

A Conceptual Model of Risk Management for Predicting Success in Construction Projects

Berenger Yembi Renault, Justus Ngala Agumba, and Nazeem Ansary

Abstract—The recurrence of project failures in construction has tarnished the image of the construction industry globally. This development has been in part due to inefficient risk management which ineluctably leads to poor project performance. However, there is scarcity of investigative studies that consider factors predicting success in South Africa construction industry and in developing economies. The objective of the study is therefore to identify the variables of risk management that are predictors of project success. The work methodology included a literature search relating to risk management which enabled the identification of core variables relevant to the study using content analysis. The review spanned a decade and lustrum between January 2000 and December 2015 and was based on a combination keyword search in three databases namely; Science Direct, Taylor and Francis Online, and Emerald. Nine core variables were identified which are perceived to predict project success. These were: organizational environment, defining project objectives, resource requirements, risk measurement, risk identification, risk assessment, risk response, communication, and monitoring and review. Furthermore, a hypothesized conceptual model of risk management was proposed. The study is mainly a literature review, hence a limitation. Despite the limitation, the study recommends that the identified variables can be considered as core variables of risk management and ultimately predictors of project success in construction.

Keywords—Conceptual model, risk management, predictors, project success.

I. Introduction

Risk management in construction has for many years been an important issue and therefore has become an area of concern for the industry [1]. This development has been in general due to the recurrence of poor project performances (in the form of project cost and time overruns, poor quality achievement, project not meeting technical requirement, and clients not satisfied), introduction of government policies, procedures and systems, responsibility and accountability of top management regarding risk management for their

organizations [2]. According to Round and Segner [3], the rate of projects that failed to achieve pre-established objectives in the construction industry is among the highest of all industries. Additional reasons include the need to address the high rate of project failures and to ameliorate the image of the construction industry which is perceived to be disagreeable compared to other industries as a result of ineffective risk management [4].

Risk management has become a priority in any project management. In fact, Olamiwale [5] indicated that the circumstances within the construction industry had led to adopting and implementing risk management. Risk management is the processes to manage probable risks. This process generally involves risk identification; risk assessment and responding to risk so as to reduce the likelihood of risk occurring or impact of adverse events [6] [5] [7].

Loosemore et al., [8] asserted that risk management has many complicated dimensions relating to the construction industry, with results that go beyond its direct physical detriment to the financial and cultural processes, and even the way a society operates. According to El-Sayegh [9], construction projects are precarious by nature due to their configuration, technology and resource demands, financial and organizational arrangements. Given the importance of risk management in project management, effective risk management is expected to significantly influence project performance [10] [11]. Gitau [12] carried a study on the impact of risk management on project performance in Rwanda and concluded that effective risk management lead to project success. This indicates that risk management in projects is dynamic rather than stagnant. It is, therefore, critical for stakeholders to implement risk management in order to reduce project risks in the construction industry.

The construction industry is one of the largest employers globally. A report released by the Organization for Economic Co-operation and Development [13] indicated that the construction industry employs approximately 7% of the global work force or 180 million people and it is predicted to account for approximately 13% of the Global Domestic Product (GDP) by 2020. In South Africa, the construction industry employed 1 395 000 people (formal and informal sectors), accounting for 9, 6% on average of GDP between 2008 and 2016 [14]. The construction industry is visibly a significant sector of most economies including that of South Africa. Because of its economic significance, risk management in the construction industry is also as convincing as the other underlined reasons.

Regardless of the importance of the industry, its image has been described as undesirable. The undesirable image has partially been spoilt owing to ineffective risk management. It is reported that the probability of risk occurring in the

Berenger Yembi Renault
University of Johannesburg
South Africa

Justus Ngala Agumba
Durban University of Technology
South Africa

Nazeem Ansary
University of Johannesburg
South Africa

construction industry is higher than in other industries [6] [4] [10].

Similarly, construction projects are still well acknowledged as the most risky projects to execute because of the complexity of its activities, environment in which its activities are executed, and processes involved prior to and during project execution. Further reason includes the high rate of projects that have failed to meet baseline completion dates, costs and quality requirements [11] [15]. For example, there are many projects that were not delivered within baseline objectives in the South African construction industry (SACI) recently. The Gautrain project which was only ready two years after its baseline completion date and cost R14 billion over budget [16]. 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 [17]. This can undeniably have negative consequences on the economy as a whole and also tarnish the image of the industry in terms of its inefficiency in risk management. The poor performances underlined above call for the industry to incorporate a model of risk management that comprises core variables that are predictors of success at project level in order to create a culture of risk management aimed at improving project delivery in the SACI.

