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DOI: http://dx.doi.org/10.18820/24150487/as24i2.1

ISSN: 1023-0564

e-ISSN: 2415-0487

Acta Structilia 2017 24(2): 1-43

Deciphering priority areas for improving project risk management through critical analysis of pertinent risks in the Zambian construction industry

Peer reviewed and revised

Abstract

Risk identification is the first step in the risk-management process. A plethora of current studies in literature dwell overwhelmingly on risk identification much to the exclusion of the source, and the possible mitigation interventions. In a limited effort to address this deficiency in the body of knowledge, this article reports the results of a study conducted using 15 purposive semi-structured interviews and 198 questionnaires targeting clients, contractors and consultants in the building sector in Zambia. This study uses threats to identify improvement areas in the Zambian Construction Industry (ZCI). As a consequence, this research uses the pertinent risk factors as a point of critical analysis to recommend improvement areas for project risk management.

Findings show that most of the risks could be categorised as managerial, technical and finance related and could severally be associated with clients, consultants, and contractors compared to project managers. These could be mitigated in the pre-contract phase and construction phase, with the most deficient knowledge areas being cost management, procurement management, integration management, communication management, and scope management. This article provides areas of focus for built environment professionals to improve project delivery and thereby enhance project execution efficiency.

Keywords: Building sector, risk identification, Pareto analysis, project risk management, Zambia

Abstrak

Risiko-identifikasie is die eerste stap in die risikobestuursproses. 'n Oorvloed bestaande literatuurstudies handel oorweldigend oor die identifisering van risiko's tot die uitsluiting van die bron en moontlike versagtende intervensies. In 'n beperkte poging om hierdie tekort aan kennis aan te spreek, het hierdie studie 15 doelgerigte semi-gestruktureerde onderhoude en 198 vraelys-opnames gedoen wat kliënte, kontrakteurs en konsultante in die bousektor in Zambië teiken. Bevindinge toon dat meeste van die risiko's gekategoriseer kan word as bestuurs-, tegniese en finansies verwant en kan afsonderlik met kliënte, konsultante en kontrakteurs geassosieer word met projekbestuurders. Dit kan verminder word in die voorkontrakfase en konstruksiefase, met die mees gebrekkige kennisareas, naamlik kostebestuur, verkrygingsbestuur, integrasiebestuur, kommunikasiebestuur en omvangsbestuur. Hierdie artikel bied fokusareas vir geboue in die omgewing om projeklewering te verbeter en sodoende die doeltreffendheid van projekuitvoering te verbeter.

Sleutelwoorde: Bou-sektor, risiko-identifikasie, Pareto-analise, projek risikobestuur, Zambië

1. Introduction

Although risk abounds in all spheres of life, the construction industry has the worst record, as it is only surpassed by mining as the most dangerous industry (Ardeshir, Mohajeri & Amiri, 2016: 2546). Al-Bahar and Crandall (1990: 534) define risk as "the exposure to the chance of occurrences of events adversely or favorably affecting project objectives as a consequence of uncertainty". Cano and de la Cruz (2002: 473) define risk as "an uncertain event that, if it occurs, has a positive (opportunity) or negative (threat) effect on a project objective". This definition, therefore, entails that the current body of knowledge stresses risk as an occurrence or event, which can present threats and/or opportunities. Chapman and Ward (2003: 98) and Smith, Merna and Jobling (2014: 2) posit that the manner in which risks are managed determines whether the risk would be an opportunity or a threat. Lehtiranta (2014: 647) is of the view that opportunities in project teams are rarely seen. This lack could explain why the perception of risk in projects is normally negative and the emphasis is on dealing with negative risk events as opposed to the opportunities that could be harnessed from the risk events. Project risk management is, therefore, the logical method of establishing the context, identifying, analysing, evaluating, treating, monitoring and communication of risk associated within any activity, function or process in a way that enables losses to be minimised and opportunities to be maximised (Australian and New Zealand Risk Management Standard-AS/NZ 4360 1999: 4). One of the most noted barriers to risk management is lack of knowledge (Chileshe & Kikwasi, 2014: 2; Dey, 2001: 634; Choudry, Aslam, Hinze & Arain, 2014: 1-9; Lyons & Skitmore, 2004: 60).

The construction industry in Zambia is characterised by quality shortfalls, cost and time overruns as well as project abandonment (Kaliba, Muya & Sichombo, 2009a; Muya, Kaliba, Sichombo & Shakantu, 2013; Auditor General's Office, 2006-2012: Online). The Auditor General Reports focus on public-sector projects carried out by various government ministries, agencies and authorities. In addition, the Zambia Development Agency reports that the Zambian Government procures over 70% of work in the Republic (ZDA, 2013: Online).

Mañelele and Muya (2008) found that community projects in Zambia (a subsector of the building sector projects) underperform, due to poor risk identification. The following risks were identified: participation, project initiation, budget and finance, skilled labour, material procurement, technical supervision, and quality control.

Studies by Kaliba *et al*. (2009a) and Muya *et al*. (2013) on engineering and road projects in Zambia revealed the following major causes of cost escalation in Zambia's road-construction projects: inclement weather such as heavy rains and floods; scope changes; environmental protection and mitigation costs; schedule delay; strikes; technical challenges; inflation, and local government pressures. Time overruns were attributed to delayed payments, financial processes and difficulties on the part of contractors and clients, contract modification, economic problems, materials procurement, changes in drawings, staffing problems, unavailability of equipment, poor supervision, construction mistakes, poor coordination on site, changes in specifications, labour disputes, and strikes in road-construction projects. These were grouped into four categories: poor financial planning and management; poor change management; lack of capacity, and poor schedule management. In addition, Kaliba, Muya and Sichombo (2009b) found that, in the final analysis, incomprehensible risk identification is a contributing factor to poor project delivery, contributing to poor risk allocation.

Another study by Sibanyama, Muya and Kaliba (2012) on risk factors that result in claims found that claims are rampant in the Zambian construction industry and cited poor risk-sharing as one of the contributing factors. Similarly, in a study targeted at investigating unethical practices contributing to poor project delivery in the ZCI, Mukumbwa and Muya (2013) found that construction contracts in Zambia are characteristically one-sided, with risk mainly shifted to the contractor.

Given the aforementioned, risks are prevalent in the ZCI and are affecting performance. In terms of volume, building sector projects are the majority (ZDA, 2013: online), yet few studies in the Zambian context have identified risks affecting this sector, apart from risks identified by Mañelele and Muya (2008) from a subsection of the sector. This study is, therefore, justified by focusing on the whole building sector where it is unclear in which areas the knowledge is lacking and where professionals should focus to alleviate the situation.

Given this knowledge gap, a literature study on project cycle and knowledge areas, risk categories as well as on risk factors in the construction industry of developing countries helped identify risks and assist in categorising these risks into various risk categories determined by the identified risk factor. By categorising the risks identified from the literature review, combined with the risks identified from semi-structured interviews, this study listed pertinent risk factors which were ranked in a questionnaire survey as a point of critical analysis to recommend improvement areas, possible mitigation and alleviation for project risk management in the Zambian Construction Industry.

2. Nature of risks

Risks can be known or unknown (Chapman & Ward, 2003: 98). Unknown risks are referred to as uncertainties. Jaafari (2001: 89) defines uncertainty in project contexts as "an unknown probability of impact of a project variable on its objective function". A further extension of Jafaari's (2001: 89) postulation is that certain events have a 100% probability chance of occurrence, while totally uncertain events have 0% probability chance of occurrence. Risk has to be understood as the uncertainty that can be measured, while uncertainty is the risk that cannot be measured (Serpella, Ferrada, Howard & Rubio, 2014: 655). Nonetheless, both have an impact on project delivery if unmanaged (Hilson, 2002: 239). This study focuses on the known risks influencing performance in the ZCI. Anything that increases risk or susceptibility is a risk factor (Zou, Zhang & Wang, 2007: 605). Risk factors usually have measureable characteristics or elements (Business Dictionary, 2016: Online), especially when they pertain to volatile issues such as exchange rate, interest rate, labour shortage, or market price.

2.1 Risk categories in the construction industry

Risk categorisation or classification is important as it helps identify the possible root cause for a risk factor (Chapman & Ward, 2003: 99). For instance, political risk may indicate instability in a given area.

Therefore, contracts for use in such an area should cover political risks. The classifications or categorisations of risks may occur in various forms such as political, economic, social, technological, legal, and environmental. Others are impact related, such as insurable or uninsurable; acceptable or unacceptable. Another classification could be positive or negative (Ebrahimnejad, Mousav & Seyrafianpour, 2010: 577). Some of these risks could emanate from a contractual relationship, while others are non-contractual (Murdock & Hughes, 2001: 83). Zou *et al*. (2007: 605), on the other hand, categorise the risks as quality related, cost related and time related. However, the broader classification of risk is internal and external (Tah & Carr 2000: 492; Barlish, Marco & Thaheem, 2013: 709). Furthermore, the concept of risk owner may be used as a classification method; such categorisations have been used by Jarkas and Haupt, (2015: 175-177) who categorise the risks as client related, contractor related, consultant related only when they pertain to internal risks. In this categorisation, risks external to the project team are classified under the umbrella term of external risks. When risks eventuate, more than one party may be affected. In this article, the concept of risk owner is used to refer to who is supposed to manage a particular risk (Smith *et al*., 2014: 4).

Internal risks could be local (labour, plant, subcontractors, materials, and site) and global (construction, design, financial [company/project] location, precontract, client, contractual, environmental, management, and time frame). External risks include economic, physical, political and technological (Tah & Carr, 2000: 492). Zavadskas, Turskis and Tamoscitience (2008: 351) suggest internal risks (stakeholders, designers, contractors, subcontractors and suppliers) and external risks (economic, social, weather, protetivism). Barlish *et al*. (2013: 709) formulate a risk taxonomy/category for the construction industry as internal (client/owner, design, job site related, subcontractor, operational, and managerial) and external risks (political, financial/economic, social, cultural, technological, legal regulation, and environment).

A synthesis of studies by Tah and Carr (2000: 492); Lam, Wang, Lee and Tsang (2007: 491; Rezakhani (2012: 33); Tadayon, Jaafar & Nasri (2012: 57, 66); Charoenngam and Yeh (1999: 32), as well as Barlish *et al*. (2013: 709) shows that the universal risk categories are financial, economic, environmental, legal, and political risks. In addition, further categories are formulated to determine risks present at different levels. For instance, Zhi (1995: 232) proposes categories for use on overseas projects with risk categorisation for national/regional, construction, company, and project level. This discussion provides evidence that risk categories are selected, based on the nature of information needed.

Risk factors can cause many risks and form a causal network with the risks (Tah & Carr, 2000: 500). Moreover, risks are triggered by risk factors (Ebrahimnejad *et al*. 2010: 576). Various research has been conducted on risk factors affecting the construction industry. Table 1 shows the various risk categories and risk factors found in previous research. Internal risk (within the control of a project team) categories include design risks, productivity risks, client-related risks, contractor risks, and management risks. External risk (beyond the control of a project team) categories include economic, legal, *force majeure*, political, and social (Table 1).

