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# An Appraisal of Critical Risk Factors in Construction Projects in South Africa: Perspective of Contractors

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## Abstract

The significant impact of construction projects on a nation has been characterized in literature in terms of infrastructure development and job creation. These projects are nevertheless associated with various risks that need to be managed to ensure successful delivery. Hence, the identification of these risk factors is of utmost importance. Therefore, this study aimed at assessing contractors' perception of critical risk factors in construction projects in Gauteng (South Africa). Explorative and questionnaire survey methods were employed to obtain data from literature and construction professionals all practising in Gauteng. Results revealed that supply of faulty materials, poor communication between involved parties, financial failure of the contractor, working at dangerous areas and closure were the five critical risk factors in construction projects. It is obvious from the results that the knowledge of the identified critical risk factors furnishes invaluable information to the construction contractor concerning what risk variables to focus attention on in construction activities. The paper contributes to the identification of critical risk factors in construction projects from an objective point.

**Keywords:** construction, contractors, risk factors, South Africa

## 1. Introduction

The great impact that the construction industry makes in terms of infrastructure development and job creation among economies is overwhelming in literature. The significant impact that is associated with its benefits is usually attachedto critical risks that must be managed before achieving a successful delivering of the project. In order to meet the targeted objectives of project success (time, cost and quality), effective management tools must be put in place as risk may appear in many ways and could result in increased cost and time, decreased quality and many more failures (Keçi and Mustafaraj, 2013). One of the major reasons for this situation is not handling the risks, which is about thinking ahead, simulating and searching for better solutions (Keçi and Mustafaraj, 2013). Thus, the project can be achieved successfully

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by considering the risks where it normally tends to give positive and negative effect on the project (Ayyub, 2003).

In recent years, some exhaustive studies and development have concentrated on project risk management. Project risk management is acknowledged as one of the most critical procedures and capability areas in the field of project management (Mahendra *et al.*, 2014). This is undoubtedly the most difficult aspect of project management (Mahendra *et al.*, 2014). Managing risks in construction projects have been accepted as a very important process so as to meet project goals. Hence, risk management can be defined as a complete set of activities and actions aimed at dealing with any risk to maintain control over the entire (Van Well-Stan, 2004).To achieve the set objectives, a proper risk management is indispensable. For this reason, the identification of risk factors affecting risk management is a crucial step in the risk management process since if risks are not identified, it will be almost impossible to respond to them. Moreover, it is well recognized that in construction projects, contractors are the key players in carrying out construction works and are directly involved in the physical phase of the project. They are required to manage the risks that arise during construction activities to ensure the effective completion of projects (Tang, 2012). Therefore, this study investigates contractors' perception of the risk factors impact on construction projects in Gauteng, South Africa.

# 2. Literature Review

## 2.1 Risks in construction projects

The opinion that the construction industry is the most exposed to threats (risks and uncertainty) is an agreement among authors due to the nature of its activities. Still, diverse tactics in the literature regarding the factors and characteristics of projects that expose the CI to numerous risks were found. Zoo *et al.* (2007) made reference to long, complex environment, complicated process, and the need for investment-intensive, dynamic organizational structures, technological and organizational complexity and the diverse interests of stakeholders. In succession, Ghani (2009) pointed out as factors and essential features high life cycle design, size, complexity, location, the different parties implicated and familiarity with the performer's work to be done. Zeng and Smith (2007), found a persistent change of environment, direct exposure to hazards, the high pressure involved in the compliance of costs and deadlines, and increasing the complexity of construction techniques. Likewise, in a study conducted by Chapman and Ward (2003), the changeability in the performance objectives of cost, time and quality, the ambiguity related to various aspects such as lack of clarity owing to the behaviour of participants involved, as well as the lack of evidence and detail, are listed among the critical factors.

## 2.2 Risk management process (RMP)

Risk management systems are used to ensure the control of risks in the business process. In this study, the simplest possible approach to describing the risk management process is adopted due to the context of the construction sector. There is no common definition of the scope of risk analysis, risk management or the risk process in the literature, as each one has its own twist (Chapman and Ward 2003). The risk

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management process in this study consists of the steps. It comprises the risk analysis followed by the risk response. Risk analysis includes risk identification and assessment, as depicted in Figure 1.

