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Risk Management Rules for Successful Global Sourcing in Large Capital Projects

Mahendra Dedasaniya
12361047

A research project submitted to the Gordon Institute of Business Science, University of Pretoria, in partial fulfilment of the requirements for the degree of Master of Business Administration.

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ABSTRACT

Global sourcing has become strategically important for all large capital projects in today's world. This study identified that 11% to over 51% of the budget spent on large capital projects is absorbed by global sourcing. The complexity of global sourcing requires that a multifaceted due diligence scan of the market dynamics and stakeholder interfaces be conducted to ensure that key strategic elements of projects are well understood. There is evidence that when global sourcing risks and challenges are dealt with through a structured and integrated risk management plan, project cost, time and the right level of project quality can be successfully delivered. Furthermore, experience shows that project decisions that are made purely based on capital cost whilst failing to consider the life cycle cost of equipment in terms of capital expenditure to operational expenditure ratio for the life of the project, may prove counterproductive in the long run.

This research study set out to investigate the integrated risk management framework necessary to ensure success in global sourcing for large capital projects. It looked at the impact of global sourcing for large capital projects and how pre-emptive risk management practices help to improve project performance. Global experiences and cumulative knowledge was captured from technical experts and project management teams who have handled large projects in various sectors. As a core focus, the research interrogated the most important criteria necessary to measure and ascertain the impact of non-risk adjusted global sourcing on large capital projects in terms of project time, cost and quality.

A quantitative study design was adopted to identify the risk management rules for successful global sourcing and measure their impact. Data was collated from large capital projects in 40 countries, six continents through 89 respondents via an online survey tool authenticating the global perspective of this study. A resulting risk management model derived from the consolidated input seeks to introduce a new dimension to the body of project management knowledge related to the executing of large capital projects.

Keywords: Risk Management, Global Sourcing, Large Capital Projects, Project Performance

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DECLARATION

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

Name : Mahendra Jagajivandas Dedasaniya

Signed:

Date : 4 November 2013

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GLOSSARY OF TERMS

ANOVA	:	Analysis of Variance statistical test
CAPEX	:	Capital Expenditure
CEA	:	Cause and Effect Analysis
FMEA	:	Failure Mode, and Effect Analysis
FOREX	:	Foreign Exchange
GDP	:	Gross Domestic Product
HTP	:	Hazard Totem Pole
INCOTERM	:	International Commercial Terms published by The International Chamber of Commerce
IPA	:	Independent Project Analysis
IRR	:	Internal Rate of Return
NPV	:	Net Present Value
OECD	:	The Organization for Economic Co-Operation and Development
OPEX	:	Operating Expenditure
PESTEL	:	Political, Economic, Social, Technological, Environmental and Legal
PMBOK	:	The Project Management Body of Knowledge
PRINCE2	:	Projects In controlled Environments
QAP	:	Quality Assurance Plan
QA/QC	:	Quality Assurance and Quality Control
ROI	:	Return On Investment
SHERQ	:	Safety, Health, Environmental, Risk and Quality
SPSS	:	Statistical Package for the Social Sciences
TCQ	:	Time, Cost and Quality
USA ISPS	:	United States of America International Ship and Port Facility Security Code
3PL	:	Third - Party Logistics
4PL	:	Forth - Party Logistics

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CHAPTER 1:
INTRODUCTION TO RESEARCH PROBLEM

1.1 Introduction

“Maturity in risk management is when the company does its risk assessment when it is about to kick of a project, rather than doing it at the end “ (Hürlimann, 2011, p.6).

In the aftermath of the 2008 global financial crisis and faced with the continued volatility of major economies, organisations worldwide have become more focused on risk management (Plaschke, Rodt, Pidun, & Gunther, 2013). According to Hürlimann (2011), the prospect of continuing market volatility coupled with uncertainties from the increased globalisation trend, has brought about revolutionary change for risk management in the corporate sector and has forced business leaders to look for risk both more deeply within their own organisation and more widely in the competitive world within which they operate.

The Organization for Economic Co-Operation and Development (OECD) was cited in Accenture (2012) report, to estimate that the combined investment in global projects as well as global infrastructure investment required for telecommunications, road, rail, electricity and water was likely to total around an average of 2.5% of the world gross domestic product (GDP) by 2030. If electricity generation and energy related infrastructure investments in oil, gas and coal were included, the annual share of GDP rises to around 3.5%. This figure would be even higher if one factored in other infrastructure projects such as metal and mining, ports and airports. To put this GDP impact into currency valuation context embellishing understanding of the value of managing risks in large capital projects, the world total GDP in 2012 was US Dollars 68.5 Trillion (The World Bank, 2013), 3.5% of this equates to US Dollar 2.4 Trillion being invested into large capital projects by 2030. Hence, the subject area of this research is set to have a material impact on global sourcing expenditure.

Debates and discussions on the risks involved and challenges being faced in global sourcing for large capital projects are common. Christopher, Mena, Khan & Yurt (2011) recognised that failure in global sourcing is mainly due to the absence of a structured multi-disciplinary approach for risk management and a related mitigation system. These developments are prompting many businesses to focus on pro-actively managing risks, rather than simply mitigating in a reactive way

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(Hürlimann, 2011) and adopting a new approach to risk management. Organisations need to stop thinking of risk management as regulatory issues but rather reconceive it as a value creating activity (Plaschke et al., 2013).

Therefore, there is compelling motivation for exploring the defining of a structured risk management framework for successful global sourcing in large capital projects and investigating in a positive or negative correlation of successful global sourcing on project performance with respect to project time, cost and quality.

1.2 The Background of the Problem

In today's dynamic environment, projects are becoming increasingly complex because of the global interface and connection, hence the pressures for faster, cost effective and clever solutions to cope with the fast changing business world, is making projects highly complex and intricate. The Perminova, Gustafsson, & Wikström (2008) study showed that risk, as an uncertain event when it occurs, has a positive or negative effect on at least one project objective, such as project time, project cost, project scope or project quality. A Manuj & Mentzer (2008, p.133) study showed that "there is a lack of conceptual frameworks and empirical findings to provide clear meaning and normative guidance on the phenomenon of global supply chain risk management".

In terms of the trend towards global sourcing, Monczka, Trent, & Petersen (2006) forecasted in a CAPS research report that in 2010, thirty eight per cent (38%) of firms will annually make over sixty per cent (60%) of their expenditures through global sourcing which is up from eighteen per cent (18%) of firms in year 2000. The McKenna, Schwarting, Uffhausen & Yates (2011) survey results showed that approximate ninety per cent (90%) of the total budget for large scale projects is expended on procurement activities which include everything from engineering, materials and equipment to construction and if managed effectively then the organization enjoys higher returns on investment. The Tevelson, Gocke, Alsén, Tauber & Benett (2012) study also supports this view emphasizing that external capital spending represents 80 percent or more of a project's total budget.

Hillson (2011) argued that uncertainty is both a reality and a great challenge in most projects. This view was supported by Thamhain (2013) who argued that dealing effectively with risks in large complex projects is difficult and half of the time key risks are not being detected before they affect the project performance. Any part of a project's activity which creates risks to the project often brings

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surprises throughout the project life cycle, affecting everything from technical feasibility to cost, market timing, financial performance and strategic objectives.

McKenna *et al.,* (2011) emphasized that success in capital projects depends on how an organization manages their sourcing activities which severely impacts targeted returns on investment. They highlighted that “most capital projects are off schedule, over budget and generate a nominal return on investment“(p.2).

The risks in large projects are not only associated with the technical part of the work but also related to such dimensions as the global sourcing activities to get top quality resources, services, new technology and project management practices adding to the complexity of social, cultural, political, organizational and technological environment dimensions. If global sourcing is not managed properly it increases the capital project cost. Hollmann (2003) surveyed that for each 10% increase in the capital projects cost there is a corresponding approximate 2% decrease in the Internal Rate of Return (IRR). Roberts & Schermer (2011) further highlighted that there is an inverse relationship between project cost and IRR, and advised that to maximize IRR on large capital projects, project controls are required to be implemented early in the project.

Integrated project management cycles for large capital projects have many critical elements as shown in the inner circle of Figure 1. The outer circle shows the positive or negative impact of global sourcing on various elements of a project management cycle. The project risk management component only covers the risk associated with the projects safety, health, environmental impact and typically does not include the risk assessment relevant to global sourcing. However, global sourcing decisions impact positively or negatively through all the elements of the cycle. Loch, DeMeyer, & Pich (2011) stated that over 70% of large capital projects fail to meet their stated objectives. According to Project Management Institute (2008), the integration of the elements mentioned below in Figure 1 help in continuous monitoring and controlling of project performance and on balancing the trade-off between cost and time.

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Figure 1 Impact of Global Sourcing on Various Elements of Project Management

Source: adapted from project integration management introduced by Project Management Institute, 2008, p.60)

The **P**roject **M**anagement **B**ody **o**f **K**nowledge (PMBOK) and **P**Rojects **In** **C**ontrolled **E**nvironments **(**PRINCE2) are widely used globally in effectively managing large capital projects. The PMBOK guide recognized procurement as one of its nine critical knowledge areas but not the contribution of this function to project or risk involved in sourcing and its effect on project objectives (Project Management Institute, 2008). Similarly PRINCE2 which is being used in 150 countries does not even mention any importance of having risk management in sourcing in projects(Office of Government Commerce, 2009).

It is observed that benefits derived from global sourcing are in direct proportion to the risk involved in the process, but sometimes it is difficult to understand the intensity of the risks involved in global sourcing for large capital projects. Winther (2005) argues that companies have to “expect the unexpected” (p.4) and be in a position to manage the risks that might arise through global sourcing. He further added that global sourcing is about managing risks, and not avoiding risks as they

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are here to stay and will actually increase in future, however if managed properly then global sourcing can provide a significant competitive advantage.

Plaschke *et al.,* (2013, p.3) emphasised that "risk management has now become a top management priority in every industry". The earlier study of Tevelson *et al.,* (2012) also suggested that risk management in capital procurement has become significantly more important over the last three years as capital procurement is a corner stone for project success. They further emphasized that organisations using proper capital procurement processes which includes a risk management tool as an essential part, can save as much as 15% of a capital project's net present value (NPV) while reducing risk and ensuring that budgets and timelines are met.

Masaaki Kotabe, Mol & Murray (2009) stated that 50% of organizations reported that their global sourcing initiatives fell short of expectation. In today's business environment, it is a prerequisite to source products and services across the global marketplace with the aim of reducing the overall time and cost of a project whilst delivering right project quality towards gaining competitive advantage for competing globally. Hence, how to source globally has become a critical strategic decision which is influenced by the capabilities and innovation needed to manage the risks involved whilst ensuring that organisations achieve desired objectives.

1.3 Research Objectives and Motivations

In view of the context thus outlined, it was important to study and seek to define a risk management framework in global sourcing to enhance the overall success rate potential for large capital projects understanding its correlation with project time, cost and quality. Hence, the objectives of this research were:

1. to identify the core elements for a model that can be referenced as part of the rules of risk management serving as a guide to successful global sourcing for large capital projects

2. determine the correlation between risk management rules for successful global sourcing and project performance for large capital projects in terms of project time, project cost and project quality.

3. provide guidance, and input to the Project Management Institute and to the Office of Government Commerce for managing PMBOK and PRINCE2 to be included in the tools of risk management as a section on global sourcing/procurement for large capital projects and

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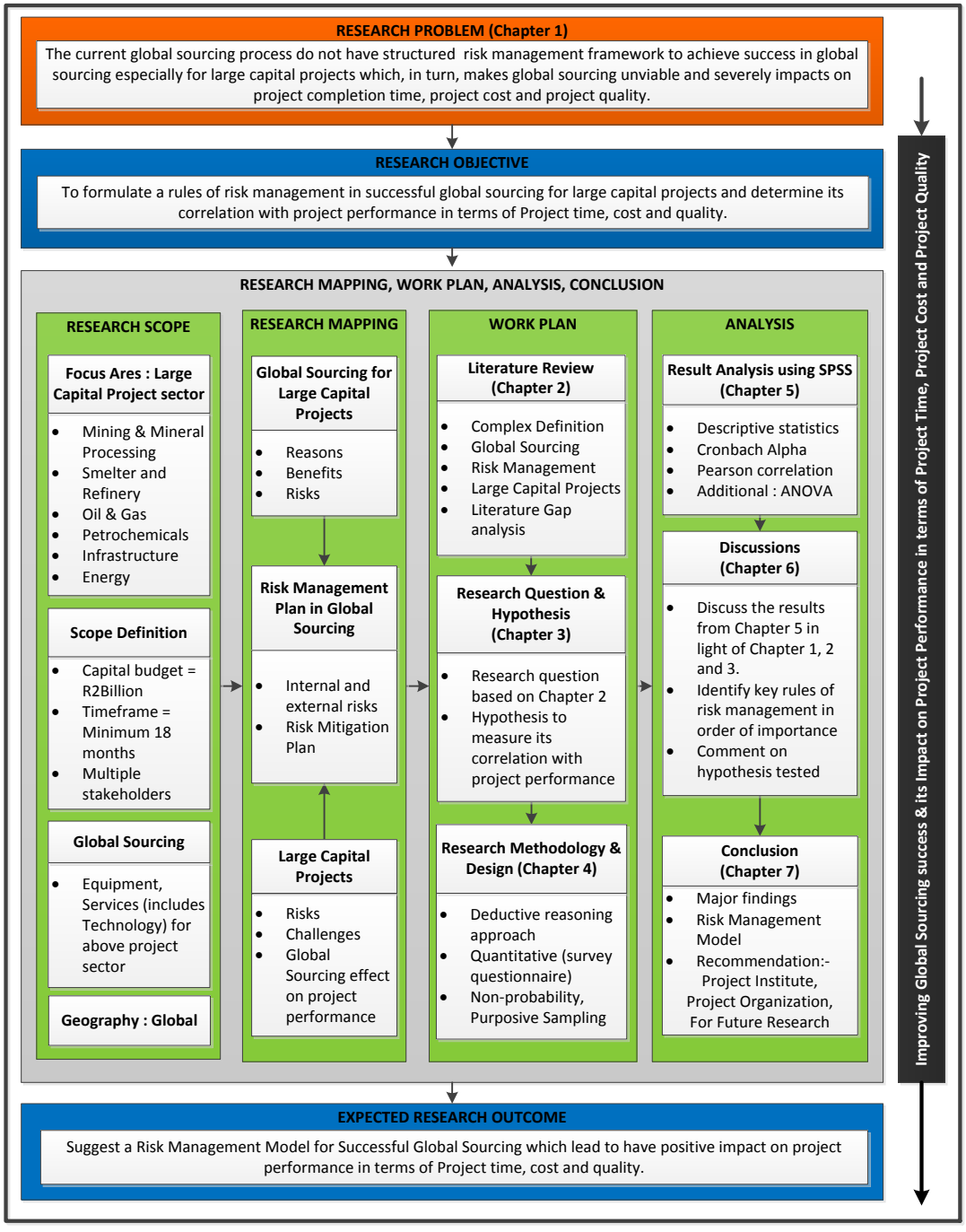
4. define a practical framework for effectively managing the risks associated with global sourcing hence increasing the success rates in global sourcing for large capital projects.

1.4 Structure of this Research Report

A research methodological framework could be developed in many ways based on the types of issues the researcher chooses to address. The structure of this research report including overview of all chapters is designed as shown in Figure 2 which provides a focused road map towards achieving the research objectives.

Figure 2 Structure of this Research Report



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The organisation of this research report outlined above is based on the following:

- Problem identification
- An upfront identification of research scope, project sectors and definition of focus of analysis
- Assessment framework which integrates mapping, work plan and analysis
- Appropriate literature review related to research topic segmentation
- The research questions identified based on literature review
- A hypothesis driven analysis based on survey questionnaire
- Interpretation of results and findings guided by statistical analysis
- Formulation of a risk management model for successful global sourcing ultimately leading towards a positive impact on project performance.

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CHAPTER 2:
THEORY AND LITERATURE REVIEW

The literature surveyed revealed the significance of risk management in global sourcing for large capital projects. This was found to be one of the critical factors for organizations seeking success in global sourcing in large capital projects.

2.1 Introduction

Monczka and Trent (2003) highlighted that the most important area where many organizations believed they could capture the benefits of globalization is through the opening up of global sourcing opportunities. Mohamad, Julien, and Kay (2009) also supported the need for globalization in order for business to overcome cost pressures and gain a competitive advantage. They argued however that it is difficult for organizations to achieve this competitive advantage due to volatile environments. On the other hand, this view was contrasted by Jensen and Petersen (2013, p.67) who cited various authors emphasizing “managers are under pressure to adopt global sourcing strategies, because evidence also indicated that many international sourcing operations failed to achieve the expected benefits."

Manuj and Mentzer (2008) argued that risk management in sourcing is an emerging topic in an interconnected world and that it is important to have a conceptual framework which provides clear definition and guidance to carry out sourcing activities. The importance of global sourcing is steadily rising, both in business (Steinle and Schiele, 2008;Trent and Monczka, 2003) as well as in scholarly research (Quintens, Pauwels and Matthyssens, 2006) as most companies engage in global sourcing in some form and to some extent. A vast amount of academic perspective has been collated on risk management practices in the supply chain for the retail sector but very little has been specifically prepared on global sourcing for large capital projects. Further, there appears to be a dearth of data that has identified the correlations between success in global sourcing and project completion on time and within target cost. Therefore, it is important to understand the risks and their framework of impact on successfully delivering global sourcing for large capital projects.

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2.2 Complex Definitions of Terms

There are a number of contextual terms used in this study which need to be understood at the onset and are thus defined.

2.2.1 Large Capital Projects

Large capital projects are those which deal with many diverse and powerful stakeholders, complex technical requirements, unbalanced large cash flows, scale effects (economies of scale) in both the project management organizations and the technology, equipment, services to be delivered often under intense regulatory scrutiny of safety, environment and probity aspects (Cooper, Grey, Raymond and Walker, 2005). The purpose of this research, large capital projects were considered as any green field project in metal, mining, mineral processing, energy, infrastructure, oil and gas and petrochemicals sector globally with a capital expenditure of more than two billion South African Rand or its equivalent amount in any currency (at an exchange rate of 1 US Dollar = 9 South African Rand as of 18th April'2013), a project life cycle greater than 18 months and many stakeholders (minimum five) involved in project execution. All these criteria are not mutually exclusive.

2.2.2 Global Sourcing

Global sourcing differs from international purchasing in terms of scope and complexities and is defined as "proactively integrating and coordinating common items and materials, processes, designs, technologies and suppliers across worldwide purchasing, engineering and operating locations" (Monczka, Trent and Handfield, 2005,p.304).

2.2.3 Successful Global Sourcing

The presence of a well-defined sourcing approach and process is the strongest differentiator between successful and less successful global sourcing (Trent and Monczka, 2002). For the purpose of this research, successful global sourcing is defined those who managed to deliver equipment, services, work packages, design and engineering with the right quality, within the agreed delivery period at lower life cycle cost.

2.2.4 Front End Loading Process

The front end loading process for large capital projects was defined by Jergeas (2008) as the period from project sanction to proceed until selection of major multiple suppliers and contractors for project execution. In practice and with

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respect to global sourcing, it included the screening and identification of emerging sourcing opportunities, risk identification and mitigation plan/s, procurement strategy based on the work breakdown structure or work packages. It also covered competitive analysis to decide which equipment, materials or service to source from where, due diligence of the vendors, and vendor involvement at an early stage of project initiation process and the setting up of required procurement policies and systems for global sourcing.

2.2.5 Project Risks

Wideman (1986) in Kayis *et al.,* (2007, p.388) defined project risk as "the chance of certain occurrences adversely affecting project objectives". It was measured in terms of consequences and likelihood of having an impact on expected outcome or event, such as a deviation from the project plan in terms of timeline, cost, IRR and performance. The consequences were highlighted as having the potential to be either positive or negative (Cooper *et al.,* 2005).

2.2.6 Risk Management in Global Sourcing

A definition of risk management in global sourcing adapted from Manuj and Mentzer(2008,p.205) describes it as "the identification and evaluation of risks and consequent losses in the global supply chain, and implementation of appropriate strategies through a coordinated approach among all stakeholders with the objective of improving supply chain performance by reducing one or more of the following – losses, probability, speed of event, speed of losses, the time for detection of the events, frequency, or exposure".

2.3 Global Sourcing

Global sourcing for large capital projects is practiced as a business tool by all major project houses to gain a competitive edge and to achieve high return on investments (ROI) on projects. Many researchers added further credence to the need for global sourcing. Manuj (2013) cited Minter (2009) and Paul *et al.,* (2010) who surveyed recent business trends that indicated that global sourcing activities were set to increase over the next few years. This view was supported by Schiele, Horn and Werner (2010) who cited Mot *et al.,* (2002, p.8) stating that "internationalization of sourcing is not only a strategic choice but to some extent also an imperative dictated by industry competitors". Kotabe and Mol (2006) pin pointed global sourcing as having the effect of causing a "leader follower behaviour effect" since many organisation just want to follow their competitor's manoeuvres closing in on any first mover advantage (p.298).

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2.3.1 Necessity of Global Sourcing

Birou and Fawcett (1993) first defined international sourcing as a buying mechanism which focuses outside the organization's country of manufacture and does not coordinate the requirements among worldwide business units of a single firm. Mohamad, Julien and Kay (2009) explained the focus on coordination and integration of the requirement of worldwide business units to differential international purchasing and global sourcing. On the other hand, Monczka and Trent (1991, p.4) referred to global sourcing as "the integration and coordination of procurement requirements across worldwide business units, looking at common items, processes, technologies and suppliers". Monczka *et al.,* (2006) modified their perspective further stating that global sourcing and supply moves beyond international purchasing and it includes the integration of sourcing operations, design/development of solutions for internal customers located in different countries. These definitions confirm and highlight that the integration and coordination of associated activities made global sourcing more complex when compared with international purchasing.

Kausik and Mahadevan (2012) placed emphasis on the strategic side of global sourcing. They referred to global sourcing as a complex process, not a temporary phenomenon and one that was here to stay. Murray (2001) emphasized the need for technological diversification to adopt competitive technologies and the formation of strategic alliances in global sourcing to gain competitive advantage. Arnold (1989) supported this view stating global sourcing was a critical feature in competitive strategies, such as supporting a global strategy to realize economies of scale.

Hence, global sourcing has become a part of corporate strategy, not only to gain competitive advantage, but also to capture benefits from a wide perspective including for example the advantages of shifting activities to other areas in the globe whose regulatory frameworks may be more conducive towards a specified endeavour offsetting the potentially uneconomical demands of more restrictive nations.

2.3.2 Levels of Global Sourcing

The sourcing strategy of organisations was described to pass through various stages based on the growth, sustainability and maturity level of the organisation before concluding on a decision to embark on global sourcing. This view was supported by Nassimbeni (2006) who researched that organizations pass through

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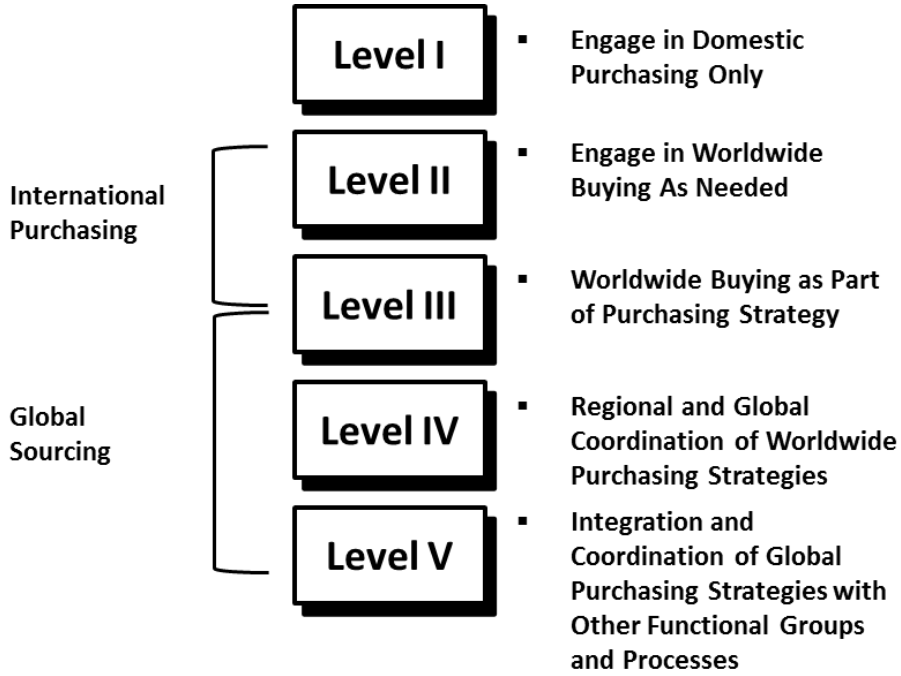
various stages to reach advanced stages of sourcing as motivated by financial factors, the organization's internationalization strategies and different national contexts. Trent and Monczka (2002) introduced levels of global sourcing as shown in Figure 3 and also explained the difference between international purchasing and global sourcing.

Figure 3 Levels of Global Sourcing



(Source: Trent and Monczka, 2002, p.69)

In an earlier study of Trent and Monczka (2002, p.70) it was stated that "a strong correlation existed between the level of international purchasing or global sourcing pursued and the benefits achieved." Mohamad *et al.,* (2009) found that mostly large organizations were operating at the higher sourcing levels and that they practiced global sourcing more extensively.

2.3.3 Benefits of Global Sourcing

As organizations have continuously sought to enhance their competitiveness, global sourcing has become a much sought after area that can add monetary value to the bottom line whilst becoming an integral part of daily activities. Monczka and Morgan (2000) argued that there must be an absolute linkage between global sourcing and target financial benefits which motivated them to research commonly accepted reasons for global sourcing such as lower costs for labour, land, raw materials and facility costs.

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Monczka and Trent (2003) and Petersen, Prayer, and Scannell (2000) identified that the cost saving benefits from global sourcing are up to 20% and Boston Consulting Group (2007) in Schiele *et al.,* (2010) refers to savings of up to 60% for certain supplies. This view was contradicted by Steinle and Schiele (2008) who stated that the savings percentages were just insights based on single product experiences and might not have been considered representative of the entire firm. They further argued that these savings were not adjusted for the costs of failed global sourcing activities and possible trade-offs with other sourcing strategies.