2.2 Risk factors in the construction industry

Table 2 highlights the various risk factors found in the construction industry as identified in different developing countries, namely China, Egypt, Ghana, India, Indonesia, Jordan, Malaysia, Mozambique, Nigeria, Pakistan, Poland, South Africa, Sri-Lanka, Swaziland, Uganda, Vietnam, and Zambia.

Knowledge of the risk factors affecting other developing countries provides a basis for risk mitigation or alleviation of similar risks. Some of the risks identified are construction sector specific, while others apply to a whole industry. Financial, planning and operational risks seem rampant in developing countries (see Table 2).

Table 1: Common risk factors and their categories in the construction industry

Risk category	*Risk factors*	*Authors*
Client related	Client interference, design change, improper intervention	El-Sayegh (2008: 437); Tadayon *et al*. (2012: 57-69); Santoso *et al*. (2003: 46-53)
Contractor related	Contractor capabilities: inexperience, contractor liability, defective construction, subcontractor failure, subcontractor default, novel construction methods	Lam *et al*. (2007: 491); Tadayon *et al*. (2012: 57-69); Tsai & Yen (2006: 396); Ghosh & Jintanapakanont (2004: 637-640); Nieto-Morote & Ruz-Villa (2011: 227); Wiguna & Scott (2006)
Coordination and cooperation	Cooperation, poor communication, teamwork between contractor and consultant	Mahamid (2011: 611); Tsai & Yen (2006: 396); Santoso *et al*. (2003: 46-53); Enshassi *et al*. (2009); Hwang *et al*. (2013: 120)
Corruption	Bribe, fraudulent practices	Baloi & Price (2003: 264)

Risk category	*Risk factors*	*Authors*
Cost	Cost overruns, estimator related, poor cost control	Baloi & Price (2003: 264); Zou *et al*. (2007: 605); Wiguna & Scott (2006); Medda (2007: 216)
Delay	Delay in resolving disputes, time overruns, tight project schedules, time constraints, unrealistic schedules	El-Sayegh (2008: 437); Tadayon *et al*. (2012: 57-69); Goh & Abdul-rahman (2013: 25); Turkey (2011: Online); Ghosh & Jintanapakanont (2004: 637-640); Medda (2007: 216)
Design	Design changes, design defects, delay in producing detailed drawing, design issues, engineering design	Santoso *et al*. (2003: 46-53); Oztas & Okmen (2005: 234); Enshassi *et al*. (2009); El-Sayegh (2008: 437); Medda (2007: 216); Chung *et al*. (2010: 47-53); Kuo & Lu (2013: 602-614); Nieto-Morote & Ruz-Villa (2011: 227); Wiguna & Scott (2006); Oztas & Okmen (2005: 234); Medda (2007: 216)
Economic and financial	Inflation rates, delayed payment, market, exchange rates, financial failure of client, price inflation, uncertainty in price, level of competition, market, unavailability of funds, financial failure of contractor	Wiguna & Scott (2006); Ghosh & Jintanapakanont (2004: 637-640); Baloi & Price (2003: 264); Zou *et al*. (2007: 605); El-Sayegh (2008: 437); Goh & Abdul-rahman (2013: 25); Mahamid (2011: 611); Turkey (2011: Online); Kuo & Lu (2013: 602-614); Chung *et al*. (2010: 47-53); Medda (2007: 216); Lam *et al*. (2007: 491); Xu *et al*. (2012: 896); Ebrahimnejad *et al*. (2010: 581)
Environment	Inclement weather, unforeseen site ground conditions	Wiguna & Scott (2006); Zou *et al*. (2007: 605)
Force majeure	Invasions, natural hazards	Kuo & Lu (2013: 602-614); Enshassi *et al*. (2009); Chung *et al*. (2010: 47-53)
Legal	Difficulty in obtaining permits, frequent changes in law and statutory regulations	Lam *et al*. (2007: 491); Tsai & Yen (2006: 396); Xu *et al*. (2012: 896)
Management	Construction management, project management, site management	Nieto-Morote & Ruz-Villa (2011: 227); Dikmen & Birgnoul (2007: 60-66); Kuo & Lu (2013: 602-614); Santoso *et al*. (2003: 46-53)

Risk category	*Risk factors*	*Authors*
Political	Frequent changes in statutory laws, government action and regulations, change in law, public risk	Enshassi *et al*. (2009); Mahamid (2011: 611); Tsai & Yen (2006: 396); Lam *et al*. (2007: 491); Tadayon *et al*. (2012: 57-69); Chung *et al*. (2010: 47-53); Medda (2007: 216)
Productivity	Shortage of labour, lack of manpower, inadequate staff by contractor, low equipment efficiency, equipment unavailability, construction equipment maintenance, labour productivity, resource risk, construction delay	Santoso *et al*. (2003: 46-53); Kartam & Kartam (2001: 329-333); Wiguna & Scott (2006); Oztas & Okmen (2005: 234); Turkey (2011: Online); Mahamid (2011: 611); El-Sayegh (2008: 437); Zeng & Smith (2007: 589-600); Dikmen & Birgnoul (2007: 60-66); Hwang *et al*. (2013: 120); Enshassi *et al*. (2009); Zou *et al*. (2007: 605); Ghosh & Jintanapakanont (2004: 637-640); Kuo & Lu (2013: 602-614); Mahamid (2011: 611)
Project related	Engineering risks, inadequate site investigation, project complexity, site factor physical/technical, unclear scope	Nieto-Morote & Ruz-Villa (2011: 227); Lam *et al*. (2007: 491); Dikmen & Birgnoul (2007: 60-66); Zeng & Smith (2007: 589-600); Xu *et al*. (2012: 896); Tadayon *et al*. (2012: 57-69); Wiguna & Scott (2006); Oztas & Okmen (2005: 234); El-Sayegh (2008: 437)
Third parties	Right-of-way problems	Ghosh & Jintanapakanont (2004: 637-640); Turkey (2011: Online)
Social	Culture, human factors	Lam *et al*. (2007: 491); Chung *et al*. (2010: 47-53); Zeng & Smith (2007: 589-600)

.

Table 2: Risk factors in selected developing countries

Country	*Author*	*Nature of construction*	*Financial and payment*	*Improper planning*	*Operational risks*	*Economic risks*	*Design risks*	*Change orders and scoping*	*Owner related*	*Weather conditions*	*Poor site management*	*Coordination*	*Subcontractor*	*Inadequate contractor experience*	*Inadequate site investigation*	*Poor contract and project management*	*Political instability*
China	Zou *et al.* (2007: 605)		x													x	
Egypt	Khodeir & Mohamed (2014: 5)	Construction		x	x	x											x
	Frimpong *et al.* (2003: 324)		x	x	x	x											
	Agyakwa-Baah & Chileshe (2009: 933)	Construction				x				x		x			x		
India	Iyer & Jha (2005: 291)								x	x		x				x	
	Doloi *et al.* (2012: 484)			x				x			x	x					
Indonesia	Wiguna & Scott (2006: 1129-1135)	Buildings	x			x	x			x							
	Soepriyono (2013: 465-472)		x	x									x			x	
Jordan	Odeh & Battaineth (2002: 70)	Construction	x	x	x				x				x	x			
	Sweis *et al.* (2008: 672-674)		x	x	x				x								
Malaysia	Goh & Abul-Rahman (2013: 25)		x	x													
	Shehu *et al.* (2014: 64)		x														
	Tipili & Ilyasu (2014: 11-13)	Construction		x			x					x				x	
	Belel & Mahmood (2012: 3-4)		x				x	x					x				
	Aibinu & Odeyinka (2006: 672)		x		x		x						x				
Mozambique	Muianga *et al.* (2014: Online)	Construction	x	x	x		x	x	x							x	
Pakistan	Choudry *et al.* (2014: 1-9)		x	x						x					x		
Poland	Skorupka (2008: 121-122)	Construction	x		x	x											
South Africa	Chihuri & Pretorius (2010: Online)	Engineering and construction	x		x	x											
Sri-Lanka	Perera *et al.* (2009: 93)	Roads				x			x						x	x	
	Perera *et al.* (2014: 1)	Roads	x	x			x			x							
Uganda	Apolot *et al.* (2011)	Construction	x					x								x	x
Vietnam	Le-Hoai *et al.* (2008)		x				x				x					x	
Zambia	Mañelele & Muya (2008: 4)	Community projects	x	x	x												
	Muya *et al.* (2013: 53-68)	Roads	x		x	x	x	x		x							
Total			19	12	10	8	8	5	5	6	2	4	4	1	3	8	2

2.3 Risks, project cycle and knowledge areas

Given that the gap identified is a knowledge gap, it is important to have a basic understanding of construction stages and processes in order to determine where the knowledge gaps could reside. Different risks factors affect a project at different stages of the project, while some risk factors may permeate all stages and processes of the project. The generic stages of the project include: 1 - Pre-project stage, 2 - Pre-construction stage, 3 - Construction stage, 4 - Post-construction stage (Kagioglou, Cooper, Aouad & Sexton, 2000: 148-150), while PMBOK (2008: 18) and ISO 21500 (2012: online) highlight the following processes: 1 - Initiate, 2 - Plan, 3 - Execute, 4 - Controlling, 5 - Close out. Though risks mostly eventuate and manifest themselves in the construction phase (Lehtiranta, 2014: 129; Osipova & Eriksson, 2011: 1151), this does not entail that this is the stage where the risks have their source.

The PMBOK (2008: 67-69) further outlines knowledge areas for practice and application as shown below. Other knowledge areas are also considered:

- Integration Management (PMBOK 2008: 71-101): The knowledge area is devoted to identifying and defining the work in all project phases. This knowledge area deals with efficiently integrating changes into the project at all stages.
- Scope Management (PMBOK, 2008: 103-128): This knowledge area deals with the project scope, project requirement scope, project work, making the work breakdown structure, making the scope baselines, and managing the scope of the project. This area aims to plan the ways in which to keep the project within the established boundaries. This is applied at initiation, planning, and control/monitoring.
- Time Management (PMBOK, 2008: 129-163): The project managers/leaders estimate the duration of the tasks in this knowledge area. Tasks are sequenced here and the choices of resources required for achieving the objective of the project are made. The schedule is monitored and managed to keep the project on track. This knowledge area permeates planning, execution, and control/monitoring.
- Cost Management (PMBOK, 2008: 165-187): Budget baseline is established and costs are estimated in this knowledge area. The plan to manage the costs is categorised in the cost management knowledge area. This knowledge area permeates planning, control/monitoring, and execution.

