract terms and conditions
- Crisis management and disaster recovery plans

According to Thomas (2009) risks which should be reduced can also be shared with parties that have more resources and knowledge about the consequences. In this way, one project team can take advantage of another's resources and experience.

3.2.3.3 Transfer

According to the PMI (2008) risk can never be eliminated, it is only transferred to the party that is best able to manage it. Shifting of risks and the negative impact they bring becomes a viable option when dealing with risks that are outside the project manager's control (Darnall and Preston, 2010).

3.2.3.4 Retention

When a risk cannot be transferred, or avoided or when the available options are uneconomical, the best solution is to retain the risk. Retention enables the risk to be controlled, to minimize the impact of its occurrence (Potts, 2008).

3.2.3.5 Monitoring

This is a method of creating a risk register where all risks and their management can be allocated. This becomes a way to improve the project work, since it highlights all the advantages and disadvantages and helps in the facilitation of future projects (PMI, 2008).

Tools and techniques used to monitor and control risk may be (PMI, 2008):

- Risk reassessment
- Monitoring of the overall project status
- Status meetings
- Risk register updates

Tadayon *et al.* (2012) postulate that risk management is a logical and consistent framework used to discover and comprehend risks, through an assessment process of the risk and the



consequence of its uncertainty. The benefit of which, assists in the identification of the risk and the selection of the appropriate course of action to address these risk factors to maintain the desired project results (Tadayon *et al.* 2012).

The identification of these risks is not a science but an art according to Barkley (2004), he argues that risk identification does not require a sophisticated, mathematical exercise. Given a project description including project goals, work breakdown schedule and resource allocation, potential risks can be identified and categorized using various tools (Barkley, 2004), these tools are discussed in detail below.

3.3 Risk Identification Tools

Risk identification is a process that registers the characteristics of risks and determines which risks affect the project. It is an interactive process that sieves out new or unknown risks as the project progresses through its life cycle. Therefore, to improve project success and minimize disruptions, it is imperative to proactively investigate and evaluate any possible risks using risk identification tools (Thompson and Perry, 1992).

As previously mentioned by Winch (2002), risks can be assessed using either a qualitative or quantitative analysis. According to Banaitiene and Banaitis (2012) in the construction industry, qualitative methods of risk assessment are used most frequently ahead of quantitative methods. Further, qualitative risk analysis covers a range of techniques for assessing the impact and likelihood of the identified risks. These approaches range but are not limited to experience based judgment, checklists, specialist review and analysis techniques (Pawar, *et al.* 2010).

As every project has individual characteristics which make it unique, different tools and techniques are used for risk identification. The following techniques are commonly used to identify risks in construction projects:

3.3.1 Brainstorming

This is an idea generation group technique which is divided into two phases. The idea generation phase, in which participants generate as many ideas as possible and the idea selection phase, in which each participant supports his/her idea to convince others. In the second phase, the ideas are filtered and only those that are approved by the entire group remain. This technique is based on the rules of no criticism, plenty of free-wheeling and lots of idea generation (Morano *et al.*, 2006).

According to the PMI (2008) and Chapman (2001) brainstorming is the most common approach to risk identification and it is usually completed as a project team. The risks that are identified are posted and the risk characteristics are detailed. The identified risks are then further categorized and pass through qualitative and quantitative risk analyses (PMI, 2008).

Chapman (2001) adds that brainstorming is a process by which individuals openly air their views and discuss the identified risks. A rule of brainstorming is that no criticism is permitted during the generation of ideas, as previously mentioned by Morano *et al.* (2006). However according to Chapman (2001), it is not easy to create an atmosphere in which criticism is deferred. Unfortunately, ideas are often criticized with the consequence that many ideas are then lost. The criticism of ideas often deters the participant from contributing fully to the group and thus impairs the quality of the data obtained (Chapman, 2001).

3.3.2 Delphi technique

Delphi is a technique used to obtain an opinion consensus about future events from a group of experts. It is supported by structured knowledge, experience and creativity from an expert panel. This technique uses written responses instead of physical group meetings. It is a method that requires systematic gathering and critical comparison of judgments from anonymous participants, physically isolated about a specific subject. With the use of a set of questionnaires



carefully prepared, intermingled with summary information and feedbacks derived from previous responses (Morano *et al.*, 2006).

Chihuri and Pretorius (2011) further clarify that in this process, each expert is anonymously provided with the opinion of all the others and must make new predictions based on feedback; after which the new information is once again sent to all the experts and this process is repeated until answers start to converge. According to them, although this is an effective technique it can be time-consuming (Chihuri and Pretorius, 2011).

Unlike brainstorming, the participants are isolated and therefore not subject to power pressure or criticism of ideas. The only downside is that the lack of opportunity for verbal clarification or comment creates communication and interpretation difficulties amongst respondents. Respondents do not know to whom they are expressing their ideas and are therefore unsure of how to express their responses in a language which will be understood (Chihuri and Pretorius, 2011).

3.3.3 Influence diagram

An Influence diagram charts out a decision problem by identifying all the elements, variables, decisions and objectives of how each factor influences another. The technique provides information on the project risk variables which potentially have a serious impact on project cost and time estimates. The popularity of this analysis, compared with other formal techniques of project risk analysis and management is because this technique provides answers to a whole range of what if questions. It is also quite simple to use and has the ability to focus on a particular estimate (Akintoye and MacLeod, 1997).

3.3.4 Interview/ expert judgment

This is an unstructured, semi structured or structured interview individually or collectively conducted with a set of experienced project members, specialists or project stakeholders (Morano *et al.*, 2006). This process includes experts or personnel with sufficient experience in a project to assist in avoiding or solving similar problems repeatedly (Mahendra *et al.*, 2013).

According to Chihuri and Pretorius (2011) this is considered one of the main sources of risk identification and data gathering, through interviewing experienced project participants, stakeholders and experts.

3.3.5 Checklist

This consists of a list of items that are marked as yes or no and could be used by an individual project team member, a group or in an interview (Morano *et al.*, 2006). Chihuri and Pretorius (2011) add that a risk identification checklist can be developed based on historical information and knowledge accumulated from previous similar projects. They further state that it is impossible to build an exhaustive checklist, therefore care should be taken to explore items that do not appear on the list. According to them the checklist should be reviewed during project closure to improve its' use on future projects (Chihuri and Pretorius, 2011).

Akintoye and McLeod (1997) argue against the benefit of the checklist, stating that the approach of this process, although tedious and time consuming in its nature. Gives little confidence that all risks have been identified (Akintoye and MacLeod, 1997).

3.3.6 Nominal group technique

This technique is composed through a silent generation of written ideas which are presented using simple sentences in postcards or paper band. Discussions about each are recorded for clarification and evaluation (Morano *et al.*, 2006).



This technique overcomes the shortcomings of brainstorming which succumbs to the influence of a few individuals who dominate idea generation and discussion. In direct contrast to the problem-solving methods followed to resolve conflicts in the brainstorming process, the Nominal Group Technique (NGT) group confronts disagreements openly, more frequently and depersonalizes the problem. Since each participant's ideas are recorded on a chart during the round-robin phase of the NGT meeting, during the discussion phase, group participants attack items on the chart not individuals. Therefore rhetorical, ideological and emotional comments are more easily transformed into objective problem issues (Chapman, 2001).

3.3.7 Flowcharts

This technique is applied for a better comprehension of the risks and is a graphical tool that shows the steps of a process. Flow charts system or process flow charts show the relation between components and how the overall process works. These are useful for identifying risks between system components (Morano *et al.*, 2006).

3.3.8 Scenario building

This is characterized by the development of hypothetical scenarios that represent the processes to be developed through the logical construction of each event, as well as its interactions and results. The process involves identifying the risk trigger, planning a scenario with uncertainty variables, computing their impacts on the project. Identifying the risk factor and computing the impact caused by risk triggers on the project's objectives and combining the occurrence of possible events and the correlation among them through simulation techniques (Morano *et al.*, 2006).

Scenario building is again an approach where the risks will be identified from past experience. The difference between this approach and the others is the way the risks are recognized and treated. The project process is looked at from two extreme scenarios, which hopefully cover the full range of variation in project outcome, in this way the risk consequences are looked at in the whole scheme of the project (Bajaj *et al.*, 1996).



3.3.9 Pondering

This is a simple and basic approach involving the use of one single person to identify risks and may serve as a default option if other approaches are not feasible or suitable. During the practical application of this technique the individual considers or ponders the problem, generating a list of options (Morano *et al.*, 2006).

3.3.10 Root cause identification

It is a graphical process used in the investigation and categorization of the essential causes of project's risk divided in four phases: data collection, causal factor charting, root cause identification, recommendation generation and implementation (Morano *et al.*, 2006). According to Chihuri and Pretorius (2011) this is an inquiry into the essential cause of a project's risks that allows the grouping of risks by its cause, to enable effective risk responses if the root cause of the risk is addressed (Chihuri and Pretorius, 2011).

3.3.11 Cause-and-effect diagrams

These are also known as fishbone diagrams, they illustrate how various factors might be linked to potential problems or effects. The diagram is designed by listing the effect on the right side and the causes on the left side. There are categories for each effect, and the main causes must be grouped according to these categories (Morano *et al.*, 2006).

The effectiveness and use of construction risk identification tools are expanded further in the research done by Chihuri and Pretorius (2011) on a variety of project practitioners in the South African Engineering and Construction environment. The responses from the questionnaire indicated that 36% of the project managers use brainstorming to identify risks. It also emerged that 18% use risk checklists while 23% prefer interviews. Figure 3.2 illustrates the proportion of use of the various techniques for risk identification.

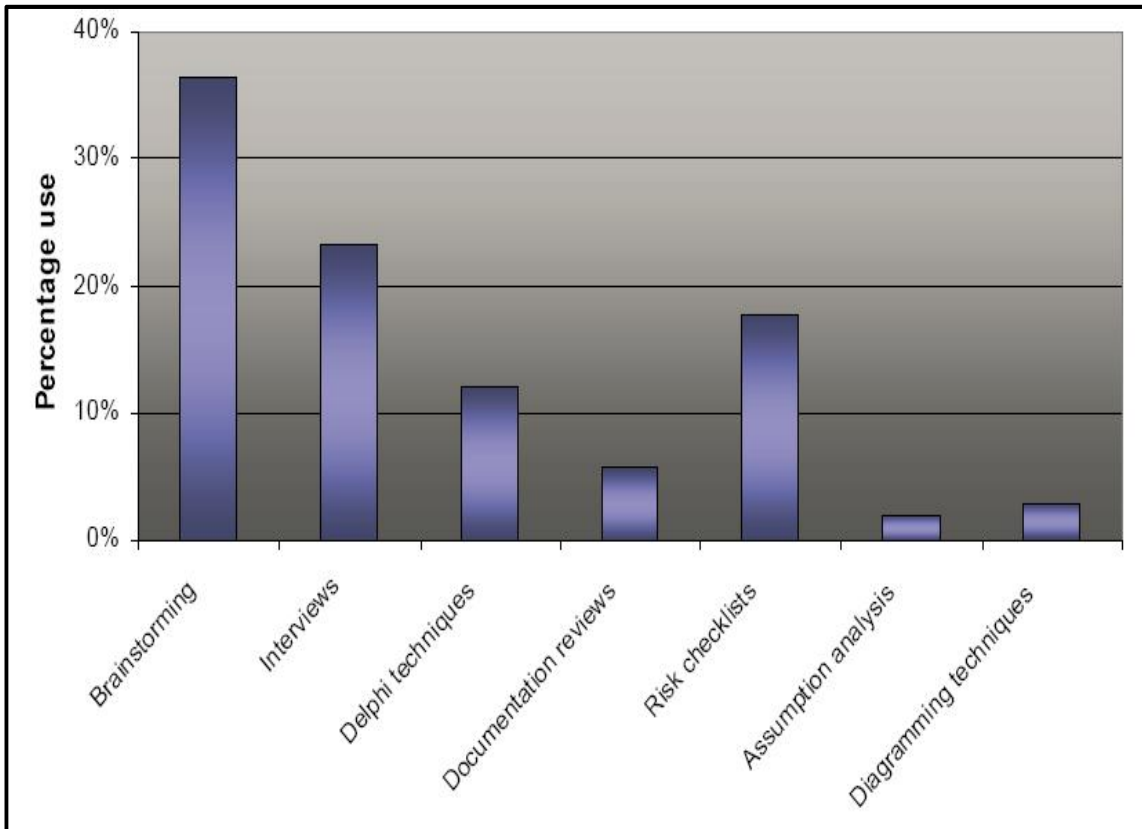


Figure 3.2: Risk identification technique (Chihuri and Pretorius, 2011)

As illustrated in the figure above, brainstorming is considered the preferred technique in the South African Engineering and Construction environment, eight respondents cited its simplicity and six cited reliability. It is most effective through the involvement of dialogue and stakeholder participation. The second preferred technique is interviews, followed by Risk checklist.

Akintoye and Mcleod (1997) posit that the use of risk analysis techniques in construction projects is generally low, with the exception of intuition, judgement, experience and the use of checklists. These checklists according to Akintoye and Mcleod (1997) are recorded as the highest familiarity with respondents. This is in line with Garrido *et al.* (2011) who concur with Akintoye and Mcleod (1997), expressing that Checklist are the most used, followed by the Flowchart method and Brainstorming. The least used tool is identified as the Delphi Technique (Garrido *et al.*,2011).

Raz and Michael (1999) are of the view that the use of risk identification tools is unchanged whether a risk management process is in place or not. They posit that many organizations believe in a structured process and are seemingly more likely to apply tools that assist them in the areas of risk analysis, tracking and control of risk. These tools according to Raz and Michael (1999) will help provide structure, discipline and an organized procedure which delivers quality processes and practices.

Irrespective of which tool is used, Bajaj *et al.* (1996) stress the importance of the identification of the critical risks that influence the projects objectives. According to them, failure to identify, analyze and respond to these critical risks could have a major impact on the project outcome as the contractor is unwarily exposed to risks.