Christopher *et al.,* (2011) argued that the benefits to be gained from global sourcing are more than mere cost savings. They extend to greater access to new technologies, emerging markets, better quality, higher delivery speed with flexibility, guaranteeing the availability of limited resources, introduction of competition to the domestic supplier base and improved political and regulatory environment in supply market. These views were echoed by Mohamad *et al.,* (2009) who further referred to the highest benefit of global sourcing as lower costs and added that other benefits include access to higher-quality goods, worldwide technology, and better delivery service.

Hauer (2003) gave a different perspective to global sourcing and introduced risk controlled global sourcing to deliver an improved financial performance as well as to give an organization a competitive advantage in today's increasingly complex environment. Organisation has come to be believed that a dollar saved through sourcing, contributes directly to the bottom line of the balance sheet of the company. In contrast to these discussions, Steinle and Schiele (2008) argued that there are limits to global sourcing and that sometimes it is better to develop a local source rather than going for global sourcing. They went on to refer to global sourcing as a technology adoption paradox and introduced the cluster theory which highlighted interconnecting geographically proximate groups of companies in terms of their economic geography and regional economy to grab consolidated benefits.

Lau and Zhang (2006) and Lynch (2004) discussed the importance of global sourcing as an economic improvement since it helps in cost reduction, capital cost reduction, cost savings and strategic improvement for process re-engineering. On contrast, Najafi, Dubois, and Hulthén (2013) argued that the many organisation aimed for global sourcing in an attempt bid to achieve higher margins and not necessarily to capture the efficiency improvements in a long-term perspective.

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2.3.4 Challenges in Global Sourcing

Various authors have highlighted that the benefits of global sourcing are in direct proportion to the organizational capability for handling the risks associated with this process. Kausik and Mahadevan (2012) referred to global sourcing as a far more complex process than that being studied in this literature review. They focused on multi-currency transactions and exchange rate fluctuation uncertainties which offset the benefits of global sourcing. They stated that the challenges associated in understanding logistics cost, cultural, behavioural and economic differences have not yet been well understood. In their reflections on perspectives on the matter, Steinle and Schiele (2008) asserted that machinery, equipment and software displays lower productivity in foreign countries more than they do at home as each item has a cultural content which does not perform for fit for purpose and arose the technical difficulty in operating and maintaining this equipment.

In addition to the above, Jensen and Petersen (2013) focused on global sourcing of services and their research indicated that whilst higher returns can be captured, this strategy was also associated with increased risks. They further highlighted that the success of global sourcing in services was determined by managers' risk perceptions, related levels of tolerance, and ability to employ risk-reducing measures when dealing with global sourcing challenges.

2.3.5 Global Sourcing Success Factors

Trent and Monczka (2005) identified that the most important factor for global sourcing success is access to personnel with the right knowledge, skills and abilities. Petersen *et al.,* (2000) supported this view emphasising the importance of identifying the right skills equipped to successfully drive global sourcing.

In an earlier study, Trent and Monczka (2002) identified 22 factors which differentiate between successful global sourcing and efforts that are less so and subsequently highlighted the first seven factors as set out below to be the most important for successful global sourcing. An eighth one was added by Mohamad *et al.,* (2009).

1. Executive commitment to global sourcing – emphasized the role of senior management and executive leadership in the development and implementation of a global sourcing strategy.
2. Rigorous and well-defined processes – explained the importance of having a global sourcing process in place.

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3. Availability of needed resources – focussed on allocation of proper resources to support the global sourcing process.

4. Integration through information technology – highlighted the importance of having the latest innovative technology and compatible information systems with all stakeholders.

5. Supportive organizational design – advocated that there should be internal groups that are responsible for overseeing the global sourcing process, development of the procurement plan, sourcing strategy development, identification and exploitation of global opportunities.

6. Structured approaches to communication and relationship building with suppliers – explained the requirement for cross functional efforts and timely communication across the organization and all business partners worldwide.

7. Methodologies for measuring performance – defined the key performance indicators and measures to evaluate the performance improvement and benefits from global sourcing initiatives.

8. Qualified personnel – addressed the required knowledge and skills that purchasing personnel must possess to perform global sourcing successfully.

2.3.6 Lessons Learnt from Global Sourcing

Trent and Monczka (2002) summarized the lessons learnt from global sourcing and best practices in Table 1 which have led to the enhancement of the success attained in global sourcing.

Table 1 Lessons Learnt from Global Sourcing

RESOURCE COMMITMENT	INFORMATION TECHNOLOGY SUPPORT
• Executive management committed formal budget and other resources to support sourcing initiatives and activities. • Global project teams received support from others external to the team, particularly those who were responsible for executing global strategies or required to use approved global suppliers during operations.	• Participants had access to a wide range of data and information, ideally through a global data warehouse. • Support documents, guidelines, templates, and progress updates were maintained on the firm's intranet for easy access by participants.

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PROCESS	COMMUNICATION AND COORDINATION
• Global sourcing strategy development followed a rigorous and well-defined approach or process. • The global process involved individuals with the right skill set who were capable of taking a global rather than local or regional sourcing perspective. • Lessons-learned sessions were conducted at the conclusion of each project with results distributed company-wide for continuous process improvement. • Global sourcing contracts were continuously managed, reviewed, and re-established as required.	• Well-established communication methods and mechanisms were in place to coordinate worldwide activities among participants. Worldwide strategy review and coordination sessions occurred involving managers, team leaders, and other participants. • Project teams developed plans to manage the risks associated with global sourcing and supply. • Global strategy development efforts aligned directly with business objectives as well as the objectives of technology and new product development groups.
ORGANISATIONAL DESIGN	**MEASUREMENT**
• The global sourcing process relied extensively on cross-functional/cross-locational teams with support from functional and executive managers. • An executive steering committee provided leadership and guidance to the process. • Users or other internal customers were involved during global sourcing projects. • Sourcing support personnel were (1) collocated with technical and marketing personnel during product design and development projects and then (2) linked to the appropriate global sourcing team.	• Expected savings from global sourcing initiatives were considered during the calculation of a firm's financial projections. Global supplier evaluations were conducted and included site visits to assess and measure the worldwide performance capabilities of suppliers. • They were able to quantify and report savings from global sourcing activities and individual projects that routinely occurred.

(Source: Trent and Monczka, 2002, p.79)

In conclusion, these lessons highlight the role of the right execution skills and the following of a well defined global sourcing process, preparing risk mitigation plans to manage identified risks and conducting a proper due diligence of global suppliers before engaging with them. Furthermore, there is clear indication that the success of global sourcing also depends on proper integration and cross functional coordination. Executive support in allocating the cost, time and resources to global sourcing initiative is critical (Trent and Monczka, 2002).

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2.4 Large Capital Projects

Many authors have referred to large capital projects as mega projects, complex projects and giant projects. Grün (2004) is cited to have argued that giant projects characteristics are based on singularity, complexity, goal-orientation (technical, financial, time) and the nature and the number of project stakeholders (Zidane, Johansen, and Ekambaram, 2013). Turner and Zolin (2012) suggested that large, complex projects often fail to meet project output objectives in terms of the triangle of time, cost, and quality (TCQ) however these are not the best measure of project success. He suggested considering the views of multiple stakeholders over multiple time frames to accurately evaluate the project success.

2.4.1 Characteristics of Large Capital Projects

Eweje, Turner, and Müller (2012) expressed a slightly different view and argued that large capital projects are long life cycle projects and therefore less predictable in terms of time and scope with high probabilities of failure. Miller and Lessard (2000) said rewards in projects improve the probability of success as the project performance is skewed based on the reward structures for key stakeholders.

Zidane *et al.,* (2013) summarized the characteristics of mega projects as tabulated in Table 2 and describe megaprojects as large scale complex projects that often fail to meet project completion time, costs and anticipated project objectives.

Table 2 Megaproject Characteristics and Descriptions

Element	Characteristic and Description
Size	Large scale project (huge scope) Technologically and logistically demanding
Cost	Exceeds one billion US dollar
Time	Exceeds 5 years long duration Always schedule urgency to complete the project before time
Success	Projects are successful when project objectives are achieved in terms of costs estimations, time schedules, and anticipated project performance.
Complexity	Associated with high risk. They require the management of numerous, concurrent, and complex activities and tend to contain large elements of technological innovation.
Impacts	High impact on the community, environment, state budgets.
Singularity	Typically unique, no megaproject looks like another.
Stakeholders	Such projects attract a high level of public or political interests.
Implementation owner	Multifaceted and hence require multidisciplinary inputs from many organizations

(Source: Adapted from Zidane *et al.,* 2013, p.351)

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2.4.2 Factors Causing Cost Overrun for Large Capital Projects

Jergeas (2008) cited Independent Projects Analysis Inc (2006) whose research showed that poor front-end planning is the biggest contributor to cost overruns. The Construction Industry Institute (CII,1987) in Jergeas (2008) identified many reasons for cost overruns in projects including but not limited to:

- scope that was inadequately defined in the agreement,
- insufficient front-end loading,
- unrealistic or overly optimistic original cost estimate and schedules,
- under appreciation of project complexity, interfaces, interdependencies, and risks associated with the mega project environment,
- lack of knowledgeable leadership in the engineering, procurement, construction, and start-up of mega/major facilities,
- non-selection of proper supplier of choice as a part of procurement strategies,
- lack of logistics knowledge and transportation cost,
- lack of understanding of the cost and impact of environmental and regulatory work, and
- labour related issues - labour productivity and unavailability of high skilled resource.

The other reasons for cost overruns identified by Rahman, Memon and Karim (2013) are illustrated in Table 3.

Table 3 Internal and external Drivers of Cost Overruns

Risk Classification Category	Drivers of Cost Overruns
Internal – Controllable by the organisation	• Lack of expertise to manage the performance of suppliers/contractors • Frequent changes in design, lay out • Execution of highly complex project without proper front end loading • Frequent conflict among various stake holders due to non-clarity in scope, battery limits and contract conditions
External – Beyond control of the Organisation and mainly related to Political, Economical, Social, Technological, Legal and Environmental (PESTEL factors)	• inflation of prices • fluctuation in currency • unstable government policies • weak regulation, • unpredictable weather conditions, • non availability of skilled manpower • unstable interest rates

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This view is further supported by Flyvbjerg, Skamris Holm, and Buhl (2003) who studied 258 projects in 20 different nations with a total cost of USD 98 billion and average project cost of USD 1.5 to USD 9 billion and concluded that 9 out of 10 projects have cost overruns of more than 28% of forecasted cost and that their cost performance has not improved in the last 70 years.

2.4.3 Challenges in Large Capital Projects

Eweje *et al.,* (2012) observed four risk areas in mega projects and suggested one of the major challenges in executing large capital projects is the area of contracting and procurement management. Badri, Nadeau, and Gbodossou (2013) highlighted that mining projects performance has often influenced by several factors such as project complexity, and in particular scale, duration, budget, number of suppliers and subcontractors. A number of authors referred to other factors such as variability of equipment, worker experience, skill and geographic origin, management tools and most significantly the operational methods employed (Rousseau, 2011)). Radosavljevic, Lilic, Curcic and Radosavljevic (2009) emphasized interdependencies, in particular between workers, promoters, teams, relationships and organizations as a challenge in large capital project management.

2.4.4 Realisation of Project Success

There are different views and perspectives to measure project success. Turner and Zolin (2012) argued that project success is measured not only by completion of the scope of work on time, and within cost and quality requirements, but also by the performance of the project based on outcomes, impacts and the achievement of the desired business objectives, as assessed by different stakeholders over different timescales. Eweje *et al.,* (2012) argued that the impact of large projects goes well beyond the immediate completion of the project. On the other hand, Olawale and Sun (2010) only emphasized that cost performance is the most important indicator for project success. In contrast, Miller and Lessard (2000) argued that the success of large engineering projects depends on managing complex structures, contractual mechanisms, and risk relationships as well as supplier selection.

Turner (2009) cited and extended the Shenhar and Dvir (2007) model of project success based on efficiency, impact on the team and impact on the customer, business success measuring schedule, cost, yield and performance. The other characteristics are stipulated in Table 2.

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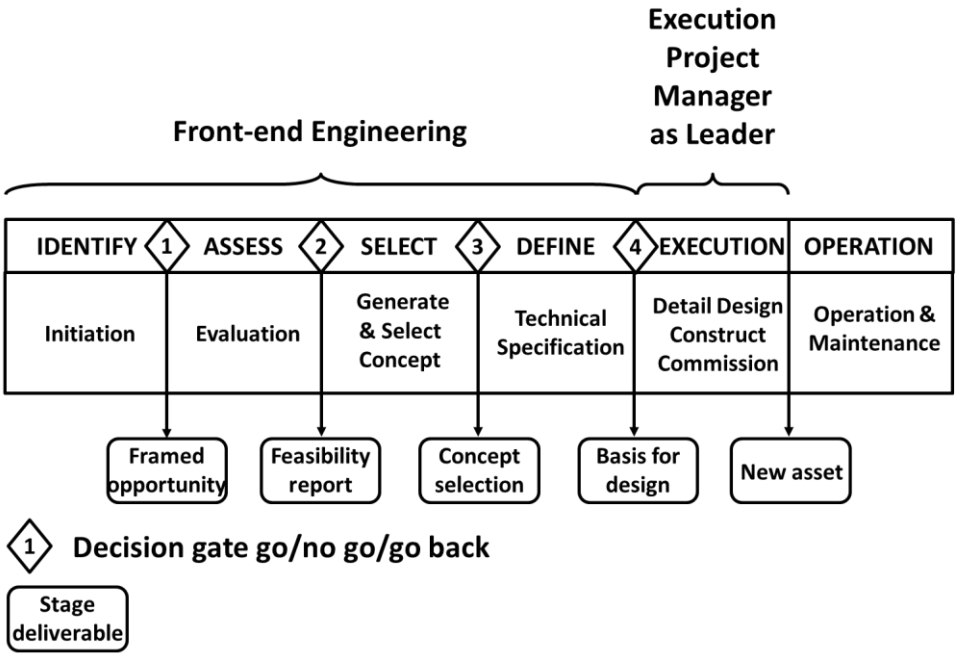
Eweje *et al.,* (2012) also argued that past training and the experience level of the project manager, as well as his ability to manage contracts determined the project success. They introduced a typical project delivery process as shown in Figure 4 which was decision based and heavily dependent on the front end engineering where the most value is created.

Figure 4 Project Realisation Process



(Source : Eweje *et al.,* 2012, p.640)

Teller (2013) cited work by various authors who summarized that insufficient risk management increases unexpected events, causing cost overruns and delays leading the project towards reduced success or failure. Xue, Turner, Lecoeuvre and Anbari (2013) focused on negative effects on project performance due to poor attention in the front end loading process.

2.5 Risk Events in Global Sourcing

"*Only those who will risk going too far can possibly find out how far one can go". By T.S.Eliot (1948).*

Manuj and Mentzer (2008) referred to risk as an uncertain future event that creates difficulty in achieving the planned objective. According to Christopher *et al.,* (2011, p.77)"Global sourcing trends are making the supply chain longer and more fragmented and this is exposing firms to greater costs and risks". The cost and risk involved in a global sourcing strategy may sound daunting, but the benefits can be substantial.

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2.5.1 Risks in Global Sourcing

Historically, global sourcing has been practiced for a long time by maritime nations. With ever changing technology and a country's competitiveness over time, the type as well as degree of risks have continuously changed and evolved. British Standard 4778 (1991) was cited to define risks as a "combination of probability or frequency of occurrence of a defined hazard and magnitude of the occurrence" (Tummala and Schoenherr,2011, p.474). The article goes on to further embellish this definition stating that supply chain risk was an event that adversely affected the supply chain performance, service levels as well as costs.

Christopher and Peck (2004) identified global sourcing risks in five categories such as process risk and control risk (internal to the organization), demand risk and supply risk (internal to the supply chain) and environmental risk (external to the supply chain). A similar classification was developed by Ghosal (1987) who classified supply chain risks as macroeconomic risks, policy risks, competitive risks and resource risks which are all external to the organization.

Manuj and Mentzer (2008) further built on this and added four other categories of risks such as supply risks which affect the customer demand in terms of both quantity and quality. Demand risks were said to be those that bring about variance in the volume supplied and desired by the customer. Operational risks being an organization's internal ability to produce right quality of equipment, services at right time while maintaining the profitability and finally security risks as related to operations integrity, information systems and pattern infringement.

Guided by these classifications, Manuj and Mentzer (2008) studied and identified the risk events as currency and oil price fluctuation, safety and quality requirement, as well as uncertain risk events not anticipated by either the suppliers or purchasers and emphasised that any of this risk influence the outcome of other risks. For example; positive results for one stakeholders in supply chain may be a risk event for another stakeholder.

Monczka *et al.,* (2006) also emphasised risks in successful global sourcing as - adherence to contract conditions, intellectual property, logistics, taxes, lead time, quality and language/cultural barriers. Similar risks in global sourcing have also been identified by various authors and are here compiled and tabulated in Table 4. According to Cousins, Lamming, and Bowen (2004) appropriate management of these risks can assist in receiving the right quality of materials and increasing the organization reputation, revenue and share price.

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Table 4 Risks in Global Sourcing

Risks in Global Sourcing	Referred by
Hidden costs – These are difficult to identify and ultimately result into a decrease in the envisaged benefits from global sourcing.	Braithwaite and Wilding (2003);Fagan (1991);Fitzgerald (2005);Trent and Monczka (2005);Tsai, Liao, and Han (2008)
Quality issues – Quality standards that are not in line with the stipulated requirement.	Tsai *et al.,* (2008); Braithwaite and Wilding (2003);Liu, Berger, Zeng, and Gerstenfeld (2008); Fitzgerald (2005);Zsidisin (2003); Wagner and Bode (2008)
Higher lead time compared to local source.	Fagan(1991);Fitzgerald,(2005); (Levy,1995)
Higher transport cost due to long distance.	Fagan(1991);(Levy,1995)
Slow responsiveness due to long distance and culture barrier.	Braithwaite and Wilding, (2003)
Poor infrastructure and communication leading to supply disruption.	Fitzgerald,(2005); Liu *et al.,* (2008); Tsai *et al.,* (2008)
Political instability.	Fitzgerald,(2005); Liu *et al.,* (2008);Fagan (1991)
Exchange rate fluctuation.	Liu *et al.,* (2008);Fagan (1991); Trent and Monczka, (2005)
Cultural and time differences.	Liu *et al.,*(2008);Trent and Monczka, (2005)
Increased rules and regulations.	Trent and Monczka, (2005)
Negative impact on sustainability, environmental risk and Corporate Social Responsibility (CSR).	Andersen and Skjoett-Larsen(2009);Mollenkopf, Stolze, Tate, and Ueltschy,(2010);Ellegaard (2008)
Uncertainty over the long-term impact on supply and demand.	Braithwaite and Wilding,(2003)
Challenges in handling cross function and cross border work coordination.	Trent and Monczka, (2005); Liu *et al.,* (2008); Tsai *et al.,* (2008)
Selection of different type of technology	Giunipero and Eltantawy (2004)
Supplier performance on cycle time.	Zsidisin (2003);Wagner and Bode (2008)
Capacity not available to deliver on promise.	Wagner and Bode (2008)
Intellectual property risks.	Barry (2004)
Opportunity cost of not working with other suppliers.	Swink and Zsidisin (2006)
Reliability of Logistics service provider	Wagner and Bode (2008)
Fuel prices, Macroeconomic changes	Barry (2004)

(Source : Adapted from Christopher *et al.,*2011, p.70)

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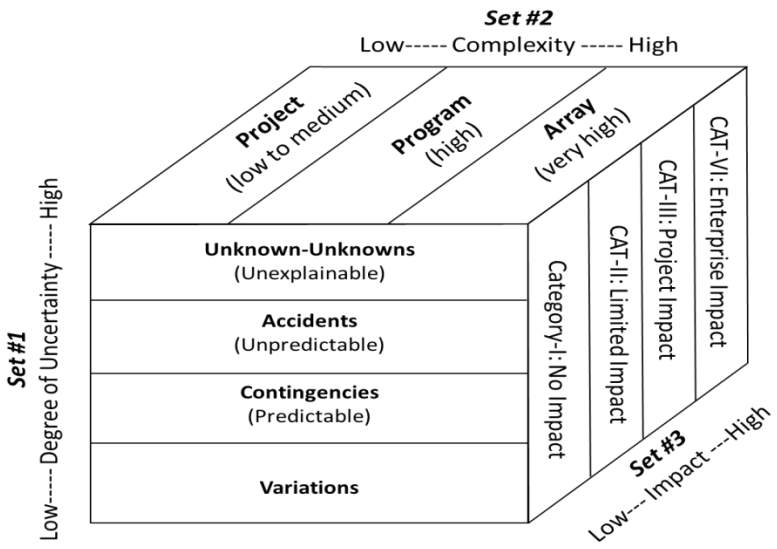
2.5.2 Dealing with Unknown Risks

Thamhain (2013) argued that project teams have tended to be efficient at identifying, and analysing known risk factors which are mainly focused on schedule, budget and technical areas but weak in dealing with unknown risks which could directly affect the project performance. He further identified three sets of variables which have created risk and, affected the cost and overall ability of dealing with the risks, as shown in Figure 5. These variables include degree of uncertainty (Set # 1), project complexity (Set # 2) and impact of risk on projects and an enterprise (Set # 3).

Global sourcing in large capital projects has had impact on both the internal and external environment of the organization and typically affected both category – III (referred as significant impact on project performance leading schedule delay and budget overrun) and category - IV risks (referred as significant impact on project and organisation/enterprise). These categories of risk have had a direct impact on project performance in terms of time and cost. To overcome these risks Thamhain (2013) stated that identifying the risks at an early stage of the project was a critical pre-condition to managing the risks While Jensen and Petersen (2013) highlighted that the major issue in dealing with this risk is for the organization to know the extent to which the risks are perceived by the management team as being acceptable.

Figure 5 Dimensions of Risk Management



(Source: Thamhain, 2013, p.4)

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The dimensions model was supported by Loch *et al.,* (2011) who stated that dealing with the unknown-unknowns is inevitably uncomfortable and dangerous.

Tummala and Schoenherr (2011) stated that in today's environment, a global supply chain had become more and more complex with less possibility of achieving the desired performance of a sourcing strategy due to risks not being properly managed throughout the supply chain. They further emphasized that an organization should plan for disruptions and develop contingency plans based on supply chain interdependencies of potential risk factors and their consequences and severities.

2.6 Effect of Global Sourcing on Large Capital Projects

The success of large capital projects can be attributed to an organization's ability to manage global sourcing as this plays an important role in determining the successful delivery of projects. Large capital projects, often being multifaceted in nature, are extremely complex to manage. Fredriksson and Jonsson (2009) argued that global sourcing probably increased project costs due to longer lead time for the delivery, inability to forecast all the cost involved in a transaction and reduced the flexibility in the project schedule.

According to Deane, Craighead, and Ragsdale (2009) the recent upsurge in political and cultural unrest in various countries coupled with catastrophic weather related events around the world has created a heightened sensitivity and awareness of the risks associated with global sourcing. Green (2004) reported that most executives acknowledged that supply chain disruption is one of their largest organizational risks and many of them are not sure what to do about it. Roberts and Schermer (2011) emphasised that the contract terms are important to minimize the owner's risk in executing a large capital project.

Sourcing methods and other motivational factors have also had a direct impact on managing risk and therefore impact on project performance. Eriksson and Westerberg (2011) concluded that the higher the focus on soft parameters in the sourcing process, the better the project performance in terms of cost, time, quality, environmental impact, work environment and innovation. Table 5 summarises the opinion of various authors who identified the sourcing process parameters and its impact on project performance in terms of time, cost and quality.

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Table 5 Sourcing Process and its Impact on Project Performance

Sourcing Process	Success criteria		
	Cost	Time	Quality
Front end loading: higher coordination between project owner and suppliers/ contractors in the early project phase to improve the project performance.	Rahman and Kumaraswamy (2004a,b) ;Errasti, Beach, Oyarbide and Santos (2007) ;Song, Mohamed and AbouRizk (2009)	Rahman and Kumaraswamy (2004a,b);Song *et al.,*(2009)	Ahola, Laitinen, Kujala and Wikström (2008) ;Eriksson (2008)
Tendering with a preferred bidder: Inviting the preferred bidder in tendering to improve the project performance.		Lam, Hu, Thomas Ng, Skitmore and Cheung (2001); Elfving, Tommelein and Ballard (2005)	
Techno-Commercial evaluation: higher weightage on soft parameters in the bid evaluation improve the project performance.		Assaf and Al-Hejji (2006)	Yasamis, Arditi and Mohammadi (2002)
Joint approval for Subcontractor selection: Joint selection of subcontractors to improve project performance.		Elfving *et al.,* (2005)	Karim, Marosszeky; Davis (2006)
Incentive based contract payment terms: the milestone based payment terms improve the project performance.	Bayliss, Cheung, Suen, and Wong (2004);Tang, Duffield, and Young (2006)		Koehn and Datta (2003)
Alliances tools: collaborative approach improves the project performance.	Yang (2007);Woksepp and Olofsson(2008)	Yang (2007); Woksepp and Olofsson (2008)	Yang (2007); Woksepp and Olofsson (2008)

(Source: Adapted from Eriksson and Westerberg, 2011, p.203)

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2.7 Risk Management Framework for Successful Global Sourcing

It is important to have a planned and holistic approach in preparing a risk management process to mitigate the risks identified in global sourcing activities on large capital projects. Manuj and Menzer (2008) identified a five step process to follow, from risk identification to strategy definition to mitigate risks as shown below in Figure 6. They further emphasized that “it is important to understand the source of the risk to establish the responsibility for management of the risk” (p.137).

2.7.1 Risk Management Objective

Cooper *et al.,* (2005, p.4) emphasized that “Risk management facilitates better business and project outcomes” and that risk management also helped in achieving the following objectives :

- making better decisions about planning , defining contingencies, allocation of proper resources and dealing with risks in design processes preventing risks and exploiting opportunities,
- better decisions for proper allocation of risk among all project stakeholders, and
- controlling project cost and time.

On the other hand, Tummala and Schoenherr (2011) proposed a framework for non-project environments using a scenario planning process by asking “what if” questions. This approach was used to assess the suitability of certain suppliers in a cross functional team approach and to articulate the risks from different perspectives resulting in the development of a risk mitigation strategy.