- Quality Management (PMBOK, 2008: 189-213): This is the knowledge area where the quality requirements for project deliverables are planned and tracked. In this area, all the quality issues are monitored and fixed. This is applied to planning, execution, and monitoring/control.
- Human Resources Management (PMBOK, 2008: 215-241): This comprises the essential processes to define the ways in which human resources are utilised, developed, acquired, and managed. This is dealt with in the planning and execution phases.
- Communications Management (PMBOK, 2008: 243-270): The knowledge area defines how communications within the project will work. The project manager/leader makes the communication management plan, ensures the plan is followed, and controls information flow within the project. The knowledge area permeates all phases of a project.
- Risk Management (PMBOK, 2008: 273-311): This consists of identifying risks, planning risk management, conducting risk assessments, and controlling risks. This knowledge is used in the planning and control/monitoring phases. The area concentrates on identifying, analysing, and planning responses to both 'threat risks' (negative) and 'opportunity risks' (positive).
- Procurement Management (PMBOK, 2008: 313-340): This deals with the processes, which project managers/leaders usually follow to acquire the material required for the successful completion of the project. In this knowledge area, project managers/leaders come up with the plan for conducting procurements, controlling the procurements, and closing out the procurements. This is utilised in the planning, execution, controlling/monitoring, and closing out phases.
- Stakeholder Management (PMBOK, 2008: 261-265): The area encompasses all the processes used by a project manager/leader for recognising and satisfying those who are affected by the project. The affected party can be either internal or external in nature. Close attention needs to be paid to stakeholders who have a powerful positive or negative impact on the project. This is applied throughout the project cycle.
- Claim Management (Lichtenthaler, 2017: online): This is the process of systematically and efficiently managing claims (construction defects) in building projects. Claims run through

the phases of detection, examination, and correction of the defects. This occurs in the construction phase.

- Safety management defines the safety obligations on all duty holders, including the client, project supervisor for design process and construction process (Smart market report, 2013: 15). This is normally planned in the pre-contract stage by either the design team or the contractor submits a risk management plan at the tender stage. It is executed in the construction phase.
- Project Financial Management: This process brings together planning, budgeting, accounting, financial reporting, internal control, auditing, procurement, disbursement, and the physical performance of the project with the aim of managing project resources properly and achieving the project's objectives (NCTC, 2017: online). This is normally planned in the pre-contract stage and executed in the construction phase. It is done in the form of an audit to check the planned against the actual work completed.
- Environmental management (He, 2010: 208). This is the management of the impacts of a project management's activities on the environment. It provides a structured approach to planning and implementing environment-protection measures. This is normally planned in the pre-contract stage and executed in the construction phase.

The knowledge areas are important for managing a project, as project management is the application of knowledge to achieve the project objective(s). Therefore, these knowledge areas were used as the basis for determining knowledge gaps.

3. Methodology

This article is part of a bigger study on risk allocation on building projects; therefore, the methodology reported here reflects what was done for the whole study. Saunders, Lewis, and Thornhill (2012: 138) suggest that the methodology comprises the research philosophy, approaches and strategies, choices in methods, time horizons, techniques and procedures for data collection and analysis. The research used a pragmatism philosophy.

Pragmatism entails focusing on problems, and problem-solving to inform future practice (Saunders, Lewis & Thornhill, 2016: 137). The philosophy normally allows mixing of qualitative and quantitative data or several approaches. The strategies employed in this study are interviews and surveys in a sequential manner, as shown in

Figure 1. The methods chosen are semi-structured interviews and questionnaire surveys collected in a cross-sectional manner. Therefore, the research is both qualitative and quantitative, because the approach makes use of both numbers and words in determining the pertinent risks impacting on the Zambian building sector and further, deciphering the root causes of such risks. This approach was deemed appropriate, as the nature of the problem is a practical one. The importance of this worldview is that it focuses attention on the research problem and uses several approaches to derive knowledge about the problem (Creswell & Clark, 2011: 45-46). A deeper understanding of the nature of the risks enabled the identification of possible target areas for improvement. The study respondents were consultants, clients and contractors involved in building projects in the Zambian construction industry.

Research flow diagram

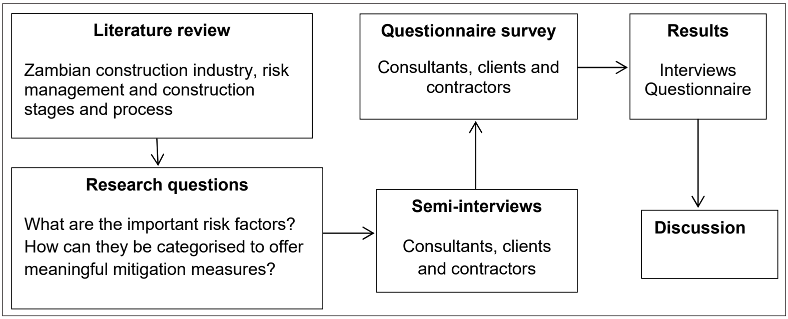

Figure 1: Research flow diagram applicable to this article

3.1 Sampling method

The construction industry in Zambia is, comparatively speaking (*vis-à-vis* South Africa, for instance), very small. The people who were approached were from the public and private sectors working in the construction industry. Sampling is the process or technique of selecting a suitable sample for determining parameters or characteristics of the entire population (Adams, Khan, Raeside & White, 2012: 87).

The study took each sub-population (clients, professionals and contractors) (see Table 4) as manifesting different characteristics and dynamics and, as such, different sampling techniques were employed to acknowledge these differences, in order to enable credible data to be elicited from the different groups/ sub-populations. Four sampling methods were used based on probability (random sampling and stratified random sampling) and non-probability (purposive and census) for the various categories of respondents as shown in Tables 3 and 4.

3.1.1 Semi-structured interviews

The purposive method was employed for the semi-structured interviews to select participants, with at least 10 years' experience in the construction industry, from diverse backgrounds, professions and project experiences. The purposive heterogeneous sampling was intentionally selected for this purpose. This method of sampling enables accessing respondents from diverse backgrounds with in-depth knowledge about a particular issue (Adams *et al*., 2012: 87: Babbie, 2013: 126). Leedy and Ormrod (2014: 196) propose a sample of five to 25 participants for semi-structured interviews. In this research, 15 respondents participated, as shown in Table 3. Triangulation of risk factors from different respondents was used as a measure of validity for the interviews.

3.1.2 Questionnaire survey

The questionnaire survey utilised three types of sampling: simple random sampling for consultants who are ordered or arranged according to services (for example, Architecture, Quantity Surveying and Engineers), while a simple census was done for clients and project managers, as these populations were less than 30 (Saunders *et al.*, 2012: 266). For contractors, stratified random sampling was used, as the contractors targeted were listed in different building categories and had different capacities, thereby presenting heterogeneous characteristics across groups and homogeneous characteristics within groups. Each contractor grade (grades 1-3) was treated as a stratum where proportional samples were drawn (Adams *et al*., 2012: 89). For building category grade 1, limitation of contract value to be tendered is over K40Million (US$ 4 M); grade 2 between K20M and K40 (US$ between 2M & 4M), while the grade 3 category is K10M and K20M (US$ between 1M & 2M) using an exchange rate of 1US$=K9.77.

3.2 Sample size

The sample sizes are shown in Tables 3 and 4 for the respective data-collection methods used. The sample size for the interviews is 15 and for the questionnaire survey the sample is 198. Table 3 further shows the nature of building projects in which the interviewees have participated.

Table 3: Respondent profile for interviewees sampled purposively

Respondent no.	*Sector*	*Years of experience*	*Role in construction*	*Nature of building projects engaged in*
1	Public	15	Quantity surveyor	Offices, houses, schools
2	Public	12	Civil engineer	Offices, hospitals, schools
3	Public	10	Procurement officers	Offices, houses
4	Public	20	Quantity surveyor	Housing units, offices, health facilities, hospitals
5	Public	19	Architect	Schools, offices, border infrastructure, houses
6	Private	10	Contractor	Houses, student hostels, high-rise buildings
7	Private	32	Quantity surveyor/Project Manager	Offices, hospitals, residential, banks, filling stations, stadia, factories
8	Public	21	Client org	Primary schools, secondary schools, colleges, houses
9	Public	23	Project manager	Prisons, military installations, houses, rural health centres, flight terminals, border facilities, offices
10	Private	30	Engineer consultant	Showrooms, schools, filling stations, hospitals, hotels, office buildings
11	Private	29	Contractor	Housing, offices, banks, schools, hostels
12	Private	10	Contractor	High schools, maternity wards, student hostels, offices
13	Private	10	Client org	Markets, fire stations, bus shelters, houses
14	Public	15	Procurement officer	Office blocks, houses, farm layouts and different buildings, lodges, banks
15	Private	10	Architect	Houses, offices, shops, farm buildings, banks

Table 4: Respondent profile for questionnaire survey

Category	*Sampling/ selection strategy*	*Subgroup*	*Population*	*Responses*	*Response rate %*
Contractors as at 14 August 2014	Stratified random sampling	Group 1	51	22	43.1
		Group 2	30	15	50.0
		Group 3	69	43	62.3
Consultants (firms) engaged in buildings	Random sampling	Quantity surveyor	36	32	88.9
		Engineers	32	28	87.5
		Architects	54	38	70.4

Category	*Sampling/ selection strategy*	*Subgroup*	*Population*	*Responses*	*Response rate %*
Project managers (firms)	Census	Project managers	17	14	82.0
Clients	Census	Public (ministries) Private	6 5	4 2	66.7 40.0
Total			300	198	66.0

The sample size for construction-related professionals was calculated in accordance with the table recommended by Krejcie & Morgan (1970: 608). The table gives recommended sample sizes for general research activities, applicable to any defined population. From the table, the recommended sample size for a population of 300 is 169, for 10 000 it is 370, and for 1 000 000 it is 384. This recommendation validates the sample size of 198 as efficient for the population of 300.

3.3 Data collection

Data collections were twofold: semi-structured interviews and a self-administering questionnaire. An interview protocol was used to collect the primary data for the semi- structured interviews in a face-to-face interaction.

The interview protocol had three main sections. The first section included questions regarding the background of the respondent; the second section, questions on the risks perceived as pertinent to building projects, and the last question addressed the possible risk management and mitigation measures for the risks used in practice. This article deals with only the analysis on pertinent risks. During the interview sessions, probing questions were asked to gain a deeper understanding (Babbie, 2013: 253). The interviews ranged between 30 minutes and 70 minutes. The interviews were captured using a digital recorder. Back-up notes were taken during the session in case any problems occurred with the audio-taping and for respondents who did not agree to be audio-recorded. The recording was then transcribed prior to the commencement of the analysis.

Respondent bias during the questionnaire survey was reduced with closed ended questions (Bryman & Bell, 2015: 175). The nature of questions for the survey was similar to that of the semi-structured interviews, starting with background or demographic information, risk practices and measures taken for mitigation and management of encountered risks. A reliability test using Cronbach's Alpha was calculated for the 55 items and the reliability test scored was 0.96. According to Reynold and Santos (1999: 35-36), a Cronbach's alpha value greater than 0.7 implies that the instrument is reliable.

