Investigating the Impact of Risk Factors on Project outcome of Small and Medium Contractors in South Africa

Berenger Y. Renault[1], Justus N. Agumba[2] and N. Ansary[3]

[1]Postgraduate; Department of Construction Management & Quantity Surveying; University of Johannesburg; PO Box 17011, Doornfontein Johannesburg, South Africa; renault08@yahoo.fr.
[2]Senior Lecturer; Department of Construction Management & Quantity Surveying; Durban University of Technology; Steve Biko Campus, Durban, South Africa; justusa@dut.ac.za
[3]HOD; Department of Construction Management & Quantity Surveying; University of Johannesburg; PO Box 17011, Doornfontein Johannesburg, South Africa; nansary@uj.ac.za

Abstract

The delivery of construction project is often affected by several risks factors which can threaten the achievement of project outcome in terms of time, cost, quality and health and safety (H&S). Regrettably, there is a paucity of empirical studies investigating the impact of these risks on project outcome in the South African construction industry (SACI), especially in the small and medium enterprises (SMEs) sector. Hence, the current study sought to investigate the impact of these risk factors on project outcome of SMEs in the Gauteng province of South Africa. A structured questionnaire consisting of nineteen risk factors was used to collect data from SMEs who were conveniently sampled. The data was analysed using the Statistical Package for the Social Sciences (SPSS) version 23, computing descriptive statistics. Empirical findings revealed that time and cost were both impacted by variation by the client, design variation, incomplete approval and unsuitable construction program planning while incomplete or inaccurate cost estimates impacted highly on cost and quality objectives. Furthermore, accidents due to poor safety procedure, the absence of fire safety systems on site, equipment damage and labour injuries were deemed to have a high impact on project H&S outcome. The results of the study will boost the knowledge of industry practitioners on the risk factors affecting project outcome of SMEs

Keywords: Contractors, project outcome, risk impact

1. Introduction

Despite growing uncertainty and seasonal swings, the SACI moves forwards. According to StatsSA (2016), the total employment in SA has risen from 14,2 million to 15,9 million between the period 2009 to 2015 and the CI is one of the eight industries that has contributed to this increase by creating 216 000 jobs over this period. Currently, the SACI contributes to around 9.7% of the country Gross Domestic Product (GDP) and accounts for 11% of total employment (Construction Industry Development Board (CIDB), 2016). Regardless of the social and economic value of the CI, cost and time overruns continue to occur especially at project level of SMEs (Chadhliwa, 2015). Research indicates that there have been a number of mega projects that have failed to meet baseline completion dates,

costs and quality requirements in SA; for example, the Gautrain project which was only delivered two years following its initial completion date and cost R14 billion over budget (SA Politics, 2013). A further example is an R2.5 billion contract for a multi-product pipeline between Durban and Gauteng for Transnet was estimated to cost R23.4 billion and the completion date was almost 3 years late (Guern Le, 2013). Shunmugam and Rwelamila (2014) have stressed that in order to achieve the desired project outcome, organisations have to implement and practice risk management (RM). Many studies have been conducted to understand why small contractors keep failing despite the support being provided. Studies conducted, revealed that many SMEs fail due to the lack of access to finance (Boone and Kurtz, 2006; Ramlee and Bernma, 2013; Brown and Lee, 2015). However, the results of the study conducted by Rostami et al. (2015) revealed that 80% of SMEs failures are as a result of management failure. It was further indicated, that there is a necessity to enhance corporate governance and the link to RM. Smit (2012) confirmed that the risk of not delivering the project within its set target in SMEs was higher than in larger enterprises. Furthermore, Rostami et al. (2015) indicated that SMEs tend to experience more uncertainties than larger enterprises. Chihuri and Pretorious (2010) indicated that lack of RM knowledge and lack of knowledge of the risk factors which can impact the successful achievement of project outcome is one of the reasons of cost and time overruns in the construction project of SMEs.