2.7.2 Approach to Risk Management

Cooper *et al.,* (2005) identified three key areas for effectively managing project and procurement risks and these were:

- Identifying, analysing and assessing risks early and systematically, and developing plans for handling them,
- Allocating responsibility to the party best placed to manage risks including but not limited to implementing new practices and procedures or negotiating suitable contractual arrangements, and
- Ensuring that the costs incurred in reducing risks are commensurate with the importance of the project and the risks involved.

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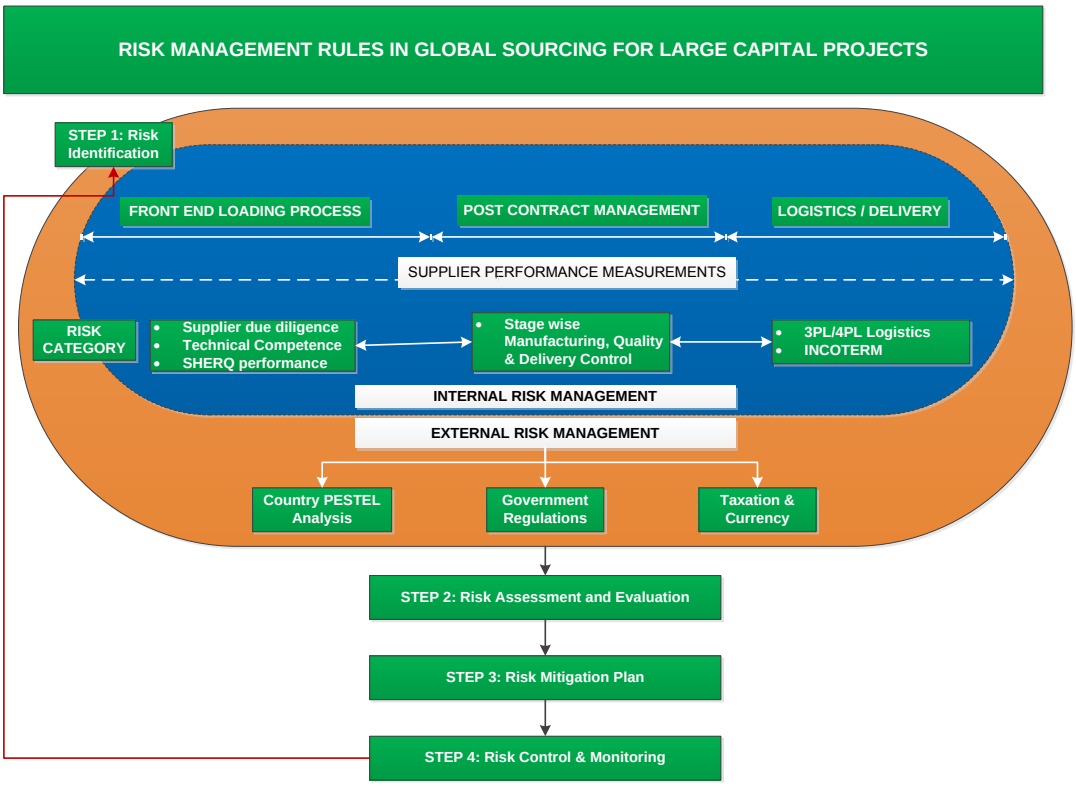
The above view is supported by Rao and Goldsby (2009) who suggested an approach for managing risks through a formal, structured risk management practice in terms of identifying, quantifying, and reducing risk. A similar argument is proposed by Manuj and Mentzer (2008), who suggest that identifying risks is the first step in developing a risk management process.

Based on the nature of the project, its context and environment, “The Global Supply Chain Risk Management and Mitigation Framework ” introduced by Manuj and Mentzer (2008,p.144) to evaluate and integrate risk evaluation aspects has been adapted to apply to global sourcing for large capital projects as shown in Figure 6. This modified approach is known as the risk management rules in global sourcing for large capital projects.

Figure 6 Risk Management Rules in Global Sourcing for Large Capital Projects



(Source : adapted from Global Supply Chain Risk Management and Mitigation Framework, Manuj and Mentzer, 2008 , p.144)

Roberts and Schermer (2011) explained that the gathering of accurate information is required for many of the criteria included in the above frame work, on a regular basis. Granular detail was said to be important to assist in the effective mitigation of risk related to schedule delays and cost increases.

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2.7.3 Risk Identification (Step 1)

Risk identification is the first and critical step in the risk management process and enables the organisation to manage the risks involved in the global sourcing process as it identifies the project's exposure to uncertainty. Tummala and Schoenherr (2011, p.476) defined risk identification as "a comprehensive and structured determination of potential supply chain risks associated with the given problem". He further emphasized that potential supply chain risks can be identified through various methods such as:

- Supply chain mapping referred to as an approach in which the supply chain and its flow of goods, information and money are represented from upstream suppliers to downstream customers.
- Checklists or check sheets tracking the risk of not delivering on time.
- Event tree analysis defined as the preparation of a plan for potential events and probable responses that may be triggered by a supply chain failure and then subsequently plan for alternatives.
- Fault tree analysis, failure mode, and effect analysis (FMEA) (Bertsche, 2008) regarded this as an important tool for determining the project environment and specially used at the design stages to identify potential risks during the manufacture stage and during its application by the end customer.
- Ishikawa's cause and effect analysis (CEA) as the process of brainstorming and understanding the depth of relationships between potential causes and failure events.

2.7.4 Risk Assessment and Evaluation (Step 2)

Risk assessment, the second step in Figure 6 takes into consideration a wide range of criteria such as the probability of occurrence of the event, the risk level and risk impact, and prioritizes the risks according to the outcome of this process (Giannakis and Louis, 2011). According to Tummala and Schoenherr (2011), there are various techniques that have become available to assess project probabilities and consequences together with their magnitude of impact in global sourcing i.e. through the delphi, parameter estimation; a five point estimation; probability encoding, or Monte Carlo simulation methods.

2.7.5 Risk Mitigation Plan (Step 3)

Step 3 of the risk management framework addressed the steps of risk mitigation and contingency plans which have helped in identifying the possible losses that

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may happen from an unexpected event. Both these parts have advised on how to draw evaluation criteria and performance measures for suppliers and logistics about the risk categories identified in Step 1 (Manuj and Mentzer, 2008).

Christopher *et al.,* (2011) tackled risk mitigation by selecting dual or multiple suppliers, building trust and relationships and managing risks in a proactive manner which helps in finding a balance between benefits gained and cost associated with the risk management method. The Hazard Totem Pole (HTP) was used to integrate the costs associated with consequence severity and risk probability levels using a HTP diagram. The risk factors placed at the top of the diagram require full attention and a close risk control action (Mak and Rao Tummala, 2001).

Once risks have been identified, and their consequence and severity has been assessed, it is important to develop the risk mitigation action plans. It has been found to be impractical to attempt to develop a mitigation plan for each risk identified, instead a risk plan can be developed to estimate the associated costs for the overall mitigation plan to contain and manage the identified supply chain risks.

2.7.6 Risk Control and Monitoring (Step 4)

In the last step of the risk management framework, risk control and monitoring helps to determine possible preventive measures and to provide guidelines for further improvement. This allows an examination of the progress to be made against specified risk categories, performance criteria and adjustment of risk response and action plans while taking corrective actions to improve the targeted project performance (Tummala and Schoenherr, 2011).

2.7.7 Supplier Due Diligence

Routroy and Pradhan (2013) identified the critical success factors for supplier development in sourcing as the need to consider long term strategic objectives, supplier's innovation capability, past experience in successful execution of projects, subcontractor's details and external environment.

On the other hand, Macbeth, Williams, Humby, and James (2012) suggested a selection of the supplier based on their intent of collaborative working and willingness to get early supplier involvement during the design phase helps to improve the performance of the entire supply chain.

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Monczka, Trent, and Handfield (2005) suggested the evaluation of suppliers in global sourcing in terms of:

- landed cost difference,
- technical capabilities,
- due diligence of the suppliers in terms of quality consciousness, cost benefits, reliability of delivery commitment and innovation ability (Fredriksson and Jonsson, 2009),
- intent to enter into long term relationship,
- patent and proprietary technology security, and
- supplier past performance measurement.

Watt, Kayis, and Willey (2010) studied the basis requirement for selection of the vendor in large capital projects and suggested that it should be based on key performance dimensions, their past experience and technical expertise. They further emphasized that the criteria should include but not be limited to relevant experience in executing projects of a similar nature, performance delivered in past projects and capacity/workload available to carry out the additional work. The other attributes important in vendor evaluation were safety performance, project management experience and organizational capability to deliver the projects on time within budget at required quality standards.

Furthermore, Manuj (2013) suggested supplier selection should incorporate both tangible and intangible criteria. The tangible selection criteria included cost, quality, delivery reliability, flexibility, and innovation. The intangible selection criteria were supplier integrity, strategic fit, and risk exposure.

2.7.8 Supplier Performance Measurement

The discipline of establishing supplier performance measurement parameters was highlighted as an important measure for tracking supplier delivery against set contractual commitments. The measured performance can be used for future decisions on whether to continue or discontinue the relationship. According to Cormican and Cunningham (2007), the performance measurement criteria should identify the parameters relevant to the organisation and assist in achieving set objectives. It should also be realistic and measurable against defined parameters such as timely execution, quality as per stipulated requirement, operational performance and cost of doing business with them.

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Lauras, Marques, and Gourc (2010) noted that performance measurement was a repetitive and cyclic process and it measured the actual performance of the project compared to the expected one. They advised the measuring of performance in terms of cost, quality, delivery and risk but it was measured in terms of relevance, efficiency, and effectiveness. The relevance referred to the measurement of the "adequacy of the means to the objectives", "effectiveness referred to assessing" whether the results of the activity met the objectives" whilst efficiency was referred to "whether the resources were well used to attain the results" (p.1059).

Toor and Ogunlana (2010) suggested that the key performance indicator for measuring the project success is beyond the iron triangle of cost, time and quality. They suggested the evaluation of mega projects in terms of project management capability and ability to manage project risks. They cited Freeman and Beale (1992) who suggested five other criteria to measure project success as being technical performance, supplier's ability to meet the safety requirement, deadlines for execution and delivering according to specifications.

2.7.9 Contracting Strategy

Roberts and Schermer (2011) suggested selecting a contracting strategy in such a way as to equitably allocate risk between the contractor and owner in order to achieve the owner's project objective. The owner should also consider including financial incentives that align the contractor's objectives with those of the owner (Eriksson and Westerberg, 2011). Inequitable risk allocation increases claims, and costs and should be avoided in the risk mitigation planning.

Roberts and Schermer (2011) highlighted that simply transferring contractual risk to a contractor was an incomplete risk management strategy. A study carried out by the Independent Project Analysis (IPA) was cited to have found that the cost and risk for claims increases based on the amount of risk the owner shifts to the contractor.

2.7.10 Risk Classification

The importance of identifying risk categories to be assessed for global sourcing in large capital projects before applying the risk management framework was discussed. Manuj (2013) highlighted the importance of external factors such as country risks in terms of political and economic stability, as one of the critical risk categories for global sourcing. Christopher and Peck (2004) also suggested considering risks related to supply countries and companies such as climate and

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weather, language skills and cultural characteristics. In addition, external risks such as terrorism, diseases and natural disasters were also highlighted.

Emblemsvag (2012) suggested different risk categories such as insufficient production capacity and poor quality control at the suppliers end affecting delivery commitment. He further added that economic indicators, price fluctuations, insolvency of suppliers as well as cross border transactions were also risks that affect delivery performance. Miller and Lessard (2000) suggested risk categories for large engineering projects as being:

- Market-related : demand, financial and supply;
- Completion : technical, construction and operational;
- Institutional : regulatory, social acceptability and sovereign.

Similarly, Dey (2010) suggested the identification of project level risks, work package level risks and activity level risks and couched an appropriate framework which helped in achieving the desired project performance and its objective.

2.8 Literature Summary

Many authors have stated that global sourcing is a business tool to gain a competitive advantage. They further identified the benefits involved and risks associated with global sourcing. If these risks are not managed in a structured way, project timelines, cost and quality can be severely impacted. The success of global sourcing also depended on many other factors such as complexity within a project, the overall complexity of the project and the risks identified during front end loading in the project life cycle. Tummala and Schoenherr (2011) further advised that risk management action plans need to be prepared to avoid the identified risks, or if not possible, at least mitigate, contain and control them.

Neiger, Rotaru, and Churilov (2009) commented that the risk management framework gave structure to both global sourcing and decision making in large capital projects. It also guided the representation of risks in a holistic business framework and articulation of the links between the risk issues and project success.

Christopher *et al.,* (2011) identified that although many managers understand the importance of risk management, they still use an informal approach to cope with the risk. Zidane *et al.,* (2013) showed that failure in sourcing is mainly due to contractual and legal issues exacerbated by the involvement of different countries,

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with different legislations and institutions. Manuj and Mentzer (2008) recommended that future research was required to test the proposition that managing and mitigating risks in the supply chain positively affected the performance of the supply chain.

Roberts and Schermer (2011) suggested having a better strategy and that the best chance of mitigating risk on large capital construction projects was for the owner to be actively engaged in sourcing as well as claims management throughout a large capital construction project.

Kausik and Mahadevan (2012) reviewed 32 papers on global sourcing published between 1997 - 2010 and found that none of them were relevant to global sourcing in projects and suggesting the need for studying several aspects for reliable global sourcing. Manuj (2013) identified a dire need to establish a link between superior sourcing risk management and its effect on outcomes.

It was observed that there were distinguishable gaps in the reviewed literature storyline. Table 6 clearly indicates areas that did not have sufficient data and literature on risk management practice in global sourcing especially for large capital project which has a direct impact in achieving the project objective in terms of time, cost and quality.

In view of the gaps identified in Table 6, it is evident that currently no formal risk management framework exists to identify, assess and evaluate risks in global sourcing for large capital projects in order to find out the correlation between risk management for successful global sourcing and project time, project cost and project quality.

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Table 6 Literature gap analysis

Topic	Theme	Author/Source	Gaps in research
Global Sourcing	Necessity	Birou and Fawcett, (1993), Mohamad *et al.,*(2009), Monczka and Trent, (1991,p.4)	It has been understood at all levels.
	Trend	Manuj (2013), Horn, and Werner (2010), Monczka and Trent (2003), Najafi, Dubois, and Hulthén (2013)	Very few articles on global sourcing related to large capital projects.
	Benefits	Monczka and Trent (2003), Monczka and Morgan, (2000), Monczka and Trent (2003), Christopher *et al.,* (2011), Mohamad *et al.,*(2009), Hauer (2003), Lau and Zhang (2006) and Lynch, (2004)	Benefits are known but not captured as estimated due to risks involved. No framework available to balance benefits and risks.
	Challenges	Steinle and Schiele, (2008),	. Mainly covers outsourcing pertaining to the retail sector but large capital projects are not included.
	Effectiveness	Trent and Monczka (2005), Trent and Monczka (2002)	
	Lessons Learnt	Trent and Monczka (2002)	
	Levels of global sourcing	Trent and Monczka (2002),Nassimbeni (2006)	
	Risks in global sourcing	Various authors as tabulated in Table 4	Risk factors identified but impact on large capital projects has not been studied.
	Analysing risk factors	Cousins, Lamming, and Bowen, (2004); Petersen (2013)	
	Risk management	Manuj and Mentzer (2008), Manuj (2013); Thamhain, (2013)	Supply chain in retail sectors was covered but large capital projects are not included.
	Successful global sourcing for large capital projects	Cooper *et al.,* (2005)	Not covered fully in any literature.
Large Capital Projects	Attributes	Zidane *et al.,* (2013); Miller and Lessard (2000)	Largely covered in the literature.
	Characteristics	Zidane *et al.,* (2013);	
	Cost over run	Jergeas, (2008); Flyvbjerg, Skamris Holm, and Buhl (2003); Rahman, Memon, and Karim (2013)	
	Risk areas	Eweje *et al.,* (2012)	Risks related to global sourcing for large capital projects have not been included.

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Topic	Theme	Author/Source	Gaps in research
	Challenges	Eweje *et al.,* (2012); Badri, Nadeau, and Gbodossou (2013); Rousseau,(2011); Radosavljevic, Lilic, Curcic, and Radosavljevic, (2009)	Challenges related to global sourcing are not included in project literature.
	Realisation of Project success	Olawale and Sun, (2010); Eweje *et al.,* (2012); Miller and Lessard, (2000); Turner(2009); Xue, Turner, Lecoeuvre, and Anbari, (2013)	It has not been linked with global sourcing.
	Effect of global sourcing on large capital projects	Jonsson and Fredriksson (2009); Deane, Craighead, and Ragsdale,(2009); Christopher *et al*. (2011);Tummala and Schoenherr (2011); Roberts and Schermer (2011)	Impact of sourcing process on project performance identified but impact of global sourcing on project performance is not included.
	Sourcing philosophy and its effect on project performance	Eriksson and Westerberg (2011); various other authors work stipulated in Table 5.	
	Risk impact of global sourcing on large capital projects	Thamhain (2013); Thamhain and Skelton (2007); Cooper *et al.,* (2005)	No framework suggested for successful global sourcing in large capital projects.
Project Management Institutes	PMBOK	Project Management Body Of Knowledge	Don't have risk management framework for global sourcing
	PRINCE2	Office of Commerce Government	
Rules of risk management in successful global sourcing for large capital projects	Risk management framework	Tummala and Schoenherr (2011);Christopher *et al.,*(2011);Manuj(2013); Miller and Lessard, (2000); (Mak and Rao Tummala, 2001); Routroy and Pradhan (2013); Christopher and Peck, (2004)**;** Manuj and Mentzer (2008)	Available risk management frameworks are related to supply chain in retail/FMCG sector but no work done on risk management for global sourcing on large capital projects.
	Its effect on project time, cost and quality		No research done in past to measure the correlation between successful global sourcing and project time, cost and quality.
Correlation	Relations between risk management in global sourcing and Project time , cost and quality		No research done in the past.

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CHAPTER 3:
RESEARCH QUESTIONS AND HYPOTHESES

3.1 Introduction

According to Saunders and Lewis (2012), research strategy should be based on research objectives, the main questions as well as the extent of the existing knowledge, the time and the resources available. The literature review illustrated the strong correlation between the level of global sourcing, the benefits achieved (Trent and Monczka, 2002). Higher levels of global sourcing are preferred by large organisations (Mohamad *et al.,* 2009) involving many stakeholders. To control a context from an internal and external environment perspective, risk management plan may need to be in place to minimise impact on project performance in terms of project time, project cost (Thamhain, 2013).

The aim of this research is to answer a problem statement along with related research questions, as detailed in this chapter.

3.2 Problem Statement

The current global sourcing process does not have critical rules for risk management to achieve success in global sourcing especially for large capital projects. In turn, this makes global sourcing unviable and severely impacts on project completion time, project cost and project quality.

3.3 Objectives of Research

- To formulate rules of risk management in successful global sourcing for large capital projects.
- To determine the correlation between the rules of risk management in successful global sourcing and project performance in terms of project completion time, project cost and project quality for large capital projects.

3.4 Research Questions

3.4.1 Research Question One

What reasons motivate global sourcing in large capital projects?

From the literature review, it was clear that the benefits to be gained from global sourcing are more than the cost savings (Christopher *et al.,* 2011). However, other benefits specifically related to large capital projects were not clear. Hence, this

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question sought to understand the reasons behind large capital projects initiating global sourcing.

3.4.2 Research Question Two

Which are the indicators that confirm the global sourcing success for large capital projects?

The literature review identified various indicators and proposed to capture the lessons learnt from global sourcing which enhance the success in global sourcing (Trent and Monczka, 2002). However, this question was aimed at finding out the indicators in successful global sourcing for large capital projects.

3.4.3 Research Question Three

How should risks be managed in global sourcing for large capital projects?

Literature reviewed revealed that large capital projects are associated with high risks, uncertainly and high probability of failure as they are influenced by project complexity, number of suppliers/sub-suppliers, various national context, budget constraint and duration of the project (Badri, Nadeau, and Gbodossou, 2013). This question sought to understand how large capital project should manage risks in global sourcing so that there is a positive impact on project performance.

3.4.4 Research Question Four

What are the reasons for failure of global sourcing in large capital projects?

Teller (2013) summarized that failure in sourcing is primarily due to the absence of a structured risk management plan to proactively circumvent cost overruns, schedule delays and ultimately project failure. This part of the investigation was framed to explore the reasons behind failure of global sourcing in large capital projects and to draw on the lessons learnt from failed global sourcing in preparing a risk management model for successful global sourcing.

3.4.5 Research Question Five

What happens to project performance (in terms of project time, project cost project quality) when an organisation prepares a risk management plan before engaging in global sourcing for large capital projects?

Manuj (2013) suggested establishing a correlation between superior sourcing risk management planning and its effect on outcomes. The focus here was to address the importance of having a risk management plan in place and how it affects

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successful execution of global sourcing along with overall project performance in terms of project time, cost and quality.

3.5 Hypothesis

3.5.1 Hypothesis Background

Manuj (2013) identified a dire need to establish a link between superior sourcing risk management and its effect on outcomes. This study aimed to establish the rules of risk management in successful global sourcing and its impact on project time, project cost and project quality. Hence, following hypotheses were formed to measure the correlation between successful global sourcing and each element of project performance.

3.5.2 Hypothesis One

Null Hypothesis (1) : H0 : $\rho = 0$, Risk management rules in global sourcing for large capital projects is NOT effective in reducing project completion time.

Alternative Hypothesis (1) : H1 : $\rho > 0$, Risk management rules in global sourcing for large capital projects is effective in reducing project completion time.

3.5.3 Hypothesis Two

Null Hypothesis (2) : H0 : $\rho = 0$, Risk management rules in global sourcing for large capital project is NOT effective in reducing project cost.

Alternative Hypothesis (2) : H1 : $\rho > 0$, Risk management rules in global sourcing for large capital project is effective in reducing project cost.

3.5.4 Hypothesis Three

Null Hypothesis (3) : H0 : $\rho = 0$, Risk management rules in global sourcing for large capital project is NOT effective in delivering right project quality in terms of required quality of equipment and services.

Alternative Hypothesis (3) : H1 : $\rho > 0$, Risk management rules in global sourcing for large capital project is effective in delivering right project quality in terms of the required quality of equipment and services.

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CHAPTER 4:
RESEARCH METHODOLOGY

4.1 Research Design

Zikmund (2003, p.67) defined “research design as a master plan specifying the methods and procedures for collecting and analysing requisite information.” Zikmund (2003) also introduced four basic research methods that are used for descriptive and causal research: surveys, experiments, secondary data studies and observation.

A realism approach was chosen which stressed that objects exist independently of our knowledge of their existence. This approach helped in understanding the structures and relationships that were beneath the surface in exploring the research topic (Saunders and Lewis, 2012).

The methodology adopted in this research was quantitative and descriptive in nature. This was deemed suitable as the basic elements of the analysis were statistical analysis, abstraction of reality and highly objective in nature. The investigation of the facts was from an outsider’s perspective and objective view of the facts kept the research process free from bias. It also helped in pattern identification to test the theory. (Welman, Kauger, and Mitchell, 2005)

A deductive reasoning approach was chosen which involved the testing of a theoretical proposition by using a research strategy specifically designed for the purpose of the test (Saunders and Lewis, 2012). This was referred to as moving from the general to the particular (Welman *et al.,* 2005). The approach helped in deriving specific relationships between successful global sourcing and project performance in terms of project time, project cost and project quality.

A 5-point Likert scale method was used in a survey questionnaire as a measure of attitudes designed to allow respondents to indicate how strongly they agree or disagree with carefully constructed statements that range from very positive to very negative toward an attitudinal assessment (Zikmund, 2003). This survey was distributed electronically to randomly selected individuals using SurveyMonkey, an online survey tool, with a maximum of 58 questions. SurveyMonkey web tool was selected as it enabled reliable expedient access to the highly geographically dispersed sample population. The tool is also set up with a flexible questionnaire design functionality to enable, customisation of the data gathering process. From an execution and tracking perspective, a researcher is able to monitor the response progress, analyse the data and generate reports in graphical and numerical coded form.

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The choice of the research method was based on its usefulness in describing characteristics of the population and the fact that it was relatively inexpensive. However, the limitations of this method were non-response errors resulting from incomplete surveys as there was heavy reliance on the respondents to independently complete the questionnaire.

4.2 Population, Sample and Sampling Method

The first step in developing a sample design is to clearly define the set of objects which are known as the Universe (Kothari, 2004). The universe for this research was organizations involved in executing large capital projects whilst the target population were organizations involved in executing projects valued at more than two billion South African Rand and had a project life cycle of more than 18 months.

Zikmund (2003) referred to the unit of analysis as the level of investigation which is focused on the collection of data about the entire organisation, departments, work groups, individuals, or objects. Thus the unit of analysis for this research was the cross functional large capital project team responsible for executing or overseeing global sourcing in large capital projects.

A non-probability, purposive sampling method was selected to conduct the survey and the statistical analysis was employed to draw conclusions. A non-probability method was chosen since it would have been difficult to define the sampling frame as a complete list of the large capital projects in the universe.

A purposive sampling method was employed in which the researcher's judgment was used to select the sample members based on a range of possible reasons and premises guided by a homogeneous purposive sampling variety which was used to explore the reasons in greater depth and reduce the variety (Saunders and Lewis, 2012;Jankowicz, 2000). This approach moderated the cost, was less time consuming and presented a convenient solution for data collection. It also allowed the research to ask confidential questions about the project hindrances in global sourcing to determine its impact on project time, project cost and project quality.

To ensure the appropriateness of responses, the researcher conducted a pre-test with a group of project managers and global sourcing experts to identify any errors, and or points of clarification related to lay out, wording and correct question interpretation before being used for the full survey. Pre-testing is useful in detecting possible flaws in the measurement procedure, identifying unclear formulated items and clarifying nonverbal behaviour (Welman *et al.,* 2005, p.261).

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The targeted sample for this research was a set of people who were in the substantive position of being project team members involved in executing large capital projects either as an executive, project manager, global sourcing manager, project procurement manager, construction manager and risk management officer. It was assumed that their inputs would be valuable to measure the effect of risk management in global sourcing and that they would be able to give more insights of its effect on time, cost and quality in large capital projects.