Problem statement and objectives

The unpredictable occurrence of risk in the construction industry makes the industry one of the riskiest industry among others. The possibilities of projects not deliver within baseline objectives exist for any construction projects, if appropriate management strategies at project level are not taken. The construction industry in developing economies is viewed as underperforming with regards to project delivery. The underperformance in the form of time and cost overruns, and poor quality achievement has led to the dissatisfaction of clients. In addition, there is limited evidence in research highlighting risk management variables that are predictors of project success in construction. The paucity of studies identifying these variables provide an opportunity for this study to unravel information from previous studies related to risk management variables that are predictors of project success in construction. The main research question to be answered is:

-What are the risk management predictors of project success in construction?

The specific research objectives are to:

- Identify risk management predictors of project success; and
- Propose a conceptual model for risk management.

II. Literature review

Risk management overview

Risk management has become a priority in any project management; including construction project management. In

fact, the Project Management Body of Knowledge (PMBOK) included risk management as one of the focuses in project management and described it as the project concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project. On the other hand, the Australian and New Zealand Standards (AS/NZS) referred risk management to the culture, processes and structures that are directed towards realizing potential opportunities whilst managing adverse effects. In agreement with these definitions, risk management in construction project management is defined as a systematic way of identifying, analyzing and dealing with risk associated with a project in an aim to achieve the project objectives [7]. Owing to its cumulative importance, risk management has been acknowledged as a necessity in today's construction industry and hence a requisite in achieving project success [2]. However, successful project delivery necessitates the identification of the risk management variables/factors that have an impact on the outcome of a project.

Identified Risk Management Variables

Literature from different authors indicated that there was no particular study with similar variables as illustrated in Table 1. The identified variables were deemed to be predictors of project success. Different themes have been presented by various authors and categorized in nine variables with the aim to propose a conceptual model of risk management.

Organizational environment

According to the Institute of Risk Management [18], the internal environment influences an organization in adopting a comprehensive and collaborative approach to risk and, therefore, impact positively on the outcome of the project. Also, it influences management decision-making to achieve the right balance of risk and opportunity. Likewise, the external environment evaluates the strategic alignment of an organization's risk management and its external operating environment [18]. In addition, Smit [19] indicated that understanding the organizational environment of risk ensures that all organizational stakeholders understand their responsibilities and accountabilities, and identify possible weak areas that may influence the project from achieving its objectives. As stakeholders play a crucial role in the success of any project, scholars studying the construction sector [20] [21] [22] [23] have established that stakeholder involvement has undeniable impacts on project outcomes. Furthermore, in exploring the effect of organizational environment, top management involvement, and stakeholder's involvement on the success of a project, Basu et al., [24] observed that these factors were considerably related to project success. From the discussion, it can be suggested that understanding the organizational environment is an important factor to project success. Hence, the following hypothesis was proposed:

H1: Understanding the environment in which the organization operates positively influence project success.

Defining project objectives

According to Goetz [25], vaguely defined objectives without objectives leads the project into overruns, personality clashes, unhappy clients and missed milestones. Defining project objectives aids in aligning the organization whereby the project objectives are clearly visible and understood, hence positive and negative risks in achieving the objectives are identified and understood, and risk responses are aligned [26]. In support of this statement, Goetz [25]; Beleiu et al., [27] added that keeping project objectives in the vanguard of every project assures that the project and the team is on the same page during the course of the projects life cycle. They concluded by declaring that clearly defined objectives will enable the projects successful result. Building on the literature, it is clear that there is a relationship between defining project objectives and project success. Therefore, we propose that:

H2: Defining project objectives positively influence project success.

Resource requirements

Risk management resources are important in a project as they enable risk management performance of the project to be achieved [28] [9]. Muthuramalingam [29] established that availability of resources was a good predictor of risk management performance and, therefore, contributing to a successful completion of the project. Haughey [30] concluded that RM resources influenced project success. Scheid [31] stated that project's resources need to be considered to keep on track with successful outcomes. This finding concurred with Manfredi and Auletta [32], who indicated that the availability of resources had an impact on the decrease of cost overruns in projects. From the literature, it can be concluded that there exists a positive link between resource requirement and project success. Therefore, the following hypothesis can be derived:

H3: Determining and documenting resource requirements positively influence project success.