3.4 Construction Project Risks

It is impossible to identify all the risks inherent in a project (Smith *et al.*,2006). The effort required to consider every risk is time consuming and counter-productive in its effect. It is therefore essential to identify only the critical risks and prioritize them for effective and efficient risk management. Goh and Abdul- Rahman (2013) concur with Smith *et al.* (2006) adding that consideration needs to be done to risks associated with a high occurrence and those which have a possible catastrophic impact on the projects objectives. These high frequency risks are known as construction risks (Goh and Abdul-Rahman, 2013).

The following studies provide a brief synopsis on the research that has been done on the identification of construction risks. These independent studies which were conducted in developed and developing countries around the world, are assimilated together to get a global perspective on the type of construction risks that different countries are exposed to.



China

Zou *et al.* (2007) conducted a study that identified the key risks that can significantly influence the delivery of construction projects in China and developed a plan to manage these risks. The research methodology comprised of a comprehensive literature review and a postal questionnaire to the Chinese construction industry practitioners. A statistical analysis of the survey data was conducted and a methodical examination of the identified risks resulted in the compilation of twenty-five risks. These were determined based on a comprehensive assessment of their likelihood of occurrence and magnitude of consequence on project objectives.

The risks that had a direct effect on the project goals with respect to time, cost and quality are indicated in the following table 3.1:

1	Tight project schedule
2	Project funding problems
3	Variations by the client
4	Design variations
5	Inadequate program scheduling
6	Inadequate site information
7	Incomplete or inaccurate cost estimate
8	Contractor's poor management ability
9	Contractors difficulty in reimbursement
10	Poor competency of labour
11	Unavailability of sufficient professionals and managers
12	Unavailability of a sufficient amount of skilled labour

Table 3.1: Project Risks - Asia related study (Zou et al., 2007)



The results of the study indicated the need for all project stakeholders to work cooperatively from the feasibility phase onwards to manage potential risks effectively and on time. Further contractors and subcontractors with robust construction management knowledge and skills be employed early to minimize construction risks and make sound preparation for carrying out safe, efficient and quality construction methods (Zou *et al.*, 2007).

Malaysia

Goh and Abdul-Rahman (2013) identified the major risks associated with the Malaysian construction industry and evaluated the practical measures that the various local construction industry players would take to respond to those risks. They used a mixed method of questionnaire and interviews to investigate the current trend of risk management implementation in the Malaysian construction industry.

Financial risk and time risk were found to be major risks in terms of occurrence, frequency and impact. The drivers of financial risk and time risk were further investigated in interviews and most local construction players believed that late payment and escalation in material costs were the main causes of financial risk. Meanwhile time risk was associated with uncertain weather (Goh and Abdul-Rahman, 2012).

Kuwait

Kartam and Kartam (2000) piloted a study that reports on a questionnaire survey of the largest Kuwait contractors and their perspective of construction risk and the effective actions taken for the management of such risks. The research results indicated that the application of formal risk analysis techniques in the Kuwait construction industry is limited. The survey results showed that contractors suffer from insufficient or incorrect design information which affects the timing and the quality of their project. They were also exposed to financial risks from late payments from the client which hindered the progress of their work and cash flow (Kartam and Kartam, 2000).

UAE

El- Sayegh (2007) did research that identified and assessed the significant risks in the UAE construction industry that affect the projects objectives. Data was collected through a questionnaire distributed to construction experts. The study revealed that economic risks such as inflation and sudden changes in prices, shortage in material and labor supply were significant risks that they were exposed to. Others include, unrealistic construction schedules and improper intervention and changes in design. The consensus was that contractors should negotiate the construction schedule with owners, if possible, or at least allow for time contingency and buffers in their schedule. Further, labor with vigorous construction and management skills should be employed early in the project lifecycle, together with the material, to minimize further construction risks (El- Sayegh, 2007).

Vietnam

Nguyen and Chileshe (2013) conducted a study that aimed to seek the perceptions of construction professionals on the critical factors causing the failure of construction projects in Vietnam. A triangulated data collection approach (mixed method) involving interviews and questionnaires was adopted for this study. The results showcased 20 factors sorted in ascending order according to their impact on causing the failure of construction projects. Disregard as to the significance of the project planning process and poor project planning were ranked first.

According to Nguyen and Chileshe (2013) the results proved that the biggest problem leading Vietnam construction projects to failure are issues associated with project management elements, hence the most pressing four risk factors were:

- Disregard as to the significance of the project planning process and poor project planning

- Lack of experience in executing complicated projects
- Poor design capacity and frequent design changes
- Lack of knowledge and ability in managing construction projects

Australia

Zou *et al.* (2009) ascertained the key risks having an influence on the delivery of construction projects in Australia. From this research 20 factors were highlighted as influencing the achievement of the project objectives. Ignoring the risk category, all risks were ranked in accordance with the index scores measuring their significance on the project cost, time, quality, environment and safety.

The study identified the following as being risks that affected all if not two of the project objectives:

- Tight project schedule
- Design variation
- Unsuitable construction programme planning
- Inaccurate cost estimate

According to Zou *et al.* (2009) many of these risks occurred in more than one phase of a construction project. Hence the need for addressing project risks earlier rather than later in the project lifecycle, to minimize the negative consequences brought about by the risks.

Nigeria

Ekung *et al.* (2015) conducted a study on Nigeria's east-west coastal highway project to determine the construction risk factors in coastal engineering projects and their allocation preference. The study focused on the pre-construction stages of the project based on the increasing emphasis to pay attention to front end issues as determinants of project success. A risk register containing 245 risks factors was presented to relevant stakeholders - design

consultants and project managers selected from consultant and contractor's organizations were asked to identify the risks which may influence project performance.

The results indicated an incompetent design team, corruption and fraud as the two risk factors that have the highest influence on the project's objectives. This is due to the inadequacy and unreliability of the consultants in the developing country (Ekung *et al.*, 2015). This is reflective of a country that has followed years of military rules which has created an environment of corruption, wealth amassment and embezzlement. According to Ekung *et al.*, (2015) symbolic of such an environment, is the high probability of project budgets and funds being diverted elsewhere due to weak institutional frameworks. Resulting in delayed payment to contractors, huge project delays and cost increases (Ekung *et al.*, 2015).

South Africa

In a study conducted by Baloyi and Bekker (2011) on the construction factors that affected the South African World Cup Stadia on meeting their project objectives. The most significant factor relating to cost was the increase in material cost. This cost of escalation remains concurrent to the research of Chihuri and Pretorius (2011), who argue that escalating costs are high risk factors on South African construction projects. According to them, this is attributed to an escalation in construction material costs over a period of months due to the instability of the rand causing prices of imported materials to increase. This escalation in cost is further affected by the downturn in the world economy and rising oil prices. The study further revealed that the highest ranked contributors to time delays on projects for the contractor are the shortage of skills, followed by poor planning and labor problems.

Interestingly Chihuri and Pretorius (2011) highlight power shortages as their second highest risk on South African Projects. according to them, this has evolved into a prominent factor whereby major projects are threatened by the Eskom national electricity crisis to the extent that some industry players have put contingency plans in place to ensure uninterrupted

progress on their projects. Some sites have negotiated non-disruptive load shedding at specific times, especially at night, when there was minimum activity on construction sites. Others have sourced alternative back-up power supplies to minimize disruptions to site work.

A fundamental component of the South African Risk Management skyline, lies in the standards implemented by the South African Bureau of Standards (SABS). They have set out to achieve consistency and reliability in risk management by creating a standard that would be applicable to all forms of risk. This national standard is the identical implementation of ISO 31000:2009 and has been adopted with the permission of the International Organization for Standardization (ISO). According to Lietch (2010) ISO applied the knowledge of experts nominated from 28 countries to guide the development of the standard.

These experts had the principal role of representing the views of their respective national and sector mirror committees and organizations. Consequently, these documents are not just the conclusions of a small committee, but represent the views and experience of hundreds of knowledgeable people involved in all aspects of risk management. According to Purdy (2010) the benefit of SANS 31000:2009 is that it calls for more thinking within many organizations. This ensures that the bar in risk management will always be raised to bring about significant and beneficial change.

Egypt

Abd El-Karim *et al.* (2015) conducted a survey questionnaire to collect project risk factors and their probability of occurrence in addition to its cost and schedule overruns from the construction industry in Egypt. Physical and telephonic interviews were conducted with senior managers of sixteen companies, which were in Egypt, or located outside Egypt but having internal projects. The surveyed results show that insufficient or incorrect Engineering and design information as well as Political unrest affects the timing and the cost of their projects (Abd El-Karim *et al.*, 2015)



Tanzania

Recent studies indicate that the Tanzanian construction industry is fraught with frequent cost overruns and delays on a lot of projects (Chileshe and Kikwasi, 2013). To improve the performance of the construction industry, some studies signify casual linkages between implementation of some of the risk management practices and project success.

Chileshe and Kikwasi (2014) conducted a study that aimed at assessing the causes and effects of delays and disruptions in Tanzanian construction projects. Findings of this study further reinforce the observation that despite the quest of the Tanzanian construction industry to remain competitive, low capacity and capability of the local contractors and consultants as a result of a weak resource base and inadequate experience are the risks that cause disruptions and delays (Chileshe and Kikwasi, 2014).

The studies have indicated that practitioners are able to identify the risks that have an effect on the projects objectives, but there is a lack of implementation as to the planning, coordination and directing of these risks and their risk financing activities. This postulates that they have failed to grasp the significance of Risk management in successful project delivery.

3.5 Conclusion

This chapter presents the concept that risk management and its processes need to be explicitly built into the decision-making procedure of construction projects to ensure that all potential risks are managed effectively. This enables risks to be systematically and quantitatively assessed and allows for the most appropriate methods in dealing with the possible causes and effects to be selected. The commencement of this processes at the earliest time possible, is imperative as it ensures enough room for any changes to be made early during project procurement to reduce the impact of late risk mitigation.

The different tools used in risk identification were discussed, highlighting the importance of these tools in registering the characteristics of risks and determining which risks affect the project. Bajaj *et al.* (1996) argued the importance of not only sieving out risks, but focusing on those that are critical in hindering the project in reaching its objectives. A wide spectrum of tools and techniques were deliberated, but brainstorming, interviews and checklists seemed to be the preferred approach over the other risk identification tools.

The global perspective of construction risks was reflected, bringing to light some of the different construction risks that different projects were exposed to throughout the world. Interestingly to note, the following risks were common to most projects across the globe:

- Constant design changes
- Unrealistic planning schedules
- Unskilled labour
- Incomplete or inaccurate costs
- Price increases or escalation

Over and above these, a few Risks that were unique to some countries were:

- Power shortages
- Corruption and Fraud
- Political Risk
- Uncertain weather

Chapter 4: Methodology

The purpose of this research is to understand the risk of South African construction projects in the Western Cape. The research problem has emerged from current issues that are prominent in the construction industry as discussed in Chapter Three.

The research question for this study is:

What are the risks governing South African construction projects that affect the success of the project in meeting its objectives with respect to time, cost and quality?

The research questions will be addressed through the following objectives:

1. An enquiry of the tools commonly used to identify risks on projects.
2. An examination of the risks that construction contractors in South Africa are exposed to.
3. An investigation as to the relevance of the construction risks proposed in existing literature to South African projects.

The research paradigm described, suggests the use of qualitative research to enable the investigation and interpretation of a small sample until data saturation is acquired (Welman *et al.*, 2005). Griffen (2004) posits, that this method allows the research design to be more flexible and avoids relying on the researchers pre-determined assumptions but focuses on the meaning of the participant's key issues (Griffin, 2004).

The flexibility of the qualitative method allows for greater spontaneity in the interaction between the researcher and the study participant. The use of open ended questions with this type of method ensures that questions are not worded in the same way with each participant

(Welman *et al.*, 2005). Griffen (2004) adds, participants are therefore free to respond in their own words and these responses tend to be more complex than simply 'yes' or 'no'.

Kothari (2004) concurs with Welman *et al.* (2005) and adds that the relationship between the researcher and the participant in a qualitative method is often less formal compared to quantitative research, as participants have the freedom to respond more elaborately with greater detail. Researchers in turn, tailor their questions to suit the information that the participant has provided (Kothari, 2004).

Qualitative research methodology helps to understand construction risks in their most comprehensive form. Risks can be explored and understood as objectively as possible by using the qualitative method of in-depth interviewing thus not contaminating the perceptions of the participant, with those of the researcher. This method enables the researcher to be the tool through which the required data is collected, to meet the desired objectives (Polkinghorne, 2008).

The limitations of the qualitative research include the expensive and time-consuming nature of the collection and analysis of research information and the reliance on a relatively small number of participants (Griffen, 2004).

4.1 Case Study

The case study method is a qualitative analysis that involves a careful and complete observation of a social unit. The study places more emphasis on the analysis of a limited number of events and their interrelations, according to Kothari (2004), the method represents a real record of personal experiences. Yin (2009) adds that case studies are particularly suited to situations where the researcher seeks to investigate a current phenomenon which is difficult to isolate due to the number of interested variables.

4.1.1 Multiple case study

Multiple case studies allow the researcher to analyze individual situations and several situations collectively to understand the similarities and differences transversely. Yin (2003) describes how multiple case studies can be used to either:

- Predict similar results
- Form a literal replication
- Predict contrasting results
- Predict reasons

The information collected from this type of study is considered robust and reliable, but it can also be extremely time consuming and expensive to conduct (Yin, 2003).

This research will follow the advice of Eisenhardt (1989) who postulated that there is no ideal number of cases, a number between four and ten usually works well. This is parallel with Perry (2001) who stated that there are no guides to the number of cases to be included, some researches advocate a minimum of two. Although the usual view is that the accepted range is between two and four.

Based on the above premise, this research will be constructed on an analysis of six cases.

4.2 The Research Sample Selection

Purposive sampling will be used for this research to provide a good representation of contractors, whilst ensuring that they have a heterogeneous background based on:

- Diverse Construction Industry Development Board (CIDB) grading
- Varied projects within the Construction Industry
- Close involvement in projects throughout the project life cycle

- A selection of projects that have been constructed within the Western Cape
- Over 10 years' experience in the Construction and Built Environment

Interviewees who will satisfy the criteria of the research design will be deliberately selected. Furthermore, because this will be a multiple case study research, of six organizations, the choice of cases will be based on conceptual grounds not representative grounds.