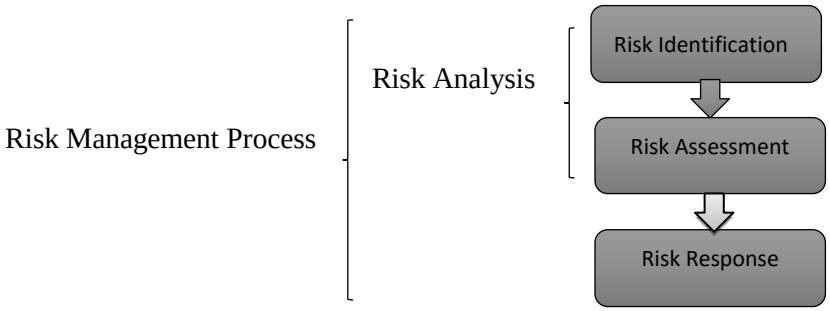


***Figure 1: Risk management process (Adapted from Simu, 2006)***

The first step of the RMP is risk identification. This is probably the most important and time-consuming step, because if risks are incorrectly identified, incorrect assessments and responses will follow (Simu, 2006). Several techniques are available for identifying risks; the most known in construction are brainstorming, interviews, Expert opinion, questionnaire, checklist, Delphi technique, Expert systems, past experience and documentation review (Khalafallah, 2002).

The second step is assessing the risks. It can be assessed based on the possibility of risk occurrence and severity of its impact (Lester, 2007) by developing risk matrix. It aims at assessing the risk to evaluate the effect of each risk on the project. Risk assessment is conducted in various ways. There are tools and techniques that have been developed to consider probabilities and consequences, using historical data, statistical data or estimated judgment translated to numerical information (Aven, 2003). Common are the estimation of probability and consequence and the usage of software tools to manage the data. Scoring techniques are developed checklists that include the judgment of both probability and consequence of a risk breakdown. This is a common technique for risk assessment in construction projects that is widely used due to its simple approach. In the risk response step, actions are taken to control the risks analysed in the first two steps. In this study, the response step includes both the planned and the monitoring responses. There are four different ways of responding to risks in a construction project, namely, risk avoidance, risk reduction, risk retention and risk transfer (Abu Mousa, 2005).

## 2.3 Risk factors

Some studies have identified risk factors for construction projects. In a survey conducted by (Mussa, 2005), it was revealed that financial failure of the contractor, working in the hot environment, closure, defective design and delayed payment on contracts were the most important risk factors. This was followed by difficulty to access the site, lack of consistency and inaccurate quantities which were also considered as high significant risks. The findings showed that there are some risk factors contractors could not allocate to the party that should bear these risk's consequences. Wong and Cheung (2005) also

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stressed that the most significant risk occurred in design and built include time and cost overrun. The main reason for these risks is an employer or government delay, lack of information from the employer, the difficulty of following instructions, conflict of interest and variation to changes. Ibrahim *et al.* (2006) opined that construction projects are attributed to financial, technical, politics, act of God and social risks that may influence the projected profit. Therefore, for this study, a thorough review of existing literature was performed to identify common risk factor that may stand in front of construction projects. The current literature search identified forty-four factors categorized into nine groups including:

- Physical factors such as occurrence of accidents due to poor safety procedures, supplies of faulty materials, varied labour and equipment productivity;
- Environmental factors such as difficulty to access the site and adverse weather conditions;
- Design including defective designs, uncoordinated designs, Inaccurate quantities, Lack of consistency between bill of quantities, drawings and specifications, rushing designs, awarding designs to unqualified designers;
- Logistics, including factors such as unavailability of labour, materials, and equipment, undefined scope of working, high competition in bids, inaccurate project program and poor communications (the home and field offices);
- Financial, including inflation, delayed payments on contract, financial failure of the company, unmanaged cash flow, exchange rate fluctuations and monopolizing of materials;
- Legal factors including difficulty to get permit, ambiguity of work legislations, legal disputes during the construction phase, delayed disputes resolutions and lack of specialized arbitrators to help settle fast;
- Construction issues such as rush bidding, gaps between the implementation & specifications, undocumented change orders poor work quality in presence of time constraints, design changes and actual quantities which differ from contract quantities;
- Political factors such as new governmental acts or legislations, unstable security circumstances, closure and segmentation of Gauteng; and
- Managerial factors such as vague planning due to project complexity, poor resource management, changes in management strategies, information availability and poor communication between involved parties.