A review of literature indicates that most of the studies conducted on risk factors in South Africa, identified holistically and categorised risk according to their nature (Wadiwalla, 2004; Chihuri and Pretorius, 2011; Mpakama, 2016; Renault et al. 2016) and that limited studies have been conducted to investigate project outcome (time, cost, quality and health and safety) related risk factors and their impact on project outcome. Therefore, the current study sought to fill this gap by identifying project outcome related risk factors and investigating their impact on each project outcome. The results of the study will boost the knowledge of industry practitioners on the risk factors affecting project outcome of SMEs but also they will provide information on specific risk factors that impact project outcome. In addition, other construction firms can use the risk factors identified in this study to prepare their customized list of project outcome related risk factors.

2. Review of literature

Literature review is one of the key features of carrying out a study and also as a way to be aware of what has already been covered on the topic in order to establish the trends in the solutions that are being proceeded to resolve the various problems that face mankind (Heppner and Heppner (2004). Hence, it was compulsory to review literature related to Risk and RM in construction in order to establish project outcome related risk factors.

2.1 Project outcome

Over the years, numerous studies have been conducted on project outcome, and most of them have suggested various dimensions for measuring project outcome. Wang and Huang (2006) opined that project outcome is contrastingly viewed among researchers and

practitioners. The conventional measures of time, cost, and quality known as the Iron triangle have been the leading success metrics in construction (Toor and Ogunlana, 2010). The Iron triangle is cited in nearly every study (Na Ranong and Phuenngam, 2009; Hinze et al. 2013; Chou and Pham, 2013) on project success. Contrariwise, Collins and Baccarini (2004) posited that project outcome should not be limited to just the Iron triangle and the project management community need to be informed about this. Toor and Ogunlana (2010) indicated that while other definitions of project outcome have emerged, the iron triangle is constantly cited in the unconventional definitions. In addition to the conventional measures, Ojiako et al. (2008) supported that dimensions for project outcome should also encompass project psychosocial outcomes which involve the contentment of interpersonal relations with the project team. Individual dimensions such as participants' satisfaction level are referred to as soft dimensions. The incorporation of satisfaction as a success metric is recommended by Weninger et al. (2013). Berssaneti and Carvalho (2015) further suggested incorporating the absence of legal claims as a measure of project success. This indicates the importance of including safety as a success measure since it is logical to anticipate that if accidents materialise, both clients and contractors may be subject to financial loss, contract delay as well as legal claims. Ahadzie et al. (2010) assessed project outcome extensively based on five criteria namely; maintenance cost, construction cost, time, safety and flexibility to users. Lam et al. (2008) stated that it is problematic to evaluate whether the performance of a project is a success or a failure owing to the fact that the notion of success remains unclear amongst project participants. According to Roelen and Klompstra (2012), the project is a complete success if it attains the technical performance specifications to be executed, and if there is satisfaction regarding the project outcome among key users and project team members. In evaluating project outcome or project success, Chou and Pham (2013) included a range of criteria which included project meeting planned cost, time, quality of work, affability of the environment, transfer of technology, client and project manager's satisfaction, and health and safety. Chou and Yang (2012) defined project outcome based on four measures namely; achieving design goals, the value to the end user, the value to the organisation, the value of the technological infrastructure of the country and of organisations implicated in the development process. All these measures combined provide the inclusive evaluation of project outcome.

2.2 Project outcome related risks factors

Various studies have been conducted in the area of RM for construction projects, a notable outcome of which is the identification of many risks that may impact the project outcome. Chen et al. (2004) identified fifteen risks associated with project cost and grouped them into resource, parent and management groups. Furthermore, they found that price escalation of material was associated with the resource group; inaccurate cost budget and supplier or subcontractors' default pertained to management group, and excessive interface on project management was associated with the parent factors. Tam et al. (2004) established that the leading factors impacting safety performance included lack of training, poor safety awareness of top management, poor safety awareness of project managers, reckless operation and reluctance to input resources to safety.

Klemetti (2006) stated that construction risks can be classified based not only on their impact on the project objectives but also the source of the risk, while Karimi et al. (2010) indicated that risks are mainly grouped into two groups according to their source namely, internal and external. Oztas and Okmen (2004) included management of project risk into the design risks which comprised but were not limited to “difficulty in capturing and specifying the user requirements”, “difficulty of estimating the time and resources required to complete the design”, “difficulty of measuring progress during the development of the design”. In assessing the significance of risks in construction projects in Gaza, Abu Mousa (2005) identified forty-four risk factors which were further divided into nine (9) groups of physical, design, logistics, environmental, financial, political, legal, construction and management.