Two advantages of this style of purposive sampling is that it tends to mitigate any biases that often creep in when random sampling is adopted and it ensures that a more representative sample of interviews is selected for the research.

4.3 Data-gathering Technique

The data collecting method that will be adopted will be a semi structured interview method through the Repertory Grid Technique.

4.3.1 Interview method

The method of collecting information will be through personal interviews. According to Kothari (2004) this is usually carried out in a semi structured way, as it enables a flexible approach to questioning that does not conform to a system of pre-determined questions and standardized techniques of recording information. The interviewer has freedom to ask supplementary questions or even omit certain questions depending upon the situation. The only hindrance is that this sort of flexibility results in a lack of comparability of one interview with another and the analysis of unstructured responses becomes much more difficult and time-consuming (Kothari, 2004).

The merits of the interview method according to Kothari (2004) are:

- More information with much greater depth can be obtained
- Interviewer can overcome respondent resistance

- Greater flexibility to restructure questions
- Greater control over which person(s) will answer the questions – which is not possible in a mailed questionnaire approach

4.3.2 The Repertory grid

The Repertory grid is widely applied in the Information System (IS) research and has lately gained some attention in project management research (Baloi and Price, 2003); (Napier *et al.*, 2009) and Geraldi *et al.*, 2010). This technique is adequately used to articulate perceptions about complex issues so that the explanations go beyond verbiage and new insights emerge (Geraldi, 2010).

The technique has its origins in construct psychology, which is one of several major theories of psychology in the world today. It is derived from Kelly's (1955/1991) personal construct psychology theory, which focuses on ways in which people make anticipations, which Kelly called constructs.

These construct systems are highly individual in nature and may guide people's behavior, provided that they develop a reflective awareness of how negative constructs that impede their behavior can be changed. People observe, draw conclusions about patterns of cause and effect and behave according to those conclusions (Fransella *et al.*, 2004).

These constructs are the basis from which the person construes or understands the world. According to Fransella *et al.* (2004) people's construct systems are not static, but are challenged every moment they are conscious. The aim of the RGT is to understand peoples' perception by analyzing their individual construct systems in order to try and change their awareness if need be. This is done through the researcher endeavoring to understand the conception of the interviewees' world, as they see them, by constructing mental models using the words made during the repertory grid interview. This allows the researcher to perceive the nature of the reality, as the interviewees explains it (Fransella *et al.*, 2004).

For an adequate sample size, a total of six participants will be interviewed using the repertory grid technique. This method does not require the use of a large sample to reach its point of redundancy, according to studies undertaken by Botterill (1989); Botterill and Crompton (1987) and Pearce (1982) who confirm the acceptability of a sample size between one and ten. Therefore, a total of six interviews will generate adequate and dependable data.

The data collection process strictly adheres to the established guidelines of the RGT as a method of conducting semi-structured interviews. By complying with an established interviewing technique such as the RGT, the validity and the reliability of the data collected can be assumed to be representative of the quality of the RGT process that is reported.

4.3.3 Idiogrid software

The Idiogrid software will be used to capture and analyse the constructs that emerge from the RGT interview. The Idiogrid software is a Windows computer based program that is used for the management and analysis of the repertory grids. It is designed to manage large numbers of grids simultaneously and conduct analyses that are particular to repertory grid data. Although the software is designed to capture the findings of the interviews, it has the added benefit of providing a wide range of analyses on the data (Grice, 2002).

4.4 Data-gathering Process

The repertory grid technique which will be used in the data gathering process, is systematically organized to ensure that favorable conditions are created for the participant in the study. Interviews will be scheduled to be approximately one hour in duration and all administered in a comfortable location devoid of noise and distraction. Each interview will start off by establishing rapport – welcoming the participant and briefing them, followed by an introduction of the study and an overview of the repertory grid technique.

For this particular study, the RGT will be structured as follows:

The respondent will select a few elements (projects) from the various projects that he/she has been involved in. The exhaustion of the elements under different constructs will take place during the Triadic Elicitation process, whereby the participant will be asked to randomly select three index cards from the stack (the stack will be the stack of selected projects up for discussion that has been agreed on by the participant and the researcher beforehand). Constructs will be elicited by asking: Regarding the following two projects, how are two of these the same and yet different from the third, looking at their exposure to risk within the context of achieving the projects objectives with respect to time, cost and quality.

Participants will be encouraged to verbalize their thoughts while going through the decision process, in a process known as laddering. The researcher will probe how and why to further clarify meaning. Why (underlying meaning of the minds) and how (understanding of the perception). Because the risk that the projects are subjected to are broad and numerous, creating these context areas' narrows the contractors focus or perspective to such an extent that one can eliminate those risks elements that have a low impact on meeting the projects objectives during the analysis stage.

The participant will then place the three cards back in the stack, shuffles the deck of index cards and selects another three cards and the exercise is repeated. The participant will continue to select triads until they are not able to think of any new constructs. Figure 4.1 provides an overview of the steps taken during the data collection and analysis process.



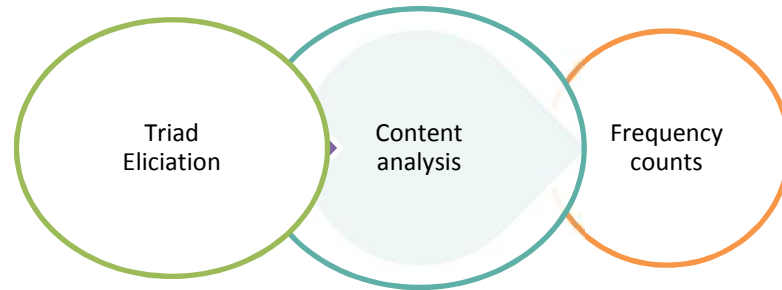


Figure 4.1: Data collection and analysis methodology.

4.4.1 Triad elicitation

This is a process used to elicit risk constructs (characteristics), through the comparison of the projects which the participant has been involved in.

4.4.2 Content analysis

Content analysis is a technique that allows one to create thematic categories from the constructs described in the interviews (Napier *et al.*, 2009). The goal of the analysis is the development of a reduced set of risk categories that represent the constructs elicited by the participants in our study, these categories are further verified for credibility using Cohen's Kappa.

Cohen's Kappa is a measure of the agreement between two raters who determine which category a finite number of subjects belong to, whereby agreement due to chance is factored out (Stemler, 2001). According to Fleiss and Cohen (1973) Cohens Kappa is a useful measure of inter-rate agreement which is scaled to vary from -1 to +1. So that a negative value indicates poorer than chance agreement, zero indicates exactly chance agreement and a positive value indicates better than chance agreement, with a value of unity indicating perfect agreement.

4.4.3 Frequency counts

This involves a simple counting of the number of times a particular construct is mentioned in a specific category generated through the content analysis. This gives an approximate indication of the categories importance (Bernard and Filtman, 2002).

4.5 Limitations of Study

A key limitation to the research is that the RGT only elicits the constructs to which a person can attach verbal labels (Fransella *et al.*, 2004).

4.6 Anonymity of Respondents

This dissertation will maintain the anonymity of all the respondents, this means that the researcher holds the information about the participant in confidence and keeps it away from the public. If the information is released, it will be done in such a way that it will not be possible for the public to figure out the person. Even as the details of the case are given, the participants identities have been protected and the individual remains unknown to the readers of the case studies.



Chapter 5: Research Findings and Discussions

This chapter reports on the case studies conducted of six construction companies, of different grading's within the Western Cape. The repertory grid method was used to explore the risks governing South African construction projects that affect the success of the project in meeting its objectives with respect to time, cost and quality. The results were solicited using a variety of qualitative repertory grid analysis techniques. The structure of this section, is such that each participant is analysed individually but in a similar format for cohesion. The findings drawn from each of the cases will be discussed and evaluated in the following chapter.

The sample used for the findings is relatively small, but this number fits within the guidelines established by Eisenhardt (1989), who recommends a sample of between four and ten for in-depth qualitative case studies. Further, the use of the repertory grid technique provides an added advantage, as this method does not require the use of a large sample to reach its point of redundancy. This is according to studies undertaken by Botterill (1989); Botterill and Crompton (1987) and Pearce (1982) who confirm the acceptability of a sample size between one and ten.

5.1 Participant Demographics

The physical demographic parameters of this research are confined to the Western Cape. Ten contractors of various grades were contacted to participate in this case study. Six responded positively to this request, two declined and two did not reply. Pseudonyms have been used for some of the participants, as per their request, to protect their privacy. The following table 5.1 illustrates the demographical distribution and CIDB grading's of the participants.



PSEUDONYM	GENDER	GRADING
Participant 1	Male	Level 9
Participant 2	Male	Level 8
Participant 3	Male	Level 4
Participant 4	Male	Level 7
Participant 5	Male	Level 3
Participant 6	Male	Level 8

Table 5.1: Participant Demographics

5.2 Primary Research Findings

5.2.1 Participant 1

Participant one is a Site agent with over 20 years' experience working on a broad spectrum of projects within the construction industry. The projects that he has been involved in are diverse in scope, size and cost. Ranging from Civil, Healthcare, Mining, Retail and Private works.

The participant is involved at the coal face of each one of his construction projects. Part of his immediate team are two junior site agents who are employed to perform an assistive role, reporting and managing all issues that occur within their respective parameters back to him. The other members part of the team are the Contractors Quantity Surveyor, the Contracts Manager and the Programme Planner. The Contractors Quantity Surveyor has jurisdiction over the construction cost and all matters that affect or are related to cost, the Contracts Manager is responsible for all administrative and contractual issues at a higher level. The Programme Planner oversees that the project is running to schedule and plans the absorption

of all slippages that would cause it to be otherwise. The following figure 5.1 is a graphic representation of the members of the construction team deployed on projects at a high level.

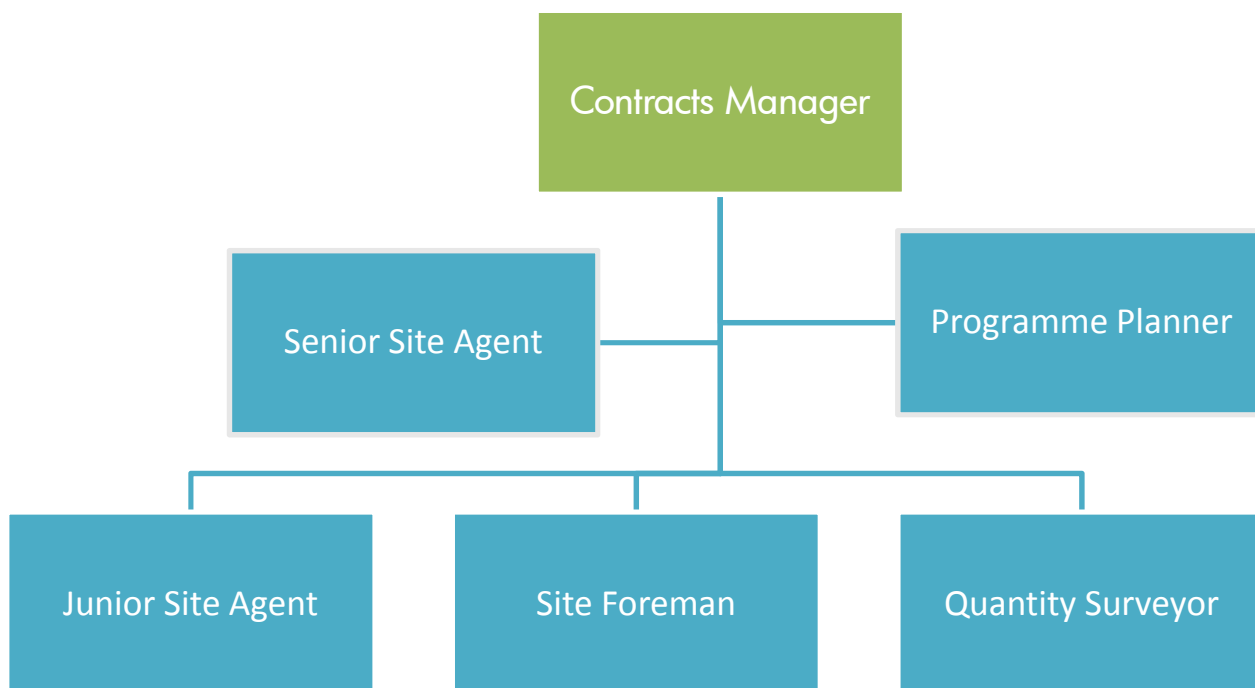


Figure 5.1: Participant 1 - Organogram of construction team

The case study was centred around four projects that Participant one had been involved in. The projects were of varying scope and size, two were new build and two were a combination of alterations and new work. All projects used the JBCC Principal Building Agreement (PBA) conditions of contract and were constructed within the Western Cape Region. The following Table 5.2 provides a brief summary of the projects discussed in the interview.

	PROJECT 1	PROJECT 2	PROJECT 3	PROJECT 4
Description	New Hospital	Hotel Refurbishment	Apartment Block	Hotel Refurbishment
Contract	JBCC PBA Contract	JBCC PBA Contract	JBCC PBA Contract	JBCC PBA Contract
Approximate Contract Value	R 295 000 000	R 127 133 000	R 103 000 000	R 60 000 000
Completed Time	No	Yes	Yes	Yes
Completed Budget	No	No	No	No
Completed to Specification	Yes	Yes	Yes	No

Table 5.2: Participant 1 - Summary of projects

5.2.1.1 Definition of risk

The Participant described project risk as a barrier to delivering a project's scope within the clients' anticipated cost, time and schedule parameters, while maintaining and conforming to the statutory health and safety standards and environmental levels. He further expressed that due to there being so many unknown knowns, risk is always a prevalent factor that one needs to constantly look out for in every facet of the project.

5.2.1.2 Risk management implementation within the organization

The participant stated that their organisation has a tender committee that is tasked with identifying all potential explicit and implicit risks and pricing them into the tender for submission. According to the participant, once the committee has priced the tender document, it is presented to a Pre-contract committee for approval. During this process, the site agent who will be assigned to the project, is brought on board to provide input before the tender is approved or declined by the Pre-contract committee based on the risk profile of the contract.