# 3. Research Methodology

## 3.1 Population and data collection

The targeted population for this study included large building contractors who have a valid registration with the Construction Industry Development Board (CIDB). The three highest gradings (7-9) were considered large and were selected from the contractor's list published by CIDB. The respondents included top management (mostly project managers, construction managers, and quantity surveyors) who were willing to participate in the study. Based on their positions, education, work experience and professional background, the authors inferred that the respondents had adequate knowledge of risk management as well as the activities associated with construction.

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In order to fulfil the objective of the study, both secondary and primary data were employed to examine contractors' perception of risk factors. The secondary data was gathered through a comprehensive related literature review. Various sources were consulted including accredited academic and journals, books, the internet, theses,and dissertations. The primary data, on the other hand,was obtained from a well-structured questionnaire. The questionnaire was pilot-tested before being distributed to the respondents, to ensure simplicity, suitability, readability, understanding and time taken in answering the questions. Ratings regarding the impact of risk factors on construction projectswere hence needed from top management of these contractors. The drop-off and collect strategy was adopted to increase response rates, as was used by Agumba (2013).

## 3.2 Sample and sampling procedures

All contractors in CIDB grade 7-9 in Gauteng had an equal chance to be drawn and participate in the study.Out of 50 questionnaires sent out, 44 were returned and used representing 88% response rate which formed the basis of this study. The study used probability-sampling procedures to get the sample for the research. Probability sampling with the process of stratified sampling was used. The probability sampling is preferable to non-probability sampling as it ensures accurate results. This technique was selected because of the various categories of contractors. This method hence assured a better representation of the population. The data presentation and analysis made use of frequency distributions and percentages of all the respondents. The study was conducted between the months of June to August 2014.

## 3.3 Data analysis

A five-point Likert scale was used to examine the impact of each identified risk factor. The adopted scale was as follows: 1- No impact, 2-Law impact, 3-Medium impact, 4-High impact, 5-Very high impact.Data collected were analysed statistically using the Mean Item Score (MIS). The indices were used to determine the relative impact and ranking of each item. The ranking made it possible to cross compare the relative importance of the items as perceived by the respondents. The similar approach has been used by some researchers to analyse the data gathered from questionnaire survey (Le-Hoai *et al.,* 2008).

The computation of the relative mean item score (MIS) was calculated from the total of all weighted responses and then relating it to the total responses on a particular aspect. This was based on the principle that respondents' scores on all the selected criteria, considered together, are the empirically determined indices of relative importance. The index of MIS of a particular factor is the sum of the respondents' actual scores (on the 5-point scale) given by all the respondents' as a proportion of the sum of all maximum possible scores on the 5-point scale that all the respondents could give to that criterion. Weighting was assigned to each responses ranging from one to five for the responses of 'No impact risk' to 'Very high impact. The mean item score (MIS) was calculated for each item as follows;

$$MIS= \frac{1n_1 + 2n_2 + 3n_3 + 4n_4 + 5n_5}{\sum N} \quad \text{Equation1.0}$$

Where: $n_1$ = Number of respondents for 'No impact', $n_2$ = Number of respondents for 'Law impact', $n_3$ = Number of respondents for 'Medium impact', $n_4$ = Number of respondents for 'High impact', $n_5$ =

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Number of respondents for 'Very high impact', N = Total number of respondents. After mathematical computations, the criteria were then ranked in descending order of their mean item score. The next section presents the findings and discussion of the survey.

# 5. Findings and Discussion

The questionnaire consisted of four sections to accomplish the aim of this study. The first section was the contractor organization profile which was designed to show the population properties in terms of theposition of the respondent, executed projects, experience of the contractor's organization and the status of the contractor in the past five years. Section two presented the risk factors identified by literature, section three covered management methods which can be used to manage risks and the last section addressed the risk analysis strategies which can be used to analyze and estimate risk factor impact. The findings from the studyare presented below.