3.4 Response rate

Of the 222 questionnaires distributed, 198 completed questionnaires were returned, resulting in an overall response rate of 66% (see Table 3). This is beyond the response rate, recommended by Moyo and Crafford (2010: 68) for the built environment, of between 7% and 40%. The number of purposive interviews was well within the range of recommended numbers advocated by Leedy and Ormrod (2014: 196) of between five and 25 respondents (see Table 3). The response rates demonstrate a high level of reliability.

3.5 Data analysis

The research for the semi-structured interviews used content analysis to determine pertinent risk factors and other categories arising. For the questionnaire survey, descriptive statistics in the form of frequency/counts, mean and standard deviation were calculated. In addition, Pareto analysis was conducted to determine the stage at which most of the risks could be mitigated, the owners of the risks considered pertinent, the possible deficiency in knowledge areas using the project management body of knowledge (PMBOK, 2008) and to determine the risk categories of the pertinent risks. A total of 31 pertinent risk factors were generated from a list of 55 important risks generated from the literature and semi-structured interviews. From the literature, over 100 risk factors were generated; some of these were eliminated because they do not apply either to the context of building projects or in the Zambian built environment, e.g. snow, and so on.

3.5.1 Qualitative data analysis from the interviews

The qualitative data arising from the interviews was transcribed and a manual 10-step thematic content analysis, adapted from Burnard (1991: 463-466), was conducted and strictly followed as follows:

1. Notes were made after the interviews regarding topics discussed during the interviews. The interest was mainly in areas considered pertinent to the study.
2. The reading of transcripts elicited themes which were then categorised to map out some trends in the data.

3. The categories were revisited in order to expand on their meaning in terms of what they were telling the researchers.
4. Any commonalities between categories were identified and the categories were ranked according to whether they were major or minor categories in terms of the themes they encapsulated.
5. Once the ranking was done, the categories were compared and contrasted, in order to merge and observe any inclinations.
6. A similar approach was done for all the transcripts.
7. The categories from different transcripts were further juxtaposed to identify any fits or divergences, in order to elicit any useful signals from the data.
8. The next stage was simply to check if there was uniformity in all the transcripts in the data.
9. Once discrepancies were dealt with, some categories were merged and some had to be subcategories, as they could, in the whole, be subsumed by major categories.
10. In the last stage, the transcripts were revisited to find out whether all that needs to be done was done, and to avoid any major mistakes in recording data.

In addition to the thematic analysis after the risk factors were identified, a process of categorisation took place. The project management body of knowledge (2008) processes and knowledge areas were used to map out the processes and knowledge areas of the project in which the identified risks could be mitigated. Kagioglou *et al*.'s (2000: 148-150) stages of contract were also used to map out the stages in the construction process where the risk factors reside. This was done to give an indication of the project process and stages where a risk could be alleviated or eliminated.

3.5.2 Quantitative data analysis (Questionnaire)

For the questionnaire survey, a 5-point Likert-scale measurement was used to obtain perceptions of the respondents on risks considered pertinent and affecting performance. The scale was ordinal in nature, where 1 was not important at all and 5 exceptionally important. The quantitative data was imputed and analysed using Excel and SPSS 20 programs. Interpretations were then made to make meaning of the data. The mean score and standard deviation were used to determine the factors considered pertinent, as the approach has been applied in other similar research [see Shehu *et al*. (2014: 61-63);

Mbachu & Taylor (2014: 29); Wang & Yuan (2011: 214)]. In addition, Pareto analysis was used. This technique prioritises possible changes by identifying the problems that might be resolved by making the proposed changes. The analysis is based on the Pareto principle, also known as the 80/20 rule, based on the idea that 20% of the causes generate 80% of the results (Kendrick, 2010: online). The Pareto is guided by the following procedure:

- Identify and list problems (risk factors);
- Identify the root cause for each (knowledge area, phase in project, risk category);
- Score problem;
- Group problems together by root cause;
- Add up the score of each group (Kendrick, 2010: online)

4. Results and discussion

4.1 Respondent profile

The respondents for the interviews had an average of 17 years' experience, a median of 15 years, and a mode of 10 years. The minimum qualification was first degree, except for procurement officers who had training at advanced diploma level. Table 4 shows that the respondents have been involved in various types of projects with a mix of small- to large-scale building projects.

The qualifications of the respondents were as follows; for clients, all had the minimum of first degree, with over 80% having 6-10 years' experience. For project managers, the majority (79%) had first degree, while 21% had qualification at masters level. For consultants, first degree qualification (70%), Masters degree (20.4%), Diploma (5%) and certificate (1%). Lastly, contractors' academic qualifications were as follows: first degree qualification (74%), Masters degree (6%), Diploma (13%), and certificate (6%). Project managers had on average 10 years' experience, whereas clients, contractors and consultants had an average of nine years' experience each. The respondents are of acceptable experience levels.

4.2 Nature of building works engaged in

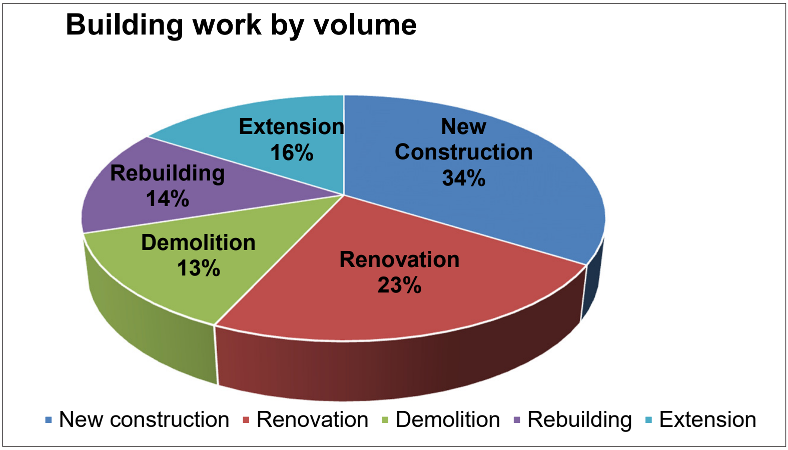

Figure 1: Building works by volume

The findings from the questionnaire survey show that the majority of works, in which consultants, project managers and contractors are engaged, are new works (34% by volume). Renovations and refurbishments (23% by volume) of existing buildings are also common, followed by extension (16% by volume) of existing buildings (Figure 2). The least practised are rebuilding works (14%), which are often necessitated by demolition works (13%).

4.3 Types of buildings

There are various types of buildings. Table 3 shows the nature of building projects on which various interview respondents have worked, while Figure 2 shows the nature of building projects from the questionnaire survey data.

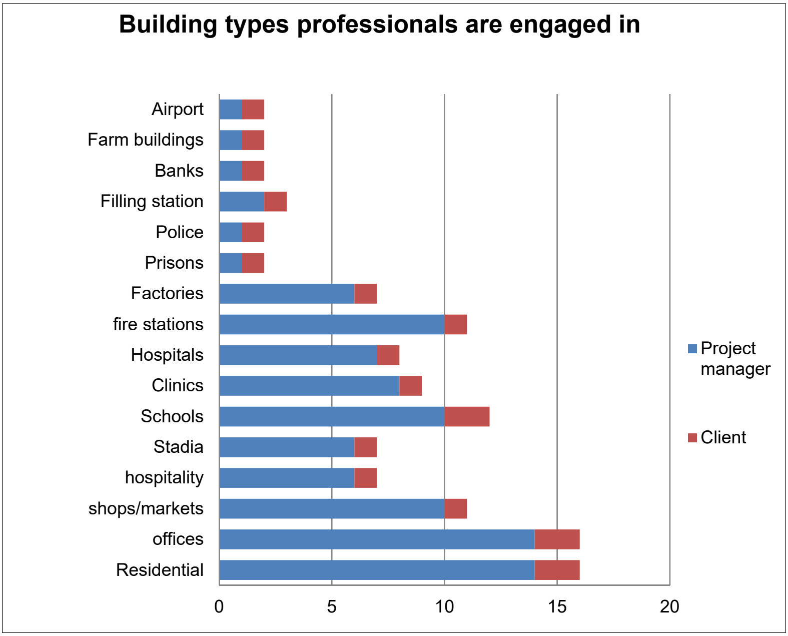

Figure 2: Types of buildings - Questionnaire survey

On examining the two data sets closely (Table 3 and Figure 2), it appears that the common building types in the Zambian construction industry are residential, offices, schools, fire stations and health facilities such as clinics, health centres and hospitals.

4.4 Pertinent risks in the building sector

To gain an understanding of the pertinent risks in the Zambian building sector, the respondents were asked to identify pertinent risks, which have been categorised according to prevalence, depending on the count from the content analysis. Table 5 shows the results from the interview data.

Table 5: Risk factors from interviewees

Risk prevalence	*Risk factors*
High prevalence (indicated by 10-15)	Late payment; contractors' financial difficulty; lack of inspection, monitoring and supervision by contractor and consultants; lack of adherence to contractual provisions by public client

Risk prevalence	*Risk factors*
Moderate prevalence (indicated by 5-9)	Change in material prices and exchange rates; slow and bureaucratic decision-making process; poorly skilled artisans and poor workmanship; incomplete and insufficient designs; extension of time without costs; unavailability of funds/budget; changes in scope
Low prevalence (indicated by 0-4)	Lack of interest on delayed payment; poor quality works; non-compliance with tender requirements on site; difficulty in implementing clauses by contracting parties; poorly prepared contract documents; poor quality of materials; unavailable material; contractors' lack of skill and experience; difficult access to site; late site hand-over by client; corruption; poor interpretation of contract; poor safety on site; disputes; high taxes; political interference; inclement weather; low level of subcontracting; inadequate site investigation

Table 5 shows that the majority of the pertinent risks categorised as highly prevalent are financial in nature, while those categorised as moderately important are mainly linked to scoping and technical know-how. Lastly, the low importance category includes diverse risks that could be termed project specific. These could be linked to managerial or operational risks. The interview data helped generate risks for the questionnaire.

Interviews revealed that clients and consultants (60%) perceived that contractors account for more risks, followed by external risks. In addition, the findings from the interviews and questionnaire point out that stages in the risk management include risk identification (using brainstorming, checklist, local knowledge, and expert judgement) and qualitative risk (brainstorming and expert judgement) analysis, communication and occassional monitoring, especially in the public sector, due to lack of finance and inadequate personnel.

4.5 Pertinent risk categories and risk owner

Fifty-five risk factors identified by source (client related, contractor related, consultant related, and external risks) were used in the questionnaire to determine the pertinent risk factor in the industry. The perceptions of respondents were indicated using the 5-point Likert scale where 1 has no importance on performance and 5 is exceptionally important to performance. The mean and the standard deviations of each factor are calculated to determine the rank. If two or more factors have the same mean item score value, then the one with a lower standard deviation was considered more important. The risk factors with mean item score values greater than the average value of all mean values (3.81) are classified as important/pertinent risk factors affecting construction in the Zambian building sector. The pertinent factors are shown in Table 6.