If approval is granted by the Pre-contract committee, a tender risk review document is prepared and presented at a risk review meeting which is attended by senior management and board members. At this meeting, the Pre-contract committee presents the tender document

to a panel and they advise the tender committee on improvements to the tender and possible qualifications to the tender that should be included to adequately mitigate risk.

Once the recommendations by the risk review committee are made, the tender is submitted to the client. Any changes made to the tender document during the tender adjudication and negotiation period are required to be approved by the risk review committee prior to signing the final contract.

When the contract is awarded, there is a formal handover of the tender and risk information to the contract start up team that reviews and updates the information. The contract start up team thereafter hands over to the construction team who maintain and update the risk registers and related action plans, in line with the organisations risk framework.

The participant mentioned that their Risk Management framework focuses on the effective and ongoing management of risk on all their projects. The framework entails the rigorous processes of early identification, quantification and assessment of risks and the application of risk mitigation measures to reduce the potential impact. He further added that the framework model ensures that key risks are identified and mitigated, this process is based on the Bottom-up and Top down method which are adhered to during the construction phase:

Bottom-up Method

- This method is a process whereby risks from the contract are captured on a database and consolidated through to group level, were they are graded based on priority.

Top down Method

- This involves senior management checking that the contractor is adhering to the conditions approved by the risk committee and analysing the risks that are captured on the data base. While identifying those that are key threats in order to establish a suitable solution to mitigate the risk.

The participant stated that the site team usually receives feedback on areas of improvement and possible opportunities on site that can be changed to enhance the contractor's profitability. He also added that usually at the end of the contract, the lessons learnt are updated and approved by the relevant contracts director. This process is frequently captured and uploaded electronically onto a lesson learnt database, which is accessible to all employees within the group and used to ensure that processes or policies are constantly improved to prevent similar incidents on other projects.

5.2.1.3 Tools used for risk identification

The Participant confirmed that brainstorming is the primary tool of risk identification on site prior to the acceptance of any new project. Once the project has been accepted the Senior site agent has a formal meeting with the tendering committee to discuss the project and the potential risks that they have identified during site establishment. This is followed by a site walk with the committee to pick out any other obvious known unknowns on site. These are then recorded on a risk register and submitted to Senior management for mitigation during the construction phase.

The participant further confirmed that most high and middle level contract managers, site agents and quantity surveyors often undergo risk management training workshops to empower them on:

- Risk identification
- Risk reporting procedures
- Risk Mitigation



The participant stressed that these workshops are of great importance as they equip the team with the necessary skills and knowledge to be able to identify and mitigate risks that require an immediate response and solution. The following table 5.3 illustrates the risk identification tools that the participant is familiar with and those that he has utilised on his projects.

RISK TOOL	KNOWLEDGE OF TOOL	USE OF TOOL
Brainstorming	✓	×
Delphi Technique	×	×
Influence Diagram	✓	✓
Expert Judgement	✓	✓
Checklist	✓	✓
Nominal group Technique	×	×
Flow charts	✓	✓
Scenario Building	×	×
Pondering	×	×
Root cause Identification	×	×
Cause effect diagram	✓	×

Table 5.3: Participant 1 - Risk Identification tools

5.2.1.4 Project risks

The following table 5.4 depicts and classifies the risks that were solicited during the triading and laddering process:

RISKS SOLICITED DURING TRIADING AND LADDERING
Client has a bad track record
Subcontractors have no capacity
Subcontractors have dismal financial standing
Subcontractors are incompetent and unskilled
Many long lead items
Unsuitable construction programme
Subsurface investigation is inaccurate
Weather is unpredictable
Site has a history of hazardous material
Site has access restrictions
Unskilled labour
Material not readily available locally
Contract schedule accelerated
Imported material not easily accessible
Health and safety measures ineffective
Client financially constrained
Public liability insurance not adequate
Contract schedule accelerated
Interest rates are volatile
Incompetent professional consultants

Table 5.4: Participant 1 - Risks solicited from RGT interview

5.2.2 Participant 2:

Participant number two is a site agent with over 15 years' experience working on a diverse number of projects in the construction industry. Although the projects are diverse in scope and size, they are limited to the construction and refurbishments of office blocks, apartments and private dwellings.

The participant is responsible for the daily running of the construction project on site, his biggest task is in ensuring that the construction project conforms to the statutory building requirements and that the site is running with minimal incidents or accidents. He stressed the significance of ensuring that the entire project team adhere to strict building regulations, as a single fatality or casualty poses the risk of complete site shutdown for an indefinite period of time.

The participant works hand in hand with the rest of the site team who are tasked to assist him perform his duties with due diligence. On a high level, the team is comprised of the Contractors Quantity Surveyor, Programme Planner, Site Agent and a few junior staff. Figure 5.2 depicts the organogram of the construction team deployed on all projects:





Figure 5.2: Participant 2 - Organogram of construction team

The case study was centred around three projects that Participant Two had been involved in, the projects were of varying scope and sizes. One was the construction of a new office block, the other two were the construction of an Apartment block and the refurbishment of an existing clinic. All projects used the JBCC Principal Building Agreement (PBA) conditions of contract and were constructed within the Western Cape Region. The following Table 5.5 provides a brief summary of the projects discussed in the interview:

	PROJECT 1	PROJECT 2	PROJECT 3
Description	New Office Block	Apartment Block	Clinic Refurbishment
Contract	JBCC PBA Contract	JBCC PBA Contract	JBCC PBA Contract
Approximate Contract Value	R 79 000 000	R 91 000 000	R 28 884 000
Completed Time	No	Yes	Yes
Completed Budget	Yes	No	Yes
Completed to Specification	Yes	Yes	No

Table 5.5: Participant 2 - Summary of projects

5.2.2.1 Definition of risk

The participant defined construction risk as the exposure to an unexpected loss with emphasis on the fact that every construction project is different and each site offers a multitude of varying risks that are not always easily identifiable on the outset. He stressed that there are risks that are identified and those that are unidentified that crop up during the construction process and force the team to re analyse its schedule, to meet the client's objectives.

5.2.2.2 Risk management implementation within the organization

According to the participant, a high level of risk awareness and response has been entrenched in the daily management and operational activities of their organisation. Given the size and complexity of the projects that the organisation takes on, they acknowledged that risk can never be fully eliminated. For this reason, top management has designed and implemented a planned and structured approach to identify, assess, address, monitor, communicate and report risk in the form of a Risk Management Strategy.

This strategy sets the minimum standard required in the management of risks across all projects in the organisation. The framework is comprised of a consistent set of processes and controls against which each project is tested on. The Project risk management activities include Risk identification, Risk Qualification, Risk Mitigation and Risk Control.

According to the participant, this strategy ensures that the project team constantly reviews the project to extract areas in which risk can cause the project to be in distress and stipulates specific steps that can be taken to improve the project status in relation to the risks. This process is done bi-weekly, to enable the team to review the projects performance and devise recovery plans and programmes to mitigate the risks to keep the project on schedule. He emphasised that this is an important strategy of their organisation that seeks to embed the awareness and management of risk in all its team members.

5.2.2.3 Tools used for risk identification

The participant considers experience in high regard when it comes to risk identification, followed by the conventional method of brainstorming. He did however acknowledge that due to the ever-changing facets of the construction industry, experience becomes the greatest and most treasured weapon against risk. Often the identification of risk stems from the fact that one has encountered the same or similar risk on another project and has mitigated it in a certain way which has either proved to be effective or not - this experience thus becomes key when one is encountered with the same risk in future.

The following table 5.6 illustrates the risk identification tools that the participant is familiar with and those that he has utilised on his projects.

RISK TOOL	KNOWLEDGE OF TOOL	USE OF TOOL
Brainstorming	√	×
Delphi Technique	×	×
Influence Diagram	×	×
Expert Judgement	√	√
Checklist	√	√
Nominal group Technique	×	×
Flow charts	×	×
Scenario Building	×	×
Pondering	×	×
Root cause Identification	√	×
Cause effect diagram	×	×

Table 5.6: Participant 2 - Risk identification tools

5.2.2.4 Project risks

The following table 5.7 depicts and classifies the risks that were solicited during the triading and laddering process:

RISKS SOLICITED DURING TRIADING AND LADDERING
Insufficient documentation control
Restricted productivity hours
Labour disputes
Unskilled labour
Poor labour allocation
Numerous design changes
Unfamiliar client
Unfamiliar subcontractor
Escalation of materials
Volatile economic conditions
Unfamiliar client

Table 5.7: Participant 2 - Risks solicited from RGT interview

5.2.3 Participant 3

Participant three is a Site Agent part of a small construction organisation, with a few years' experience working in the construction industry. His lack of experience was showcased in the interview, in his inability to answer and comprehend certain questions that were asked. He has worked on a few projects ranging from private to public work and the magnitude of risks that he has been exposed are similar to those of the larger contractors.

According to the participant, he is a part of a small organisation that is hardly exposed to the complexities and management techniques that are involved in the execution of the large works. Therefore, he has a more hands-on approach when it comes to the operation of projects. Himself and the Director are actively involved in the tendering, planning, scheduling, resourcing, purchasing and managing of the entire project process. Figure 5.3 is a graphic representation of the organogram of the construction team deployed on the high-level projects:

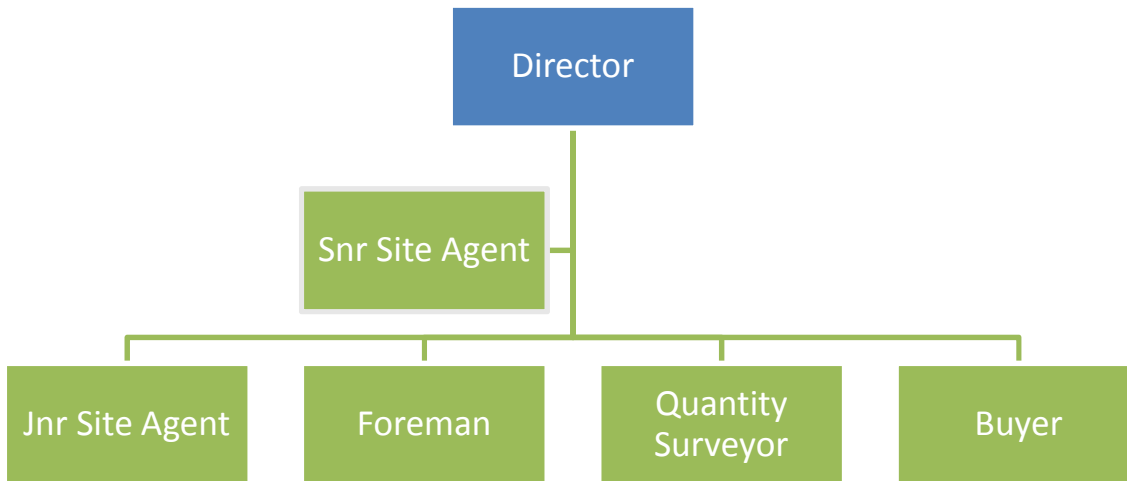


Figure 5.3: Participant 3 - Organogram of construction team

The case study was centred around three projects that participant had been involved in. The projects were of similar scope and size, two of projects were alteration jobs and one was a new build. All projects used the NEC contract and were constructed within the Western Cape Region. The following Table 5.8 provides a brief summary of the projects discussed in the interview.

	PROJECT 1	PROJECT 2	PROJECT 3
Description	New School	School Refurbishment	School Refurbishment
Contract	NEC Contract	NEC Contract	NEC Contract
Approximate Contract Value	R 4 000 000	R 2 000 000	R 2 000 000
Completed Time	Yes	No	No
Completed Budget	No	No	No
Completed to Specification	Yes	Yes	Yes

Table 5.8: Participant 3 - Summary of projects

5.2.3.1 Definition of risk

The participant defined risk as having a damaging impact on the organisations earnings. He stated that the organisation that he works for tries not to adopt risk that they do not understand, therefore they seldom take on projects that they have no prior experience in constructing. This 'rule' assists their organisation in minimising their involvement with projects of a scope that they are unfamiliar with and to an extent limits their exposure to certain risks. Consequently, their organisation predominately deals with the construction and refurbishment of schools as opposed to high end projects such as Retail and Health care.

5.2.3.2 Risk management implementation within the organization

The participant conveyed that the organisation did not have any effective risk management framework plan in place. Their organisation has attached a low priority to risk management, due to the view that it is a waste of time and it takes the project team away from the more pertinent tasks of managing projects and ensuring that the targeted profit margins are met. He emphasizes that they are a relatively small organisation who prefer a more hands on approach that ensures that risk management is an embedded part of their daily construction project process.

5.2.3.3 Tools commonly used to identify risk on projects.

The participant stated that the only tools that he considers imperative to risk identification are experience and brainstorming. He stressed the invaluable importance of accumulating experience given the exposure to the right projects. However, he concurred that the quality of one's experience can fall short if they are only exposed to certain repetitive projects, like some members of their organisation. According to him, this poses a huge risk as the contractor is only aware and experienced on how to tackle certain risks within certain projects of a specific scale. The downfall of which, is a lack of a broader experience base to tackle projects that are evolving with technology in terms of design. He added that construction processes are moving



further and further away from the traditional method of construction, this leaves many exposed to a magnitude of 'new' risks as project evolution surpasses ones' knowledge and experience base.

The following table 5.9 illustrates the risk identification tools that the participant is familiar with and those that he has utilised on his projects.