## 5.1 Demographic characteristics

A total of 50 questionnaires were sent out, 44 were returned and used which represent 88% the overall sample. The distribution of the respondents is shown intable 1. The majority of respondents were construction managers 15 (34.1%), 11 (25%) were quantity surveyors, 9 (20.5%) were project managers, 4 (9.1%) were named as others while 3 (6.8%) were directors, and 2 (4.5%) were architects.

***Table 1: Distribution of respondents***

| Position | Frequency | Percentage (%) |
|---|---|---|
| Director | 3 | 6.8 |
| Project Manager | 9 | 20.5 |
| Construction Manager | 15 | 34.1 |
| Architect | 2 | 4.5 |
| Quantity Surveyor | 11 | 25.0 |
| Other | 4 | 9.1 |
| **Total** | 44 | 100 |

With regard to working experience, 48% had working experience that ranged from 1-5 years, 25% had between 6-10 years working experience, 14% had working experience that ranged between 11-15 years, 5% had experience that ranged from 16-20 years and8% had more than 20 years of working experience. Based on their function, education, work experience and professional background, it can be deemed that the respondents have sufficient knowledge of construction activities.

The results relating to the number of construction projects executed in the last five years revealed that 32% of the respondents were involved in 3-4 projects, 26% were involved in more than 8 projects, 18% were involved in 1-2 projects, 17% were involved in 5-6 projects, 5% of the respondents were involved in 7-8 projects, and 2% were not involved in any construction projects during the last five years.

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## 5.2 Construction risk factors

Results from the study revealed that supplies of faulty materials (MIS=4.88, R=1), poor communication between involved parties (MIS=4.82, R=2) and financial failure of the contractor (MIS=4.78, R=3) were perceived as very significant risk factors in construction projects. Furthermore, contractors' respondents perceived working at dangerous areas (MIS=3.78, R=4), closure (MIS=3.18, R=5), delayed payment on contract (MIS=3.09, R=6) and undocumented change orders (MIS=3.02, R=7) as significant risks while others such as legal dispute during the construction phase (MIS=2.91, R=1) and ambiguity of work legislations (MIS=1.98, R=26) were considered to be medium and low risks respectively (Table 2).

These five risk factors are from four major categories namely physical, management, financial and political group risks. These results draw the contractor's attention to the appropriateness of materials that contribute 70% of the total value of the project (Enshassi *et al.*, 2003). Hence, any problems related to construction materials would affect the project (Enshassi *et al.*, 2003). These findings are in agreement with the studies of Abu Mousa (2005), which reported defective material as very important risks. The results further emphasize the importance of communication in early stages of the project as poor communication between involved parties results in a waste of time and thus affecting the budget. These results concord with the findings of Hoezen *et al.*, (2006), where it was found that, making adjustments in later stages of the building process, as a result of poor communication, usually cost extra money. Contractors are advised to communicate at early stages of the project, as early and or improved communication would undoubtedly lead to fewer delays and lower expenses.

Another important risk factor is the financial failure of the contractor. This can significantly affect the procurement of material, therefore, delaying the project from being delivered in due time. These results are in line with the studies of Hallaq (2003) that concluded that more than 80% of financial contract failures were caused by financials factors such as depending on banks and paying high, low margin of profit due to competition, award contract to the lowest price, lack of capital and cash flow management. Consequently, Contractors are recommended to have enough cash to lessen financial problems (Enshassi *et al.*, 2003).

Working at hot (dangerous) areas and closure in the political group came as the fourth and fifth most important risk factors. It is evident that working at dangerous areas risk is perceived as a significant risk; contractors cannot be imposed to work in such conditions. On the other hand, the closure could be the result of material unavailability and inflation due to monopoly. Table 2 shows the results of risk factors ranking in descendant order.

The current findings concord with previous studies reviewed in the literature review regarding the severity of risk factors during construction projects. However, it is remarkable to note the exclusion in the current study, the risk of information unavailability, changes in management ways, design changes and occurrence of accidents due to poor safety procedures as part of the list of most significant risk factors while reviewed literature revealed them as the most important risk factors during the life of a construction project.