Table 6: Pertinent risks factors in the Zambian building sector from questionnaire survey

Risk factor	*N*	*Mean*	*Std. deviation*	*Risk rank*
Lack of clarity of drawings and technical specifications	180	4.328	.775	1
Contractor's underestimate of construction cost	194	4.309	.793	2
Client's financial stability	197	4.254	.787	3
Contractor's financial difficulties	191	4.157	.904	4
Defective workmanship and rework	193	4.124	.767	5
Poor supervision	184	4.103	.878	6
Poor quality materials	193	4.067	.872	7
Errors and omissions in design drawings	192	4.057	.875	8
Unclear scope of works	185	4.054	.901	9
Inadequate site investigation	191	4.037	.903	10
Poor coordination and communication	192	4.036	.808	11
Poor supervision on site	190	4.016	.826	12
Inadequate budgeting and contingencies	194	4.016	.908	13
Poor planning of resources - materials, labour, equipment	195	4.010	.919	14
Delay in payment process by the client	194	3.990	.846	15
Lack of inspection of works	189	3.990	.881	16
Delay in consultant's approval of materials submission	197	3.980	.926	17
Inadequate specification	194	3.974	.890	18
Escalation in material prices	191	3.974	.986	19
Lack of coordination among design disciplines	190	3.963	.939	20
Delay in contractor's payment certification by the consultant	193	3.953	.909	21
Poor labour productivity	192	3.938	.890	22
Omission in design contract documents	189	3.937	.873	23
Holding key decisions in isolation	191	3.911	.851	24

Risk factor	*N*	*Mean*	*Std. deviation*	*Risk rank*
Delay in consultant's approval of shop drawings	193	3.907	.953	25
Delay in consultant's response to requests for information	196	3.898	.900	26
Unstable exchange rates	191	3.895	.906	27
Ineffective monitoring of risks	193	3.855	.935	28
Late delivery of materials	192	3.849	.900	29
Lack of experience in similar projects	194	3.835	.860	30
Frequent change of orders by client	192	3.823	.921	31

Though not all respondents ranked each risk, the responses obtained present a reliable overview. The respondents were diverse in nature and some decided not to provide a response for areas outside their expertise, as they feel that they are not qualified to rank the risk or that their knowledge on the influence of a particular risk was limited.

Table 7: Pertinent risk factors in the Zambian building sector

Risk factor	*Internal*	*External*	*Risk category*	*Risk owner*
Lack of clarity of drawings and technical specifications	X		Design	Consultant
Delay in consultant's approval of materials submission	X		Managerial	Consultant
Inadequate site investigation	X		Technical	Consultant
Inadequate specification	X		Technical	Consultant
Omission in design contract documents	X		Design	Consultant
Delay in contractor's payment certification by the consultant	X		Managerial	Consultant
Delay in consultant's response to requests for information	X		Managerial	Consultant
Delay in consultant's approval of shop drawings	X		Managerial	Consultant
Poor supervision	X		Managerial	Consultant
Errors and omissions in design drawings	X		Design	Consultant
Poor labour productivity	X		Technical	Contractor/ Consultant

Risk factor	*Internal*	*External*	*Risk category*	*Risk owner*
Poor quality materials	X		Technical	Consultant/ Contractor
Poor supervision on site	X		Managerial	Contractor/ Project manager
Poor planning of resources - materials, labour, equipment	X		Managerial	Contractor
Contractor's underestimate of construction cost	X		Financial	Contractor
Late delivery of materials	X		Managerial	Contractor
Lack of experience in similar projects	X		Technical	Contractor
Contractor's financial difficulties	X		Financial	Contractor
Defective workmanship and rework	X		Technical	Contractor
Unstable exchange rates		X	Economic	Client/ Contractor
Escalation in material prices		X	Economic	Client/ Contractor
Client's financial stability	X		Financial	Client
Delay in payment process by the client	X		Managerial	Client
Frequent change orders by client	X		Managerial	Client
Inadequate budgeting and contingencies	X		Technical	Client/ Consultant
Unclear scope of works	X		Managerial	Client
Poor coordination and communication	X		Managerial	Project manager
Lack of inspection of works	X		Managerial	Project manager/ Consultant
Lack of coordination among design disciplines	X		Managerial	Project manager
Holding key decisions in isolation	X		Managerial	Project manager
Ineffective monitoring of risks	X		Managerial	Project manager

4.5.1 Risk categories

Figure 3 shows the risk categories for the pertinent risks, with over half (54.84%) of the risks being managerial/operational in nature. The lowest categories are economic risks (which is normally grouped with financial risks) and design. Economic risks are normally external in nature, while financial risks are normally internal, hence the need to separate them in this instance. The Pareto chart shows that the managerial, technical and financial risks are risk categories associated with 80% of the pertinent risks.

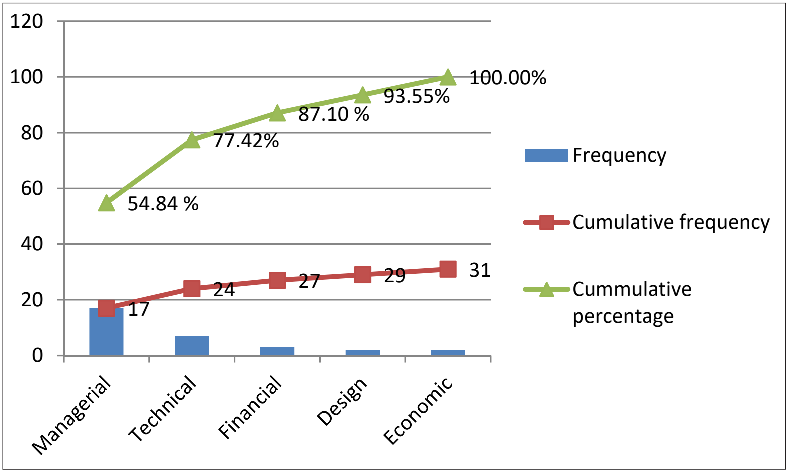

Figure 3: Risk categories

These results are not different to risks categories shown in Tables 1 and 2 for risks found in other countries. Therefore, the planning phase and monitoring phase should be given particular attention to these categories of risk. Moreover, going by the Pareto analysis, it can be argued that paying particular attention to these processes will result in mitigation of 80% of the risks (Kendrick, 2010: online).

4.5.2 Risk owner

The risk owners for most of the pertinent risks are the consultant and the contractor. However, this basically depends on the procurement method used. But, in this instance, the traditional method is applied, as it is the most prevalent procurement method in the ZCI.

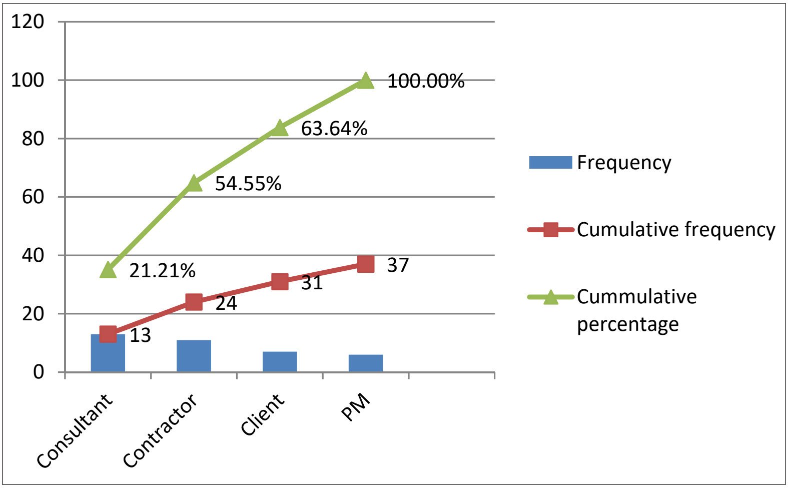

Figure 4: Risk owner analysis

The Pareto chart in Figure 4 shows all project participants as risk owners of pertinent risks at 80%. However, consultants and contractors account for over 50% of the risks. This means that both parties' contractor and consultant (normally acting on behalf of clients) should contribute more in managing risk.

4.6 Pertinent risks according to project stage and knowledge area

The mitigation stages for the pertinent risks shows that the majority of the risks occur in the construction phase, while others occur in the planning stage-pre-contract phase (see Table 10).

Table 10: Pertinent risks according to project stage, knowledge area and process

Risk factor	**Stage in the project when risk could have been mitigated using generic stages**	**Process in the project management knowledge areas that could be a possible problem area (PMBOK 5)**	**Process mapping using PMBOK 5**
Errors and omissions in design drawings	Pre-contract	Procurement	Planning
Unclear scope of works	Pre-contract	Scope	Planning

Risk factor	**Stage in the project when risk could have been mitigated using generic stages**	**Process in the project management knowledge areas that could be a possible problem area (PMBOK 5)**	**Process mapping using PMBOK 5**
Inadequate site investigation	Pre-contract	Scope	Planning
Inadequate budgeting and contingencies	Pre-contract	Cost	Planning
Inadequate specification	Pre-contract	Procurement	Planning
Omission in design contract documents	Pre-contract	Procurement	Planning
Clarity of drawings and technical specifications	Pre-contract	Procurement	Planning
Lack of experience in similar projects	Tender stage-Pre-contract	Human resources	Planning
Contractor's underestimate of construction cost	Tendering-Pre-Contract	Cost	Planning
Contractor's financial difficulties	Construction	Cost	Execution
Defective workmanship and rework	Construction	Quality	Monitoring and control
Poor supervision by consultants	Construction	Integration	Monitoring and control
Poor quality materials	Construction	Quality	Execution
Poor coordination and communication	Construction	Communications	Whole project cycle
Poor supervision on site - contractor	Construction	Integration	Execution
Poor planning of resources - materials, labour, equipment	Construction	Procurement	Execution
Delay in payment process by the client	Construction	Cost	Execution
Lack of inspection of works	Construction	Integration	Monitoring and control
Delay in consultant's approval of materials submission	Construction	Time	Execution

Risk factor	Stage in the project when risk could have been mitigated using generic stages	Process in the project management knowledge areas that could be a possible problem area (PMBOK 5)	Process mapping using PMBOK 5
Escalation in material prices	Construction	Cost	Execution
Delay in contractor's payment certification by the consultant	Construction	Cost	Monitoring and control
Poor labour productivity	Construction	Human resources	Execution
Holding key decisions in isolation	Construction	Communication	Execution
Delay in consultant's approval of shop drawings	Construction	Time	Execution
Delay in consultant's response to requests for information	Construction	Integration	Execution
Unstable exchange rates	Construction	Cost	Monitoring and control
Ineffective monitoring of work	Construction	Integration	Monitoring and control
Late delivery of materials	Construction	Procurement	Execution
Lack of coordination among design disciplines	Project cycle	Communication	Monitoring and control
Frequent change orders by client	Project cycle	Scope	Execution
Client's financial stability	Project cycle	Financial	Whole project cycle

4.6.1 Risk stage

The Pareto analysis in Figure 5 shows that 80% of the risks are caused by poor mitigation in the construction phase and pre-contract phase; very few risks could be said to occur on account of the tendering stage.