Zikmund (2003) suggested a sample of at least 30 units which are usually recommended as the statistically significant sample size. However, Welman *et al*., (2005) commented that having a larger sample size lowers the potential error in generalizing to the population ensuring an increased confidence level. Hence, a larger sample size of individuals was targeted and analysis was done based on 89 valid responses in order to have a more representative, reliable, and more widely geographically dispersed sample to examine the role of risk management in successful global sourcing and how it leads to improved project performance.

4.3 Assumptions

The following broad assumptions were made in establishing a baseline to drive the study.

1. Large capital projects prefer to source their materials, equipment and services through a global sourcing approach.
2. Such project would typically have a minimum investment of South African Rand 2 Billion per project.
3. Project duration timelines should have been at least 18 months.
4. Such projects must have had many stakeholders involved in project execution.
5. The study sample represents the population and that respondents gave a true reflection of the various situations when sharing sensitive information during the survey.
6. A valid sample size of 89 would fulfil the requirements of efficiency, representativeness, reliability and flexibility (Kothari, 2004).
7. The testing factor, bias and ambiguity about the causal direction in assembling the data might affect the validity of research findings.
8. Respondents were able to clearly articulate the answers to research questions and had enough knowledge in the area of research.

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4.4 The Research Instrument

This research design was based on a survey questionnaire with a valid response from 89 experts involved in global sourcing for large capital projects and project managers, executives actively managing projects. Response input was guided by a set of fixed, alternative questions and respondents were given specific limited alternative responses and asked to choose the one closest to their viewpoint.

These responses to the questions provided comparability of answers and made it easier to code, tabulate and interpret whilst taking minimal time and being easier for the respondent to answer (Zikumnd, 2003).

4.4.1 Survey Questionnaire Design

In the survey, respondents were asked to rate 22 questions which included 58 statements identified from the literature. Question 1 to Question 4 (Section A) was related to demographics. Question 5 to question 16 (Section B.1) were general questions based on previous experience. Question 17 to question 22 (Section B.2 to B.7) were aimed at deriving risk management rules for successful global sourcing in large capital projects and understanding its correlation with project timelines, cost and quality. The responses were based on the Rensis 5 point Likert rating scale on a scale of 1-5, where 5 was “strongly agree“ and 1 was “strongly disagree” for close ended questions except survey question 2 which was an open ended question.

A total of six sectors across the large capital project industry such as metal and mining, mineral processing, oil and gas, energy, petrochemicals, infrastructure were targeted to give a wide perspective to the data. These sectors were selected mainly due to the large number of projects typically being executed by companies. The records show that large capital investments are regularly undertaken (generally more than 2 Billion South African Rand in most of the green field projects). These projects are complex in nature and have long execution timeframes. Consequently, many stakeholders are involved and global sourcing is employed as part of the sourcing strategy to either access specialist requirements or contain costs and schedules.

4.4.2 Survey Tool and Pre-Testing

The data was collected in two phases being a pretesting phase and then the main study. The pretesting captured responses from a small sample in a bid to test the reliability of the data gathering tool and processes. Respondents were contacted by email containing a cover note outlining the research objectives, express confirmation of the researcher’s commitment to keep respondent’s information confidential, contact/e-mail details for the researcher and the project supervisor and the survey link. The e-mail and questionnaire

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went through four rounds of pretesting before being sent out for the main survey. After each round of pretesting, the feedback was incorporated into the questionnaire prior to sending it for the next round of pretesting. Respondents for pretesting were selected from cross functional teams to obtain a varied opinion about the questionnaire. It also helped to be able to test the tabulation of the data ensuring that the responses actually answered the questions posed (Zikmund, 2003).

The research was administered with an online questionnaire survey tool (Appendix B) including the cover note (Appendix A). A questionnaire was delivered by e-mail to a target population through the Survey Monkey software. The prevalence of use of an online based questionnaire has steadily increased and presented convenient and efficient access to the targeted population. In a bid to improve the response rate, a phone call was made to most of the respondents before sending out the questionnaires. Further to this, questionnaires were sent out addressed by name to individuals in key positions involved in managing and executing global sourcing in large capital projects.

4.4.3 Survey Questionnaire - Accuracy, Reliability and Validity

Accuracy means the information collected was reliable and valid and was largely influenced by questions sequence, language and construct (Zikmund, 2003). The questions were simplified by using short easily worded sentences. A funnel technique was used in asking general questions before specific questions were posed to deepen understanding of the respondent's frame of reference before asking about their opinions (Zikmund, 2003).

Zikmund (2003) defined reliability and validity as evaluating measurements. He explained that reliability refers to the degree to which measures are free from error and therefore yield consistent results. Validity refers to the ability of a measure to measure what it is supposed to measured. The tabulation in Table 7 specifies the action/s taken to ensure the rigour of this research, and to improve the validity and reliability of the findings. Subject and observer bias factors were also anticipated to affect the reliability of the research findings.

Table 7 Measurement and Actions taken to Ensure Quality of the Research

Evaluating measurement	Purpose of control	Actions taken
External validity	To generalise this research for large project sectors	Sampling covered six different project sectors and pilot testing was done.
		Target population was selected from 40 different countries and six continents with higher global sourcing and project management experience.
Reliability	To determine this study can be repeated with the same results	Sought assistance from an independent researcher to cross verify the results.
		An internal researcher in the researcher's organisation was engaged to analyse the results and compare his findings to arrive at the most meaningful conclusions.

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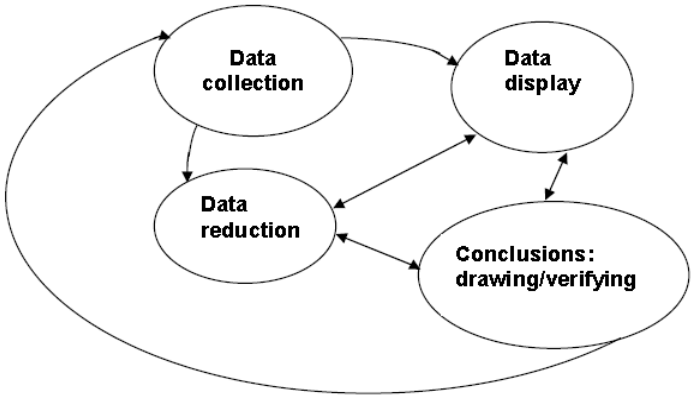
4.5 Data Analysis and Interpretation

The researcher used a cross sectional approach where a data snapshot was collected i.e. data from participants at one specific period in time (Saunders and Lewis, 2012), as it would have been difficult to monitor the results over a period of time within the constraint of the research timelines.

In order to answer the research questions, descriptive statistics, reliability analysis, correlation analysis (Cronbach's alpha) and correlation coefficient tests were run using the Statistical Package for the Social Sciences (SPSS) version 20.0 software. Based on a mean score for each construct, the constructs were ranked from those having the highest mean, to those having the least mean score. This meant that the higher the mean score, the greater the construct's importance. The order of importance based on higher mean was derived to collate the rules of risk management in successful global sourcing for large capital projects. Later, it was decided to run the additional analysis – a one-way analysis of variance (ANOVA) test to measure the differences among the means between different levels. The method shown in Figure 7 was used for data analysis.

Figure 7 Components of Data Analysis: An Interactive Model



(Source: Matthew, Miles, and Huberman, 1994.p12.)

4.5.1 Data Collection (Step 1)

Quantitative data was collected through a survey questionnaire using a web based tool as described in section 4.2. Then this data was analysed in form of data reduction, data display, and conclusion as above.

Out of 120 questionnaires sent out, a total of 96 responses were received within fifteen days from various respondents responsible for delivering global sourcing within large capital projects. This research was designed to gather the learning from various sectors from different countries hence the responses received reflect the large capital project experience in 40 countries and six continents. These responses were coded as shown in the Table 8 for easy interpretation when analysing the data.

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4.5.2 Data Reduction (Step 2)

All responses were collated and, analysed and then categories were developed to represent the various data. Out of 96 responses, 7 responses were omitted from the analysis as they either did not answer any questions or omitted more than 50% of survey questions. Hence, all questions were analysed based on a valid set of 89 responses. There was only one open ended question which addressed the issue of geographical location of the project. Responses to this were consolidated in Table 9.

4.5.3 Data Display (Step 3)

Data gathered through the questionnaire was displayed in the form of graphs, tables, and figures. This was aimed at summarizing and, clarifying, as well as providing evidence for assertions.

As discussed in section 4.4 and shown in Appendix B, the survey questionnaire contained all closed ended questions except question 2 which was an open ended question. Survey Monkey, an online data collection tool, gave the option to download the survey results in various formats. The numerical coded format was chosen and the data was captured in Microsoft Excel. The close ended questions together with the numerical codes are shown in Table 8.

Table 8 Numerical Code for the Close Ended Survey Questions

Position	Code
Global Sourcing Manager	1
Project Procurement Manager	2
Project Team Member	3
Project Manager	4
Project Engineering Manager	5
Other	6
Financial Controller/CFO	7
Risk Management Officer	8
Executive Director/Exco Member	9
Construction Manager	10

Response	Code
Strongly Agree	5
Agree	4
Neutral	3
Disagree	2
Strongly disagree	1

Type of Large Capital Project Sector	Code					
% Spend in Global Sourcing	**Zero to 10%**	**11% to 20%**	**21% to 30%**	**31% to 40%**	**41% to 50%**	**Over 51%**
Mining and Mineral processing	1	2	3	4	5	6
Smelter and Refinery	1	2	3	4	5	6
Oil and Gas	1	2	3	4	5	6
Energy	1	2	3	4	5	6
Infrastructure	1	2	3	4	5	6
Petrochemicals	1	2	3	4	5	6

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Years of experience	Code	
	Total Years of experience	Years of experience in large capital projects
Zero to 10 Years	1	2
10 to 15 Years	1	2
15 to 20 years	1	2
20 to 25 years	1	2
Over 25 years	1	2

4.5.4 Conclusion Drawing / Verification (Step 4)

In this step the researcher checked for biases that might have affected the research.

To measure internal consistency (reliability), Cronbach alpha test was run for each and all constructs as an overall reliability. According to George and Mallery (2003) as cited in Gliem and Gliem (2003) the average value of Cronbach's alpha should be within 0.7 to 0.8 hence indicating an acceptable internal consistency and reliability and closure to 1.0 indicate the greater internal consistency of the items in the scale. The correlations were measured between risk management in successful global sourcing and its effect on project performance in terms of project completion time, project cost and project quality.

4.6 Limitations of the Study

The limitation of this methodology is systematic error in the form of response bias and nonresponse error. A response bias is expected when respondents tend to answer all questions in the same direction by consciously or unconsciously misrepresenting the truth. Non response error is the statistical difference between who responded in the survey and who failed to respond (Zikmund, 2003).

Since non-probability purposive sampling was used and the sample size of 89 from six large capital project sectors might not be representative of all organizations/sectors involved in projects globally for more than two billion South African Rand, the results cannot be generalised to the entire population.

Furthermore, the survey response and results were also dependent on the following :

- nature and complexity of the project,
- the organization ability to quickly recognize, deal and manage the risks,
- complexity of the projects,
- varying level of front end loading process before project start up
- origin of sourcing,
- skill of project management team,
- external environment, the effect of macroeconomic indicators, and
- logistics challenges.

Hence the findings cannot be generalized for all projects at international level.

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CHAPTER 5:
RESULTS

5.1 Introduction

The objective of this section of the research is to present an overview and summary of key findings of the survey relative to the research questions and hypothesis that were stated in Chapter 3 and to see whether the researcher's expectations regarding data characteristics and quality were met.

The analysis of the survey data included, descriptive statistics, internal consistency test, a one sample t-test for sample mean comparison being executed in order of importance. An additional analysis through ANOVA test was conducted to measure the differences among the means between different levels. Hypotheses were tested based on measuring correlations between risk management rules for successful global sourcing in large capital projects and its correlation with project time, cost and quality. Comparison of opinion between key positions responsible for large capital project performance is discussed in this chapter.

5.2 Response Rate

Out of 120 questionnaires sent out, a total of 97 responses were received. Eight responses were excluded as the respondents did not answer most of the questions. 89 responses were valid responses resulting in 74.2% response rate.

5.3 Demographics

Out of 89 valid responses, two responses had missing data thus t-value of 87 responses was used for the questions where data were missing instead of using the arithmetic mean of the other responses. All questions were analysed based on 89 responses that were deemed to be valid.

5.3.1 Position of Respondent in Large Capital Projects

Figure 8 indicates the respondents' position in the current organisation. This was used as a proxy to determine the seniority level within the organisation and to get an opinion on the research topic from various perspectives and how the opinion varies between the various levels when it comes to establishing risk management rules in global sourcing to achieve project success.

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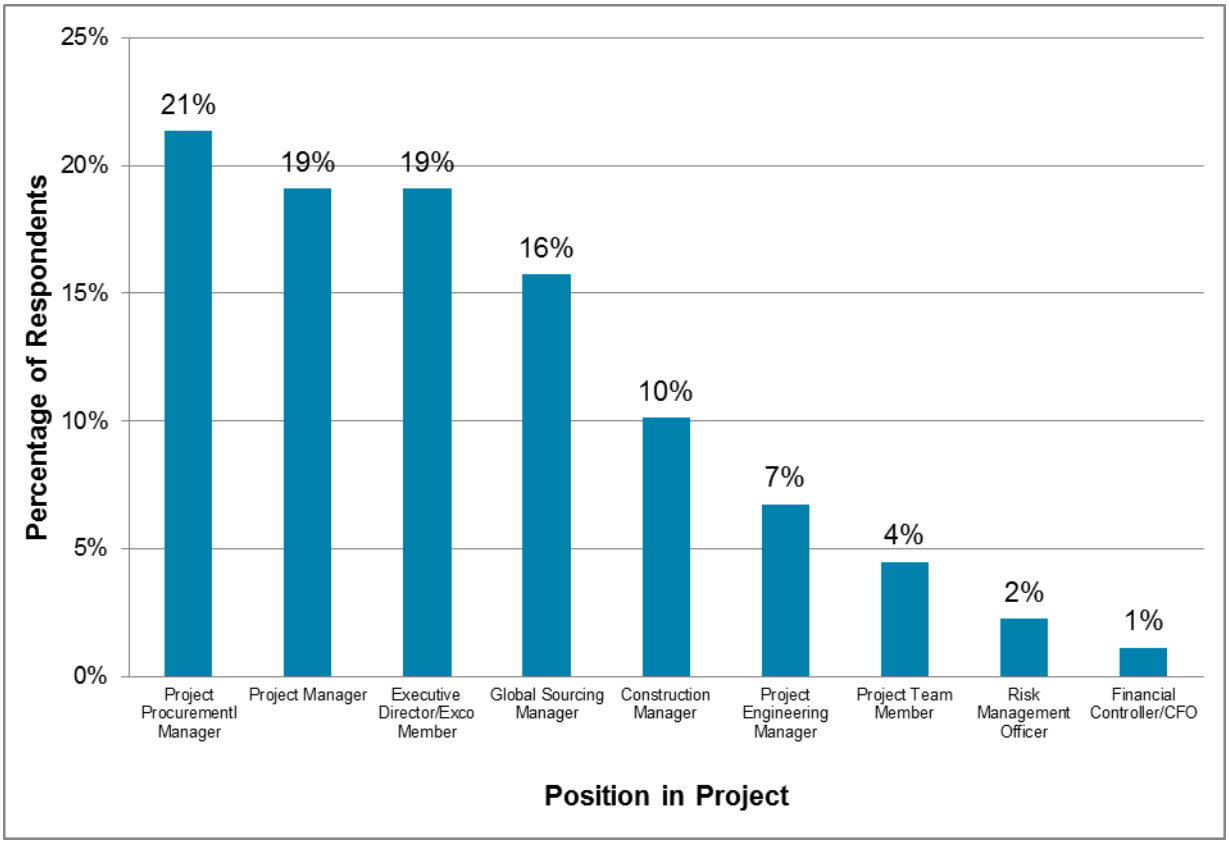
The largest proportion of respondents were Project Procurement Managers (21%), followed by Project Managers (19%), Executive Director/Exco Members (19%), Global sourcing managers (16%) and the least proportion was for Financial Controller/CFO (1%).

Figure 8 Position of Respondent in Large Capital Projects



It was reassuring to note that almost an equal spread amongst the first four positions which is 75% of the responses, comprised key positions involved in making decisions for global sourcing in large capital projects.

5.3.2 Respondent's Geographical Experience in Large Capital Projects

Open ended questions to know the geographical experience of respondents were asked to confirm the experience of respondents in various geography/continent/country in executing large capital projects. Table 9 indicated that the respondents with on-going or past experience of executing large capital projects came from six different continents in 40 various countries as shown in Table 9.

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Table 9 Respondents Geographical Experience in Large Capital Projects

Africa (14)	Asia (11)	Europe (7)	North America (3)	Oceania (1)	South America (4)
South Africa	India	Switzerland	United States of America	Australia	Brazil
Zambia	China	United Kingdom	Canada		Peru
Namibia	South Korea	Italy	Mexico		Chile
Democratic Republic of Congo	United Arab Emirates	Germany			Bolivia
Mozambique	Qatar	Poland			
Zimbabwe	Saudi Arabia	Sweden			
Botswana	Philippines	Spain			
Angola	Indonesia				
Ghana	Kuwait				
Liberia	Vietnam				
Mali	Russia				
Mauritania					
Tanzania					
Sierra Leone					

5.3.3 Respondent's Years of Experience

The total year(s) of experience and relevant experience in large capital projects was a factor that was used to determine the average years of the respondent total experience especially in large capital projects.

Table 10 summarise the respondent's total years of experience and a specific experience in executing large capital projects. The largest proportion of the respondents had over twenty-five years' of experience (39%) in total, out of which 16% respondents had more than twenty five years of experience in executing large capital projects.

Table 10 Summary of Respondent's Experience

	Total Years of Experience	Years of Large Capital Project Experience
Zero to 10 Years	4%	18%
10 to15 Years	16%	29%
15 to 20 years	26%	26%
20 to 25 years	15%	10%
Over 25 years	39%	16%
Total	100.0	100.0

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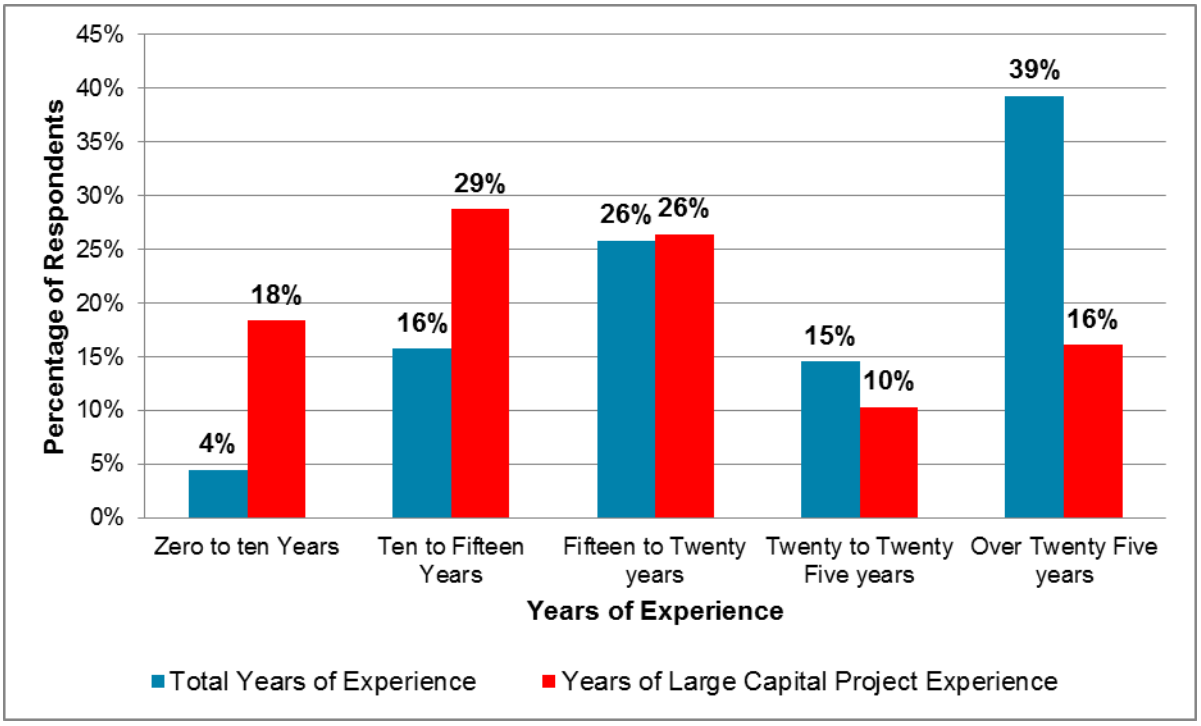
80% of the respondents had more than fifteen years of experience out of which 39% held more than 25 years of experience and 82% had more than ten years of experience in executing large capital projects. The results are further illustrated in Figure 9.

Figure 9 Respondent Experience in Large Capital Projects



5.3.4 Global Sourcing Spend in Large Capital Project Sector

Respondents were asked what percentage of their procurement was sourced globally in projects that they were working on or had worked on previously. This was asked to track the amount being spent globally in large capital projects and observe the difference of global sourcing spend among various project sectors. Table 11 summarises the respondents opinion about global sourcing spend in the large capital project sector.

The results illustrated in Table 11 indicate that mining and mineral processing, oil and gas and energy sectors have higher spend for global sourcing. In the mineral and mining sector, 26% indicated that they spend over 51%, 4% indicated that they spent 41% to 50% of their procurement and 20% indicated that it may vary between Zero to 10% of their procurement being sourced globally. Energy, Oil and gas had the highest proportion of respondents 35% and 31% respectively indicating that they use over 51% of their procurement budgets in global sourcing.

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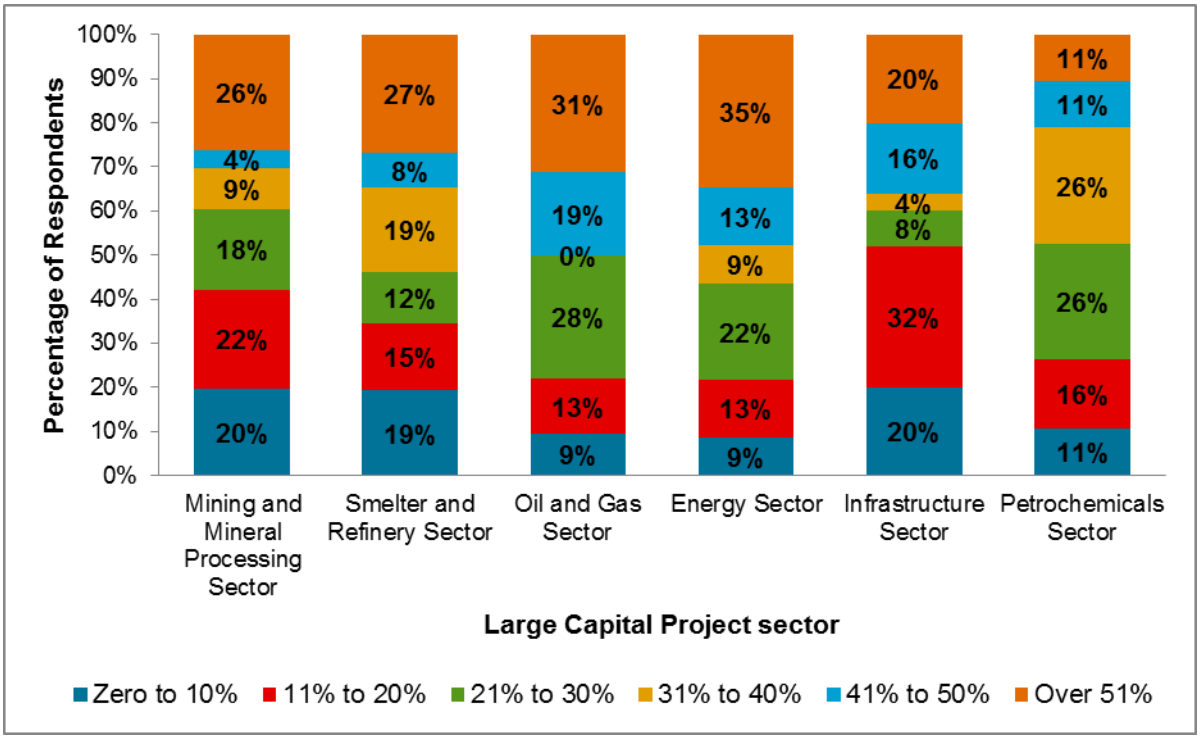
Table 11 Global sourcing Spend in Large Capital Project Sector

% Procurement Spend Sourced Globally	Mining and Mineral Processing Sector		Smelter and Refinery Sector		Oil and Gas Sector		Energy Sector		Infrastructure Sector		Petrochemicals Sector	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
Zero to 10%	15	20%	5	19%	3	9%	2	9%	5	20%	2	11%
11% to 20%	17	22%	4	15%	4	13%	3	13%	8	32%	3	16%
21% to 30%	14	18%	3	12%	9	28%	5	22%	2	8%	5	26%
31% to 40%	7	9%	5	19%	0	0%	2	9%	1	4%	5	26%
41% to 50%	3	4%	2	8%	6	19%	3	13%	4	16%	2	11%
Over 51%	20	26%	7	27%	10	31%	8	35%	5	20%	2	11%
Total	76	100%	26	100%	32	100%	23	100%	25	100%	19	100%

These results are graphically illustrated in Figure 10.

Figure 10 Global sourcing Spend in Large Capital Project Sector



In summary, more than 80% of the respondents believed that their global sourcing expenditure in large capital projects varied between 11% to over 50%. Out of these, 40% of respondents believed that their levels of investment ranged from 11% to 30%.

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5.4 Internal Consistency (Reliability) Test

Cronbach's alpha was used to assess the internal consistency (reliability) of items on the scale. Internal consistency describes the extent to which all the items in a test measure the same concept or construct. The value of the Cronbach's Alpha ranges from zero to one and the closer the Cronbach's alpha coefficient is to 1 the greater the internal consistency of the statements in the scale (Gliem and Gliem, 2003).