Similarly, Kishan et al. (2014) identified forty-four risk factors for building construction which was further categorised in ten groups of physical, logistics, design, environmental, legal, financial, management, cultural, construction and political. Of the identified factors, design changes, poor communication and delayed payment on contracts were found as the major causes of project delay. In Addition, Abu Mousa (2005); Ahmed et al. (1999); National Audit office (2001); Okeyo et al. (2015) found that delayed payment of the contractor affected the project by causing loss of productivity, inefficiency, and increase in time-related costs. Regardless of these various classifications, risks are meant to attain a common objective, that is, they are an important aid in RM and assist in forming risk lists that are used when detecting a risk (Wong and Hui 2006; Klemetti, 2006).

Based on the reviewed literature and the opinion of practitioners and experts in the field of construction and RM, several risk factors that affect project outcome were identified and studied. For the purpose of this research, risks were categorised based on their impacts on project outcome in terms of time, cost, quality as well as health and safety. The detail of each category of project outcome related risk factors is outlined in Table 1.

Table 1: Project outcome related risks (adapted from Zou et al. 2005; Olamiwale, 2014)

Risk Type	Description
Time-related risks	Design variations, high performance, variations by the client, incomplete approval, and other documents, unsuitable construction program planning, bureaucracy of government, inadequate program scheduling, pressure from high performance or quality expectations and variation of construction programs.
Cost related risks	Variations by the client, occurrence of dispute, unsuitable construction program planning, price inflation of construction materials, incomplete or inaccurate cost estimates, incomplete approval, inadequate program scheduling, and design variations.
Quality related risks	Unsuitable construction program planning, inadequate program scheduling, incomplete or inaccurate cost estimates , pressure from high performance or quality expectations, low management competency of subcontractors, variations of construction programs, design variations, lack of coordination between project participants, unavailability of sufficient amount of skilled labour
H&S related risks	Accidents due to poor safety procedures, labour injuries, equipment damage, materials or property damage, absence of fire safety systems on site.

3. Research methodology

This section reports on the methodology used to conduct this study. The target population, method to collect data and the sample used are described. The tool used to analyse data as well as issues pertaining to validity and internal consistency of the measurement instrument were also described.

3.1 Population and data collection

An extensive review of literature was conducted in conference proceedings, journal articles and relevant risk management books. A list of 18 obstacles was identified which were included in the structured questionnaire which was later pre-tested among construction SMEs drawn from the CIDB register of contractors. The respondents rated the risk factors on a five- point Likert scale where: 1=Very low impact (VLI), 2=Low impact (LI); 3=Moderate impact (MI); 4=high impact (HI) and 5=very high impact (VHI). In order to present the outcomes appropriately, a number of range were established, that is; VLI=1.00-1.80, LI=1.81-2.60, MI=2.61-3.40, HI=3.41-4.20, VHI=4.21-5.00.

3.2 Sample and sampling method

Following the questionnaire pre-testing, the final refined version of the questionnaire was distributed to 225 conveniently sampled SMEs using personal hand delivery and collect method. Of the 225 questionnaires distributed, 187 were returned of which 6 were excluded from the study due to various ambiguities (questionnaire incorrectly answered, respondents' information missing and inadequate information provided). Consequently, the remaining 181questionnaires were deemed usable representing approximately 80% response rate.

3.3 Data analysis

SPSS version 23 was employed to analyse the data generated by the research questions. The following statistical methods were used: frequency analysis, percentage, means score, and standard deviation. Frequency and percentages were employed to analyse the socio-demographic characteristics of the respondent and the information about the company. Mean and standard deviation values were used to respond to the research questions on the risk factors impacting project outcome. Review of the literature indicates that such approaches have been adopted previously in survey related studies (Visser and Joubert, 2008; Rostami et al. 2015).