RISK TOOL	KNOWLEDGE OF TOOL	USE OF TOOL
Brainstorming	√	√
Delphi Technique	×	×
Influence Diagram	×	×
Expert Judgement	√	√
Checklist	√	√
Nominal group Technique	×	×
Flow charts	√	×
Scenario Building	×	×
Pondering	×	×
Root cause Identification	×	×
Cause effect diagram	×	×

Table 5.9: Participant 3 - Risk identification tools

5.2.3.4 Project risks

The following table 5.10 depicts the risks that were solicited during the triading and laddering process:



RISKS SOLICITED DURING TRIADING AND LADDERING
Unexpected inclement weather
Scope undefined
Lack of co ordination with subcontractprs
Labour strikes
Poor materiaal quality
Accidents during construction
Constant price changes
Delayed payement to contractors
Delays in resolving disputes

Table 5.10: Participant 3 - Risks solicited from RGT interview

5.2.4 Participant 4

Participant four is a Site Agent part of a medium construction organisation with a few years' experience working in the construction industry. He has worked on a large spectrum of projects ranging from Commercial, Education, Government and Residential.

According to the participant, he is part of a medium organisation that tackles projects of various scope and magnitude that are fruitful to his learning and skills acquisition. The following figure 5.4 is the organogram of the construction team deployed on the level projects:

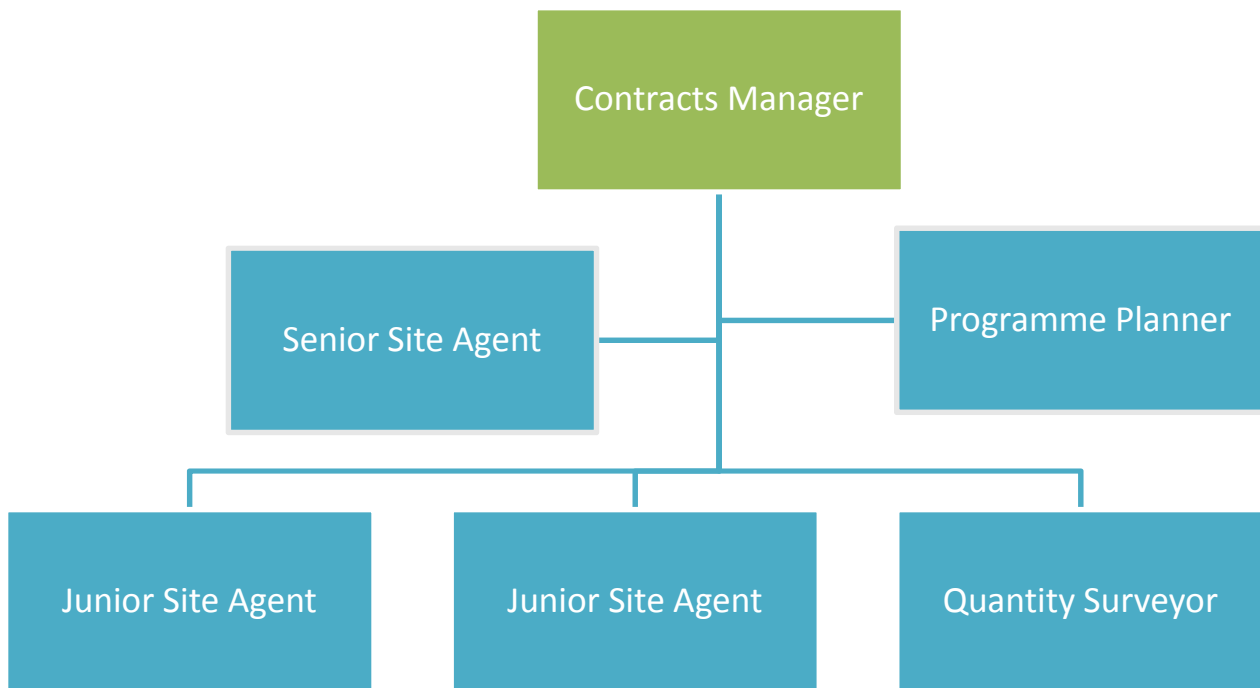


Figure 5.4: Participant 4 - Organogram of construction team

The case study was centred around four projects that the Participant had been involved in. The projects were of similar scope and sizes, three were new builds and one was a refurbishment. All projects used the JBCC contract and were constructed within the Western Cape Region. The following Table 5.11 provides a brief summary of the projects discussed in the interview

	PROJECT 1	PROJECT 2	PROJECT 3	PROJECT 4
Description	Residential refurbishment	Residential refurbishment	Residential project	Alterations to Residential property
Contract	JBCC Contract	JBCC Contract	JBCC Contract	JBCC Contract
Approximate Contract Value	R 25 000 000	R 40 000 000	R 10 000 000	R 35 000 000
Completed Time	Yes	No	Yes	No
Completed Budget	No	No	No	No
Completed to Specification	Yes	Yes	Yes	Yes

Table 5.11: Participant 4 - summary of projects

5.2.4.1 Definition of risk

The participant started off by empathising that construction is a risky business. When the contractor accepts a project, he inherits the majority of risks. He added that risks are not always known, but they have the ability to affect the successful completion of a project in terms of budget and schedule. Therefore, if most risks are not accounted for at the start of a projects' acquisition, failure can result.

5.2.4.2 Risk management implementation within the organization

The participant posited that although he is not too versed on the technicalities of risk management, he is aware that their organisation has a risk management framework plan in place. This plan was integrated at two different hierarchy levels, management at the top and management at ground level. Management at the top have jurisdiction over the preparation and the pricing of tender documents for submission. At this level, risks are usually identified based on the teams' experience and carved out contractually through qualifications that are included with their tender submission or priced into the contract and then managed within the budget.

According to the participant, management at ground level emphasises the risk management of Health and Safety. This is one of their organisations biggest concern - providing a safe and healthy work environment for employees, contractors and other stakeholders. The focus on 'ground' level is thus on communication and awareness, accountability and risk protocols centred but not limited to Health and Safety. This message is always communicated through their site inductions for any personnel that needs to be on site and through regular team building exercises for their labourers and workshops for their employees.

5.2.4.3 Tools commonly used to identify risk on projects

The Participant stated that the organisation made use of the risk register and the works breakdown schedule to identify construction risks. Over and above this, risk is also identified through brainstorming and experience that is acquired over the years from working on certain projects. The following table 5.12 illustrates the risk identification tools that the participant is familiar with and those that he has utilised on his projects.

RISK TOOL	KNOWLEDGE OF TOOL	USE OF TOOL
Brainstorming	√	√
Delphi Technique	×	×
Influence Diagram	×	×
Expert Judgement	×	×
Checklist	√	√
Nominal group Technique	×	×
Flow charts	×	×
Scenario Building	×	×
Pondering	×	×
Root cause Identification	×	×
Cause effect diagram	×	×

Table 5.12: Participant 4 - Risk Identification Tools

5.2.4.4 Project risks

The following table 5.13 depicts and classifies the risks that were solicited during the triading and laddering process.

RISKS SOLICITED DURING TRIADING AND LADDERING

Substandard workmanship

Inclement weather

Variation of design

Existing underground services

Late information

Late site handover

Labour strikes

Unavailability of skilled labour

Unavailability of materials

Accelerated programme

Table 5.13: Participant 4 - Risks solicited from RGT interview

5.2.5 Participant 5

Participant Five is a site foreman with over 10 years' experience working on a broad spectrum of projects within the construction industry, the projects that he has been involved in are diverse in scope, size and cost ranging from Healthcare, Retail and Private works.

The following figure 5.5 is a graphic representation of the members of the construction team deployed on projects at a high level:



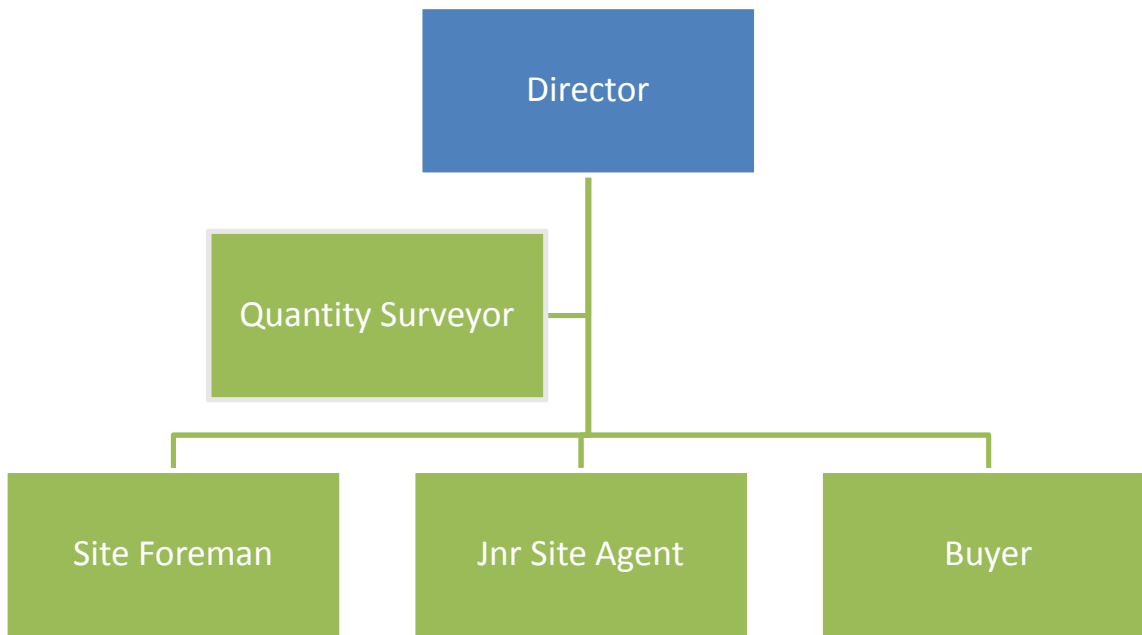


Figure 5.5: Participant 5 - Organogram of construction team

The case study was centred around four projects that Participant five had been involved in. The projects were all refurbishments of varying scope and size, which used the JBCC Principal Building Agreement (PBA) conditions of contract and were constructed within the Western Cape Region. The following table 5.14 provides a brief summary of the projects discussed in the interview.

	PROJECT 1	PROJECT 2	PROJECT 3	PROJECT 4
Description	Residential refurbishment	Office block refurbishment	Apartment refurbishment	School refurbishment
Contract	JBCC Contract	JBCC Contract	JBCC Contract	JBCC Contract
Approximate Contract Value	R 780 000	R 1 630 000	R 2 000 000	R 900 000
Completed Time	No	Yes	Yes	Yes
Completed Budget	No	No	Yes	No
Completed to Specification	Yes	Yes	No	No

Table 5.14: Participant 5 - Summary of projects

5.2.5.1 Definition of risk

The Participant described risk as being an undetectable factor that is present on any project, that has the potential to affect the projects objectives. He added that the fast nature of construction projects in today's time reduces the amount of time and information available to cover all risk aspects of a project, leaving the construction process open to endless possibilities or problems.

5.2.5.2 Risk management implementation within the organization

The participant advised that their organisation had an ad-hoc risk management strategy that was known to all members of the project team but was not formally documented. According to the participant, all members of the project team are always risk aware. Seeing as their organisation is small, every team member is tasked with the duty to ensure that all operations on site are done with due diligence and with the least amount of exposure to risk. They as an organisation cannot afford not to constantly identify and mitigate risk continuously throughout the project duration but don't need to implement the process in a tabulated and structured format, as projects are not structured in nature.

5.2.5.3 Tools used for risk identification

The Participant confirmed that brainstorming, expert judgement and checklists are the primary tools of risk identification on most of their projects, other than that the participant was not aware of any of the other risk identification tools listed in table 5.15.



RISK TOOL	KNOWLEDGE OF TOOL	USE OF TOOL
Brainstorming	√	√
Delphi Technique	×	×
Influence Diagram	×	×
Expert Judgement	√	√
Checklist	√	√
Nominal group Technique	×	×
Flow charts	×	×
Scenario Building	×	×
Pondering	×	×
Root cause Identification	×	×
Cause effect diagram	×	×

Table 5.15: Risk Identification Tools

5.2.5.4 Project risks

The following table 5.16 depicts and classifies the risks that were solicited during the triading and laddering process:



RISKS SOLICITED DURING TRIADING AND LADDERING

Labour strikes

Undefined scope

Incomplete drawings

Poor scheduling of labour and materials

Late procurement of materials

Unexperienced labour

Unskilled labour

Price fluctuations

Material cost fluctuations

Additional Labourers

Design changes

Rushed Pre tender process

Poor safety procedures

Table 5.16: Participant 5 - Risks solicited from RGT interview



5.2.6 Participant 6

Participant Six is a site agent with over 17 years' experience working on a broad spectrum of projects within the construction industry. The projects that he has been involved in are diverse in scope, size and cost ranging from Industrial, Healthcare, Heritage and Retail. The following figure 5.6 is a graphic representation of the members of the construction team deployed on projects at a high level:

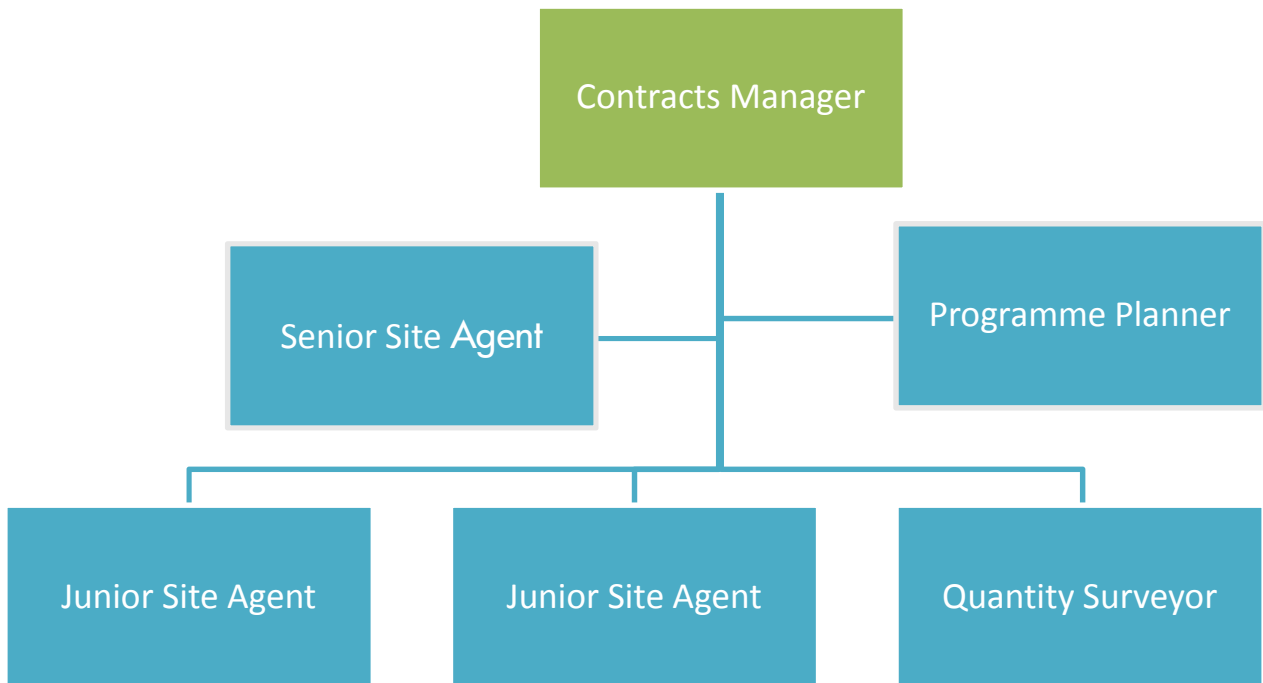


Figure 5.6: Participant 6 – Organogram of construction team

The case study was centred around four projects that Participant six had been involved in, the projects were of varying scope and sizes, two were new build and two were a combination of alterations and new work. All projects used the JBCC Principal Building Agreement (PBA) conditions of contract and were constructed within the Western Cape Region. The following table 5.17 provide a brief summary of the projects discussed in the interview.