A total of 58 statements were rated on a 5-point scale (1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree and 5=Strongly Agree). Cronbach's Alpha values were used to measure internal consistency reliability of items measured in the questionnaire. The summary of internal consistency of measurement scale for each question is shown in the Table 12.

Table 12 Summary of Internal Consistency for Measurement Scale

Measurement Scale	Number of Items	Cronbach's Alpha	Average Inter-item Correlation	Rating
Reasons for global sourcing in large capital projects	10	0.779	0.265	Excellent
Indicators that confirm the global sourcing success for large capital project	10	0.829	0.336	Excellent
How risks should be managed in global sourcing for large capital projects?	9	0.915	0.547	Excellent
Reasons for failure of global sourcing in large capital projects	7	0.716	0.265	Excellent
Effect of preparing risk management plan before engaging onto global sourcing	6	0.820	0.439	Excellent
Rules of Risk Management in global sourcing and its impact on project performance in terms of project time, project cost and project quality.	4	0.875	0.636	Excellent

George and Mallery (2003) are cited , to suggest that the general rule for Cronbach's alpha interpretation is that the range between 0.7 and 0.8 indicates an acceptable internal consistency and reliability Gliem and Gliem (2003). The Cronbach's Alpha shows an excellent level of internal consistence in each of the constructs presented in Table 12. The Cronbach's Alpha for all items was 0.907, showing a very high level of internal consistency and reliability. The results are shown in Table 13.

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Table 13 Reliability Statistics Test Summary

Responses Processing Summary			
		N	%
Responses	Valid	87	97.8
	Excluded[a]	2	2.2
	Total	89	100.0
a. List wise deletion based on all variables in the procedure.			

Reliability Statistics	
Cronbach's Alpha	N of Items
.907	58

5.5 One Sample T-Test

Respondents were asked a number of questions on global sourcing, experience related to risks in global sourcing, risk management rules for successful global sourcing and its impact on project timelines, cost and quality.

The following points were considered for analysis of a one tailed one sample t-test for question 5 to question 22 in Appendix B.

- One sample t-test was used to compare the mean of a number of statements that were rated on a 5-point Likert scale to the mid-point of a Likert scale (3). It was the chosen method because the variables were assumed to be normally distributed hence a sample mean was compared to a hypothesised mean (Park, 2009).
- A one sample t-test was carried out against the midpoint of the scale (3) for each and every statement. A value significantly greater than the mid-point of the scale was considered to mean that the respondents agreed with the statement. Hypothesis testing (t-value and p-value) was conducted for each question to assess whether the value was significantly higher than the mean value of 3 since it was the probable that the difference between 3 and the nearest number was due to chance. Thus, the smaller the value the less likely that the value was greater than mean 3 due to chance.
- The null hypothesis for each statement stated that the respondents neither agreed nor disagreed with the statement (mean = 3) and the alternative hypothesis was that the respondents agree with the statements (mean > 3). These hypotheses were only designed to measure the significance of the respondent's level of agreement with each question of the survey questionnaire. The null hypothesis was rejected if the p-value of the t-test was less than 0.05.
- If the calculated t-value was greater than the critical t-value from the statistical tables (t, 89, 0.05) then the null hypothesis was rejected.

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- The null hypothesis was rejected if the one tailed p-value <0.05 (significance level) or the calculated t-value> (t, 89, 0.05) = 1.6622 or (t, 87, 0.05) = 1.6626 where question 13 had 2 missing values.
- According to Albright, Winston, and Zappe (2009), the p-value of a sample is the probability of seeing a sample with at least as much evidence in favour of the alternative hypothesis. A smaller the p-value indicates that there is more evidence in favour of the alternative hypothesis.

The results are shown in Table 14 to Table 19 below.

5.5.1 General Questions

Table 14 represents the one-sample statistics for general questions.

Table 14 One-Sample t- test for General Questions

One-Sample Statistics				One-Sample Test against the mid-point of the scale (3)	
General Questions	N	Mean	Std. Deviation	t-value	P-value (one tailed)
Global sourcing has many challenges that can be overcome through identifying, accessing, analysing and evaluating risks before engaging in the sourcing activity.	89	4.58	0.560	26.679	0.000
Having a risk management plan in place for global sourcing is important in successful global sourcing for large capital projects.	89	4.62	0.594	25.713	0.000
In your projects, anticipated cost savings were achieved for the packages sourced globally.	89	3.70	0.760	8.649	0.000
Your project incurred additional cost due to non-anticipated risk in global sourcing.	89	3.51	0.854	5.583	0.000
We prepare a risk management plan for the items to be sourced globally.	89	3.55	1.011	5.135	0.000
Our senior management gets involved in making global sourcing decisions and accessing risk involved?	89	3.62	0.935	6.232	0.000
I experienced that there are certain TIME risks in managing projects where global sourcing is involved.	89	4.20	0.677	16.748	0.000
I experienced that there are certain COST risks in managing projects where global sourcing is involved.	89	4.08	0.711	14.318	0.000

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One-Sample Statistics				One-Sample Test against the mid-point of the scale (3)	
General Questions	N	Mean	Std. Deviation	t-value	P-value (one tailed)
I experienced that there are certain QUALITY risks in managing projects where global sourcing is involved.	87	4.16	0.888	12.200	0.000
I feel capable of handling global sourcing without proper risk assessment for large capital projects.	89	1.97	0.959	-10.171	1.000
We have a risk management process in place to evaluate the risks involved in global sourcing before making decisions on global sourcing.	89	3.46	0.905	4.801	0.000
All our stakeholders understand the importance of identifying and monitoring risks in global sourcing and its effect on project timeline and cost.	89	3.22	1.020	2.079	0.020

The results revealed that the respondents agreed for all the statements where t-value is greater than >1.6622 and 1.626 for question 13. Hence, the null hypothesis was rejected for the majority of the statements except that stating “I feel capable of handling global sourcing without a proper risk assessment for large capital projects” as referred above. Interesting to note that the respondents were in agreement with the highest mean score that having a risk management plan in place for global sourcing is important in successful global sourcing for large capital projects.

In congruence with this, respondents did not agree with the question 14 statement - I feel capable of handling global sourcing without proper risk assessment for large capital projects, since the t-value = -10.171 < 1.6622. The p-value was 1.000 hence we fail to reject the null hypothesis for this statement and it is concluded that the respondents did not agree with this statement.

All the above statements except survey question 14 had a smaller p-value and hence supported the decision based on t-value.

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5.5.2 Reasons for Global Sourcing in Large Capital Projects

The reasons for global sourcing in large capital project based on highest mean value are tabulated in descending order in Table 15.

Table 15 One-Sample Test: Reasons for Global Sourcing

	One-Sample Statistics				One-Sample Test against the mid-point of the scale (3)	
Rank	The reason for global sourcing in large capital projects is to have…	N	Mean	Std. Deviation	t-value	P-value (one tailed)
1	Lower capital cost.	89	4.25	0.830	14.183	0.000
2	Technically competent partner who can deliver better quality and high performance of equipment or services.	89	4.11	0.775	13.538	0.000
3	A greater access to new technology and innovation	89	4.07	0.850	11.846	0.000
4	Lower project cost.	89	3.92	0.895	9.715	0.000
5	Faster payback period and high IRR on project.	89	3.85	0.833	9.668	0.000
6	Lower life cycle cost of equipment.	89	3.83	0.968	8.103	0.000
7	Consolidation and standardisation of sourcing across all global projects for better synergy.	89	3.83	0.907	8.644	0.000
8	Lower project completion time.	89	3.66	0.953	6.564	0.000
9	Faster delivery compared to domestic suppliers.	89	3.61	0.973	5.886	0.000
10	Consolidation and standardisation of sourcing across all global projects for better synergy.	89	3.52	1.035	4.712	0.000

The respondents agreed with all the reasons since the t-values were all greater than 1.6626 and p-value < 0.05. Hence, the null hypothesis was rejected for all the statements.

5.5.3 Indicators for successful Global Sourcing in Large Capital Projects

The highest rated indicator leading towards success of global sourcing in large capital projects based on their mean value of responses are tabulated in descending order in Table 16.

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Table 16 One-Sample Test: Indicators for Successful Global Sourcing

	One-Sample Statistics				One-Sample Test against the mid-point of the scale (3)	
Rank	The indicators in success of global sourcing for large capital project depends on....	N	Mean	Std. Deviation	t-value	P-value (one tailed)
1	Conducting a proper due diligence of supplier's competence and capabilities.	89	4.63	0.486	31.642	0.000
2	Identifying, assessing and evaluating risk during the front end loading process before the issuing of enquiry documents globally.	89	4.48	0.693	20.199	0.000
3	Positive attitude of the project team to make it happen.	89	4.46	0.604	22.811	0.000
4	Equal involvement of members of a cross functional team to expedite design, engineering, QAP, timely clarifications, its approval and settle contract variations claims.	89	4.43	0.672	20.024	0.000
5	Implementing learning and lessons learnt from similar projects.	89	4.43	0.582	23.143	0.000
6	Risk identification, control and monitor for post award activities from receipt of raw materials, through the manufacturing stages till dispatch to the customer.	89	4.42	0.618	21.609	0.000
7	Having global sourcing expert with right skills together with past sourcing experience	89	4.42	0.580	23.022	0.000
8	Understanding the country's competitiveness for the particular equipment or service.	89	4.24	0.640	18.219	0.000
9	Preparing understandable sets of enquiry documents in the vendor's home language, clearly specifying design and engineering standards, specification, quality, performance and commercial terms.	89	4.11	0.935	11.228	0.000
10	Favourable macroeconomic indicators.	89	3.97	0.730	12.487	0.000

The respondents agreed with all the question statements presented to them since the t-values were all greater than 1.6626, and one sided p-valueless than 0.05. Hence, the null hypothesis was rejected for all the above statements.

All the above statements have a smaller p-value than significance level and hence the decision is supported based on t-value.

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5.5.4 Risk Management in Global Sourcing for Large Capital Projects

The highest rated indicator for identification of risks in global sourcing for large capital projects were tabulated in descending order based on their mean value and presented in Table 17.

Table 17 One-Sample Test: Risk Management in Global Sourcing

	One-Sample Statistics				One-Sample Test against the mid-point of the scale (3)	
Rank	How Large capital projects should manages risks in global sourcing? Through	N	Mean	Std. Deviation	t-value	P-value (one sided)
1	Supplier evaluation and performance measurement criteria suitable to the project.	89	4.39	.748	17.572	.000
2	Global sourcing risks associated with suppliers, manufacturing standards and facilities and QA/QC practices.	89	4.35	.755	16.841	.000
3	Global souring risks associated with logistics - transportation cost and packing optimisation.	89	4.35	.676	18.819	.000
4	Global sourcing risks associated with government regulations and potential disruption.	89	4.26	.683	17.381	.000
5	Global sourcing risk associated with currency fluctuations, taxation and legislation.	89	4.25	.802	14.676	.000
6	Global sourcing risks associated with country risks for the port selection, countries involved in the trans-shipment of globally sourced products or method of shipment (International Commercial Term - INCOTERM) risk.	89	4.24	.723	16.119	.000
7	Global sourcing risks in terms of differences in design, engineering standards, specifications, quality and performance requirements.	89	4.21	.746	15.350	.000
8	Risks involved in the contract which is balanced and adequately allocated between project owner and supplier/contractor.	89	4.10	.826	12.571	.000
9	Global sourcing risks through Political, Economy, Social, Technological, Environmental, Legal (PESTEL) analysis.	89	4.09	.778	13.214	.000

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There was general consensus on the ways of managing risks in large capital projects by the respondents. This was illustrated by the all the computed t-values being greater than 1.6626 and the one sided p-values less than 0.05. Hence, the null hypothesis was rejected for all the indicators.

5.5.5 Reasons for Failure of Global Sourcing in Large Capital Projects

The most significant reason for failure of global sourcing in large capital projects based on their mean values in descending order are tabulated in Table 18.

Table 18 One-Sample Test: The Reasons for Failure of Global Sourcing

	One-Sample Statistics				One-Sample Test against the mid-point of the scale (3)	
Rank	The reasons for failure of global sourcing in large capital projects are ...	N	Mean	Std. Deviation	t-value	P-value (one sided)
1	Decisions made without proper due diligence of the suppliers and reference checks.	89	4.42	0.636	20.993	0.000
2	Misunderstanding or lack of understanding of the risk associated with global sourcing in projects.	89	4.30	0.647	19.012	0.000
3	Inadequate knowledge of the challenges involved in full cycle of global sourcing.	89	4.28	0.584	20.704	0.000
4	Improper evaluation criteria for selection of country and suppliers.	89	4.28	0.639	18.899	0.000
5	Underestimation of the impact on project time and cost as a result of delays in delivering a global sourcing solution.	89	4.24	0.584	19.955	0.000
6	Decisions made purely based on cost.	89	4.22	0.901	12.817	0.000
7	Lack of skills in identifying the risks involved in global sourcing.	89	4.20	0.710	15.975	0.000

The respondents agreed with all the given reasons for failure in global sourcing since the t-values were all greater than 1.6626 and the one sided p-values were less than 0.05. Hence, the null hypothesis was rejected for all the statements.

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5.5.6 Effect of Risk Management on Global Sourcing, Project Performance

The most highly rated implications of risk identification and mitigation planning being effected before engaging in global sourcing are tabulated based on their mean value in descending order in Table 19.

Table 19 One-Sample Test: Effect of Risk Management Plan

	One-Sample Statistics				One-Sample Test against the mid-point of the scale (3)	
Rank	What happens if you conduct the risk analysis and prepare risk mitigation plan before engaging into global sourcing for large capital projects?	N	Mean	Std. Deviation	t-value	P-value (one sided)
1	It creates an awareness of the challenges involved in the execution of global sourcing and helps in effectively dealing with it.	89	4.42	.518	25.781	.000
2	It improves the success rate in global sourcing for delivering large capital project.	89	4.39	.556	23.626	.000
3	It helps in planning resource allocation and developing integrated schedule including contingency plan to forecast the anticipated completion date and budget cost.	87	4.33	.641	19.402	.000
4	It minimises the risk on project timelines and cost.	89	4.22	.653	17.698	.000
5	It helps in mitigating risk from design or inception stage to keep the project delivery on track.	89	4.18	.575	19.347	.000
6	It helps in handling the unforeseen situation.	89	4.03	.761	12.823	.000

There was agreement on the assertions made on risk management in global sourcing for large capital projects. This is because t-values were all greater than 1.6626 and the one sided p-values were less than 0.05. Hence, the null hypothesis was rejected for all the indicators.

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5.6 Correlation Coefficient and Hypothesis testing

Correlation analysis was used to assess the relationship between variables. Pearson's correlation analysis is a measure of the strength of a relationship between two variables. According to Cohen (1988), Pearson correlation coefficients is said to be weak if between 0 and 0.29, moderate if between 0.3 and 0.49, and strong if between 0.5 and 1. The sign of the correlation coefficient shows the direction of the relationship.

A positive correlation means that as the other variables are increasing the opposing variable will be increasing as well and a negative correlation coefficient implies that one variable increases as the other one decreases and vice versa.

5.6.1 Hypothesis One

This study set out to measure the correlation between risk management rules for successful global sourcing and project time. To test this, a correlation analysis was conducted.

The hypotheses were:

Null Hypothesis (1) : H0 : $\rho = 0$, Risk management rules for global sourcing are NOT effective in reducing project completion time for large capital projects.

Alternative Hypothesis (1) : H1 : $\rho > 0$, Risk Management rules for global sourcing are effective in reducing project completion time for large capital projects.

The test was conducted at 5% significance level and it was one tailed. The results are shown in Table 20.

Table 20 Correlation between Successful Global Sourcing and Project Time

Correlations		Risk management rules make global sourcing successful.
Risk Management rules in global sourcing reduce the project time.	Pearson Correlation	.678**
	Sig. (1-tailed)	.000
	N	89

**. Correlation is significant at the 0.01 level (1-tailed).

The results revealed that there is a positive correlation between risk management rules for successful global sourcing and project Time (r = 0.678). The test resulted in a p-value of 0.000 < 0.05 and thus the null hypothesis was rejected in favour of the alternative

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hypothesis. It was therefore concluded that risk management rules for global sourcing in large capital projects are effective in reducing project completion time.

5.6.2 Hypothesis Two

A secondary aspect to the study was the measurement of the correlation between risk management rules for successful global and project cost. To test this, a correlation analysis was conducted.

The hypotheses were:

Null Hypothesis (2) : H0 : $\rho = 0$, Risk management rules for global sourcing is NOT effective in reducing project cost for large capital projects.

Alternative Hypothesis (2) : H1 : $\rho > 0$, Risk management rules for global sourcing is effective in reducing project cost for large capital projects.

The test was conducted at 5% significance level and it was one tailed. The results are shown in Table 21.

Table 21 Correlation between Successful Global Sourcing and Project Cost.

Correlations		Risk management rules make global sourcing successful.
Risk management rules in global sourcing reduce the project cost.	Pearson Correlation	.660**
	Sig. (1-tailed)	.000
	N	89

**. Correlation is significant at the 0.01 level (1-tailed).

The results revealed that there was a positive correlation between risk management rules for global sourcing and project cost ($r = 0.660$) for large capital projects. The test resulted in a p-value of $0.000 < 0.05$ and thus the null hypothesis is rejected in favour of the alternative hypothesis. It is therefore concluded that risk management rules for global sourcing are effective in reducing project cost for large capital project.

5.6.3 Hypothesis Three

This investigation set out to measure the correlation between risk management rules for global sourcing and delivering right project quality. A correlation analysis was conducted to test this relationship.

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The hypotheses were:

Null Hypothesis (3) : H0: $\rho = 0$, Risk management rules for global sourcing is NOT effective in delivering required quality of equipment and services for large capital projects.

Alternative Hypothesis (3) : H1: $\rho > 0$, Risk management rules for global sourcing is effective in delivering required quality of equipment and services for large capital projects.

The test was conducted at 5% significance level and it was one tailed. The results are shown in Table 22.

Table 22 Correlation between Successful Global Sourcing and Project Quality

Correlations		Risk management rules makes global sourcing successful.
Risk management rules in global sourcing deliver the right project quality in terms of required quality of equipment and services.	Pearson Correlation	.685**
	Sig. (2-tailed)	.000
	N	87

**. Correlation is significant at the 0.01 level (1-tailed).

The results revealed that there is a positive correlation between the risk management plan for successful global sourcing and delivering right project quality ($r = 0.685$) for large capital projects. The test resulted in a p-value of $0.000 < 0.05$ and thus the null hypothesis is rejected in favour of the alternative hypothesis. It was therefore concluded that risk management rules for global sourcing in large capital projects are effective in delivering right quality of equipment and services for large capital projects.

5.7 Additional Analysis

5.7.1 Comparison of Opinion through ANOVA Test

Since the data was available there was an opportunity to interrogate the difference in opinion between two distinct positions in large capital projects. To effect this, a one-way analysis of variance (ANOVA) was conducted to assess whether there was a significant difference in the average rating of a number of statements by respondents' positions because position was insignificant in the four positions as illustrated in Table 23. If there are two factors, this analysis is equivalent to the independent sample t-test comparing two group means. In this case the factor was a respondent's position. The goal for conducting one-way analysis of variance is to test for differences among the means of the different levels of a factor and to quantify these differences. If there are two treatment levels, this analysis is equivalent to the independent sample t-test (Park, 2009).

All tests were conducted at 5% significance level.

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5.7.2 Comparison of Opinion One : Successful Global Sourcing

Risk management rules make global sourcing successful

The null and alternative hypotheses were:

Null Hypothesis H0 : All the different position levels have the same mean rating for risk management planning in making global sourcing successful.

Alternative Hypothesis H1 : At least one mean rating is different.

The results are shown in Table 23 below.

Table 23 Comparison of Opinion One: Successful Global Sourcing

Descriptive				
Dependent Variable	**Position**	**Mean**	**Mean**	**Std. Deviation**
Risk management rules make global sourcing successful.	Global Sourcing Manager, Project Procurement Manager	33	4.36	.603
	Project Manager, Engineering Manager	27	3.70	.912
	Construction Managers and Risk Management Officer	12	4.17	.937
	Executive Director/Exco Member	17	4.06	.748
	Total	89	4.08	.815

ANOVA					
Group	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	6.576	3	2.192	3.592	.017
Within Groups	51.874	85	.610		
Total	58.449	88			

The p-value of the F test in the ANOVA was less than 0.05 (p=0.017) which means the null hypothesis was rejected. It can be concluded that people at different position levels have different opinions on the effect of risk management planning on the success of global sourcing. Difference in particular organisation positions is indicated in Table 24.

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Table 24 Multiple Comparison of difference in opinion: Successful Global Sourcing

Multiple Comparisons				
Dependent Variable	(I) Position	(J) Position	Mean Difference (I-J)	P-Value
Risk management rules make global sourcing successful.	Global Sourcing Manager, Project Procurement Manager	Project Manager, Engineering Manager	.660	.002
		Construction Managers and Risk Management Officer	.197	.457
		Executive Director/Exco Member	.305	.195
	Project / Engineering Manager	Global Sourcing Manager, Project Procurement Manager	-.660	.002
		Construction Managers and Risk Management Officer	-.463	.091
		Executive Director/Exco Member	-.355	.146
	Construction Managers/ Risk Management Officer	Global Sourcing and Project Procurement Manager	-.197	.457
		Project Manager, Engineering Manager	.463	.091
		Executive Director/Exco Member	.108	.715
	Executive Director/Exco Member	Global Sourcing and Project Procurement Manager	-.305	.195
		Project / Engineering Manager	.355	.146
		Construction Managers/ Risk Management Officer	-.108	.715

The only significant differences were between the sourcing inclined Global Sourcing Manager and Project Procurement Manager against the mean rating for technically biased Project Manager and Engineering Manager. The Global Sourcing Manager and Project Procurement Manager (mean = 4.43 out of 5) rated the risk management rules making global sourcing successful significantly higher than Project / Engineering Manager (3.70). The p-value of the test was 0.02 which is significantly lower than 0.05. There were no significant differences among the rest of the positions.

5.7.3 Comparison of Opinion Two : Project Cost

Risk management rules for global sourcing reduce the project cost.

One-way analysis of variance (ANOVA) was also used to assess whether there was a difference in the opinion that risk management rules for global sourcing reduces project cost by position of respondent.

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The null and alternative hypotheses were:

Null Hypothesis (H0): All the different position levels have the same mean rating for risk management rules for the assertion that successful global sourcing reduces project cost.

Alternative Hypothesis (H1): At least one mean rating is different.

The results are shown in Table 25.

Table 25 Comparison of Opinion Two: Project Cost

Descriptive Analysis				
Dependent Variable	**Positions**	**N**	**Mean**	**Std. Deviation**
Risk management rules for global sourcing reduce the project cost.	Global Sourcing Manager, Project Procurement Manager	33	4.27	.674
	Project Manager, Engineering Manager	27	3.85	.949
	Construction Managers and Risk Management Officer	12	3.75	1.055
	Executive Director/Exco Member	17	4.12	.697
	Total	89	4.04	.838

ANOVA					
Groups	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	3.853	3	1.284	1.883	.139
Within Groups	57.968	85	.682		
Total	61.820	88			

The p-value of the F test in the ANOVA was greater than 0.05 (p=0.139) which means the null hypothesis could not be rejected. It can then be concluded that there was insufficient evidence at 5% significance level to suggest that people at different position levels have different opinions on risk management planning in global sourcing reducing project cost.

5.7.4 Comparison of Opinion Three : Project Time

Risk management rules in global sourcing reduce the project time.

One-way analysis of variance (ANOVA) was also used to assess whether there was a difference in the opinion regarding risk management rules reduces project time by position of respondent.

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The null and alternative hypotheses were:

Null Hypothesis (H0) : All the different position levels have the same mean rating for risk management rules in global sourcing reducing project time.

Alternative Hypothesis (H1) : At least one mean rating is different.

The results are shown in Table 26.

Table 26 Comparison of Opinion Three: Project Time

Descriptive Statistics				
Dependent Variable	**Position**	**N**	**Mean**	**Std. Deviation**
Risk management rules for global sourcing reduce the project time.	Global Sourcing Manager, Project Procurement Manager	33	4.36	.783
	Project Manager, Engineering Manager	27	3.78	.974
	Construction Managers and Risk Management Officer	12	3.83	.937
	Executive Director/Exco Member	17	3.76	.831
	Total	89	4.00	.905

ANOVA					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	6.971	3	2.324	3.038	.033
Within Groups	65.029	85	.765		

The p-value of the F test in the ANOVA was less than 0.05 (p=0.033) which means the null hypothesis was rejected. It can be concluded that people at different position levels have different opinions on the impact of a risk management rules for global sourcing reducing project time. The analysis showing which particular organisation levels were different is indicated in Table 27.

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Table 27 Multiple comparison of difference in opinion Three: Project Time

Multiple Comparisons				
LSD				
Dependent Variable	(I) Position	(J) Position	Mean Difference (I-J)	P-Value
Risk Management rules in global sourcing reduce the project time.	Global Sourcing Manager, Project Procurement Manager	Project Manager, Engineering Manager	.586	.012
		Construction Managers/ Risk Management Officer	.530	.076
		Executive Director/Exco Member	.599	.024
	Project / Engineering Manager	Global Sourcing Manager, Project Procurement Manager	-.586	.012
		Construction Managers/ Risk Management Officer	-.056	.855
		Executive Director/Exco Member	.013	.962
	Construction Managers/ Risk Management Officer	Global Sourcing Manager, Project Procurement Manager	-.530	.076
		Project / Engineering Manager	.056	.855
		Executive Director/Exco Member	.069	.836
	Executive Director/Exco Member	Global Sourcing Manager, Project Procurement Manager	-.599	.024
		Project / Engineering Manager	-.013	.962
		Construction Managers/ Risk Management Officer	-.069	.836

The results indicated that the opinion of Global Sourcing Manager and Project Procurement Manager (4.36 out of 5) was significantly higher than the rating by Project Manager and Engineering Manager (3.78) and also significantly higher than the ratings by Executive Director/Exco Member (3.76). The p-values were 0.012 and 0.024 respectively. There were no significant differences among the rest of the positions.

5.7.5 Comparison of Opinion Four : Project Quality

Risk management rules in global sourcing delivers the right project quality.