Risk measurement

Smit [19] indicated that defining and documenting the risk measurement of a project was crucial to its success. He observed that risk measurement influence the outcome of the project in defining the risk measurement criteria to be used (e.g. Classification system of high, medium or low), defining risk materiality (when risk is important), determining the level of acceptable risk and risk timeframe applicable to risk impact and risk probability (i.e. when is risk expected to occur, e.g. next month, next year, etc.). Phoya [33] declared that in order to successfully achieve project objectives, a project team has to define a classification rule set (risk measurement) for each impact type that is relevant. The author further indicated that risk measurement can detect the key influences on project outcome and allow the effects of uncertainty to be determined. Karimi et al., [34] indicated that risk measurement criteria were an advanced activity of risk management system. They established that when it is used, it reduces risk impact on the project regarding schedule, budget as well as quality. Goossens and Van-Gelder [35] demonstrated that risk measurement being one of the activities of RM influenced

project success and project performance. Building on the above discussion, the hypothesis proposed for testing was:

H4: Defining and documenting the risk measurement to be used in assessing risk has a direct positive influence on project success.

Risk identification

The results of Al-Shibly [1] indicated that risk identification influenced project success. Similarly, Ewer and Mustafa [36], in their study observed that some authors [37] [38] [39], observed that, as management involvement increases in risk identification, the risk of unclear or misunderstood scope seems to lessen and improve project performance and hence influence positively project outcome. A study conducted by de Bakker et al., [38] indicated that individual RM activity, risk identification, contributes to project success. They further inferred that the interaction through discussion between project members during risk identification has a positive impact on the perceived success of the project. From the above discussion, it can be said that there is a relationship between risk identification and project success; hence, the following hypothesis was proposed for testing:

H5: The risk identification process has a positive influence on project success.

Risk assessment

Roque and de Carvalho [7] established that risk assessment activity makes a greater significant impact on the success of the project. The results indicated that adopting risk assessment has a substantial positive impact on project success as project staff was able to take actions to mitigate the occurrence of risks to a greater extent. Al-Shibly [1] tested the relationship between risk assessment and planned budget. The author established that there was an impact of risk assessment on project planned budget. In order to abate the rise of unsuccessful project completion in construction, the importance of risk assessment is a fundamental factor in an organisation risk management practices as emphasized by several authors [19] [46] [9] [41] who affirmed the influence of risk assessment on the successful completion of a project. They reported that assessing uncertainties during the project, making use of the RM strategies and understand the business environment, significantly impact on project outcome. By assessing risk, managers can distinguish between acceptable and unacceptable risk events, and as a result enable them to capture and process information to assist them in the development of a risk management strategy [42] [28] [10] [34]. Likewise, Naidoo [43], indicated that risk assessment once performed, improved project objectives, accurate schedule, improved communication between relevant parties, and hence increased the chance of project success [43]. Based on the literature, we concluded that there is a relationship between risk assessment and project success. Therefore, we proposed:

H6: The risk assessment process has a positive influence on project success.

Risk responses

Al-Rousan et al., [44] argued that there is no such thing as a project without risks and problems. The authors added that if a project is successful, then it is not successful because there were not risks and problems, but because appropriate responses were developed which led to successful completion of the project. Kutsch and Hall [45] studies established that project performance can be improved by developing mitigating measures which positively influence risk response for project success. Gajewska and Ropel [46], Alberto and Timur [47], stated that risk response and action planning influenced project success. The latter authors established that when conducted, risk response will change the risk profile through the project life cycle, and risk exposure will diminish. Aimable [2] established that risk response activities are strongly linked to the success of construction projects. Aimable [2] further indicated that the impact of responding to a risk may make sense in the short term by saving design costs, allows the team to meet schedule. Moreover, Baccarini et al., [48] indicated that one of the documented keys to project success is mitigating the influence of potential project risks to improve the chance of project success. The above discussion led us to propose the following hypothesis:

H7: The risk response and action planning positively influence project success.