	PROJECT 1	PROJECT 2	PROJECT 3	PROJECT 4
Description	Apartment Block	Hotel refurbishment	Apartment Block	Hotel refurbishment
Contract	JBCC Contract	JBCC Contract	JBCC Contract	JBCC Contract
Approximate Contract Value	R 245 000 000	R 30 000 000	R 131 000 000	R 56 000 000
Completed Time	Yes	Yes	Yes	Yes
Completed Budget	Yes	No	Yes	No
Completed to Specification	No	No	No	No

Table 5.17: Participant 6 – Summary of projects

5.2.6.1 Definition of risk

The Participant described risk as playing a significant part in the decision-making process of all construction projects, as risk affects the projects performance. He emphasised that if risk is not dealt with sensibly, it often causes cost overruns, schedule delays and poor quality. He also alluded to the fact that different projects have different levels of risk and often the project team will adopt different strategies to minimise certain risks.

5.2.6.2 Risk management implementation within the organization

According to the participant their organisation has a functional support system dedicated to risk management. The activities in this system include risk tolerance filters, lessons learnt register, risk management procedures, schedule of contracting principles and project reviews. These activities are all implemented from a high level through top management and filtered down to the construction project team. Once the contract to a specific site is awarded, the tender document has already been agreed and evaluated by the risk management team. Therefore, the participants risk management jurisdiction is implemented once he gets handed the job. It therefore becomes his projects teams task to work together to identify and mitigate the risks that they encounter on the project. The organisations risk management team is tasked to sit on the peripheral of the project and offer support and direction were needed.



5.2.6.3 Tools used for risk identification

The Participant posited that brainstorming, checklists and Expert judgment are the tools that he is well versed in and has practical experience in utilising them on site. According to the participant the works breakdown structure together with the risk register are the most fundamental tools he has used in risk identification on construction projects. The following table 5.18 illustrates the risk identification tools that the participant is familiar with, and those that he has utilised on his projects.

RISK TOOL	KNOWLEDGE OF TOOL	USE OF TOOL
Brainstorming	√	×
Delphi Technique	×	×
Influence Diagram	×	×
Expert Judgement	×	×
Checklist	√	√
Nominal group Technique	×	×
Flow charts	×	×
Scenario Building	×	×
Pondering	×	×
Root cause Identification	×	×
Cause effect diagram	√	√

Table 5.18: Risk Identification Tools

5.2.6.4 Project risks

The following table 5.19 depicts and classifies the risks that were solicited during the triading and laddering process:



RISKS SOLICITED DURING TRIADING AND LADDERING
Design variations by the client
Inaccurate survey report
Inadequate programme schedule
Rushed pre tender process
Specialist sub contractors not co ordinated
New government legislation
Adverse weather conditions
Undefined scope of works
Incompetent sub contractors
Poor safety procedures
Price inflation of materials
Accelerated programme schedule
Inaccurate cost estimate
Unmanaged costs
Inaccurte quantities
Unfamiliar client

Table 5.19: Participant 6 - Risks solicited from RGT interview

5.3 Risk Definition

All participants had a firm perception and understanding of risk and the impact that it has on a projects objective. They described risk as an unknown that is not easily identifiable or understood but which has the potential to have a damaging effect on a projects' scope, delivery, objectives and organizational earnings. This discovery was in contrast to an argument made by Tadayon *et al.* (2012), who expressed that many contractors are often unfamiliar with risk and consequently they are unable to manage their projects effectively.

The perception of risk as having both a positive and negative aspect as defined by Yoe (2000) and PMBOK (2008) was not mentioned by any of the participants in the case studies. Their focus was centered around the damaging effects that risk can potentially have on the projects objectives.

A few participants articulated that all projects are unique, therefore the risk potential is always vast and undefinable. This contrasted with another participant who seemed to be of the notion that certain risks were synonymous to certain projects. Consequently, their organization tried to limit their exposure to risk by not taking on projects that they were not familiar with, hence sticking to certain types of projects i.e.: low cost housing.

The consensus amongst participants is that construction is a risky business and with the acceptance of a project, comes the inheritance of the majority or risks, many of which are not always known at the outset. This understanding is in line with the perception of Tadayon *et al.* (2012) who argue that contractors often bear most of the construction risks during project realization.



5.4 Risk Management implementation in the organization

All the participants discussed the implementation of risk management in their organization. The level and extent of implementation differed across the organizations. Some organizations had a very detailed and comprehensive framework in place that had rigorous 'stage gates' at different levels of the project cycle, to ensure that risk management was an integral part of their organizations project management process. This was found to be typical of the organizations that had a larger CIDB grading.

These larger organizations were involved with projects on a greater magnitude with a much higher monetary value than their smaller construction counter parts, who dealt with smaller projects and therefore implemented risk management at a minimalistic level. One participant from a small construction company, went as far as to make mention of only taking on projects that they were familiar with to reduce their exposure to risks that they were not used to dealing with, to protect their tight profit margins.

Five of the six participants mentioned implementing risk management from the onset. They spoke of certain processes and procedures that were in place, as early as in the pre-contract and tender stage. This early implementation of risk management lines up with Kishk and Ukaga (2008); Mobey and Parker (2002) and Tinnirello (2000) who posit, to ensure potential risks are managed effectively, the risk process needs to be explicitly built into the decision-making process before project construction; to assist in early identification and mitigation of potential risks.

Many of the participants were of the view that the risk management process was in place to identify and analyze risk throughout the project Life cycle. They addressed the different ways in which their organizations plan and implement their risk strategies or frameworks to protect the projects objectives and their organizations profit margins. This ties in with the argument from Othman and Harinarian (2009) who describe risk management as a systematic way of

analyzing the project for areas of risk and consciously determining how each should be treated. They further express that it is a process that involves planning, coordinating and directing risk and the risk financing activities, to protect the organization, its people, assets, and profits against physical and financial consequences (Othman and Harinarian, 2009).

5.5 Risk Identification Tools

5.5.1 Knowledge of various risk identification tools

The following pie chart in figure 5.7 illustrates the distribution of knowledge on risk identification tools amongst the participants. Evidently 35% of the participants understand brainstorming as a risk identification tool, followed by 23% who understand the use of the Checklist and 12% who comprehend the use of the Expert Judgment and the Cause and Effect Diagram. Influence diagrams, flow charts and Root cause identification were understood by 6% of the participants, with none of them having any idea as to the use or knowledge of the Delphi technique the Nominal group technique and Pondering.

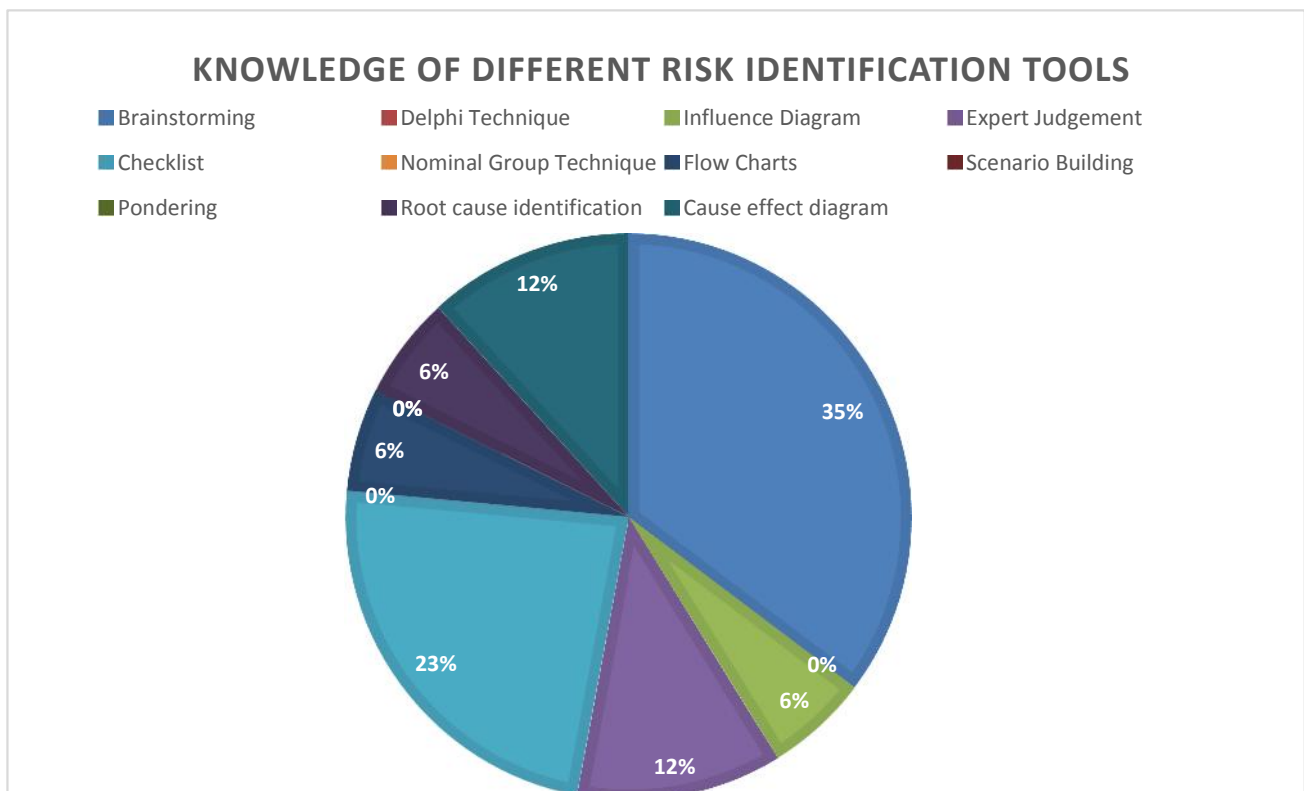


Figure 5.7: Participants knowledge of the different risk identification tools

5.5.2 Use of various risk identification tools

This section demonstrates the findings related to research objective one. The pie chart in figure 5.8 identifies the tools commonly used to classify risks on projects, by illustrating the use of the risk identification tools across all participants. Evidently, 37% of the participants have used the Checklist method as a risk identification tool, followed by 27% who have made use of the Brainstorming method, this is followed by 9% of the participants who have made use of the Influence diagram, Expert judgement, Flow charts and the Cause and effect diagram. Not one of the participants have used the Delphi technique, the Nominal group technique and Pondering as a risk identification tool.

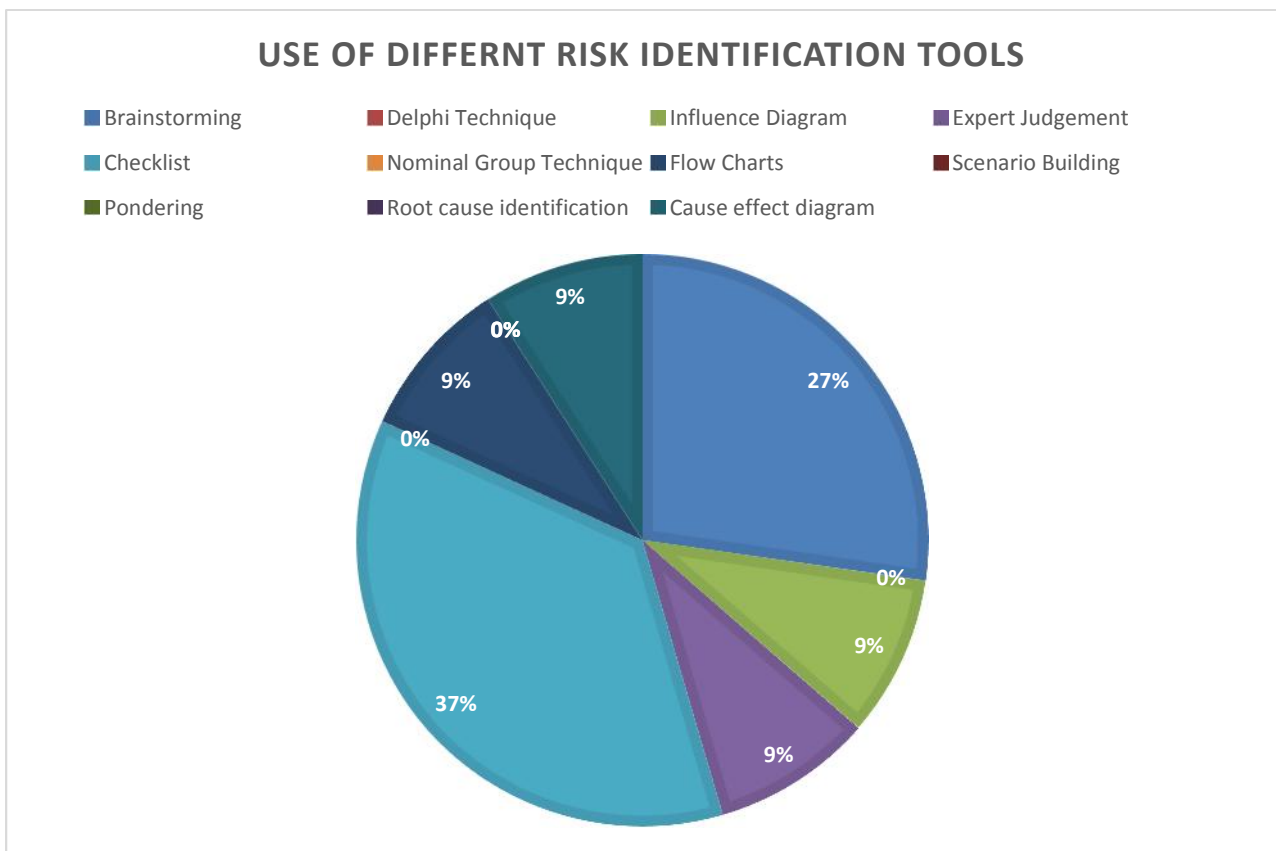


Figure 5.8: Participants use of the different risk identification tools

As illustrated in the figure 5.7 and 5.8 above, brainstorming and checklist are considered the preferred risk identification techniques among the participants. These findings are reflective of the research done by Chihuri and Pretorius (2011) and Akintoye and Mcleod (1997).