One-way analysis of variance (ANOVA) was also used to assess whether there was a difference in the opinion on risk management rules in global sourcing delivering the required quality of equipment and services.

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The null and alternative hypotheses were:

Null Hypothesis H0 : All the different position levels have the same mean rating for risk management rules in global sourcing delivering the required quality of equipment and services

Alternative Hypothesis H1 : At least one mean rating is different.

The results are shown in Table 28.

Table 28 Comparison of Opinion Four: Project Quality

Descriptive				
Dependent variable	**Position**	**N**	**Mean**	**Std. Deviation**
Risk Management rules for global sourcing to deliver the right project quality in terms of required quality of equipment and services.	Global Sourcing Manager, Project Procurement Manager	33	4.30	.728
	Project Manager, Engineering Manager	26	3.77	.815
	Construction Managers/ Risk Management Officer	12	3.83	1.030
	Executive Director/Exco Member	16	3.94	.772
	Total	87	4.01	.828

ANOVA					
	Sum of Squares	**df**	**Mean Square**	**F**	**P-Value**
Between Groups	4.799	3	1.600	2.450	.069
Within Groups	54.189	83	.653		
Total	58.989	86			

The p-value of the F test in the ANOVA was greater than 0.05 which means the null hypothesis could not be rejected. It can be concluded that there is insufficient evidence at 5% significance level to suggest that people involved at various position levels in executing large capital projects have different opinions on risk management rules for global sourcing delivering the right quality of equipment and services.

5.8 Summary of Hypotheses Tested

The research tested each of the hypotheses mentioned in Chapter 3 and based on the consistent results as shown in Table 29, it was possible to identify the strong relationship between the risk management rules for successful global sourcing and project time, project cost and project quality.

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Table 29 Summary of Hypothesis Tested

Hypothesis Number and description		Correlation Coefficient	p-Value	Relationship
1	Null Hypothesis (1) : H0 : $\rho = 0$, Risk management rules for global sourcing is NOT effective in reducing project completion time for large capital projects. Alternative Hypothesis (1): H1 : $\rho > 0$, Risk management rules for global sourcing is effective in reducing project completion time for large capital projects.	.678	0.000	Strong
		Result : Null hypothesis is rejected		
2	Null Hypothesis (2) : H0 : $\rho = 0$, Risk management rules for global sourcing is NOT effective in reducing project cost for large capital projects. Alternative Hypothesis (2): H1: $\rho > 0$, Risk management rules for global sourcing is effective in reducing project cost for large capital projects.	0.660	0.000	Strong
		Result : Null hypothesis is rejected		
3	Null Hypothesis (3) : H0 : $\rho = 0$, Risk Management rules for global sourcing is NOT effective in delivering required quality of equipment and services for large capital projects. Alternative Hypothesis (3): H1: $\rho > 0$, Risk management rules for global sourcing is effective in delivering required quality of equipment and services for large capital projects.	0.685	0.000	Strong
		Result : Null hypothesis is rejected		

* Pearson Correlation Coefficient at 0.01 level

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CHAPTER 6:
DISCUSSION OF RESULTS

6.1 Introduction

The main objective of this research was to derive a set of rules and develop a model for effective risk management enhancing the success of global sourcing in large capital projects with particular emphasis on the impact on project time, cost and quality. Primary data was collated from 89 survey responses from 40 countries and six continents forming the basis of the analysis. Statistical tests were applied to estimate high mean score, correlation coefficients comparing the opinion in the perceptions of the respondents respectively to answer the research questions and the hypothesis presented in Chapter 3.

Some literature outlining the concepts on risk management rules related to global sourcing in large capital project was discussed in Chapter 2. The results obtained in Chapter 5 from the quantitative analysis of the survey questionnaire will be discussed in detail in this chapter and related back to the research questions and hypotheses identified in Chapter 3, the literature review in Chapter 2 and the rationale behind this research in Chapter 1. It is, however, important to highlight that this research was based on the responses from executives and various stakeholders who had vast experience in handling or overseeing global sourcing for large capital project in 40 various countries, six continents which gave a different perspective to the findings of the study. The outcome of this research proved that successful global sourcing has a positive impact on project performance.

6.2 Discussion of Results

The ensuing headings summarize and correlate with the work done in previous chapters in this report as well as answering the research questions and hypothesis.

6.2.1 Research Question One

What reasons motivate global sourcing in large capital projects?

The first research question sought to assess and evaluate the respondents' opinion and experience in pursuing a global sourcing strategy in their current or past large capital projects.

Table 15 and Figure 11 identified the reasons for the organisation to go for global sourcing based on a high mean score and order of importance from top to bottom.

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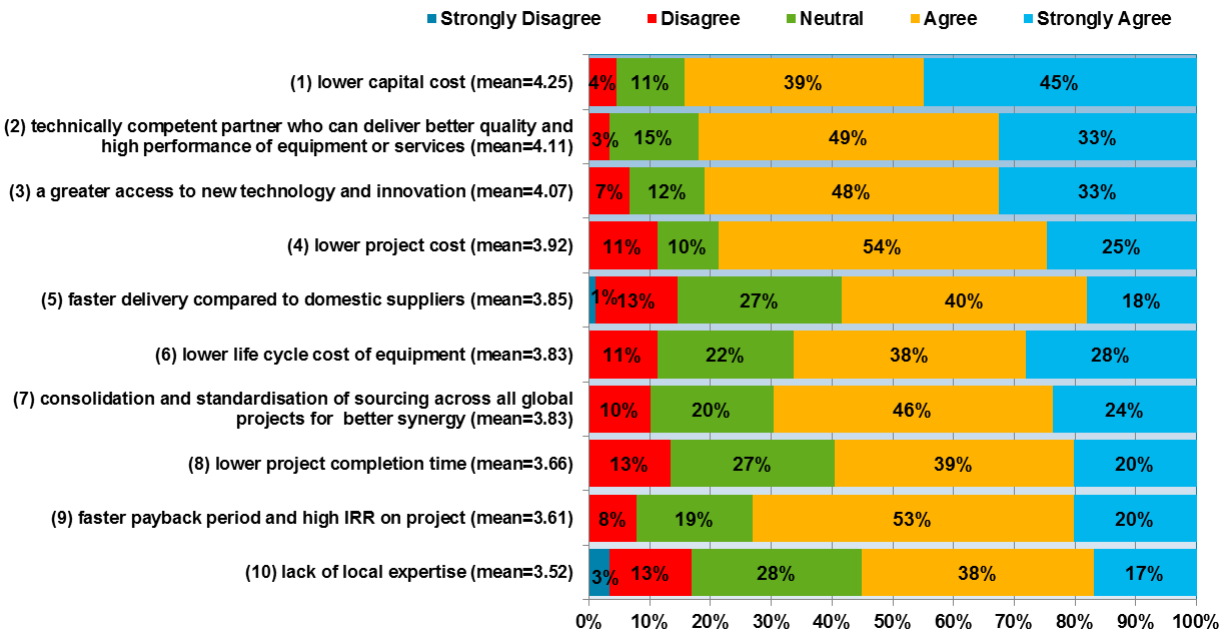
Figure 11 Reasons for Global Sourcing in Large Capital Projects



The results from the survey showed that the majority of respondents (aggregated average of 71%) either agreed or strongly agreed on the reasons specified for global sourcing in large capital projects. Only 8% felt that the stated listing of reasons was not that important for global sourcing in large capital projects. However, although the mean value of, faster delivery compared to domestic suppliers, is higher but 8% respondents for this question was lower than the respondents who agreed or strongly agreed for, lower life cycle cost of equipment. 73% of the respondents give more weighting to, faster payback period and high IRR on project, though the mean value is lower and could not be considered under the top five reasons for global sourcing.

The literature review revealed that the reasons for global sourcing are beyond the benefits of cost savings. Mohamad *et al.,* (2009) referred to the highest benefit of global sourcing to be lower costs which is consistent with the respondent's opinion illustrated in Figure 11.

Hauer (2003) supported the first reason of lower capital cost and argued that global sourcing improved the financial performance of the organisation giving it a competitive advantage as every dollar saved through a sourcing initiative contributes directly to the bottom line of the balance sheet of the organisation. These reasons indicate that everyone viewed global sourcing as a cost savings instrument and preferred its use on large capital projects to reduce the cost of capital, project cost and ultimately enhance the payback period. By having a technically competent partner for better quality and higher performance of equipment ultimately leads to cost reductions through optimisation of resources and minimising of overall cost. This view is supported by Murray (2001) who emphasized that strategic alliances with a technically competent partner in global sourcing can unlock

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competitive advantages for an organisation. On the similar lines, Christopher *et al.,* (2011) also highlighted that many organizations prefer to go for global sourcing mainly to get a greater access to technologies, emerging markets, better quality and faster delivery periods. Roberts and Schermer (2011) highlighted that there is an inverse relationship between project cost and IRR as lower capital cost and lower project cost increase the IRR and reduce payback periods. Both these reasons are strongly supported by respondents in Figure 11.

The other variables that appeared as the sixth and seventh most important factors which are not studied greatly in literature reviewed in this report are that global sourcing lowers the life cycle cost of the equipment hence reducing operating cost over the life of the equipment. Secondly the consolidation and standardisation of sourcing processes across all global projects provides better synergy and an opportunity to rationalise the supplier and standardise the equipment and spares across all projects. Hence it reduces the inventory carrying cost, maintenance cost and administrative cost. The other reasons, not explicitly interrogated in the questionnaire, however, are that it can be inferred from other reasons that global sourcing provides an opportunity to select the supplier with the lowest possible delivery period available, therefore helping to improve the anticipated project timelines by avoiding market fluctuation due to commodity price or inflation.

In view of interpreting the above graph, data and argument, the key reasons identified by the various authors for global sourcing were supported by the respondents' views in answer to the research questions. It can therefore be concluded that the main reasons for global sourcing in large capital projects are mainly to reduce the capital cost; get the better quality of equipment; gain access to new technology; improve the performance and productivity of the equipment and to lower project cost. Such external sourcing was said to also often provide faster delivery lead times compared to domestic suppliers, lower life cycle cost (meaning a lower CAPEX to OPEX ratio) all ultimately resulting in higher ROI and faster payback on the project.

6.2.2 Research Question Two

Which are the indicators that confirm the global sourcing success for large capital projects?

Research question two aimed to identify the indicators which enhance the success of global sourcing for large capital projects and evaluate them based on a hierarchy of importance. Global sourcing as a cost advantage has been practiced for many years but has not necessarily gained acceptance as a formula for success.

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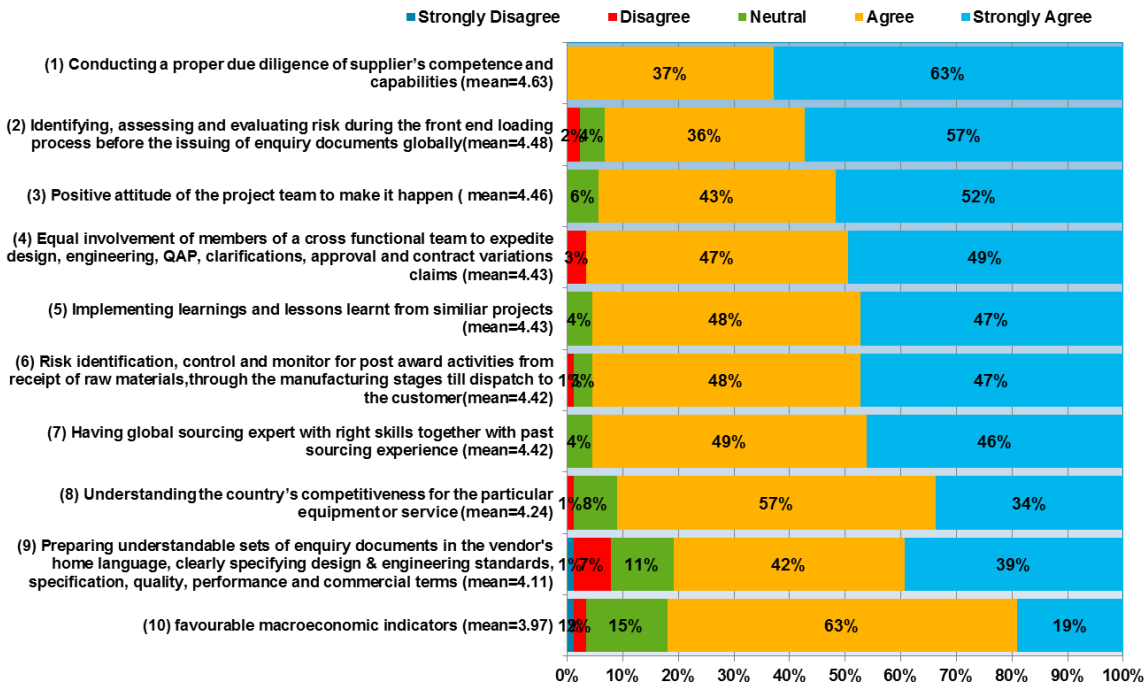
Table 16 and Figure 12 show that all except “favourable macroeconomic indicators” have a mean greater than four and hence are important indicators for successful global sourcing in large capital projects.

Figure 12 Indicators for Success of Global Sourcing in Large Capital Projects



The results from the survey showed that an aggregated average 92% of respondents either agreed or strongly agreed on the indicators which contribute to the success in global sourcing for large capital projects. In order to further examine the critical aspects for the stated success, only those that recorded a test mean greater than four were considered.

Trent and Monczka (2005) and Petersen *et al.,* (2000) identified that the most important factor for global sourcing success lies in identifying the personnel with the right knowledge, skills and abilities to lead global sourcing execution towards success. But this research has highlighted that large capital projects have different indicators to lead global sourcing towards success. The most important criteria is to conduct vendor due diligence during the front end loading process before engaging in the form of agreement. This supports the view of Jergeas (2008) who emphasized that proper vender assessment helps in controlling cost overruns. Knowing the suppliers competences, capacity and the potential risks in advance, pave the way for more effective management of the stakeholder relationship.

This also helps with planning an inbuilt contingency plan into the project schedule and, budget as well as preparing for mitigating the potential risks thus improving the project performance and avoiding costs associated with standing charges. Notably, it is essential to evaluate suppliers and reduce risks from the outset and the selection criteria should include more parameters than just the direct cost of supply. Monczka, Trent, and Handfield (2005)

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emphasized the evaluation of suppliers in global sourcing in terms of technical and quality capabilities, patent and proprietary technology security, currency trend impact, due diligence and discipline of performance measurement to manage risks in large capital projects. The respondents opinion in Figure 12 is also supported by Manuj (2013) who advised to include tangible and intangible criteria for supplier valuation such as cost, quality, delivery reliability, flexibility, and innovation, whilst the intangible selection criteria considers supplier integrity, strategic fit, and risk exposure.

Independent Projects Analysis Inc., (2006) in Jergeas (2008) research showed that poor front-end planning is the biggest contributor to cost overruns. Hence, a vendor due diligence process is important to follow before engaging with the supplier. This process must consider and evaluate many facets of the supplier's capability through comprehensive investigations as shown in Figure 13.

Figure 13 Project Vendors Due Diligence Criteria

The literature reviewed and the survey opinion of global sourcing managers, executives and project managers also revealed that, failure to take detailed precautions in selecting a proper supplier can have dire results (Manuj and Mentzer, 2008). Therefore, it is important to apply a rigorous vendor due diligence process to address short and long term goals. This will provide reasonable assurance in the front end loading process so that potential risks can be managed throughout the life time of the relationship.

The front end loading process for global sourcing on large capital projects has direct relations with project performance. The higher the level of integration between project owner and suppliers or contractors in the design stage and during the front end loading

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process, the better the project performance in terms of cost (Rahman and Kumaraswamy, 2004a,b) ;Errasti *et al.,* 2007;Song *et al.,* 2009), time (Rahman and Kumaraswamy, 2004a,b;Song *et al.,* 2009), and quality (Ahola *et al.,* 2008 ;Eriksson, 2008).

The attitudinal profile of the project team is also very important in achieving global sourcing success in large capital projects. Jensen and Petersen (2013) highlighted that the success of global sourcing is determined by the managers' risk perceptions, risk tolerance, and ability to employ risk-reducing measures while dealing with global sourcing challenges. Large capital projects have many stakeholders which add complexity to the interactions and processes. It requires the entire project team to have a positive outlook to accept the challenges and deal with them before it affects the project timelines, cost and quality. For instance, there are intricacies involved in integrating many stockholders to align scope and deliverables, performance guarantees amongst other parameters. The other challenges are to ensure that the gaps in project scope, guarantees, delivery terms, cultural and communications are identified, addressed and communicated to all stakeholders before execution commences. These are the main challenges for project manager and global sourcing manager in global sourcing and if not handled properly can affect the project performance.

The issue of, equal involvement of members of a cross functional team to expedite design, engineering, Quality Assurance Plan (QAP), timely clarifications, its approval and settle contract variations claims, is not covered in great detail under any literature. However, based on practical experiences there is clear indication that it has a high impact on project performance. It is important to have all activities well integrated, as should any of the tasks get delayed there are likely to be severe repercussions on the entire project management cycle. Miller and Lessard (2000) argued that the success of large engineering projects depends on managing complex structures, contractual mechanisms, and risk relationships as well as supplier selection. With this in mind, it is important to keep all the stakeholders at the same level of understanding, else it affects the project performance and threatens the stability of the relationships within cross-functional departmental interfaces as well as with suppliers/contractors.

It's also important to capture the learning's from the lessons learnt during the front end loading process and project execution phase so that the same type of risks or mistakes can be eliminated in future. The framework suggested by Trent and Monckza (2000) in Table 1 can be used to compile the lessons learnt in various categories and incorporate them into an organisation knowledge management database. The review of this bank of accumulated knowledge should be made a mandatory requirement before engaging in any other global sourcing project. There are many software packages being used for capturing lessons

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learnt but the project environment currently prefers to use Microsoft Share Point or a Knowledge Management tool to capture and access the real time information at any point in time from multiple locations.

In view of this, it can be concluded that the top five criteria, based on the answers given for the research question are an indicator for success of global sourcing in large capital projects. Considering the compliance and evaluation of these criteria before engaging in global sourcing will certainly enhance the success of any global sourcing strategy in large capital projects whilst reducing the risk on project performance in terms of the completion time, cost and quality.

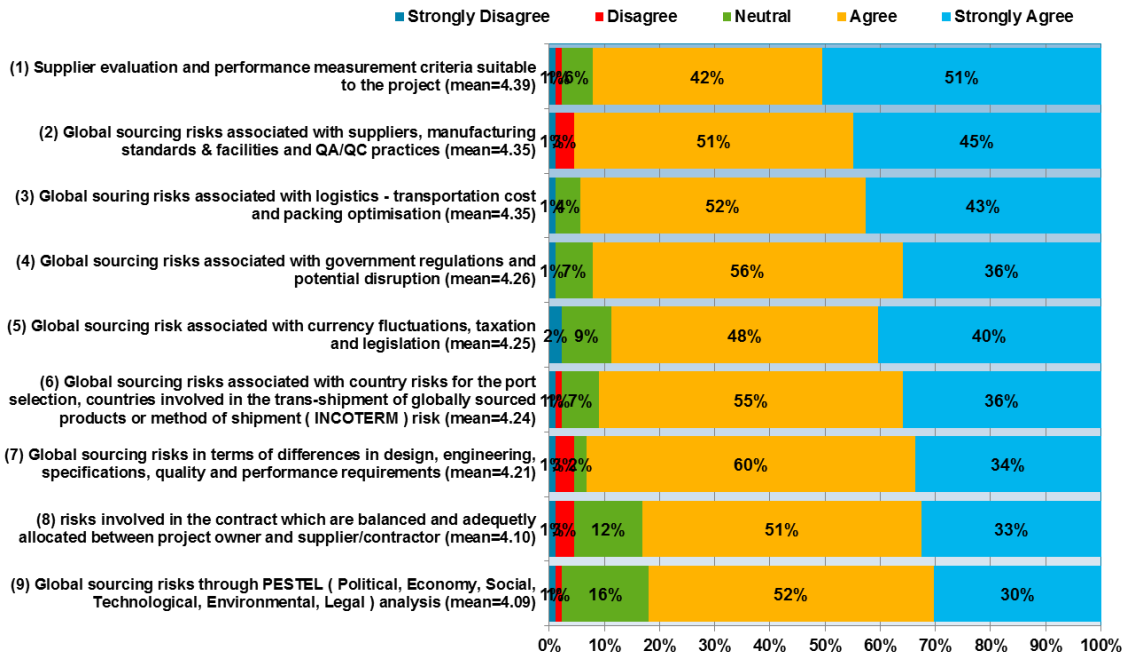
6.2.3 Research Question Three

How should risks be managed in global sourcing for large capital projects?

Research question three was aimed at identifying the risk associated with global sourcing and how large capital projects should manage these risks to create a positive impact on project performance.

In order to determine how to manage the risks involved in global sourcing for large capital projects, all the statements were found to have a mean greater than four and hence were highlighted as important to consider in managing risks. Table 16 and Figure 14 show the factors, ranked in order of importance from top to bottom, on how large capital project should manage risks in global sourcing for large capital projects.

Figure 14 How should risks be managed in global sourcing for large capital projects?



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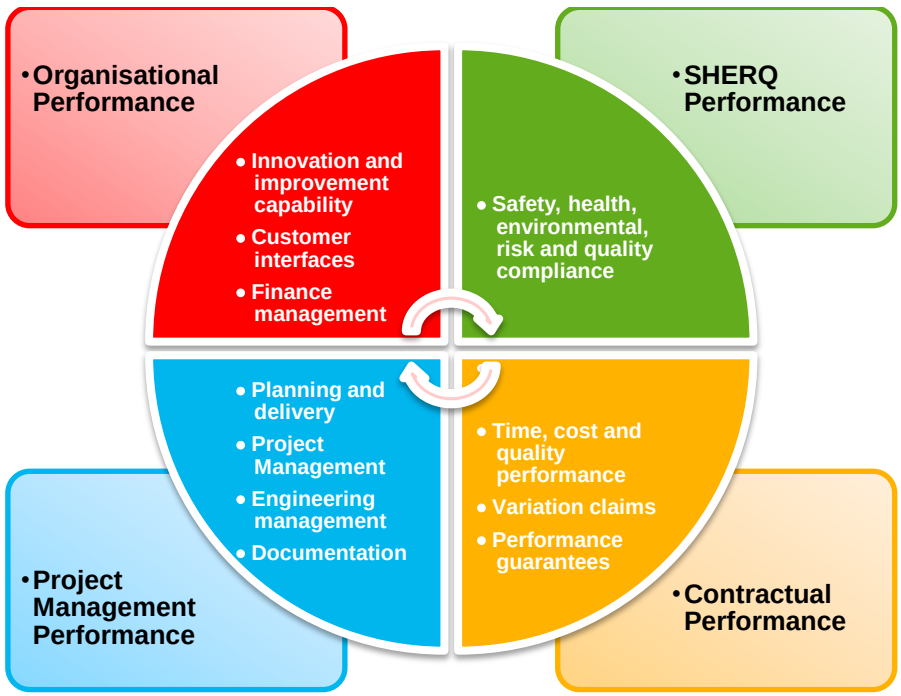
The results from the survey interestingly showed that on aggregated average 90% of respondents either agreed or strongly agreed that project performance can be improved in managing risks associated with global sourcing for large capital projects. The most critical factors are explained in detail.

The respondent gave high importance to supplier evaluation and performance measurement to improve the project performance. Watt *et al.,* (2010) suggested the selection of suppliers based on their organization experience, capability and past performance. Supplier performance measurement is an important tool to gauge supplier performance against base line performance and to guide the effecting of corrective action at an appropriate time. Some project organizations only focus on cost, time and quality as a criteria for performance measurement. Lauras, Marques, and Gourc (2010) support this view and added risk as an additional criterion to consider for measurement. Toor and Ogunlana (2010) have a contradictory position however, and advised that the key performance measurements should be supplier's ability to meet the safety, technical requirement and deliver according to stipulated quality and specifications. Cormican and Cunningham (2007) suggest the parameters should be realistic and measurable. In practice, organizations involved in executing large capital projects consider a wide variety of criteria to measure the integrated performance of the vendor throughout the life cycle of the project. The proper evaluation of this criteria helps in sustainably reducing the risks for current and subsequent projects. Figure 15 outlines the key performance indicators for the measurement of vendor performance in large capital project.

Figure 15 Vendor Key performance Measurement Criteria



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Manufacturing standards and quality assurance systems also vary to a great extent from country to country. It is important to clarify these aspects during the front end loading process in order to have a comprehensive mitigation plan in place. The global sourcing decision should be based on but not limited to, a landed cost basis (Monczka, Trent, and Handfield, 2005) and the availability of a reliable logistics service provider (Wagner and Bode, 2008). The logistics service provider should have adequate knowledge to optimize the cost of such factors as packing and transportation while managing the risk during contract execution. It is also important to clarify the International Commercial Terms (INCOTERM) basis in the agreement to have a common understanding among all stakeholders about the precise points of risk transfer at the various stages of the sourcing process. These are critical factors to consider for making the right decisions about global sourcing.

It was also determined that the risks based on the shipping methodology, port of dispatch and countries involved during the transhipment are also critical for successful global sourcing. Once the risks have been identified, it is advisable to prepare a comprehensive risk mitigation plan and to compute the costs associated with each country for the route of shipment. This ultimately leads towards timely delivery of shipments reducing the risk on project time and cost. Roberts and Schermer (2011) stated that selecting a contracting strategy in such a way that it will equitably allocate risk between the contractor and owner, has a positive impact on project performance and greatly assists in achieving the owner's project objectives. In general, project owners prefer to employ contracting methodology in such a way that all the risk remains with the contractor. For example, asking for a lump sum fixed price turnkey contract for large capital projects without having an adequate engineering design or feasibility study being completed. In such a specific instance, the contractor very often may not manage or bear the cost impact of unknown risks and may either decide on abrupt stoppage of the work or to refer to arbitration. In either event, the risks borne by the project owner are much larger than those remaining with the contractors and ultimately it leads towards non achievement of the project performance as the project owner remains at the receiving end.