Communication

Silvius and Tharp [49] indicated that Communication between project head and management is crucial to the success of construction projects. This is generally influenced by the principal-agent relationship between the parties and the contract type chosen [50]. Naidoo [43] showed that a balance between formal and informal communication between the project manager and other stakeholders reduces mistrust and conflict of interest. Likewise, Zulch [51] opined that communication influenced project success. The author further established that that managers spend about 90% of their working time engaged in some form of communication, be it meetings, writing emails, reading reports, or talking to project stakeholders. Communication in construction provides a positive contribution to projects, by improving motivation of project members and the effectiveness of the performance [52]. De Bakker et al., [38] stipulated that in situations where risks are not shared openly, the positively communicative effect may not occur, hence, stifling the success of a project. From the literature, it can be concluded that a relationship exists between communication and project success; hence, we proposed that:

H8: Communication between team members positively influences project success.

Monitoring and review

A study by Prabhakar [53], pointed that Monitoring, review and continuous improvement influenced project success. Likewise, Papke-Shields et al., [54] also asserted that the likelihood of achieving project success seemed to be enhanced by other factors by regularly monitoring the project progress. In addition, Hwang and Lim [55], Kamau and Mohamed [56], established that project monitoring and review

allow management to verify that the control actions that were applied are efficacious to achieve project success. If controls actions are found to be ineffective, these should be revised or new control actions implemented, thus enabling continuous improvement in future projects [57].

Rezakhani [58] indicated that project monitoring and continuous improvement is, even more, critical than planning in achieving project success. Equally many researchers, Andersen and Terp [59], Chin [60]; indicated that one of the elements of the project management methodology whose main aim is to achieve project success is monitoring project progress. The above discussion brought us to conclude that there is a relationship between monitoring, review and continuous improvement and project success; therefore, we propose that:

H9: Monitoring, review and continuous improvement positively influence project success.

Based on this discussion a conceptual model was proposed in Fig.1, showing the relationship between the variables.

Proposed conceptual model of risk management

Fig.1 represents the conceptual model of risk management proposed in the study. The model depicts the influence of the variables that are predictors of project success as well as their hypothesized relationships. On the other hand, project success is dependent on the level of practice of the variables namely; organizational environment, defining project objectives, resource requirements, risk measurement, risk identification, risk assessment, risk responses, communication, and monitoring and review. The results from testing the hypothesized relationships between the variables will indicate whether they are accepted or rejected. The empirical results of the variables that are predictors of project success using regression analysis will have a great practical significance to stakeholders and industry practitioners.

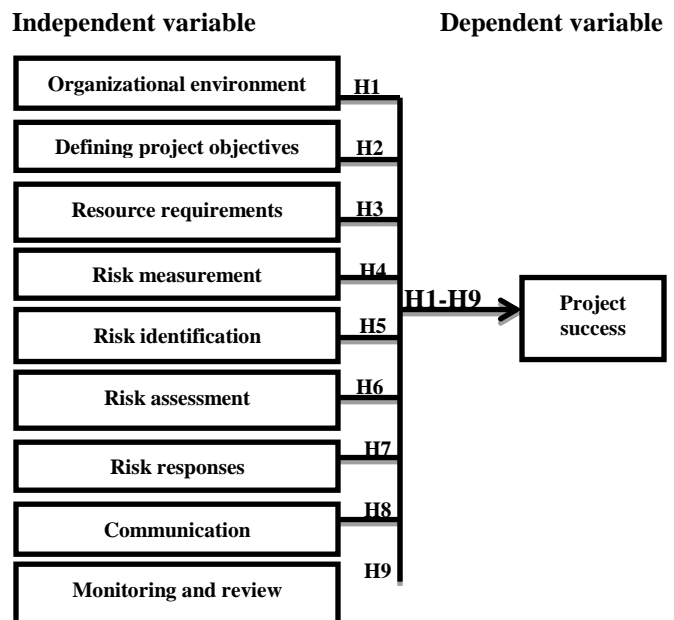


Figure 1. Proposed conceptual model

III. Methodology

The study was conducted with reference to existing theoretical literature, published and unpublished literature. This study is mainly a literature review and looks at the literature relating to risk management in construction. This is because risk management has attracted much worldwide attention in recent years. The literature search spanning a decade and lustrum between January 2000 and December 2015 was conducted. This was based on systematic keyword combination search in three databases namely; Science Direct, Taylor and Francis Online, and Emerald. The authors used advanced search for the database engines and basic search for Google. The keywords used for the data search were; “risk management factors/elements” AND “project success in construction”. The basic search used was “factors of risk management and predictors of project success in construction”. The search in the databases retrieved 3754 articles. However, after filtering the articles only twenty (25) were relevant and were all used in the study. Google search retrieved 4860 000 articles and reports of which ten (10) were relevant to the study and were not duplicates with those obtained from Taylor and Francis online, Science direct and emerald search were used. The authors ensured that the articles reviewed were peer-reviewed, were written in English, and that they should indicate the objective of the study, the method employed; report the results to the objective of this literature and a conclusion. A similar approach was used by Gildberget al., [61]. To identify the factors/variables of risk management that are predictors of project success in construction, thirty two articles, and three reports met the requirements. The relevant articles and reports were read several times to obtain a sense of the content.