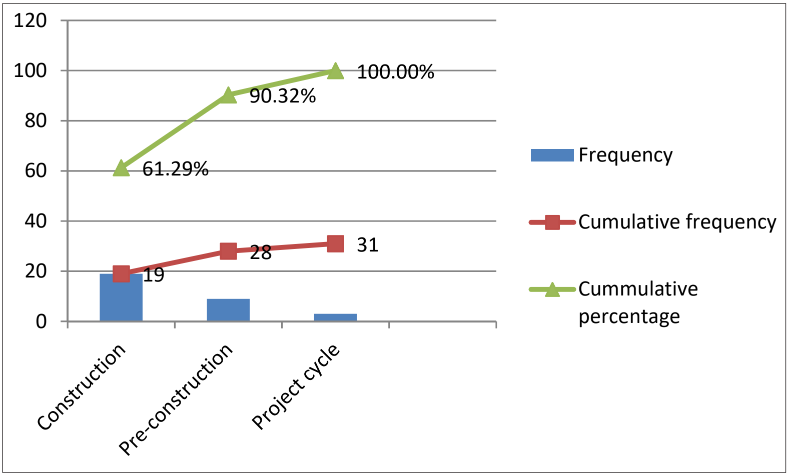

Figure 5: Risk stage

4.6.2 Knowledge area

Several knowledge areas are essential for managing projects. The pertinent areas that seem to be attributed to the risks are shown in Figure 6.

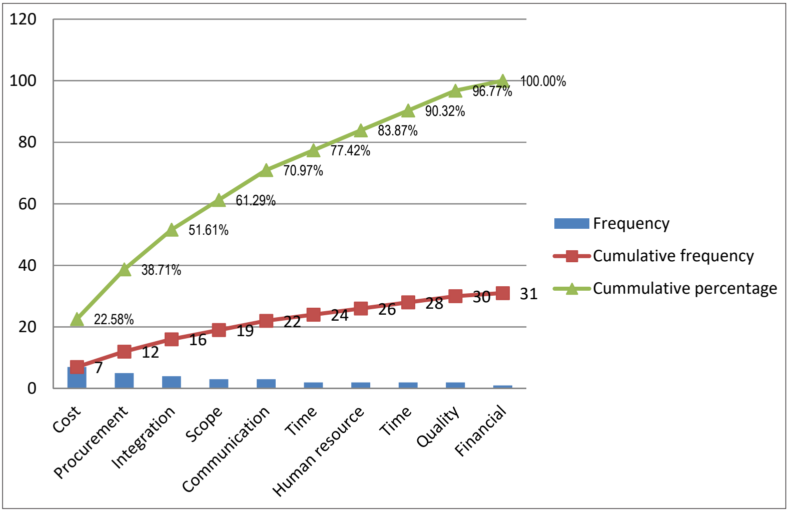

Figure 6: Knowledge area

The Pareto analysis in Figure 6 shows that 80% of the pertinent risks are caused by inappropriate application and/or lack of knowledge in cost management, procurement management, integration management, human resources management, communication management, time management, and scope management. The knowledge areas accounting for over 50% of performance are cost, procurement, scope, and integration management.

4.6.3 Process management

The Pareto analysis in Figure 7 shows that 80% of the pertinent risks are caused by inappropriate application and/or lack of knowledge in project execution, project planning, and monitoring and control. The processes accounting for over 50% of ineffective processes are execution and planning.

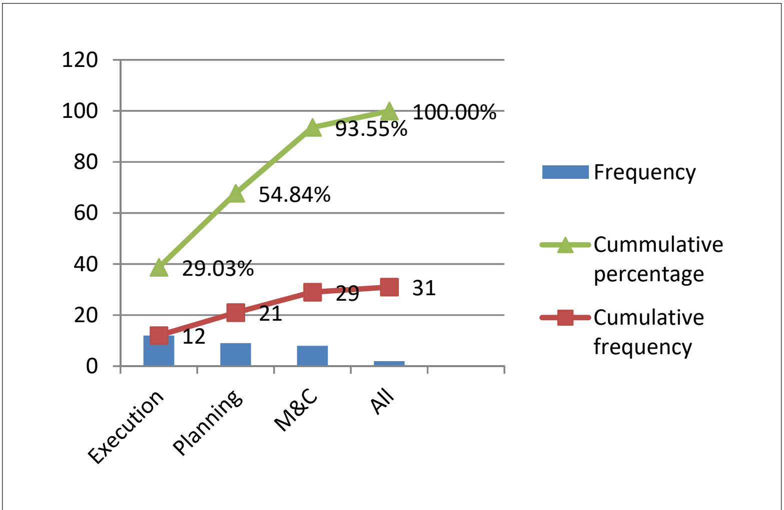

Figure 7: Processes

5. Discussion

This section discusses the pertinent risks in view of their nature, the risk owner, the stages of the project and the processes during a project where care needs to be taken. In addition, the applicable knowledge area associated with the risk is identified.

5.1 Nature of pertinent risks and risk owner

The results show that the majority of the pertinent risks are internal in nature. This implies that the mitigation of these risks lies within the project team on a given project. Therefore, risks can be reduced by careful risk planning (Goh & Abul-Rahman, 2013: 21) by the project team. This can be coupled with the selection of participants with capabilities to mitigate such risks. The important risks are from the managerial, technical and financial categories. This implies that the contracting parties must pay particular attention to these categories of risk and sharpen their skills in the aforementioned management areas. This could be dealt with during the pre-contract phase.

The results in section 4.5.2 show that all project participants, to some extent, account for the risks experienced on projects. Nevertheless, both parties (client and contractor) should carry out their roles to mitigate risks (Lehtiranta & Junnonen, 2014: 143; Mu, Chen, Chohr & Peng, 2014: 453) and improve performance. From a traditional procurement perspective, the client needs to put more effort into risk mitigation. This is important, because the interviews revealed that clients and consultants (60%) perceived that contractors account for more risks, although the analysis by risk owner proves otherwise. It has been argued that perceptions influence how risks are responded to and planned for (Lehtiranta, 2014: 641). Moreover, Amundurud and Aven (2015: 43) argue that decisions on risk are strongly dependent on perception. Consequently, imperfect perceptions may account for improper risk response and planning (Floricel, Bonneau, Aubry & Sergi, 2014: 1093). The imperfect perception by parties in the building sector could account for the poor performance in the sector. The findings provide evidence that both parties contribute to undesirable performance (quality shortfalls, cost/time overruns). This calls for the parties to manage their risks better.

5.2 Stage of project where risks should be mitigated

The findings show that most of the risks occur in the construction phase and more measures should be put into this phase. This is congruent with the finding of Osipova and Eriksson (2011: 1151) who point out that most of the risks eventuate in the construction phase. Risks during this stage are normally due to poor monitoring and control of risks (Goh & Abul-Rahman, 2013: 21). In this instance, the interview data provided evidence of poor control and monitoring, due to poor funding and inadequate personnel. This is most prevalent in the public sector. In addition, the findings suggest that planning carried out in the pre-contract phase is inadequate, as risks such as unclear specifications and omissions in design eventuate. Planning should, therefore, be effectively carried out to reduce risks in the construction stage.

5.3 The deficient knowledge areas

The PMBOK (2008: 69) posits that effective management of projects requires the application of all knowledge areas. While risk management is a distinct knowledge area, it has been demostrated, in this instance, that other knowledge areas must be applied, in order to manage risks in the construction industry, as the findings show that, for effective mitigation to be in place, all other knowledge areas might need to be applied. The Zambian building sector professionals need to gain more knowledge in cost management, procurement management, integration management, communication management, time management, human resources management, and scope management, in order to mitigate 80% of the eventuating risks. It has been argued that risks occur on projects due to lack of skill in risk management (Dey, 2001: 634; Chileshe & Kikwasi, 2014). The findings show that skill is also needed in other knowledge areas. This view is supported by Perez, Gray & Martin (2016: 8) who identify project management, technical and business management skills as skills needed for effective risk management in Queensland. In addition, the findings from the interviews and questionnaire point out that stages in the risk management conducted include risk identification and qualitative risk analysis, communication and occassional monitoring, especially in the public sector, due to lack of finance. It was clear that quantitative risk analysis is rarely done, due to lack of knowledge. This implies that the posibility of occurrence and impacts of such risk rarely have values attached to the possible loss.

6. Conclusion

The empirical findings show the pertinent risks (managerial, technical and financial) encountered in the Zambian building sector. Most of these risks are consultant and contractor related, mainly resulting from imperfect planning and monitoring in the pre-construction and construction phases of the project, respectively. Furthermore, the results show that 80% of the pertinent risks point to deficiency or imperfect application of knowledge in cost management, procurement management, integration management, communication management, and scope management. The findings presented in this study contribute significantly to local knowledge in the building sector, as this is the first such study in Zambia to analyse the pertinent risks and to point out possible mitigation and alleviation area for risks.

The mentioned knowledge areas, coupled with an improvement of skill in quantitative risk analysis and risk monitoring by contractors and consultants, could improve project delivery in the building sector. However, the gaps identified in this study may not be the same for other sectors of construction, such as roads, bridges, and so on. Therefore, a similar methodology could be applied to other sectors to decipher the knowledge areas needed in relation to the risks faced in the specific sector, in order to improve project delivery.

References

Adams, J., Khan, H.T.A., Raeside, R. & White, D. 2012. *Research methods for graduate business and social science students.* 8th edition. Washingston DC: Sage.

Agyakwa-Baah, A. & Chileshe, N. 2009. An empirical study of risk analysis and its impact on construction projects - the case of Ghana. *Proceedings of the 6th International Conference on Innovation in Architecture, Engineering and Construction (AEC)*, 9-11 June 2009, State College, Pennsylvania (PA). Loughborough University, U.K., Pennsylvania State University, pp. 926-938.

Aibinu, A. & Odeyinka, A. 2006. Construction delays and their causation factor in Nigeria. *Journal of Construction Engineering and Management,* 132(7), pp. 667-677. https://doi.org/10.1061/(ASCE)0733-9364(2006)132:7(667)

Al-Bahar, J.F. & Crandall, K.C. 1990. Systematic risk management approach for construction project. *Journal of Construction Engineering and Management,* 116(3), pp. 533-546. https://doi.org/10.1061/(ASCE)0733-9364(1990)116:3(533)

Alinaitwe, H.M. (Eds). *Proceedings of the Second International Conference on Advances in Engineering and Technology*, 31 January-1 February 2011, Entebbe, Uganda. Uganda: Macmillan, pp. 305-311.