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***Table 2: Construction risk factors***

| Risk Factors | Rank (R) | MIS |
|---|---|---|
| Supplies of faulty materials | 1 | 4.88 |
| Poor communication between involved parties | 2 | 4.82 |
| Financial failure of the contractor | 3 | 4.78 |
| Working at hot (dangerous) areas | 4 | 3.78 |
| Closure | 5 | 3.18 |
| Delayed payment on contract | 6 | 3.09 |
| Undocumented change orders | 7 | 3.02 |
| Legal dispute during the construction phase | 8 | 2.91 |
| Delayed dispute resolutions | 9 | 2.91 |
| Unmanaged cash flow | 10 | 2.86 |
| Resource management | 11 | 2.84 |
| Poor work quality in presence of time constraints | 12 | 2.80 |
| No specialized arbitrators to help settle fast | 12 | 2.80 |
| Unavailable labour, materials and equipment | 13 | 2.77 |
| Poor communication between the home and field offices | 13 | 2.77 |
| Gaps between the implementation and the specifications | 14 | 2.75 |
| Segmentation of Gauteng | 15 | 2.73 |
| Unstable security circumstances | 15 | 2.73 |
| Monopolising of materials | 16 | 2.66 |
| Occurrence of accidents due to poor safety procedures | 16 | 2.66 |
| Vague planning due to project complexity | 17 | 2.64 |
| Inflation | 18 | 2.52 |
| Exchange rate fluctuation | 19 | 2.48 |
| Defective design (incorrect) | 20 | 2.45 |
| Difficulty to access the site | 21 | 2.41 |
| High competition in bids | 22 | 2.36 |
| Changes in management ways | 23 | 2.09 |
| New governmental acts or legislations | 24 | 2.07 |
| Varied labour and equipment productivity | 25 | 2.02 |
| Design changes | 25 | 2.02 |
| Adverse weather conditions | 25 | 2.02 |
| Ambiguity of work legislations | 26 | 1.98 |
| Awarding the design to unqualified designers | 27 | 1.95 |
| Actual quantities differ from the contract quantities | 28 | 1.89 |
| Environmental factors | 28 | 1.89 |
| Undefined scope of working | 29 | 1.86 |
| Not coordinated design | 30 | 1.82 |
| Lack of consistency between bill of quantities, drawings and specifications | 31 | 1.80 |
| Information unavailability (include uncertainty) | 31 | 1.80 |
| Inaccurate project programme | 31 | 1.80 |
| Difficulty to get permit | 32 | 1.77 |
| Rush bidding | 34 | 1.68 |
| Inaccurate quantities | 35 | 1.25 |
| Rush design | 36 | 1.20 |

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Another remarkable point to note is that difficulty to access the site (MIS=2.41, R=21), lack of consistency (MIS=1.80, R=31) and inaccurate quantities (MIS=1.5, R=35) were identified by literature as high significant risks while in the current study there were considered as medium and low risk factors. Furthermore, it is clear that among the contractors' respondents there is not a general knowledge of the significant risks revealed in literature. This situation undoubtedly has an influence on the process to responding to these risks as practitioners should be conversant with these risks in order to effectively respond to them.

# 6. Conclusion

This study has showed that risks factors are the key elements that need to be consideredin order to achieve successfully the fundamental elements of a project (time, cost and quality). Forty-four risk factors were revealed through a detailed literature review which were then categorized into nine groups namely physical, environmental, design, logistics, financial, legal, management, political, and construction. Supply of faulty materials, poor communication between involved parties and financial failure of the contractor were considered by contractors' respondents as very high significant risk factors this followed by working at dangerous areas, closure, delayed payment on contract and undocumented change orders which were perceived as high significant risks, others were considered as medium and low risks. These risk factors were from four different categories of risk, i.e., physical, management, financial and political group risk. These findings will strengthen the contractors' evaluation of the risk factors.

To reduce the probability of failure of construction projects, contractors are recommended to take into consideration the importance of handling risk factors associated with construction projects. Contractors should have an adequate project planning that would allow them to foresee these risks factors. Moreover, risk should be taken into account by adding a risk premium to quotation, time estimation and this has to be supported by organizations such as the Construction Industry Development Board (CIDB), the Association of South African Quantity Surveyors (ASAQS), the Chartered Institute of Building (CIOB), the South African Federation of Civil Engineers Contractors (SAFCEC) and other organizations involved in the construction sector. Additionally, contracting firms should provide training programs for their personnel to properly apply management principles as it is the duty of organizations to provide such training.

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