3.4 Validity and reliability

The measurement instrument was also tested for validity and internal consistency. Validity was ensured as a result of conducting an extensive literature review by consulting previous related studies, this was requisite to specify the variables. The questionnaire was reviewed and revised by experts (academics, researcher's promoter, and a professional statistician) before the pilot study took place. Internal consistency was tested using Cronbach's Alpha. A generally agreed upon minimum limit for Cronbach alpha is 0.70 (Hair et al. 2006). However,

a cut-off value of 0.60 is common for exploratory research and values closer to 1 suggest good reliability (Zaiontz, 2014).

4. Findings and discussion

This section presents and discusses the findings obtained from the questionnaire survey. Demographic and findings on project risk impact are discussed.

4.1 Demographic findings

This sub-section reports on the profile of the respondents and the company. Results revealed that among the respondents, 81.80% was male while 18.20% was female, 87.56% were either owners or manager of their enterprise, 56.40% were African/Black, had either matriculation (22.70%) or a certificate (20.40%), 43.10% of respondents had 10 years' or less experience in construction. Furthermore, it was found that 37.60% of SMEs were subcontractors or general contractors (31.50%), working mostly in Johannesburg (41.40%) and Tshwane (30.90%) Metropolitan Municipalities. Nevertheless, the subcontractors either operated for the main contractor or were sole trade contractors.

4.2 Findings on risk factors' impact on project outcome

Table 2 presents the impact of risk factors on project outcomes i.e. time, cost, quality and H&S as rated by respondents. A total of nineteen risk factors were identified, among which, eight were related to time, eight were related to cost and nine were related to quality outcome. Five risk factors were related to H&S outcome. These risk factors were tested for validity and internal consistency. The overall Cronbach's alpha of each risk category (time, cost, quality, and HandS), as well as the Cronbach's alpha values (see Table 2) of the individual risk factor, were all above the cut-off value of 0.60. These results indicated the good reliability of the variables. The results are discussed in terms of the impact of risk on each project outcome.

It was revealed that of the eight-time related risk factors, variation by the client (M=3.83; SD=0.406), design variations (M=3.72; SD=0.463) and incomplete approval (M=3.67; SD=1.028) were rated by the respondents to have high impact in inhibiting the SMEs in achieving the project time.

It was further indicated that under cost related risk factors' category, design variations (M=3.98; SD=0.788), and variations by the client (M=3.97; SD=0.690) had high impact in slowing down the SMEs to achieve their project cost. Furthermore, dispute occurrence (M=3.23; SD=1.076), incomplete/inaccurate cost estimates (M=3.20; SD=1.259), inadequate programme scheduling (M=3.04; SD=1.272) and unsuitable construction programme planning (M=3.03; SD=0.922) were deemed to have a moderate impact in achieving the project outcome of cost.

Likewise, lack of coordination between project participants (M=3.42; SD=1.136), had a high impact in the SMEs not achieving the quality of the project, whereas low management competency of subcontractors (M=3.38; SD=1.001), design variations (M=3.37; SD=0.844),

incomplete/inaccurate cost estimates (M=3.29; SD=1.232), inadequate programme scheduling (M=3.10; SD=0.937) and unavailability of sufficient amount of skilled labour (M=2.94; SD=1.001) were deemed to have a moderate impact in hindering the SMEs from achieving the quality of their project.

Results of the H&S related risk factors evinced that accidents due to poor safety procedures (M=3.56; SD=1.226) were rated by respondents to have high impact in achieving the project H&S outcome. Moreover, the absence of fire safety systems on site (M=3.29; SD=1.272), equipment damage (M=3.27; SD=1.172), labour injuries (M=3.17; SD=0.853) and property and material damage (M=3.04; SD=0.942) were deemed to have a moderate impact in inhibiting the SMEs in achieving the H&S project outcome.