Amundurud, O. & Aven, T. 2015. On how to understand and acknowledge risk. *Realibility Engineering and System Safety,* 142, pp. 42-47. https://doi.org/10.1016/j.ress.2015.04.021

Apolot, R., Alinaitwe, H. & Tindiwensi, D. 2011. An investigation into the causes of delay and cost overruns in Uganda's public sector construction. In: Mwakali, J.A. & Alinaitwe, H.M. (Eds). *Proceedings of* *the Second International Conference on Advances in Engineering and Technology*, 31 January-1 February 2011, Entebbe, Uganda. Uganda: Macmillan, pp. 305-311.

Ardeshir, A., Mohajeri, M. & Amiri, M. 2016. Evaluation of safety risks in construction using Fuzzy Failure Mode and Effect Analysis (FFMEA). *Scientia Iranica. Transaction C, Chemistry, Chemical Engineering,* 23(6), pp. 2546-2556.

Auditor General's Office. 2009. *Report of the Auditor General on the accounts of the Republic for the financial year ended 31st December 2009, for the period 2006-2009*. Lusaka, Zambia: Government Press. [online]. Available at: <http://www.ago.gov.zm> [Accessed: 15 February 2017].

Auditor General's Office. 2013. *Report of the Auditor General on the accounts of the Republic for the financial year ended 31st December 2012, for the period 2009-2012*. Lusaka, Zambia: Government Printers. [online]. Available at: <http://www.ago.gov.zm> [Accessed: 15 February 2017].

Australian & New Zealand Risk Management Standard-AS/NZS 436. 1999. *Australian & New Zealand Risk Management Standard.* s.l.: Australian & New Zealand Risk Management Standard.

Babbie, E. 2013. *The practice of social research.* 13th international edition. Boston: Wadsworth Cengage learning.

Baloi, D. & Price, A. 2003. Modelling global risk factors affecting construction cost performance. *International Journal of Project Management,* 21(4), pp. 261-269. https://doi.org/10.1016/S0263-7863(02)00017-0

Barlish, K., Marco, D. & Thaheem, A. 2013. Construction risk taxonomy: An international convergence of academic and industry perspectives. *American Journal of Applied Sciences*, 10(7), pp. 706-713. https://doi.org/10.3844/ajassp.2013.706.713

Belel, A.Z. & Mahmood, H. 2012. Risk management practices in the Nigerian construction industry - A case study of Yola. *Continental Journal of Engineering Sciences,* 7(3), pp. 1-6.

Bryman, A. & Bell, E. 2015. *Business research methods.* International 4th edition. Oxford: Oxford University Press.

Burnard, P. 1991. A method of analysising interview transcript in qualitative research. *Nurse Education Today,* 11(4), pp. 461-466. https://doi.org/10.1016/0260-6917(91)90009-Y

Business Dictionary. 2016. Online business dictionary. [online]. Available at: <www.businessdictionary.com/> [Accessed: 15 February 2017].

Cano, A. del & Cruz, M.P. de la. 2002. Integrated methodology for project risk management. *Journal of Construction Engineering and Management,* 128(6), pp. 473-485. https://doi.org/10.1061/(ASCE)0733-9364(2002)128:6(473)

Chapman, C. & Ward, C. 2003. *Project risk management: Processes, techniques and insights.* Chester: Wiley.

Charoenngam, C. & Yeh, C.-Y. 1999. Contractual risk and liability sharing in hydropower construction. *International Journal of Project Management,* 17(1), pp. 29-37. https://doi.org/10.1016/S0263-7863(97)00064-1

Chihuri, S. & Pretorius, L. 2010. Managing risk for success in South African engineering and construction project environment. *South African Journal of Industrial Engineering,* 21(2), pp. 63-77. https://doi.org/10.7166/21-2-50

Chileshe, N. & Kikwasi, G.J. 2014. Risk assessment and management practices (RAMP) within the Tanzanian construction industry: Implementation barriers and advocated solutions. *International Journal of Construction Management,* 14(4), pp. 239-254. https://doi.org/10.1080/15623599.2014.967927

Choudry, R., Aslam, M., Hinze, J. & Arain, F. 2014. Cost and schedule risk analysis of bridge construction in Pakistan: Establishing risk guidelines. *Journal of Construction Engineering and Management,* 140(7), pp.1-9. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000857

Chung, D., Hansher, D.A. & Rose, J.M.R. 2010. Toward the betterment of risk allocation: Investigating risk perceptions of Australian stakeholders groups to PPP toll road projects. *Research in Transportation Economics,* 30(1), pp. 43-58. https://doi.org/10.1016/j.retrec.2010.10.007

Creswell, W.J. & Clark, P.L.V. 2011. *Designing and conducting mixed methods research.* London: Sage.

Dey, K.P. 2001. Decision support system for risk management. *Management Decision,* 39(8), pp. 634-649. https://doi.org/10.1108/00251740110399558

Dikmen, I. & Birgnoul, M.T. 2006. Analytical hierarchy process based model for risk and opportunity assessment of international construction projects. *Canadian Journal of Civil Engineering,* 33(1), pp. 58-68. https://doi.org/10.1139/l05-087

Doloi, H., Sawhney, A., Iyer, K. & Rentala, S. 2012. Analysing factors affecting delays in India construction projects. *International Journal of Project Management,* 30(4), pp. 479-489. https://doi.org/10.1016/j.ijproman.2011.10.004

Ebrahimnejad, S., Mousav, S.M.I. & Seyrafianpour, H. 2010. Risk identification and assessment for BOT projects: A Fuzzy Multi-Attribute decision-making model. *Expert Systems with Application,* 37(1), pp. 575-586. https://doi.org/10.1016/j.eswa.2009.05.037

Enshassi, A., Al-Najjar, J. & Kumaraswamy, M. 2009. Delays and cost overruns in the construction projects in the Gaza strip. *Journal of Financial Management of Property and Construction,* 14(2), pp. 126-151. https://doi.org/10.1108/13664380910977592

Floricel, S., Bonneau, C., Aubry, M. & Sergi, V. 2014. Extending project management research: Insight from social theories. *International Journal of Project Management,* 32(7), pp. 1091-1107. https://doi.org/10.1016/j.ijproman.2014.02.008

Frimpong, Y., Oluwoye, J. & Crawford, L. 2003. Causes of delay and cost overruns in construction of groundwater projects in a developing country: Ghana as a case study. *International Journal of Project Management,* 21(5), pp. 321-326. [online]. Available at: <http://dx.doi.org/10.1016/S0263-7863(02)00055-8> [Accessed: 15 February 2017].

Ghosh, S. & Jintanapakanont, J. 2004. Identifying and assessing the critical risk factors in an underground rail project in Thailand: A factor analysis approach. *International Journal of Project Management,* 22(8), pp. 633-643. https://doi.org/10.1016/j.ijproman.2004.05.004

Goh, S.C. & Abul-Rahman, H. 2013. The identification and management of major risks in the Malaysian construction industry. *Journal of Construction In Developing Countries,* 18(1), pp. 19-32.

He, Y. 2010. Environmental management on projects. *International Journal of Business Management,* 5(1), pp. 205-210.

Hilson, D. 2002. Extending the risk process to manage opportunities. *International Journal of Project Management*, 20(3), pp. 235-240. https://doi.org/10.1016/S0263-7863(01)00074-6

Hwang, B., Xianbo, Z. & Li, T.P. 2014. Risk management in small construction projects in Singapore: Status, barriers and impact.

International Journal of Project Management, 32(1), pp. 116-124. https://doi.org/10.1016/j.ijproman.2013.01.007

ISO. 2012. International Organization for Standardization. International standard ISO 21500. Guidance on project management. [online]. Available at: <https://www.iso.org/obp/ui/#iso:std:iso:21500:en> [Accessed: 20 January 2017].

Iyer, K. & Jha, K.N. 2005. Factors affecting cost performance: Evidence from Indian construction projects. *International Journal of Project Management,* 23(4), pp. 283-295. https://doi.org/10.1016/j.ijproman.2004.10.003

Jafaari, A. 2001. Management of risks, uncertainties and opportunities on projects: Time for a fundamental shift. *International Journal of Project Management,* 19(2), pp. 89-101. https://doi.org/10.1016/S0263-7863(99)00047-2

Jarkas, A.M. & Haupt, C.T. 2015. Major construction risk factors considered by general contractors in Qatar. *Journal of Engineering, Design and Technology,* 13(1), pp. 165-194. https://doi.org/10.1108/JEDT-03-2014-0012

Kagioglou, M., Cooper, R., Aouad, G. & Sexton, M. 2000. Re-thinking construction: The generic design and construction process protocol. *Engineering, Construction and Architectural Management,* 7(2), pp. 141-153. https://doi.org/10.1108/eb021139

Kaliba, C.J., Muya, M. & Sichombo, B. 2009a. Cost escalation and schedule delays in road construction. *International Journal of Project Management*, 13(1), pp. 522-531. https://doi.org/10.1016/j.ijproman.2008.07.003

Kaliba, C.J., Muya, M. & Sichombo, B. 2009b. The need to reduce costs, schedule overruns and quality shortfalls in construction. *Proceedings of the 4th Built Environment Conference* 17-19 May 2009, Livingstone, Zambia. Bellville, South Africa: Association of Schools of Construction of Southern Africa, pp. 154-158.

Kartam, N.A. & Kartam, S.A. 2001. Risk and its management in Kuwait construction industry: A contractor's perspective. *International Journal of Project Management,* 19(6), pp. 325-335. https://doi.org/10.1016/S0263-7863(00)00014-4

Kendrick, T. 2010. *The project management tool kit: 100 tips and techniques for getting the job done right.* 2nd edition. Washington DC: AMACOM. [online]. Available at: <www.questia.com> [Accessed: 15 January 2015].

Krejcie, R.V. & Morgan, D.W. 1970. Determining sample size for research activities. *Educational and Psychological Measurement*, 30(3), pp. 607-610. https://doi.org/10.1177/001316447003000308

Kuo, Y.C. & Lu, S.T. 2012. Using fuzzy multiple criteria decision making approach to enhance risk assessment for metropolitan construction projects. *International Journal of Project Management,* 31(4), pp. 602-614. https://doi.org/10.1016/j.ijproman.2012.10.003

Lam, K., Wang, P., Lee, T.K. & Tsang, Y.T. 2007. Modelling risk allocation decision in construction contracts. *International Journal of Project Management,* 25(5), pp. 485-493. https://doi.org/10.1016/j.ijproman.2006.11.005

Leedy, P.D. & Ormrod, J.E. 2014. *Practical research planning and design.* 10th edition. New York: Pearson.

Le-Hoai, L., Lee, Y.D.L. & Lee, J.Y. 2008. Delay and cost overruns in Vietnam large construction projects. *KSCE Journal of Civil Engineering,* 12(6), pp. 367-377. https://doi.org/10.1007/s12205-008-0367-7

Lehtiranta, L. 2014. Risk perceptions and approaches in multi-organisations: A critical review 2000-2012. *International Journal of Project Management,* 32(4), pp. 640-653. https://doi.org/10.1016/j.ijproman.2013.09.002

Lehtiranta, L. & Juunonen, J.-M. 2014. Stretching risk management standards: Multi-organisational perspectives. *Built Environment Project and Asset Management,* 4(2), pp. 128-145. https://doi.org/10.1108/BEPAM-06-2013-0019

Lichtenthaler, M. 2017. Project and claim management at a glance. [online]. Available at: <https://www.doag.org/formes/servlet/DocNavi?action=getFile&did=5018332> [Accessed: 10 October 2017].