Chihuri and Pretorius (2011) highlighted the importance and use of the Brainstorming technique, followed by Checklists. They emphasized that these techniques had the ability to assist participants to draw on various sources of information, including past experience and expert judgement to identify risks (Chihuri and Pretorius, 2011).

Akintoye and Mcleod (1997) concurred, adding that despite the use of risk analysis techniques in construction projects being low. Intuition, judgement, experience and the use of Checklists are the highest recorded in terms of familiarity. This is in line with Garrido *et al.* (2011) who agree with Akintoye and Mcleod (1997) expressing that Checklist are the most used tools, followed by the Flowchart method and Brainstorming. The least used tool is identified by Garrido *et al.* (2011) as the Delphi Technique. This is reflective of the findings from the participants, who had no knowledge or use of the Delphi technique, Nominal Group Technique, Pondering and Scenario building as a risk identification tool.

Looking at both diagrams it is interesting to note that there is almost a direct correlation between the knowledge and use of risk identification tools. The tools that the participants have the highest knowledge in corresponds to the risk identification tool that most of the participants use. Evidently, participants seldom make use of tools that they have no knowledge in their use of.

The consequences of the participants absence in the knowledge of all the available risk identification tools, is beyond the scope of this research. However, Raz and Michael (1999) posit that knowledge of the tools assists in the areas of risk analysis, tracking and control. Further enabling the provision of a structured and disciplined procedure that delivers quality processes and practices.

5.6 Risk Analysis

5.6.1 Frequency counts of constructs

The risks that were identified during the Triad and Elicitation process of the Repertory Grid Technique were categorized in groups based on their similarity. For this research, myself and a colleague acted in the capacity of two raters and identified and grouped the constructs into categories. This process was tried and tested numerous times in order to establish a reliable grouping system that effectively categorized the constructs and was able to meet the Cohens Kappa coefficient to symbolize the plausibility and validity of the categories identified.

After twelve attempts each, the Cohens kappa analysis yielded a value of 0.68. The value indicated a reasonably good overall agreement and is tabulated in table 5.20. The categories are ranked in order of frequency, therefore those that contain the highest number of constructs are categorised first and those that have the least last. This system assists in ranking the first six risk categories in order of importance as follows:



Risk category	Identified constructs				No. of times the risk category is mentioned
Labour	<ul style="list-style-type: none"> Labour disputes Unavailability of skilled labour Labour strikes 	<ul style="list-style-type: none"> Unskilled labour Labour skills Lack of skilled labour 	<ul style="list-style-type: none"> Poor labour allocation Unexperienced labour 	<ul style="list-style-type: none"> Labour strikes Additional labourers 	10
Material	<ul style="list-style-type: none"> Poor material quality Poor scheduling of materials and Labour Late procurement of materials 	<ul style="list-style-type: none"> Material cost fluctuations Material not readily available locally Imported material not easily accessible 	<ul style="list-style-type: none"> Many long lead items Escalation of material cost 	<ul style="list-style-type: none"> Unavailability of materials Material price fluctuation 	10
Selected Subcontractor	<ul style="list-style-type: none"> Unfamiliar subcontractors Incompetent and unskilled subcontractors Unskilled subcontractors 	<ul style="list-style-type: none"> Subcontractors have a dismal financial standing Substandard workmanship Lack of coordination with subcontractors 	<ul style="list-style-type: none"> Subcontractors have no capacity Useless subcontractors 		8
Programme and scheduling	<ul style="list-style-type: none"> Inadequate programme schedule Contract schedule accelerated Unsuitable construction programme 	<ul style="list-style-type: none"> Accelerated programme Poor scheduling of labour and materials Fast tracked programme 	<ul style="list-style-type: none"> Shortened Pre-Tender process Useless subcontractors 		8
Client	<ul style="list-style-type: none"> Unfamiliar client Client financially constrained Client has a bad track record 	<ul style="list-style-type: none"> Delayed payment to contractors Incompetent professional consultants Design variations by the client 	<ul style="list-style-type: none"> Unfamiliar client 		7
Constant design changes	<ul style="list-style-type: none"> Design variations by the client Incomplete information on drawings Lack of information 	<ul style="list-style-type: none"> Design changes Numerous design changes Inaccurate service co ordination 			6
Economic conditions	<ul style="list-style-type: none"> Price fluctuations Material cost fluctuations Constant price changes 	<ul style="list-style-type: none"> Escalation of materials Volatile economic conditions Fluctuating interest rates 			6
Professional team	<ul style="list-style-type: none"> Delays in resolving disputes Late information Late site handover 	<ul style="list-style-type: none"> Rushed Pre-Tender process Insufficient documentation control Poor cost reporting 			6
Health and Safety	<ul style="list-style-type: none"> Accidents during construction Health and safety plan ineffective Poor safety procedures 	<ul style="list-style-type: none"> Short cuts in safety measures 			4
Ground conditions	<ul style="list-style-type: none"> Existing underground services Sub surface investigation is inaccurate Site has a history of hazardous material 	<ul style="list-style-type: none"> Inaccurate survey report 			4
Weather conditions	<ul style="list-style-type: none"> Adverse weather conditions Weather is unpredictable Unexpected inclement weather 	<ul style="list-style-type: none"> Inclement weather 			4
Contract	<ul style="list-style-type: none"> Insufficient insurance cover Inadequate productivity hours Inaccurate estimate 				3
Scope	<ul style="list-style-type: none"> Undefined scope of works Scope undefined Scope creep 				3
Legislation	<ul style="list-style-type: none"> Site has access restrictions New government legislations 				2

Table 5.20: Constructs identified from the RGT interviews

The results reveal that there are similarities and concession across both comparisons. Labour as a risk continues to dominate amongst the individual participants, this is reflective of the group consensus analysed previously. However, the restriction of productivity hours and new government legislation is found to be discussed and signified as important individually, but having no weighting or basis in the group consensus.

What are the risks governing South African construction projects that affect the success of the project in meeting its objectives with respect to time, cost and quality?

The second research objective is associated with the above research question. The following paragraphs demonstrate the findings related to the second research objective.

These are the risk categories that have been solicited during the case studies, that constitute the contractors' most frequent concerns:

- Labour
- Material
- Selected subcontractor
- Programme and scheduling
- Client

5.6.2 Labour

This category is broad and encompasses a multitude of labor aspect and concerns that continue to have a negative influence on projects. The government is aware of this challenge and has tried to put mitigating processes in place to assist contractors, but this category continues to be recognized as a threat to the South African construction industry.



5.6.3 Material

The looming economic issues affect project costs and increase the price of construction materials. This causes a subsequent decrease in revenue which is felt by all major and minor construction firms. The government is still trying to regulate this issue, as a poor-performing currency means plummeting profitability for construction firms. This filters down to the employees and poses a serious challenge to the country as the demand for construction projects decreases.

5.6.4 Selected subcontractor

The quality of the subcontractors in terms of skill, workmanship and their capacity continues to pose a huge risk on many projects. This affects the quality of work produced and the management of the different teams thereof.

5.6.5 Programme and scheduling

Programme and scheduling and constant design changes go hand in hand because constant design changes affect the ability of adequate programming and scheduling. The more changes that are made on a project the longer it takes for the project to be complete. It is therefore paramount that the contractor can get a handle on the changes to reflect a realistic programme.

5.6.6 Client

The client continues to pose a risk on projects due to the inability of contractors to vet out unreliable and interfering clients. Often the number of demands that the client imposes on a project, affects the project cost and has a ripple effect on the time and schedule. Further, the delayed or inconsistent payment runs has a negative impact on the contractor's cash flow which affects the rigor with which the projects are able to be completed.



These risk categories were solicited due to the frequency within which they were mentioned across all the undertaken case studies; they addressed the research objective 'to examine the risks that construction contractors in South Africa are exposed to'.

These are the findings related to the third research objective. The risks that had an overlap in this research and in literature were Labour, Programme and Scheduling, Constant design changes and Economic conditions. These were the consented risks that hinder the achievement of a projects objectives with regards to time, cost and quality. These risks fulfill the research objective 'to examine whether the construction risks proposed in existing literature are relevant to South African projects'.

It is interesting to note that the participants regarded the following risks as being one of the primary risks that affect the projects objectives, although these risks were mentioned they were not given the same reverence in the presiding literature:

- Health and Safety
- Scope
- Ground conditions
- Material issues
- Subcontract issues
- Client issues

Chapter 6: Conclusion and Recommendation

This chapter brings to a close the research that was undertaken, summarising the purpose of the study. The limitations faced with the research and the findings that were made and concludes by highlighting some of the research aspects that extend beyond the scope of this minor dissertation and makes recommendations for future research in the field.

6.1 Conclusion

6.1.1 Risk

The findings reveal that the concept of risk is understood and interpreted by the contractors based on the project and responsibilities that they have been exposed to. The use process of risk management differs across the different organizations, irrespective of size and grading. Were some organizations have a formal and rigorous risk management system in place, others are more ad hoc and on a need to use basis. The inherent consensus is therefore that regardless of the magnitude of an organization, there is always a formal or informal risk management process in place. The extent to which this process is effective or not, is beyond the scope of this research.

6.1.2 Research objective one - risk identification tools

The research has achieved the first research objective. There is a direct correlation between the knowledge and use of risk identification tools, the tools that the participants have the highest knowledge in, correspond to the risk identification tool that most of the participants use. Seemingly contractors that are in an organization that have a more formal risk management structure are more likely to identify and use a wide spectrum of risk identification tools as opposed to those who have a more informal approach to risk management. There was a collective understanding that irrespective of the similarities in the scope of projects, each construction project is unique and similar and risks may not recur on similar projects. Therefore, most projects rely heavily on experience, interpretation and insight of key project personnel to navigate a project through to success. Nonetheless, there was an understanding

amongst participants that one's experience, however vast, needed to keep abreast of the technological influence that are overtaking projects and changing traditional construction methodology.

6.1.3 Research objective two - major risk categories

The second research objective has been achieved through the identification of the five major risks categories listed below that reflect the contractors most common concerns:

- Labour
- Materials
- Selected subcontractors
- Programme and scheduling
- Client

The above risk categories are the most crucial to the construction industry. More needs to be done to address these categories to relieve the threat that they have on projects.

6.1.4 Research objective three – relevancy of existing literature to South African projects

The third research objective has been achieved. The risks that had an overlap in this research and in literature were Labour, Programme and Scheduling, Constant design changes and Economic conditions.

The following risks are the primary risks that affect the projects objectives, although these risks were mentioned they were not given the same reverence in the presiding literature:

- Health and Safety
- Scope
- Ground conditions
- Material issues
- Subcontract issues
- Client issues

6.2 Limitations of This Research Study

The Research was limited to the Western Cape, an opportunity for further research would be the widening of the research pool to include other provinces within South Africa.

The study is limited to construction projects, a study of projects in other domains could reflect quite a different picture. It would also be interesting to compare the risks of Civil and Construction projects to see if there are any similarities or differences with regards to risk management and risk exposure.

6.3 Recommendations

6.3.1 Analyzing risk management characteristics across all organizations

Future research can examine in greater detail how the risk management structures add or take away from an organizations ability to meet the projects' objectives, by unpacking what positive characteristics are found to be common across all organizations.

6.3.2 Correlation on the effects of similar risks on similar projects

Future research can further analyze construction risks, by trying to understand in what way they affect the projects' objectives; to try and draw a correlation between the effects of similar risks on multiple projects to determine if their impact is the same and if not, to what extent it differs.