Table 2: Risk factors' impact on project outcome

Risk category	Mean	SD	Cronbach's alpha	Rank
Time related risks			**0.856**	
Variations by the client	3.83	0.406	0.864	1
Design variations	3.72	0.463	0.883	2
Incomplete approval	3.67	1.028	0.825	3
Inadequate program scheduling	3.29	1.348	0.820	4
Unsuitable construction program planning	3.07	0.987	0.815	5
Variation of construction programs	3.02	1.174	0.828	6
Pressure from high performance or quality expectations	2.88	1.097	0.827	7
Bureaucracy of government	2.63	0.913	0.822	8
Cost related risks			**0.912**	
Design variations	3.98	0.788	0.910	1
Variations by the client	3.97	0.690	0.916	2
Occurrence of dispute	3.23	1.076	0.891	3
Incomplete or inaccurate cost estimates	3.20	1.259	0.898	4
Inadequate program scheduling	3.04	1.272	0.886	5
Unsuitable construction program planning	3.03	0.922	0.903	6
Incomplete approval	3.02	1.186	0.887	7
Price inflation of construction materials	2.96	1.082	0.904	8
Quality related risks			**0.862**	
Lack of coordination between project participants	3.42	1.136	0.833	1
Low management competency of subcontractors	3.38	1.001	0.877	2
Design variations	3.37	0.844	0.855	3
Incomplete or inaccurate cost estimates	3.29	1.232	0.845	4
Inadequate program scheduling	3.10	0.937	0.841	5
Unavailability of sufficient amount of skilled labour	2.94	1.001	0.835	6
Pressure from high performance or quality expectations	2.90	0.975	0.838	7
Variation of construction programs	2.86	0.922	0.835	8

Unsuitable construction program planning	2.80	0.957	0.860	9
Health and Safety related risks			**0.909**	
Accidents due to poor safety procedures	3.56	1.226	0.892	1
Absence of fire safety systems on site	3.29	1.272	0.883	2
Equipment damage	3.27	1.172	0.881	3
Labour injuries	3.17	0.853	0.902	4
Property and materials damage	3.04	0.942	0.884	5

Values in bold represent the overall Cronbach's alpha of each risk category.

4.3 Discussions on risk factors' impact on project outcome

4.3.1 Time-related risk factors

The results indicated that variation by the client, design variations, and incomplete approval had a high impact on project time not being achieved. These results are in accord with the results of Zou et al. (2005); Wang and Huang (2006), who observed that variations by the client can engender variations in the planning, design, and construction. Wang and Huang (2006) further added that variations probably emanates from three reasons namely; change of mind by the clients and misconception of the clients' needs. This situation, for example, can be avoided if the client does not interfere with the process of the project.

Furthermore, inadequate program scheduling was deemed to have a high impact on project time not being achieved. This result corresponds with the findings Zou et al. (2005) who concluded that inadequate program scheduling had a high impact on project time objective. They further indicated that program scheduling frequently appears in projects with a tight schedule when some programs need to be reduced to achieve the project timeline. However, the high impact of pressure from high performance and bureaucracy of government were contrary to the finding of Zou et al. (2005) where high performance was identified as a risk with a major impact on project time outcome.

4.3.2 Cost related risk factors

Design variation, variations by the clients, the occurrence of dispute and incomplete or inaccurate cost estimates were deemed to have a high impact on project cost not being achieved. These results suggested that design variation usually arises in the design phase of a project and may derive from matters such as variations by the client and faulty design. These results concur with the results of the study conducted by Probhakar (2008) where design variations and variations by the client were both considered as the major cause of construction project cost overruns. The high impact of occurrence of dispute indicates the concern of communication between project participants. The occurrence of the dispute is frequent in construction, due to inconsistency and changes in the design and construction (Probhakar, 2008). Contractors should constantly communicate with the project team and initiate negotiations with the project manager (particularly the representative of clients) about prospective variations in the documentation and record the resulted delay of progress in construction log. This finding agrees with the finding of Enshassi et al. (2008) where the

occurrence of legal disputes between project participants during the life of a project was identified as a major cause of project delay. Incomplete or inaccurate cost estimates seems to be directly correlated with the designers/consultants' knowledge and attitude towards work.

Many unpredicted factors comprise construction activities, which often deviates the estimated cost from the real cost. Hence, choosing skilled and qualified designers and involving the contractor or subcontractor early can help minimize the incorrectness. These results concur with those reported by de Bakker et al. (2011) where inaccurate material estimates were identified as the major causes of construction project cost and schedule overruns. The other cost-related risks were considered by the contractor to have a moderate impact on project cost outcome.