Lyons, T. & Skitmore, M. 2004. Project risk management in the Queensland engineering construction industry: A survey. *International Journal of Project Management,* 22(1), pp. 51-61. https://doi.org/10.1016/S0263-7863(03)00005-X

Mahamid, I. 2011. Risk matrix for factors affecting time delay in road construction projects: Owner's perspectives. *Engineering, Construction and Architectural Management*, 18(6), pp. 609-617. https://doi.org/10.1108/09699981111180917

Mañelele, I. & Muya, M. 2008. Risk identification on community-based construction projects in Zambia. *Journal of Engineering, Design and Technology*, 6(2), pp.145-161. https://doi.org/10.1108/17260530810891289

Mbachu, J. & Taylor, S. 2014. Contractual risks in the New Zealand construction industry: Analysis and mitigation measures. *International Journal of Construction Supply Chain,* 4(2), pp. 22-33.

Medda, F. 2007. A game theory approach for the allocation of risks in transport public private partnership. *International Journal of Project Management*, 25(3), pp. 213-218. https://doi.org/10.1016/j.ijproman.2006.06.003

Moyo, A. & Crafford, G. 2010. The impact of hyperinflation on the Zimbabwean construction industry. *Acta Structilia*, 17(2), pp. 53-83.

Mu, S., Chen, H., Chohr, M. & Peng, W. 2014. Assessing risk management capabilities of contractors in subway projects in mainland China. *International Journal of Project Management,* 32(3), pp. 452-460. https://doi.org/10.1016/j.ijproman.2013.08.007

Muianga, D.A.E., Granja, A.D. & Ruiz, J.A. 2014. Influence factors on cost and time overruns in Mozambican construction projects: Preliminary findings. In: Tamosaitiene, J., Panuwatwanich, K., Mishima, N. & Ko, C.H. *Proceedings of the 5th Conference on Engineering, Project and Production Management*, 24-28 November 2014, Port Elizabeth, South Africa. Port Elizabeth, South Africa: Nelson Mandela Metropolitan University, Department of Construction Management, pp.10-21.

Mukumbwa, B. & Muya, M. 2013. Ethics in the construction industry in Zambia. *International Journal of Construction Management,* 13(2), pp. 43-65. https://doi.org/10.1080/15623599.2013.10773211

Murdock, J. & Hughes, W. 2001. *Construction contracts: Law and management.* 3rd edition. London:Taylor and Francis.

Muya, M., Kaliba, C., Sichombo, B. & Shakantu, W. 2013. Cost escalation, schedule overruns and quality shortfalls on construction projects: A case of Zambia. *International Journal of Construction* Management, 13(1), pp. 53-68. https://doi.org/10.1080/15623599.2013.10773205

NCTC. 2017. North Carolina Training Consortium. Project financial management. [online]. Available at: <https://research.ncsu.edu/nctc/study-guide/project-administration/project-management/project-financial-management/> [Accessed: 19 October 2017].

Nieto-Morote, A. & Roz-Vila, F. 2011. A fuzzy approach to construction project risk assessment. *International Journal of Project Management,* 29(2), pp. 220-231. https://doi.org/10.1016/j.ijproman.2010.02.002

Odeh, A. & Battaineh, H.T. 2002. Causes of construction delay: Traditional contracts. *International Journal of Project Management,* 20(1), pp. 67-73. https://doi.org/10.1016/S0263-7863(00)00037-5

Osipova, E. & Eriksson, P.E. 2011. How procurement options influence risk management in construction projects. *Construction Management and Economics,* 29(11), pp. 1149-1158. https://doi.org/10.1080/01446193.2011.639379

Oztas, A. & Okmen, O. 2004. Risk analysis in fixed-price design construction projects. *Building and Environment*, 39(2), pp. 229-237. https://doi.org/10.1016/j.buildenv.2003.08.018

Perera, B., Dhanasinghe, I. & Rameezdeen, R. 2009. Risk management in road construction: The case of Sri Lanka. *International Journal of Strategic Property Management,* 13(2), pp. 87-102. https://doi.org/10.3846/1648-715X.2009.13.87-102

Perera, B., Rameezdeen, R., Chileshe, N. & Hosseini, R. 2014. Enhancing the effectiveness of risk management practices in Sri-Lankan road construction projects: A Delphi approach. *International Journal of Construction Management,* 14(1), pp. 1-19. https://doi.org/10.1080/15623599.2013.875271

Perez, D., Gray, J. & Martin, S. 2016. Perceptions of risk allocation methods and equitable risk distribution: A study of medium to large Southeast Queensland and commercial construction projects. *International Journal of Construction Management*, 17(2), pp. 1-11.

PMBOK. 2008. Project Management Institute. *A guide to the project management body of knowledge.* 4th edition. Newtown Square, US: Project Management Institute.

Reynold, J. & Santos, A. 1999. Cronbach's alpha: A tool for assessing the reliability of scales. *The Journal of Extension*, 37(7), pp. 35-36.

Rezakhani, P. 2012. Classifying key risk factors in construction projects. *Buletinul Institutului Politehnic din iasi,* LVIII(LXII), pp. 27-38.

Santoso, S.D., Ogunlana, S.O. & Minato, T. 2003. Assessment of risks in high-rise building construction in Jakarta. *Engineering, Construction and Architectural Management*, 10(1), pp. 43-55. https://doi.org/10.1108/09699980310466541

Saunders, M., Lewis, M. & Thornhill, A. 2012. *Research methods for business students.* 6th edition. London: Prentice Hall.

Saunders, M., Lewis, M. & Thornhill, A. 2016. *Research methods for business students.* 7th edition. London: Prentice Hall.

Serpella, A.F., Ferrada, X., Howard, R. & Rubio, L. 2014. Risk management in construction projects: A knowledge-based approach. *Procedia Social and Behavioral Sciences,* 119, pp. 653-662. https://doi.org/10.1016/j.sbspro.2014.03.073

Shehu, Z., Endut, I.R. & Akintoye, A. 2014. Factors contributing to project time and hence cost overrun in the Malaysian construction industry. *Journal of Financial Management of Property and Construction,* 19(1), pp. 55-75. https://doi.org/10.1108/JFMPC-04-2013-0009

Sibanyama, G., Muya, M. & Kaliba, C. 2012. An overview of construction claims: A case study of the Zambian construction industry. *International Journal of Construction Management,* 12(1), pp. 65-81. https://doi.org/10.1080/15623599.2012.10773185

Skorupka, D. 2008. Identification and intial risk assesssment of construction projects in Poland. *Journal of Management Engineering,* 24(3), pp. 120-127. https://doi.org/10.1061/(ASCE)0742-597X(2008)24:3(120)

Smart market report. 2013. *Safety management in the construction industry: Identifying risks and reducing accidents to improve site productivity and ROI*. New York: McGraw Hill Construction.

Smith, N., Merna, T. & Jobling, P. 2014. *Management of risk in construction projects.* 3rd edition. Oxford: Blackwell Publishing.

Soepriyono, M.H. 2013. Risk analysis using state budget changes (APBN-P) in the implementation of construction projects in Indonesia. *Journal of Basic and Applied Scientific Research,* 3(10), pp. 465-472.

Sweis, G., Sweis, R., Abu Hammad, A. & Shboul, A. 2008. Delays in construction projects: The case of Jordan. *International Journal of Project Management,* 26(6), pp. 665-674. https://doi.org/10.1016/j.ijproman.2007.09.009

Tadayon, M.A., Jaafar, M. & Nasri, E. 2012. An assessment of risk identification in large construction projects in Iran. *Journal of Construction in Developing Countries*, 17(1), pp. 57-69.

Tah, J. & Carr, V. 2000. A proposal for construction risk assessment using fuzzy logic. *Construction Management and Economics,* 18(4), pp. 494-500. DOI: 10.1080/01446190050024905. https://doi.org/10.1080/01446190050024905

Tipili, L.G. & Ilyasu, M.S. 2014. Evaluating the impact of risk factors on construction project cost in Nigeria. *The International Journal of Engineering and Science (IJES),* 3(6), pp. 10-15.

Tsai, T.-C. & Yen, C.-C. 2006. Risk allocation of interfaces between construction and core system contracts: A case study on Taiwan high-speed rail project. *Proceedings of the 23rd International Symposium on Automation and Robotics in Construction*, 3-5 October 2006, Tokyo, Japan. Tokyo: Japan Robot Association, pp. 394-399. https://doi.org/10.22260/ISARC2006/0076

Turkey, W. 2011. Risk factors leading to cost overrun in Ethiopian federal road construction projects and its consequences. Unpublished thesis, Addis Ababa University Repository. [online]. Available at: <http://hdl.handle.net/123456789/9965> [Accessed: 15 February 2017].

Wang, J. & Yuan, H. 2011. Factors affecting contractors' risk attitudes in construction projects: Case study from China. *International Journal of Project Management*, 29(2), pp. 209-219. https://doi.org/10.1016/j.ijproman.2010.02.006

Wiguna, I.A. & Scott, S. 2006. Risk to project performance in Indonesian building contracts. *Construction Management and Economics,* 24(11), pp. 1125-1135. https://doi.org/10.1080/01446190600799760

Xu, Y., Chan, A. & Yeung, J. 2010. Developing a fuzzy risk allocation model for PPP projects in China. *Journal of Construction Engineering Management,* 136(8), pp. 894-903. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000189

Zavadskas, E.K., Turskis, Z. & Tamoscitience, J. 2008. Construction risk assessment of small-scale objects by applying Topsis method with attribute values determined at intervals. In: Kabashkin, I.V. & Yatskiv, I.V. (Eds). *Proceedings of the 8th International Conference Reliability and Statistics*, 15-18 October 2008, Riga, Latvia. Latvia: Transport and Telecommunication Institute, pp 351-357.

ZDA. 2013. Zambia Development Agency. *Zambia infrastructure sector profile*. Lusaka: Governement Printers.

Zeng, J.A.M. & Smith, N.J. 2007. Application of a fuzzy based decision-making methodology to construction project risk assessment. *International Journal of Project Management,* 25(6), pp. 589-600. https://doi.org/10.1016/j.ijproman.2007.02.006

Zhi, H. 1995. Risk management for overseas construction. *International Journal of Project Management,* 13(4), pp. 231-237. https://doi.org/10.1016/0263-7863(95)00015-I

Zou, P., Zhang, G. & Wang, J. 2007. Understanding the key risks in construction projects in China. *International Journal of Project Management,* 25(6), pp. 601-614. https://doi.org/10.1016/j.ijproman.2007.03.001