References

- Abd El-Karim, M. S. B. A., El Nawawy, O. A. M. & Abdel-Alim, A. M., 2015, 'Identification and assessment of risk factors affecting construction projects', *Journal of Construction Engineering* 20 (15),1-6.
- Akintoye, A. S. & MacLeod, J. M., 1997, 'Risk analysis and management in construction', *International Journal of Project Management* 15(1), 31-38.
- Baloi, D. & Price, A.D.F., 2003, 'Modelling Global Risk Factors Affecting Construction Cost Performance', *International Journal of Project Management* (21), 261-269.
- Banaitiene, N. & Banaitis, A., 2012, 'Risk Management in Construction Projects', *Intech*, 429-448.
- Baloyi, L. & Bekker, M., 2011, 'Causes of Construction Cost and Time Overruns: The 2010 FIFA World Cup stadia in South Africa ', *Acta Structilia* 18(1), 51-67.
- Barkley, B.T., 2004, *Project Risk Management*, McGraw Hill
- Bajaj, D., Oluwoye, J. & Lenard, D., 1996, 'An Analysis of Contractors' Approaches to Risk Identification in New South Wales, Australia ' *Construction Management and Economics* (15), 363-369.
- Bernard, T. & Flitman, A., 2002, 'Using Repertory Grid Analysis to Gather Qualitative Data for Information Systems Research', *Association for Information Systems* 12(31), 98.
- Birch, D.G.W. & McEvoy, N.A., 1992, 'Risk analysis for Information Systems', *Journal of Information Technology* 7(1): 44-53.
- Botterill, T. D.,1989, 'Humanistic Tourism? Personal Constructions of a Tourist: Sam Visits Japan', *Leisure Studies* 8: 281-293.
- Botterill, T. D. & Crompton, J. L., 1987, 'Personal Constructions of Holiday Snapshots', *Annals of Tourism Research* (14), 152-156.
- Bowen, P. A., Hall, K. A., Edwards, P.J., Pearl, R. G. & Cattell, K. S., 2012, 'Perceptions of Time, Cost and Quality Management on Building Projects', *The Australian Journal of Construction Economics and Building* (2) 2, 48-56.



Caltrans, 2007, *Project Risk Management Handbook – Threats and Opportunities*: Office of Statewide Project Management Improvement.

Chapman, R., 2001, 'The controlling influences on effective risk identification and assessment for construction design management', *International Journal of Project Management* (19), 147-160.

Chihuri, S. & Pretorius, L., 2011, 'Managing Risk for Success in a South African Engineering and Construction Project Environment', *South African Journal of Industrial Engineering* 21(2), 63 -77.

Chileshe, N & Kikwasi, G. J., 2014, 'Risk assessment and management practices (RAMP) within the Tanzania construction industry: Implementation barriers and advocated solutions', *International Journal of Construction Management* 14(4), 239-254.

Chileshe, N. & Kikwasi, G. J., 2013, 'Perception of barriers to implementing risk assessment and management practices by construction professionals in Tanzania', in Smith, S.D & Ahiaga-Dagbui, D.D (eds.), *Procs 29th Annual ARCOM Conference, Association of Researchers in Construction Management*, September 4, 2013, pp. 1137-1146.

Cooper, D., Grey, S., Raymond, G. & Walker, P., 2005, *Project Risk Management Guidelines: Managing Risk in Large Projects and Complex Procurements*, John Wiley & Sons.

Dainty, A.R.J, Bryman, A. & Price, A.D.F., 2002, 'Empowerment within the UK construction sector', *Leadership and Organization Development Journal* 23(6), 333-342.

Darnall, R. & Preston, J.M., 2010, *Project Management from Simple to Complex*, Flat World Knowledge.

Donnelly, L., 2012. Eskom grilled on power price. (online). Available from: <<http://mg.co.za/article/2012-08-24-00-eskom-grilled-on-power-price>> [Accessed: 2 July 2013].

Eisenhardt, K. M., 1989, 'Building Theories from Case Study Research', *The Academy of Management review* 14(4), 532-550.

Ekung, S., Adeniran, L. & Adu, E., 2015, 'Theoretical Risk Identification within The Nigeria East – West Coastal Highway Project', *Civil Engineering and Urban Planning: An International Journal* 12(1), 1-11.

El-Sayegh, S. M., 2007, 'Risk assessment and allocation in the UAE construction industry', *International Journal of Project Management* (26), 431-438.

Flanagan, R. & Norman, G., 1993, 'Risk management and construction', *The Built & Human Environment Review* 4(1), 87-97.

Fleiss, L. & Cohen, J., 1973, 'The equivalence of weighted kappa and the intraclass correlation coefficient as measures of reliability', *Educational and Psychological Measurement* (33), 613-619.

Fransella, F., Bell, R. & Bannister, D., 2004, *A manual for repertory grid technique – Second edition*, John Wiley & Sons.

Garrido, M. C., Ruotolo, M. C. A., Ribeiro, F. M. L. & Naked, H. A., 2011, 'Risk identification techniques knowledge and application in the Brazilian construction' *Journal of Civil Engineering and Construction Technology* 2(11), 242-252.

Geraldi, J.G., Kutsch, E. & Lee-Kelley, L., 2010, 'The Titanic sunk, so what? Project manager response to unexpected events', *International Journal of Project Management* 28(6), 547-558.

Grice, J.W., 2002, 'Idiogrid: Software for the management and analysis of repertory grids', *Behavior Research Methods, Instruments & Computers* 34(3), 338-341.

Griffin, C., 2004, 'The Advantages and Limitations of Qualitative Research in Psychology and Education', *Hellenic Journal of Psychology* (2), 3-15.

Goh, C. S & Abdul-Rahman, H., 2013, 'The Identification and Management of Major Risks in the Malaysian Construction Industry', *Journal of Construction in Developing Countries* 18 (1), 19-32.

Hwang, B., Zhao, X. & Toh, L.P., 2013, 'Risk management in small construction projects in Singapore: Status, barriers and impact', *International Journal of Project Management* 32 (14), 116-124.

Jaafari, A., 2001, 'Management of risks, uncertainties and opportunities on projects: time for a fundamental shift', *International Journal of Project Management* (19), 89-101.

Junior, R. R., & Monteiro de Carvalho, M., 2013, 'Understanding the Impact of Project Risk Management on Project Performance: An Empirical Study', *Journal of Technology Management and Innovation* (8), 64-78.



Kishk, M. & Ukaga, C., 2008, 'The Impact of Successful Risk Management on Project Success', in Dainty, A. (eds.), Procs 24th Annual ARCOM Conference, Association of Researchers in Construction Management, September 1-3, 2008, pp. 799-808.

Kartam, N. A. & Kartam, S. A., 2000, 'Risk and its management in the Kuwaiti construction industry: a contractor's perspective', *International Journal of Project Management* (19), 325-335.

Kothari, C.R., 2004, *Research Methodology – Methods and Techniques*. New Age International Limited.

Lambert, S. C. & Davidson, R. A., 2004, 'Applying the Australian and New Zealand Risk Management Standard to Information Systems in SMES', *Australasian Journal of Information Systems* 12 (1), 4-17.

Laryea, S. & Hughes, W., 2008, 'How contractors price risk in bids: theory and Practice', *Construction Management and Economics* 26(9), 911-924.

Latham, S. M., 1994, *Constructing the Team*, HMSO Publications.

Leitch, M., 2010, 'ISO 31000:2009 –The New International Standard on Risk Management', *Risk Analysis an International Journal* (30), 887 - 892.

Miller, R. & Lessard, D.R., 2000, 'Public goods and private strategies: making sense of project performance.' In: Miller, R., Lessard, D.R. (Eds.), *The Strategic Management of Large Engineering Projects: Shaping Institutions, Risks and Governance*. MIT Press, Cambridge MA, pp. 19–49.

Mahendra, P. A., Pitroda, J. R., & Bhavsar, J. J., 2013, 'A Study of Risk Management Techniques for Construction Projects in Developing Countries', *International Journal of Innovative Technology and Exploring Engineering* 3 (5), 139-142.

Mack, N., Woodsong, C., MacQueen, K. M., Guest, G. & Namey, E., 2011, *Qualitative Research Methods: A Data Collector's Field Guide*, USAID Publications.

Makombo, H. M., 2011, 'The Risk Management Framework for Organizations dealing with Construction Project Management in South Africa ', Master's thesis, Faculty of Engineering, Built Environment and Information Technology, University of Pretoria.



Martins, C.G., Morano, C.A.R., Ferreira M. L. R., & Haddad A. N., 2011, 'Risk identification techniques knowledge and application in the Brazilian construction', *Journal of Civil Engineering and Construction Technology* 2(11), 242-252.

Mobey, A. & Parker, D., 2002, 'Risk evaluation and its importance to project implementation', *Work Study* 51(4), 202-208.

Morano C.A.R, Martins C.G, Ferreira M.L.R ,2006, 'Application of techniques for the identification of risk in the E & P ventures', *Engevista* 8(2),120-133.

Meyer, N., 2014, 'A Critical Analysis of Risk Management Knowledge within the Sedibeng District Municipality, South Africa', *Mediterranean Journal of Social Sciences* 5(7), 163-170.

Napier, N. P., Keil, M., & Tan, F. B., 2009, 'IT project managers' construction of successful project management practice: a repertory grid investigation', *Information Systems Journal* (19), 255-282.

Nguyen, T. P & Chileshe N., 2013, 'Revisiting the critical factors causing failure of construction projects in Vietnam', *Built Environment Project and Asset Management* 5(4), 2-24.

Othman, A. and Harinarain, N., 1996, 'Managing risks associated with the JBCC (principal building agreement) from the South African contractor's perspective', *Acta Structilia* 16(1), 84-119.

Oracle (2010) Why Projects Fail (online). Available from:<[http://cs.anu.edu.ac/courses/comp3120/public docs/PPM-US-EN-WP/WhyProjectsFail](http://cs.anu.edu.ac/courses/comp3120/public_docs/PPM-US-EN-WP/WhyProjectsFail)>[Accessed: 7 June 2017].

Pawar, V., Attarde, P. M., Ayachit, A. C. & Kulkarni, S., 2010, 'Risk in Fast Track Construction', *International Journal of Advanced Engineering Research and Studies* 14(6), 17-20.

Pearce, P. L., 1982, 'The use of Repertory Grid Analysis to Elicit Salient Short Break Holiday Attributes', *Journal of Travel Research* 41(3), 326-330.

PICC (2012) A summary of the South African National Infrastructure Plan, viewed 22 August 2017, from http://www.gov.za/sites/www.gov.za/files/PICC_Final.pdf

Purdy, G., 2010, 'ISO 31000:2009 – Setting a New Standard for Risk Management', *Risk Analysis an International Journal* (30), 881 - 886.

PWC (2013) Highlighting trends in the South African construction industry, viewed 7 June 2017, from <https://www.pwc.co.za/en/assets/pdf/sa-construction-december-2013.pdf>
Polkinghorne, P.J. & Craig, J.P., 2004, 'Northern New Zealand Rhegmatogenous Retinal Detachment Study: epidemiology and risk factors', *Clin Exp Ophthalmol* 32,159–163.

Potts, K., 2008, *Construction Cost Management – Learning from Case studies*, Taylor and Francis Group.

Project Management Institute (2008) *A Guide to the Project Management Body of Knowledge: PMBOK Guide*. Pennsylvania.

Rafindadi, A.D, Mikic, M., Kovacic, I. & Cekic, Z., 2014, 'Global Perception of Sustainable Construction Project Risks', *Procedia - Social and Behavioral Sciences* 119 (14), 456 – 465.

Rafferty, J., 1994, 'Human aspects of project risk management', *Engineering Construction and Architectural Management* 22(1), 91-107.

Raz, T. & Michael, E., 1999, 'Use and Benefits of Tools for Project Risk Management', *International Journal of Project Management* 19, 9-17.

Ritchie, J. & Lewis, J., 2003, *Qualitative Research Practice – A Guide for Social Science Students and Researchers*, SAGE Publications Ltd.

Sanchez, H., Robert, B., Bourgault, M. & Pellerin, R., 2008, 'Risk management applied to projects, programs, and portfolios', *International Journal of Managing Projects in Business* 2(1), 14-35.

Serpellaa, A. F., Ferradaa, X., Howarda, R. & Rubioa, L., 2014, 'Risk management in construction projects: a knowledge-based approach', *Procedia - Social and Behavioral Sciences* 119, 653 – 662.

Schieg, M., 2010, 'Risk management in Construction Project Management', *Journal of Business Economics and Management* 7(2), 77-83.

Smith. N.J., Merna, T. & Jobbling P., 2006, *Managing Risk in Construction Projects. 2nd edition*, Blackwell Publishing.

Stemler, S., 2001, 'An Overview of Content Analysis. Practical Assessment, Research, and Evaluation, viewed 22 August from https://www.researchgate.net/profile/Steven_Stemler/publication/269037805_An_overview_of_content_analysis/links/547e0aba0cf2de80e7cc402a.pdf

Tadayon, M., Jaafar, M. & Nasri, E., 2012, 'An Assessment of Risk Identification in Large Construction Projects in Iran', *Journal of Construction in Developing Countries* (1), 57-69.

Tinnirello, P. C., 2000, *Best Practices Series- Project Management*, Auerbach.

Thomas, P., 2009, 'Risk Management Practices in a Construction Project – a case study', Master's thesis, Department of Civil and Environmental Engineering, Chalmers University of Technology.

Thompson, P.A. & Perry, J.G., 1992, *Engineering Construction Risks*, Thomas Telford Publishing.

Tweeds, 1996, *Laxton's guide to risk analysis & management*. Oxford: Tweeds Chartered Quantity Surveyors Firm.

Visser, K. & Joubert, P., 2008, 'Risk Assessment Modelling for the South African Construction Industry', *Portland International Center for Management of Engineering and Technology Proceedings*, 1371-1379.

Welman, C., Kruger, F., & Mitchell, B., 2005, *Research Methodology*. Wiley

Williams, T., 1995, 'A classified bibliography of recent research relating to project risk management', *European Journal of Operational Research* (85), 18-38.

Winch, G.M., 2002, *Managing Construction Projects: An Information Processing Approach*, Blackwell Publishing.

Yeo, K.T. & Tiong, R. L. K., 2000, 'Positive management of differences for risk reduction in BOT projects', *International Journal of Project Management* 18(4), 257-265.

Yin, K.R., 2003, *Case Study Research – Design and Methods Fourth Edition*, Sage Publishers.

Yin, R. K., 2009, *Case study research: Design and methods (4th Ed.)*, Thousand Oaks, CA: Sage.

Zhi, H., 1995, 'Risk management for overseas construction projects', *International Journal of Project Management* 13(4), 231-237.

Zou, P. X. W., Zhang, G. & Wang, J-Y., 2009, 'Identifying Key Risks in Construction Projects: Life Cycle and Stakeholder Perspectives', *International Journal of Construction Management* (9), 1-14.



Zou, P. X. W, Zhang, G. & Wang, J., 2007, 'Understanding the key risks in construction projects in China', *International Journal of Project Management* (25), 601-614.