The proposed theoretical conceptual model of risk management was developed in following the steps depicted in Figure 2 where a review of literature was first conducted which enabled the identification of risk management variables, formulation of hypotheses, and development of the conceptual model. The identified variables were analyzed using content analysis.

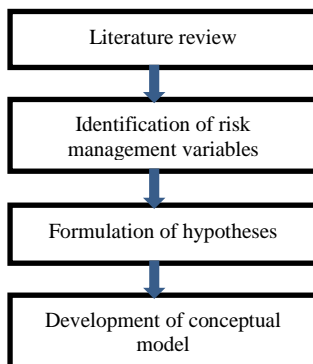


Figure 2. Research path

IV. Conclusion and recommendations

The main objective of the study was to identify the core risk management variables that are predictors of project success in construction. A review of literature on current theory development in risk management was conducted in order to identify the variables. Two gaps in literature were disclosed namely; the lack of consensus of risk management variables that are predictors of project success in construction and the paucity of studies in developed and developing economies that have identified the variables.

Despite the noted gaps, the review identified nine broad variables that might predict success at project level. The identified predictors were; organizational environment, defining project objectives, resource requirements, risk measurement, risk identification, risk assessment, risk response, communication, and monitoring and review. Therefore, a conceptual model of risk management was proposed depicting the hypothesized relationships between the variables. The need to test the hypothesized conceptual model was suggested for future research in the South African construction industry, using regression analysis.

It is envisaged that the results of regression analysis will establish the predictors of project success and be of great practical significance to industry practitioners and stakeholders. This will further enable senior management in developing economies and in South Africa to focus their resources on the variables of risk management that are predictors of project success in construction.

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About Authors:



Berenger Yembi Renault (MTech, BTech, ND) was born in Gabon on June 26, 1989. He obtained his National Diploma in Construction Management and Quantity Surveying, Bachelor's Degree in Quantity Surveying, and Master's Degree in Construction Management from University of Johannesburg, South Africa in 2012, 2014 and 2017 respectively. He has been a Tutor at the Faculty of Engineering and The Built Environment since 2013. Renault is also a member of the Association of South African Quantity Surveyors. He is currently a PhD student at the Department of Construction Management and Quantity Surveying at the University of Johannesburg. His work is animated by an interest in the area of risk management.



Justus Ngala Agumba (PhD, MTech, BTech, PrCM, MCIOB, MAQS) holds a Bachelor's Degree in Construction Management and Quantity Surveying and also obtained in 2006 his Master's Degree in Construction Management, from University of Johannesburg, South Africa. In 2013, he received his PhD in Engineering Management, from University of Johannesburg, South Africa. He is a Professional Construction Manager, and also a Member of the Association of South African Quantity Surveyors and

has many years of working experience in the Construction Industry. He is currently a Senior lecturer and academic researcher at the Department of Construction Management and Quantity Surveying, University of Johannesburg. He has published extensively in various refereed journals and has also presented papers in many international conferences all over the world. His main research interests are construction project management, construction management, risk management and Health and Safety in construction.



Nazeem Ansary (NHD, BTech QS, MCPM, PrQS, PMAQS, MRICS, MCIOB) holds a National Higher Diploma in Building Surveying and Bachelor's Degree in Quantity Surveying from Cape Peninsula University of Technology, South Africa and Tshwane University of Technology respectively. He received in 2010 his Master's Degree, Master of Construction Project Management from University of New South Wales, Australia. He is a Professional Quantity Surveyor and has many years of working experience

in the construction industry and currently working as a senior lecturer and Head of Department Construction Management and Quantity Surveying at the University of Johannesburg, South Africa. He has published several accredited articles in refereed journals and has presented papers in many international conferences all over the world. His main research interests are construction project management, construction management, dispute resolution, and risk management in construction.