Different countries often have different packaging norms, for example in China or Turkey, structural steel is often packed in steel crates for transport, which adds significant bench cubic meter and weight to the packaging for the sea freight, whilst some other countries use wooden packaging. The use of packaging materials should be in line with regulation stipulated by each country and should be clearly defined in the supply agreement. It is also important to survey the bridge and road conditions in order to ensure that proper packing and fleets requirements are identified ensuring that the goods are suitable prepared for

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transportation over the anticipated conditions. It is often advisable to use the internationally accepted packaging standards such as United States of America International Ship and Port Facility Security Code (USA ISPS) regulations to ensure the use of appropriate materials for packaging.

The PESTEL framework provides the analysis that gives due structure to the review of the internal dimensions of a country as a valuable input into the planning process. Manuj (2013) and Christopher and Peck (2004) suggested the need to evaluate the country risks in terms of political, environment, social and legal risks to improve the global sourcing success. Political stability has overarching contextual implications in developing stable international relationships (Fitzgerald, 2005). The other factors beyond the control of the project owners are inflation, frequent changes in taxation/levies, currency variation, trade environment, technological changes, legal and environmental framework and regulations which have direct impact on project performance. These are important criteria to analyse and integrate into the project schedule before engaging in global sourcing. Tax and duty considerations are also equally important in the decision process as there may be either a positive or negative tax impact at the time of assessment such as withholding tax or double taxation treaties between the countries. It is also advisable to gather the trade and taxation intelligence to explore the tax efficient structure and the possibility of getting duty exemption on capital projects or export credit benefits. This opportunity makes global sourcing more lucrative and further improves the project performance.

In today's volatile market, currency fluctuations make global sourcing decisions more complex and potentially increase the operational costs while taking away the competitive advantage of global sourcing. Exchange rate fluctuation (Liu *et al.,* 2008; Fagan,1991; Trent and Monczka, 2005) is a critical risk to be managed in global sourcing. This risk can be managed through using Foreign Exchange (FOREX) and financial hedging instruments (either by the project owner or supplier) regardless, there needs to be strategies already in place at the time of tendering to avoid any financial risks on the projects.

The other most important risks in global sourcing for large capital projects are to deal with different design and engineering standards, different quality, specification and performance requirements. It is vital to identify these gaps during the front end loading process and include the design and engineering requirements in an understandable format for all the stakeholders involved. This approach enables reduction in the risks and any mismatch between scope, quality, delivery, performance and price to avoid any potential risks on project time and avoid disputes among stakeholders at a later stage.

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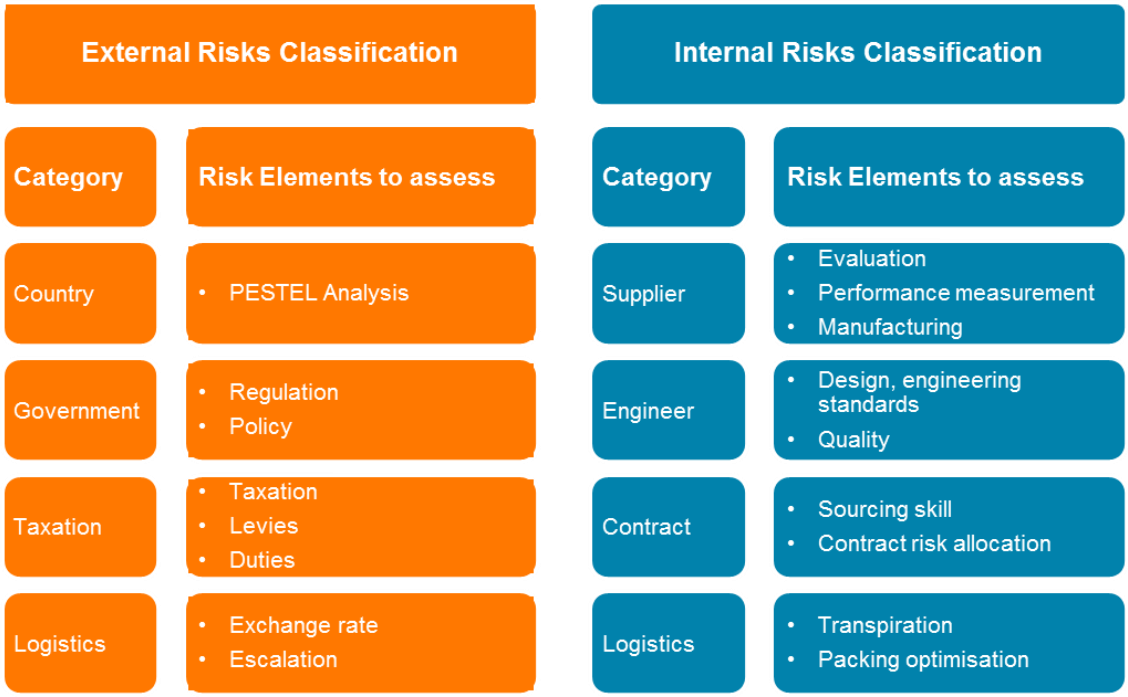
Based on the above, the risks are classified into internal and external risks and shown in Figure 16. This classification is further sub divided into various categories and appropriate risk elements are shown against each category.

Figure 16 Risk Classification and Elements of Risk Assessment



In light of the pragmatic view on the criteria thus identified in the study is that it is set to guide the effective management of the risks in global sourcing for large capital projects and answer the research question. Large capital projects should manage the risks in global sourcing through supplier evaluation and performance measurement and analysing risks associated with suppliers. It is also important to identify the differences in manufacturing standards and facilities and adopt well defined quality assurance (QA) and quality control (QC) practices to manage and mitigate identified risks. Furthermore, analysing government regulations, taxation and legislation and political situation also helps in analysing the probably risks in executing global sourcing. Evaluating the impact of currency fluctuations, transportation cost and packing optimization options is equally important in controlling risks in global sourcing.

6.2.4 Research Question Four

What are the reasons for failure of global sourcing in large capital projects?

Research question four was aimed at understanding the respondents' experiences with failure of global sourcing in large capital projects. Lessons from elements of these experiences have thus far been detailed and will be consolidated in a condensed risk

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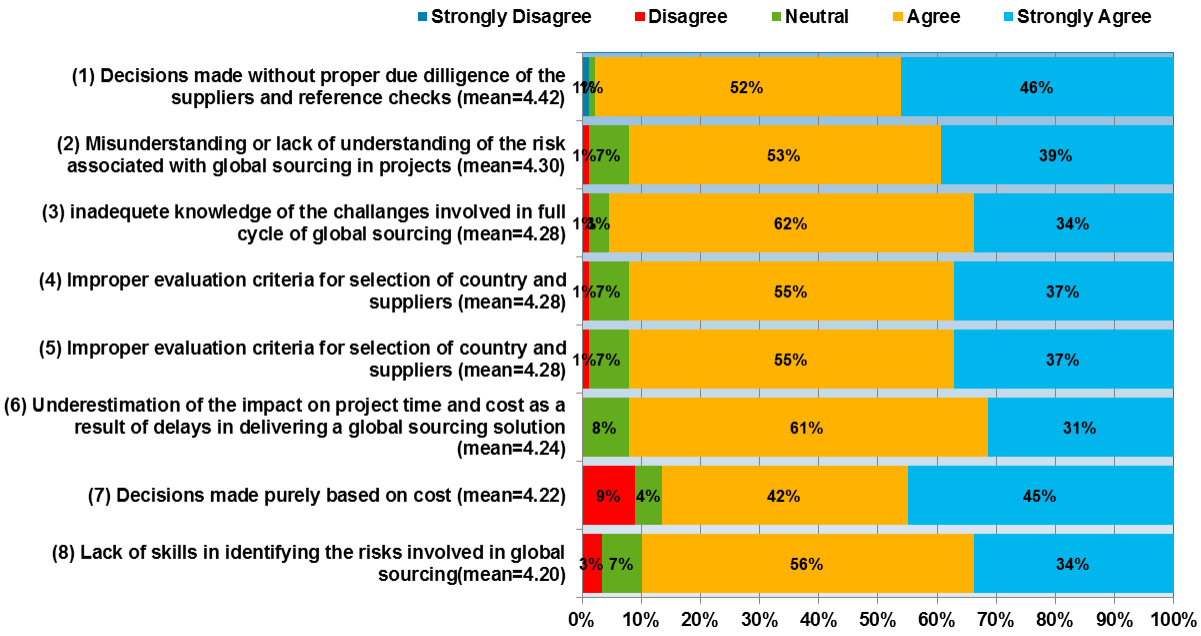
management model to be proposed in Chapter 7 as a critical step towards contributing to the enhancement of successful experiences in global sourcing.

The reasons for failure of global sourcing are ranked in order of importance in Table 18 and Figure 17. All the statements included in the statistical testing scored a mean higher than 4 and are hence important to consider in defining a model for rules of risk management for successful global sourcing. The reasons are stated in order of importance from top to bottom.

Figure 17 Reasons for Failure of Global Sourcing in Large Capital Projects



The results from the survey showed that an aggregated average of 92% of respondents either agreed or strongly agreed on all the above reasons for failure in global sourcing.

Teller (2013) summarized that insufficient risk management increases unexpected events, causes cost overruns, delays and leads the project towards failure or reduced success. Two themes emerged from Figure 17. One theme was the most common reason for failure of global sourcing stemming from key decisions being made without proper due diligence of the suppliers and reference checks, which supports the most important indicators identified for success of global sourcing as shown in Table 15 and Table 16. The second theme was that of not having the right skill in the form of a global sourcing expert who has adequate knowledge of identifying risks and challenges involved in leading the global sourcing process. Being familiar with the impact of the related decisions on project schedule, timelines and cost, as well as right skills in global sourcing helps in proper evaluation of the risk involved in global sourcing execution. Green (2004) reported that most executives acknowledge that a supply chain disruption is one of their largest organizational risks and many of them are not sure what to do about it.

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Project managers are in the key position responsible for making all the decisions and they are sometimes not familiar with the sourcing challenges and risks involved. Thus, making decisions purely based on cost to contain the task within the budget, increases the potential of sourcing failure. Thamhain (2013) argued that a project team can be efficient in identifying, and analysing known risk factors which mainly focus on schedule, budget and technical areas but are weak in dealing with unknown risks that can directly affect the project performance. Christopher *et al*. (2011) and Tummala and Schoenherr (2011) advised that the success of global sourcing in large capital projects largely depends on the inherent project organization's capabilities to manage the sourcing risks and their effect on the project time and cost.

In view of the above, the criteria identified for failure of global sourcing initiative should become part of rules of risk management for successful global sourcing in future. This should include proper supplier due diligence incorporating proper evaluation criteria for the selection of the source country and vendor, identifying risk categories, competent sourcing management team capable of making decisions based on accurate cost ratio of capital expenditure (CAPEX) to estimated operating expenditure (OPEX).

6.2.5 Research Question Five

What happens to project performance (in terms of project time, project cost project quality) when an organisation prepares a risk management plan before engaging in global sourcing for large capital projects?

Research question five was aimed at understanding what the effect would be on project time, project cost and project quality if risk management plans were prepared before engaging in global sourcing.

Table 19 and Figure 18 show the effect of preparing a risk management plan for global sourcing on large capital projects with criteria ranked in order of importance from top to bottom. All the statements included have a mean equal or higher than 4.00 and hence important to consider for evaluation.

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Figure 18 Effect of Preparing Risk Management Plan before Engaging into Global Sourcing

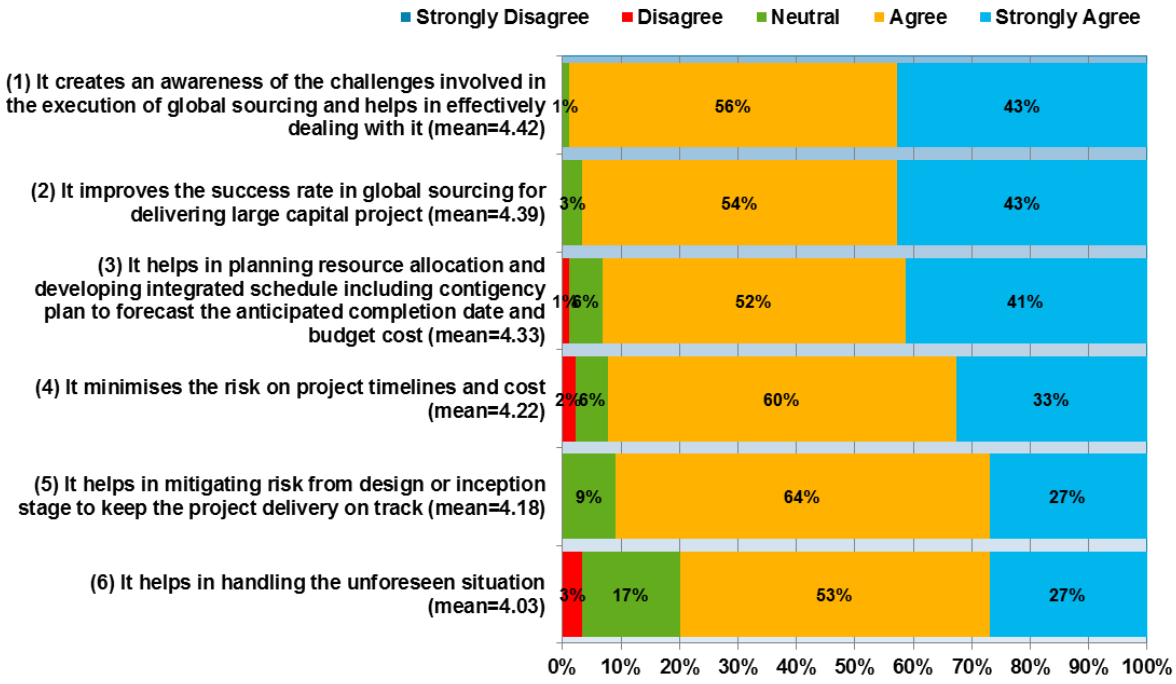

Figure 18 showed that on aggregated average, 92% of the respondents either strongly agreed or agreed that preparing risk management plan before engaging into global sourcing would be effective.

”Global sourcing trends are making the supply chain longer and more fragmented and this is exposing firms to greater costs and risks” Christopher *et al.,* (2011, p.77). Hence, it is important to know the challenges involved, how it affects the project time, cost and quality and how to mitigate any negative impact before engaging in global sourcing. The findings in this section are also in agreement with Thamhain (2013) findings whose results highlighted that identifying the risks at an early stage of the project is a critical pre-condition to managing the risks. Manuj and Menzer (2008) emphasized that it is essential to know the source of the risk at an early stage to identify the responsibility of the management team for each risk.

Cooper *et al.,*(2005) advised that preparing a risk management plan helps in better allocation and utilization of resources, making better decisions and controlling the project cost and project time. Various authors suggested that risk identification should be the first and critical step in preparing a risk management plan.

Preparing a risk management plan and knowing the possible risks involved helps in developing and having a contingency plan in place. There are benefits in scheduling the project activities in such a way that the parallel activities can be performed in absence of unforeseen risks in global sourcing which reduces the fixed cost of contractors by managing the project schedule. It also helps in boosting the team’s rhythm and speed in

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achieving the set target. Risk management planning supports the development of the critical human and organizational capability building confidence in handling future global sourcing initiatives. It is vital to identify the risk categories as defined in Figure 6 and prepare a risk assessment, evaluation and mitigation plan. The vendor due diligence and evaluation criteria are the most important factors in identifying, analysing the risks involved and planning how these should be positioned in monitoring the performance of the vendor throughout the project life cycle for effective results and knowledge creation.

Table 24 and Table 27 indicate the significant difference in opinion between the sourcing inclined positions being the Global Sourcing Manager, Project Procurement Manager versus the technically biased positions, Project Manager, Engineering Manager in their related experiences. The contrasts in opinion between these two categories could stem from the differences in their direct responsibilities towards the project performance delivery, hence technically biased positions would for instance, prefer to avoid any activities where uncertainty and challenges are involved. Furthermore, the other reasons could be that their direct involvement in global sourcing is negligible due to insufficient experience in handling cross border transactions and limited understanding of the risk involved in global sourcing. Hence, their opinion differs compared to global sourcing managers. Interestingly, their opinion contradicts in Table 25 and Table 28 where there is no significant difference in opinion between any category asserting that risk management in successful global sourcing reduces the project cost and deliver the right quality of project.

Respondents' opinion on rules of risk management in global sourcing and its impact on project performance in terms of project time, cost and quality is stipulated in Figure 19.

Figure 19 Successful Global Sourcing and its Impact on Project Performance

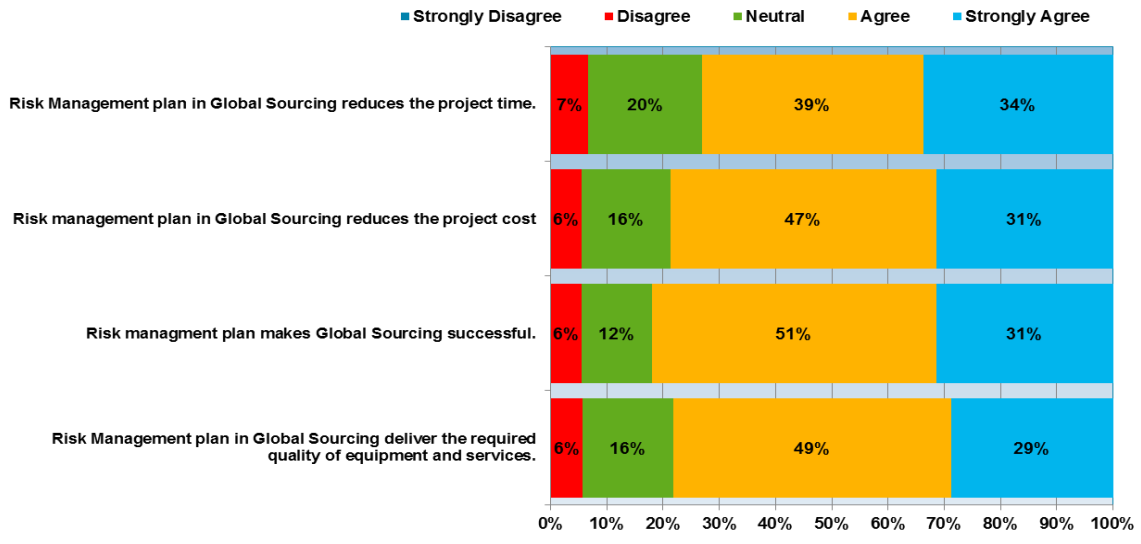

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Figure 19 showed that on aggregated average, 78% of the respondents either strongly agreed or agreed that a risk management rules makes global sourcing successful and that it reduced the project time, cost and improved the quality. This view is in agreement with the view from Teller (2013) which highlighted that insufficient risk management increases unexpected events, causing cost overruns, delays and leading the project towards failure.

It was concluded that Table 29 and Figure 19 answer the research questions that risk management makes global sourcing successful and has a positive impact on project time, project cost and project quality.

6.2.6 Hypothesis One

Hypothesis one was aimed at establishing whether there is any correlation between risk management rules in global sourcing and the reduction in project completion time.

Null Hypothesis (1) : H0 : $\rho = 0$, Risk management rules in global sourcing for large capital projects is NOT effective in reducing project completion time.

Alternative Hypothesis (1) : H1 : $\rho > 0$, Risk management rules in global sourcing for large capital projects is effective in reducing project completion time.

Figure 1 shows that global sourcing can have a positive or negative impact on many elements of the integrated project management cycle and project time management is one of the elements in this cycle. This is supported by Table 14 which shows that the respondents agreed that there are certain *time* risks in managing projects where global sourcing is involved. They were also in agreement with the highest means score that having a risk management plan in place for global sourcing is important for successful global sourcing in large capital projects. However, this contradicts with Table 27 results which reflect a difference in opinion between Global Sourcing Managers and Project Procurement Managers (sourcing team, mean =4.36 out of 5) against Project Managers and Engineering Managers (technical team, mean = 3.78) or the Executive Director/Exco Member (mean = 3.76) in believing that establishing rules for risk management in global sourcing reduces the project time.

Cooper *et al.,* (2005) emphasised the importance of risk management in controlling project time and project cost. Table 29 supports this view and shows that there is a strong correlation between the risk management plan for successful global sourcing and project Time (r = 0.678). This outcome indicates that if risks in global sourcing are not managed properly at the appropriate time they can have a severe impact on the project time however if are controlled properly, project timelines can be reduced. The possible reasons for this strong correlation could also be that adjusting the risk management in global sourcing helps

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strong correlation could also be that adjusting the risk management in global sourcing helps to identify the capacity available to achieve the lowest possible delivery period. Standardisation and selection of modular technology (fast delivery and optimisation in the amount of equipment required) lowers the installation and commissioning period. Hence, a well thought risk management plan ensures that delivery happens as planned and reduces any potential risk on project performance.

Furthermore, this leads to the easy integration between many stakeholders since they are all available in the same area and by using the modular concepts from global suppliers helps in reducing the amount of time require to coordinate the project activities. All these reasons together could help in reducing the overall project period. This is possible through the identification of the important indicators as shown in Table 15 and Table 16.

Based on the above discussion, it can be inferred that the results of hypothesis one conclude that risk management rules for global sourcing in large capital projects would be effective in reducing project completion time.

6.2.7 Hypothesis Two

Hypothesis two sought to determine whether rules of risk management for successful global sourcing had an impact on project cost.

Null Hypothesis (2) : H0 : $\rho = 0$, Risk management rules in global sourcing for large capital project is NOT effective in reducing project cost.

Alternative Hypothesis (2) : H1 : $\rho > 0$, Risk management rules in global sourcing for large capital project is effective in reducing project cost.

Figure 1 showed that global sourcing can have a positive or negative impact on project cost management and this view is supported by Table 14 which presented that the respondents agreed that there are certain *cost* risks in managing projects where global sourcing is involved.

Interestingly, Table 25 displayed that all the different positions and levels involved in global sourcing have the same range of mean rating in believing that a risk management plan in global sourcing reduces project cost.

Table 29 highlighted that there is a strong correlation between risk management rules for global sourcing and project cost (r = 0.660) for large capital projects. The following could be the possible reasons for the positive correlation between these two aspects. Firstly, it could be that the selection of the supplier without proper due diligence has an effect on project

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cost during and after execution of the project. This result in additional costs being incurred in many activities and increases the supplier's demurrage claims since they would be standing idle without materials or services. Jergeas (2008) has also identified that a poor front end loading process leads the projects to a cost overrun.

Secondly, underestimation of the technical differences in terms of specifications, design, engineering standards, quality requirement, and logistics cost could be the reasons for an increase in project cost in global sourcing.

Lastly, the possible reasons for an increase in project cost could also be attributed to other known risks that were not evaluated before engaging into global sourcing such as currency fluctuation and taxation. Unknown risks may also play a role, for instance any change in government policy, regulations and war or force majeure conditions will negatively impact outcomes. Hence it is important to identify, assess, and evaluate the risk categories at the outset to reduce the project cost.

It can thus be concluded that there is a strong correlation between these two variables which make up the risk management rules for global sourcing in effectively reducing the project cost for large capital project.

6.2.8 Hypothesis Three

Hypothesis three sought to determine whether rules of risk management for successful global sourcing had an impact in delivering the required project quality.

Null Hypothesis (3) : H0 : $\rho = 0$, Risk management rules in global sourcing for large capital project is NOT effective in delivering right project quality in terms of required quality of equipment and services.

Alternative Hypothesis (3) : H1 : $\rho > 0$, Risk management rules in global sourcing for large capital project is effective in delivering right project quality in terms of required quality of equipment and services.

Figure 1 shows that global sourcing can have a positive or negative impact on project quality management and this view is supported by Table 14 which confirmed that the respondents agreed that there are certain *quality* risks in managing projects where global sourcing is involved.

Table 28 presented that there is insufficient evidence that people involved at various position levels in executing large capital projects have different opinions. All positions

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believed that risk management rules for global sourcing helps in delivering the right project quality in terms of required quality of equipment and services

Results in Table 29 revealed that there is a positive correlation between a risk management plan for successful global sourcing and delivering the right project quality (r = 0.685) for large capital projects.

The literature indicates that poorly managed risks in the front end loading and throughout global sourcing can lead to quality issues (Cousins *et al.,* 2004). Table 17 indicates that the risks in terms of differences in design, engineering standards, specifications, quality and performance requirements need to be identified upfront to control the quality of the project. This helps to ensure that the cost paid is commensurate with the quality.

The other possible reasons for the strong correlations between risk management and project quality could be the complexity stemming from the large number of stakeholders involved in this process as well as poor performance leading to higher operating cost. It was evident that if a global sourcing process is not monitored closely, there is high probability of an undesired outcome. The poor quality of equipment or service in project requires higher maintenance, higher operational cost and reduces the productivity of the entire project chain. This ultimately reduces the revenues and profit margin increasing the payback period.

There was sufficient evidence in favour of the alternative hypothesis and having strong correlations, it can be concluded that establishing risk management rules for global sourcing in large capital projects would be effective in delivering right project quality in terms of required quality of equipment and services.

6.3 Conclusion

This chapter used the literature from Chapter two in answering the research questions and hypothesis positioned in Chapter three. The key benefits of the sample used in this research is that the respondents' experiences were spread from 40 various countries, six continents and worked in key positions in executing large capital projects. Insights and interpretations derived from analysing the data resulted in the findings presented in Chapter five linking back to the rationale behind the research from Chapter one.

The research objective stated in Chapter 1 and research hypothesis stated in Chapter 3 have been met with rules of risk management being derived for successful global sourcing and proven effective in reducing project time, project cost and delivering better project quality.

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CHAPTER 7:
CONCLUSION

7.1 Introduction

This chapter highlights the major findings of the research and recommendations to the Project Management Institutes, organisation involved in executing large capital projects and areas of future research. A model for rules of risk management for successful global sourcing in large capital projects is presented based on the findings creating a functional tool for the project management body to enhance the global sourcing success and improve the project performance in terms of project time, project cost and project quality.

7.2 Major Findings

Introduction of risk management in global sourcing has the potential to enhance the success of global sourcing. A strong correlation between successful global sourcing and project performance was highlighted as having a positive impact on project time, project cost and project quality. While all large capital projects spend large amounts in global sourcing, metal and mining, energy, oil and gas sectors, spend significantly more in this regard with their spend varying from 11% to more than 50% of total project budgets. A core aim of global sourcing for large capital project sector is to achieve lower capital cost, faster payback, improve IRR and a greater access to new technology and innovation.