4.3.3 Quality related risk factors

Lack of coordination between project participants was deemed to have a high impact on project quality not being achieved. This result indicated that lack of coordination between project participants may lead to chaos in the management of construction team and programs. A general contractor or project manager who is skillful in the team and program coordination should be engaged. On the other hand, strengthening the participant's perception of cooperation and communication is also of importance for improving construction quality and efficiency. This finding was in line with the empirical findings of Enshassi et al. (2008) who established that lack or poor communication between parties had a high impact on the quality of the end product. This result raises the importance of management topics for contractors and the existence of the type of risk, which need high-level management skills.

Furthermore, low management competency of subcontractors had a high impact on project quality not being achieved. This is probably the only recognised key risk related to subcontractors. Unlike a general contractor who constantly manages a construction site for a long period, subcontractors normally allocate their manpower and other resources to different projects in order to achieve a maximum profit of their own business. Without competent management skills, subcontractors cannot successfully manage their resources to meet the needs from several concurrent construction sites. Accordingly, in addition to specialist abilities, the management competency should be considered as one of the key criteria for appointing subcontractors. These results were in general agreement with the study of Abu Mousa (2005) who also identified low management competency as one of the causes of construction project delay. The rest of factors namely: pressure from high performance or quality expectations; unavailability of enough skilled labour, variation of construction programs and unsuitable construction program planning were considered as risk with a moderate impact on project quality outcome. However, these results were contrary to the empirical results of Kishan et al. (2014); Mahendra et al. (2013) that identified these factors as factors with high impact on project quality outcome.

4.3.4 H&S related risk factors

The H&S success was negatively impacted by poor safety procedure, the absence of fire safety systems on site, equipment damage and labour injuries. This result is accordance of those of Ahmed et al. (1999); the National Audit Office (2001), which established the risks of defective materials and safety measures as very important risks. However, they are contrary to the findings of Phoya (2012); Oztas and Okmen (2004) which identified accidents are caused by poor safety measures, labour injuries, and damage to materials and equipment as risks with a moderate impact on H&S objectives. However, in order to overcome some of these risk factors that exacerbated poor H&S performance among construction SMEs, Agumba (2013) found that upper management commitment and involvement in H&S, H&S resources and training and project performance supervision improved the H&S performance.

5. Conclusion

The study sought to investigate the impact of risk factors on project outcome of SMEs in the Gauteng province of South Africa. Nineteen risk factors were identified and categorised into time, cost, quality, and H&S related risk factors. Empirical findings established that variations by the client, design variations, incomplete approval and inadequate program scheduling were deemed to have a high impact on project time outcome. It was further revealed that design variations had a high impact on project cost outcome followed by variations by the client, occurrence of dispute and incomplete or inaccurate cost estimates. Furthermore, project quality outcome was highly impacted by the lack of coordination between project participants, low management competency of subcontractors, design variations, and incomplete or inaccurate cost estimates. In addition, accidents due to poor safety procedure, the absence of fire safety systems on site, equipment damage and labour injuries were deemed to have a high impact on project health and safety outcome. Further exploration of the empirical findings revealed that variation by the client, design variation, incomplete approval, and unsuitable construction program planning can negatively impact both project time and cost outcomes. Similarly, inadequate program scheduling impacted simultaneously the three project outcomes namely; time, cost and quality objectives, while incomplete or inaccurate cost estimates impacted highly on cost and quality objectives. To reduce chances of project failure, the risk factors as revealed in this study should be properly handled in managing the risks. This paper further sheds light and provides insights on the understanding of the risk factors impacting construction project, an area previously under-researched. Furthermore, this study makes a contribution to the body of knowledge on the subject within a previously unexplored context. Regardless of the achievement of the study objectives, there were boundaries to the conclusions. The study was conducted in South Africa; however, it was delimited to the province of Gauteng. The surveyed respondents were SMEs in the CI; hence, the findings of this study may not be representative of the entire country

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