Although global sourcing adds tangible value to the project, it is fraught with risks which too often outweigh the benefits expected from global sourcing. Hence, such expenditure in large capital projects if not managed properly, can be a source of high risk on project performance. This suggests that a structured evaluation of risks is important to identify, assess and evaluate the potential challenges before engaging in global sourcing with any hope of achieving the expected benefits and project performance. Various activities involved in the global sourcing process have direct impact on project performance however the key to successful global sourcing lies in rigorous risk management planning and this should include the following:

- identification of risk categories,
- vendor due diligence,
- vendor performance measurement,
- monitoring capital expenditure to operating expenditure (CAPEX to OPEX) ratio,
- benchmarking past performance and the productivity achieved, and
- capturing lessons learnt from successful global sourcing experiences, practices and systems into a sustainable knowledge management system.

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There was overall consensus across the secondary and primary data inputs over the importance of risk management in global sourcing and its direct effect on project performance. However, there were significant differences between the key positions of opinion on risk management planning making global sourcing successful and reducing project time. There were no major differences of perspective on the impact of risk management planning on the reduction of project cost and the delivery of the right project quality.

Based on the empirical findings of the study, key elements were identified for global sourcing success namely, vendor due-diligence, vendor performance measurement, risk classification and lessons learnt. These elements were integrated into a single risk management and mitigation plan. These are included in the model as shown in Figure 20. This model was constructed with an aim to enhance global sourcing success leading to a positive impact on project time, cost and quality.

The top block of the model shows three internal and three external elements for successful global sourcing which should be evaluated through risk management and mitigation planning. The left column in the middle of the model shows the internal and external risk classifications which are important to evaluate before deciding on global sourcing solutions in large capital projects. The internal risk classification indicates what can be controlled between project and a target supplier organisation whilst external risk classification indicates what can arise due to external context and conditions. The corresponding right hand column shows two components, vendor due diligence and vendor performance measurement, which are important to evaluate during the front end loading process and post contract management phases. Various critical elements are highlighted under both the components and evaluation of these elements is set to enhance success in global sourcing for large capital projects. The inputs from the left and right hand side of the model are fed into the middle block which addresses risk management and mitigation planning. This is the central processing unit of the entire model and correct inputs from each block will determine the results obtainable from the model.

It is proposed that the outcome of this process can be further controlled, monitored and measured in terms of the CAPEX to OPEX ratio throughout the project life cycle as this will be the basis for future decisions to implement successful global sourcing. It is envisaged that the lessons learnt under each project coupled with benchmarking with past performance and best practices of other successful global sourcing programs would be captured in a knowledge management system and be used for future global sourcing risk management and mitigation planning. Based on the research findings and literature review outcomes, the bottom section of the model serves to indicate that the final outcome is the attainment of a positive impact on project performance.

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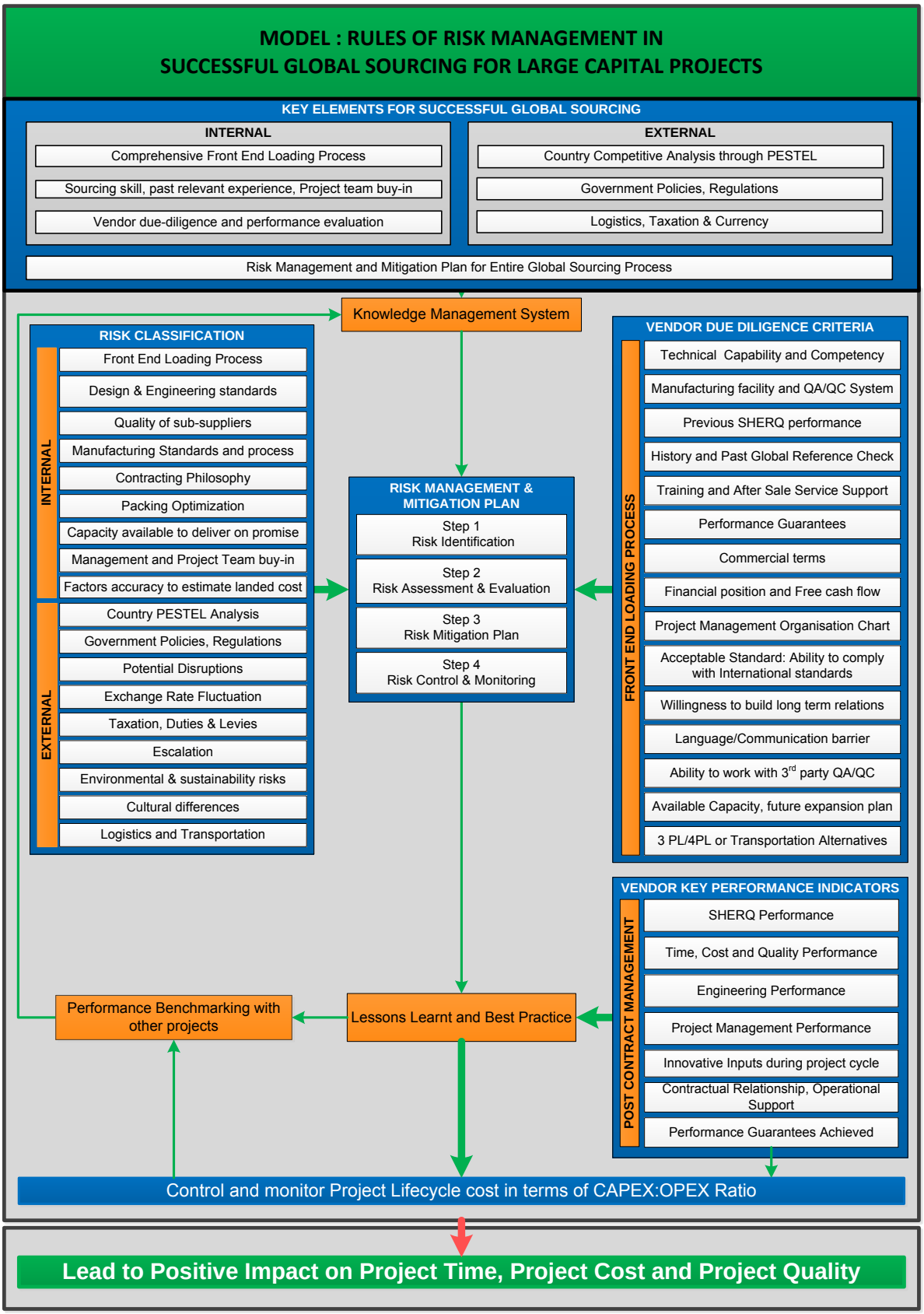
Figure 20 Model for Risk Management Rules in Successful Global Sourcing for Large Capital Projects



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The model integrates the risk classification involved in the entire cycle from front end loading process till the end of life phase of the project including lessons learnt from previous projects. This is set to help improve global sourcing success resulting in better project performance by effectively handling the risks at different stages in projects, potentially mitigating them before they can take effect and measuring the impact and outcome

7.3 Benefits of the Model

The risk classification shown in Figure 20 above is not unique or innovative, however, what is a differentiator is the combining of risk classifications, supplier due-diligence and supplier performance measurement into one risk management and mitigation framework. Similarly the proposal to monitor supplier performance using the CAPEX to OPEX ratio is innovative and set to enhance global sourcing success in future positively contributing to overall project performance.

The envisaged benefits of the model suggested in Figure 20 include but are not limited to the following:

- Making informed and better decisions based on risk and benefits trade-off as risks will now be better identified, and evaluated during the front end loading process,
- Delivering project objectives and performance as planned,
- Minimising unanticipated cost and time overruns,
- Selecting right supplier, contract type, methodology and execution partnerships.
- Measuring actual benefits achieved versus those initially anticipated at the time of finalisation of the agreement,
- Managing organisation reputation and relations with various stakeholders,
- Deciding, controlling and monitoring the allocation of proper cost, time and resources,
- Adequately balancing the risks between various stakeholders,
- Accurate planning and better forecasting to enable the parallel planning of other activity streams for better cost containment,
- Calculating appropriate contingencies in budgets and schedules, and
- Delivering required quality and performance of equipment, materials and services at right time and at right cost.

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7.4 Applicability of this Model

The risk management model proposed in figure 20 is set to provide project teams with a useful framework for detailed preemptive planning to identify and prepare to meet challenges likely to be faced in executing large capital projects. This model was derived from the consolidated perspective of the academic literature reviewed and respondents' practical experiences in six sectors that undertake large scale operations. Whilst the risk classification requirement during front end loading might vary from project to project, aspects such as vendor due diligence criteria and vendor performance measurement indicators can be standardized for any global sourcing initiative irrespective of the nature of the projects. Consequently, the framework can further be applied to a wide diversity of projects across multiple sectors improving global sourcing success and hence project performance. This structured thinking is also applicable to any organization involved in executing projects to guide risk management and procurement management in selecting technology partners, consultants, contractors, design and engineering partners and logistics service providers.

7.5 Considerations and Limitations

It must be noted that the insights informing the proposed model were based on a limited sample of 89 key experienced individuals and executives involved in large capital projects. It is also important to indicate that the above model is generic in nature and based on the respondents who participated in the survey. The benefits and success of this model is largely dependent on:

- the project size, location, nature and complexity,
- number of stakeholders involved in the project,
- the organization's ability to quickly recognize, deal and manage the unforeseen risks at various stages,
- adequacy and accuracy of vendor due diligence at the front end loading process,
- level of risks associated with projects,
- origin of sourcing,
- communication and cultural differences,
- skill and past experience of the incumbent global sourcing and project team,
- the external environment ,
- the overall effect of macroeconomic indicators, and
- other logistics challenges.

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It is essential to note that the model developed here cannot be generalized for all projects at an international level. It is therefore necessary to take a contextual view of the risk management plan for the project specific to improve project performance.

It is reasonable to assume that there might be a few organizations that are already practicing some level of risk management discipline in global sourcing. If organisations involved in executing large capital projects could be identified and convinced to share some of their risk management practices, it would greatly contribute towards a more measured evaluation of the accuracy of the proposed model further substantiating the accumulated technical project management knowledge.

The model proposed here outlines the rules of risk management in successful global sourcing for large capital project and can be used to increase global sourcing success with positive impact on project time, cost and quality. This model can also be used by organisations involved in executing large capital projects, engineering and project management consultants, Project Management Institutes and various project management elements and stakeholders within an organisation.

7.6 Recommendations for Project Management Institutes

As procurement has been shown to be one of the critical elements in the project management cycle, the absence of a structured risk management approach in global sourcing is a cause of material concern. Global sourcing has an immense impact on various elements of the project management cycle resulting in a negating effect on project performance. As has been illustrated through this study, it is vital to mitigate, control and monitor the effect of global sourcing on each element of the project management cycle during the front end loading process to improve project performance. Therefore, it is recommended that more emphasis be placed on the inclusion of a structured approach to strategic risk management for successful global sourcing. Moreover, the benchmarking in performance and the consolidation of lessons learnt to track best practices in global sourcing that should be shared regularly among various projects to further improve the risk management process in global sourcing.

7.7 Recommendations for Organisation Executing Large Capital Projects

Large Capital Project management should be aware of the fact that global sourcing brings many benefits to the organisation but if not handled effectively it can severely affect the various elements of project management and ultimately project performance. Therefore, before an organisation embarks on global sourcing, it is recommended that a comprehensive risk management and mitigation plan should be prepared and appropriate

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due-diligence conducted on the vendors for each global sourcing initiative. The project leadership should also plan to have brainstorming sessions with cross disciplinary project teams to seek inputs and thereby secure buy-in of their collective experience upfront and, to further strengthen the global sourcing process through the preparation of detailed risk mitigation plans.

7.8 Recommendations for Future Research

This research added value by identifying critical elements and presenting these in a model framing the rules for risk management towards successful global sourcing for large capital project. It also increased understanding of the correlations between successful global sourcing and project performance.

However, the following are recommendations for future research:

- Testing the reliability of the model suggested in Figure 20 to measure its impact on project performance in different project sectors.
- Determining the order of importance of individual risk classifications in global sourcing based on their impact on project performance.
- An investigation to determine which parts of the model suggested in Figure 20 yield the greatest benefits and that should be prioritized. What should the focus be?
- Multi project case study based approach to analyse failed global sourcing initiatives in large capital projects and quantifying its impact on project performance.
- Exploring integration of vendor's performance with sourcing risks and its impact on project performance.

7.9 Conclusion

This study has shown that there are various risks involved in global sourcing but that these can be controlled and mitigated by adopting a structured risk management process, designed for global sourcing in large capital projects. Some of the risks related to vendor due diligence during the front end loading process, post contract management, as well as potential internal and external risk classifications have been detailed to illustrate materiality. Conclusively, this research has suggested a risk management framework for global sourcing and also demonstrated that adopting pre-emptive risk management processes increases global sourcing success with positive impact on project performance in terms of project time, cost and quality. Further, the insights presented have raised awareness about the strong correlation between successful global sourcing and its impact on project performance. By conducting a thorough vendor due diligence, identifying, analysing and

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evaluating risk categories during the front end loading process and monitoring the vendors performance during the life of the projects, key lessons were identified and documented.

In general, this research presented a clear case for the establishing of set rules for risk management to make global sourcing successful. The findings are set to have a positive impact on project performance in terms of project time, cost and quality. This outcome is anticipated to add further credence for the Project Management Institute and organisations involved in executing large capital projects to focus on and highlight the importance of risk management in global sourcing as a critical component of project management.

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APPENDICIES

APPENDIX A: COVER NOTE OF SURVEY QUESTIONNAIRE

Dear Colleagues,

The purpose of this survey is to give selected expert an opportunity to express their views on rules of risk management in success of global sourcing for large capital projects based on your project work experience. The study specifically focuses on how to make the global sourcing successful for large capital projects through identifying and managing all risks involved in the process. The benefit of this study will depend on the honesty of your responses. It should not take more than 20 minutes of your time to complete the questionnaire. Your participation is voluntary and you can withdraw at any time without penalty. Respondents can rest assured that all survey questionnaires will be treated in strictest confidence. By completing the survey, you indicate that you voluntarily participate in this research. If you have any concerns, please contact me or my supervisor. Our details are provided below.

Researcher

Name : Mahendra Dedasaniya

Email : patelmahendra9@yahoo.co.in

Phone : + 27 82 8775275

Research Supervisor

Name : Dinesh Kumar

Email : kumardin@yahoo.com

Phone : + 27 827178725

Please follow the instructions carefully and return the completed questionnaire via email.

Thank you for your participation.

Sincerely,

Mahendra Dedasaniya

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APPENDIX B : SURVEY QUESTIONNAIRE

SECTION A: PERSONAL QUESTIONS

Please mark the appropriate box with a tick (√) in the space provided.

Q.1: WHAT IS THE JOB TITLE FOR YOUR CURRENT POSITION?

Project Manager	
Project Team Member	
Global Sourcing Manager	
Project Procurement Manager	
Project Engineering Manager	
Financial Controller/CFO	
Executive Director/Executive committee Member	
Construction Manager	
Risk Management Officer	
Other	

Q.2: IN WHICH COUNTRY YOUR PROJECT IS LOCATED OR YOU WORKED PREVIOUSLY?

Q.3: WHAT IS YOUR TOTAL YEARS OF EXPERIENCE AND OUT OF WHICH, HOW MANY YEARS OF EXPERIENCE IN LARGE CAPITAL PROJECTS?

	Total years of experience	Years of experience in large capital projects
0 to 10 years		
10 to 15 years		
15 to 20 years		
20 to 25 years		
Over 25 years		

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Q.4: WHAT PERCENTAGE OF PROCUREMENT (SUPPLY AND SERVICES) SPEND IS SOURCED GLOBALLY IN PROJECT YOU ARE WORKING OR WORKED IN PAST ?

	% of Project Spend for global sourcing in large capital projects					
Project sector	**Zero to 10%**	**11% to 20%**	**21 % to 30%**	**31% t0 40%**	**41% to 50%**	**Over 51%**
Mining and Mineral processing						
Smelter and Refinery						
Oil & Gas						
Energy						
Infrastructure						
Petrochemicals						

SECTION B: RESPONSE SECTION

This section consists of a series of statements indicative of global sourcing performance in large capital projects. Please indicate with an **"√"** under your selected answer on a scale of 1 - 5, where 5 is "strongly agree " and 1 is "strongly disagree. Please answer all sub questions under each section.

Question No	Question / Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)
SECTION B.1 : GENERAL QUESTIONS						
Q.5	Global sourcing has many challenges that can be overcome through identifying, accessing, analysing and evaluating risks before engaging in the sourcing activity.					
Q.6	Having a risk management plan in place for global sourcing is important in successful global sourcing for large capital projects.					
Q.7	In your projects, anticipated cost savings were achieved for the packages sourced globally.					
Q.8	Your project incurred additional cost due to non-anticipated risk in global sourcing.					
Q.9	We prepare a risk management plan for the items to be sourced globally.					
Q.10	Our senior management gets involved in making global sourcing decisions and accessing risk involved ?					

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Question No	Question / Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)
Q.11	I experienced that there are certain TIME risks in managing projects where global sourcing is involved.					
Q.12	I experienced that there are certain COST risks in managing projects where global sourcing is involved.					
Q.13	I experienced that there are certain QUALITY risks in managing projects where global sourcing is involved.					
Q.14	I feel capable of handling global sourcing without proper risk assessment for large capital projects.					
Q.15	We have a risk management process in place to evaluate the risks involved in global sourcing before making decisions on global sourcing.					
Q.16	All our stakeholders understand the importance of identifying and monitoring risks in global sourcing and its effect on project timeline and cost.					
Q.17	**Section B.2 : The reasons for global sourcing in large capital projects is to have..(Note : this text is applicable to all questions under this section)**					
Q.17.1	a greater access to new technology and innovation					
Q.17.2	technically competent partner who can deliver better quality and high performance of equipment or services.					
Q.17.3	lower capital cost.					
Q.17.4	lower life cycle cost of equipment.					
Q.17.5	faster delivery compared to domestic suppliers.					
Q.17.6	lack of local expertise.					
Q.17.7	lower project completion time.					
Q.17.8	lower project cost.					
Q.17.9	faster payback period and high IRR on project.					
Q.17.10	consolidation and standardisation of sourcing across all global projects for better synergy.					
Q.18	**Section B.3 : The success of global sourcing in large capital project depends on.....(Note : this text is applicable to all questions under this section)**					
Q.18.1	Identifying, assessing and evaluating risk during the front end loading process before the issuing of enquiry documents globally.					
Q.18.2	Understanding the country's competitiveness for the particular equipment or service.					
Q.18.3	Conducting a proper due diligence of supplier's competence and capabilities.					
Q.18.4	favourable macroeconomic indicators.					

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Question No	Question / Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)
Q.18.5	Preparing understandable sets of enquiry documents in the vendor's home language, clearly specifying design & engineering standards, specification, quality, performance and commercial terms.					
Q.18.6	Risk identification, control and monitor for post award activities from receipt of raw materials, through the manufacturing stages till dispatch to the customer.					
Q.18.7	Positive attitude of the project team to make it happen (Project team buy-in)					
Q.18.8	Equal involvement of members of a cross functional team to expedite design, engineering, QAP, timely clarifications, its approval and settle contract variations claims.					
Q.18.9	Implementing learning and lessons learnt from similar projects.					
Q.18.10	Having global sourcing expert with right skills together with past sourcing experience					
Q.19	**Section B.4 : Large capital projects should manages risks in global sourcing through identification of .....(Note : this text is applicable to all questions under this section)**					
Q.19.1	Global sourcing risks in terms of differences in design, engineering standards, specifications, quality and performance requirements.					
Q.19.2	Global sourcing risks through PESTEL (Political, Economy, Social, Technological, Environmental, Legal) analysis.					
Q.19.3	Global sourcing risks associated with suppliers, manufacturing standards & facilities and QA/QC practices.					
Q.19.4	Global souring risks associated with logistics - transportation cost and packing optimisation.					
Q.19.5	Global sourcing risks associated with government regulations and potential disruption.					
Q.19.6	Global sourcing risk associated with currency fluctuations, taxation and legislation.					
Q.19.7	Global sourcing risks associated with country risks for the port selection, countries involved in the trans-shipment of globally sourced products or method of shipment (INCOTERM) risk.					

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Question No	Question / Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)
Q.19.8	Supplier evaluation and performance measurement criteria suitable to the project.					
Q.19.9	risks involved in the contract which are balanced and adequately allocated between project owner and supplier/contractor.					
Q.20	**Section B.5 : The reasons for failure of global sourcing in large capital projects are due to... (Note : this text is applicable to all questions under this section)**					
Q.20.1	Decisions made purely based on cost.					
Q.20.2	Decisions made without proper due diligence of the suppliers and reference checks.					
Q.20.3	Misunderstanding or lack of understanding of the risk associated with global sourcing in projects.					
Q.20.4	inadequate knowledge of the challenges involved in full cycle of global sourcing.					
Q.20.5	Underestimation of the impact on project time and cost as a result of delays in delivering a global sourcing solution.					
Q.20.6	Lack of skills in identifying the risks involved in global sourcing.					
Q.20.7	Improper evaluation criteria for selection of country and suppliers.					
Q.21	**Section B.6 : What happens if you conduct the risk analysis and prepare risk mitigation plan before engaging into global sourcing for large capital projects?.....(Note : this text is applicable to all questions under this section)**					
Q.21.1	It helps in planning resource allocation and developing integrated schedule including contingency plan to forecast the anticipated completion date and budget cost.					
Q.21.2	It creates an awareness of the challenges involved in the execution of global sourcing and helps in effectively dealing with it.					
Q.21.3	It helps in handling the unforeseen situation.					
Q.21.4	It minimises the risk on project timelines and cost.					
Q.21.5	It helps in mitigating risk from design or inception stage to keep the project delivery on track.					
Q.21.6	It improves the success rate in global sourcing for delivering large capital project.					

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Question No	Question / Statement	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly disagree (1)
Q.22	**Section B.7 : Based on all above, Impact on project performance (project time, cost and quality) is experienced when...(Note : this text is applicable to all questions under this section)**					
Q.22.1	Risk Management plan for global sourcing deliver the right project quality in terms of required quality of equipment and services.					
Q.22.2	Risk management rules make global sourcing successful.					
Q.22.3	Risk management rules for global sourcing reduce the project cost.					
Q.22.4	Risk Management rules for global sourcing reduce the project time.					

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APPENDIX C : CONSISTENCY MATRIX

Title : Risk Management Rules for Successful Global Sourcing in Large Capital Projects

Research questions and Hypothesis	Literature review	Data collection tool	Analysis
Research Question One: What reasons motivate global sourcing in large capital projects?	Najafi, Dubois, & Hulthen (2013) Christopher, Mena, Yurt (2011) Horn & Werner (2010) Mohamad, Julien & Kay (2009) Trent & Monczka (2005) Hauer (2003)	Questionnaire, Question 17	Internal consistency test Descriptive statistics One sample T-test
Research Question Two: Which are the indicators that confirm the global sourcing success for large capital projects?	Jensen & Petersen (2013) Manuj (2013) Jergeas (2008) Cooper, Grey, Raymond, & Walker (2005), Trent & Monczka (2005) Trent & Monczka (2002)	Questionnaire, Question 18	Internal consistency test Descriptive statistics One sample T-test
Research Question Three: How should risks be managed in global sourcing for large capital projects?	Badri, Nadeau, & Gbodossou (2013) Zidane, Johnsen, Ekambaram (2013) Christopher, Mena, Khan, & Yurt (2011) Tummala & Schoenherr (2011)	Questionnaire Question 19	Internal consistency test Descriptive statistics One sample T-test
Research Question Four: What are the reasons for failure of global sourcing in large capital projects?	Teller (2013) Schiele, Horn, & Werner (2010) Steinle & Schiele (2008) Trent & Monczka (2002)	Questionnaire Question 20	Internal consistency test Descriptive statistics One sample T-test

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Research questions and Hypothesis	Literature review	Data collection tool	Analysis
Research Question Five: What happens to project performance (in terms of project time, project cost project quality) when an organisation prepares a risk management plan before engaging in global sourcing for large capital projects?	Thamhain (2013) Badri, Nadeau, & Gbodossou (2013) Xue, Turner, Lecoeuvre, & Anbari (2013) Christopher, Mena, Khan, & Yurt (2011) Manuj & Menzer (2008) Cooper, Grey, Raymond, & Walker (2005)	Questionnaire Question 21	Internal consistency test Descriptive statistics One sample T-test
Hypothesis One : Null Hypothesis (1) : H0 : $\rho = 0$, Risk management rules in global sourcing for large capital projects is NOT effective in reducing project completion time. Alternative Hypothesis (1) : H1 : $\rho > 0$, Risk management rules in global sourcing for large capital projects is effective in reducing project completion time.	Badri, Nadeau, & Gbodossou (2013) Xue, Turner, Lecoeuvre, & Anbari (2013) Eweje, Turner & Muller (2012) Cooper, Grey, Raymond, & Walker (2005)	Questionnaire Question 22	Pearson Correlation test ANOVA test

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Research questions and Hypothesis	Literature review	Data collection tool	Analysis
Hypothesis Two : Null Hypothesis (2) : H0 : ρ = 0, Risk management rules in global sourcing for large capital project is NOT effective in reducing project cost. Alternative Hypothesis (2) : H1 : ρ > 0, Risk management rules in global sourcing for large capital project is effective in reducing project cost.	Manuj (2013) Thamhain (2013) Emblemsvag (2012) Eriksson & Westerberg (2011) Jergeas (2008) Manuj & Menzer (2008)	Questionnaire Question 22	Pearson Correlation test ANOVA test
Hypothesis Three : Null Hypothesis (3) : H0 : ρ = 0, Risk management rules in global sourcing for large capital project is NOT effective in delivering right project quality in terms of required quality of equipment and services. Alternative Hypothesis (3) : H1 : ρ > 0, Risk management rules in global sourcing for large capital project is effective in delivering right project quality in terms of the required quality of equipment and services.	Thamhain (2013) Roberts & Schermer (2011) Christopher, Mena & Yule (2011) Tummala & Schoenherr (2011) Eriksson & Westerberg (2011) Cousins, Lemming & Bowen (2004)	Questionnaire Question 22	Pearson Correlation test ANOVA test

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