Identifying Key Risk Influencing Project Delivery in Kenya from Contractors' Perspective

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Abstract: ***The construction industry is crucial in the country's economy growth. The Kenyan construction industry has been contributing immensely towards the Gross Domestic Product (GDP). The statistics by the Kenya Bureau Statistics (Republic of Kenya, 2014), indicate that the industry contributed 4.2%, 4.1%, 4.2%, and 4.4% towards the Gross Domestic Product (GDP) for the years 2010, 2011, 2012 and 2013 respectively. Despite this praise, studies in recent years have shown poor delivery of construction projects in relation to project objectives. This has been attributed to the many risks inherent in the industry (Ehsan et al., 2010). This has provoked an increased interest into the need for risk management in the industry. The main objective of this study was to determine the key construction risk which affects construction project delivery in Kenya in terms of cost, time, quality, environmental sustainability, and health and safety from contractors' perspective. Response measures to these risks are believed shall enhance project delivery among contractors.This study was conducted through a review of existing literature and through self-administered questionnaires. The study targeted contractors registered in Kenya by the National Construction Authority (NCA). A sample of 190 respondents was selected through stratified random sampling to participate in this study. Sixteen (16) of the respondents were from class NCA 1, 12 from class NCA 2, 22 from class NCA 3, 74 from class NCA 4 and 66 from class NCA 5. Senior managers, project managers, technical managers, architects, quantity surveyors and engineers working with the contractors constituted the sample units for this study. Ninety eight (98) valid questionnaires were returned.The study assessed the likelihood of occurrence of risks and their impact on project objectives in terms of cost, time, quality, environment and health and safety; ranked the risks depending on their significance index score thus determined the key risks. Statistical package for social science (SPSS) analysis software was used to analyze data collected for the purpose of interpretation and conclusions. Descriptive statistic was applied where some measures of distribution, central tendency and dispersion were used. Findings were presented using descriptive statistical tools like tables and radar diagram. Based on a comprehensive assessment of risk probability and impact on the project objectives, 26 key risk factors were identified and ranked. Project time and cost were found to be the project objectives most vulnerable to construction risk. "Delay in payments" had the highest level of impact on both time and cost having a Risk Significance Index Score (RSIS) of 0.5849 and 0.5514 respectively. The second ranked risk was "excessive approval procedures in administrative government departments" The risk had a major impact on both time and cost at RSIS of 0.5641 and 0.5000 respectively. "Information unavailability-details, drawings, sketches" is the third ranked risk.***

The risk has a significant impact on project quality having RSIS of 0.5188 and its highest impact on project time having RSIS of 0.5527. "Design variations required by clients" was found to have high impact on both time and cost having RSIS of 0.5474 and 0.5322 respectively.

The findings of this study shall be useful not only to contractors but also consultants and policy makers in the construction industry in managing construction risks thereby improving project delivery in Kenya

Keywords: risk, risk management, construction projects objectives, contractors' perspective

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I. INTRODUCTION

Despite construction industry being a significant contributor to the development process of any economy it is prone to several risks. Managing of risk in construction projects has been recognized as a key project management process to achieve project objectives in terms of cost, time, quality, environment, health and safety. In recent years, poor performance of construction projects has provoked an increased interest into the nature and mechanism of risk analysis and management (Smith *et al.*, 2006). It has been observed that the industry has a poor reputation for coping with the adverse effects of change, with many projects failing to meet deadlines and cost and quality targets.

Risk is the potential for complications and problems with respect to the completion of a project and the achievement of project objectives (Mark, *et al.*, 2004). According to Jomaah (2010) construction project risk is an uncertain event or condition that, if it occurs, has a negative effect on at least one project objective. Trying to eliminate all risks in construction projects is unattainable but it is well accepted that risk can be effectively managed to mitigate adverse effects on project objectives. It is therefore important that contractors face risks by identifying them and analyzing their effects associated with delivery of construction projects.

Risk management involves the identification of influencing factors which could negatively impact on cost, schedule or quality objective of the project, quantification of the impact of potential risk and implementation of measures to mitigate the potential impact of the risk (Ehsan *et al.*, 2010). PMI (2013) proposes an almost similar definition for project management, as to include the process concerned with conducting risk management planning, identification, analysis, responses and monitoring and control on project. All these steps of the risk management process should be included to deal with risk in order to implement the processes of the project management (Mahendra *et al.,* 2013). Risk management can therefore help in deciding which of the projects is more risky, planning for the potential sources of risk in each project, and managing each source during construction (Zayed *et al*., 2008). Contractors should for that reason establish and maintain a cost effective risk management in construction projects the aim being to ensure better decision making through good understanding of risks.

Very little research has been done in Kenya on risk management in construction projects. Researches in this field have mainly looked into construction risk in relation to cost and time. This paper looked into the impact of construction risks on project objectives. This was achieved by a systematic approach of assessing risks likelihood of occurrence and their impact on each of the project objectives if they happen to occur. This study has provided the much needed information regarding risk significance in relation to the project delivery objectives of cost, time, quality, environmental sustainability, and health and safety from contractors' perspective.

II. STATEMENT OF PROBLEM

According to Kishk and Ukaga (2008) the success of any project is judged by the satisfaction of stakeholders' needs and is measured by the extent of meeting standards laid down at the start of the project. This is in regard to delivery of construction projects by contractors within budget, time, quality, environment, safety and performance. Hayes *et al.* (1986) observes that construction industry is one of the most dynamic, risky and challenging business nevertheless, the industry is characterized with poor management of risks with many projects failing to meet deadlines and cost targets. Studies carried out in Kenya by Mbatha (1986), Talukhaba (1999) and Msafiri (2015) support these observations. Al-Bahar and Crandall, (1990) notes that the risk management performed in the construction industry had traditionally been of gut feel or series of rules-of-thumb and most of the times risks are either ignored or handled in an arbitrary way. Because of the complex nature of construction projects, this approach has resulted to delays, litigation and even bankruptcy (Hayes *et al.* (1986). Kishk and Ukaga (2008) noted that the degree of risk management process undertaken during the project lifecycle impacts directly on the project success. They further observes that failure to manage construction risks in a systematic way have resulted to projects experiencing cost overruns, delayed completion, non-completion or even fail to meet the quality specifications and the benefits they were intended for.

This paper, through a comprehensive assessment of likelihood of risk occurrence and impact on project objectives, has established 26 key risks influencing project delivery among contractors in Kenya. This finding has been useful in that with management of these risks construction projects can be delivered within delivery objectives of time, cost, quality, environment sustainability and health and safety.

III. LITERATURE REVIEW

Worldwide substantive research has been done in the field of risk management. As earlier asserted, very little has been done in this field in Kenya especially on the effects of risks on project objectives. Most of studies have concentrated on the impact of risks on project cost and project time while other project objectives are overlooked. Gichunge, H. (2000) in his research has looked into risk management in the building industry in Kenya while Talukhaba, (1988) has looked into time and cost performance of construction projects. Studies have shown that 73 percent of projects in Kenya experienced time overrun and 38 percent suffered cost overruns (Mbatha, 1986). According to Gichunge, (2000) the most serious source of cost and time related risks in building projects during construction period is "variations". This occurs in 73 percent of building projects whereas "defective materials" accounts for 38.2 percent for observed unacceptable quality work cases. Msafiri (2015) endeavored to find the causes of delay in road construction in Kenya. "Payment by the client"; "slow decision making" and "Bureaucracy in client organization"; "Claims"; "Inadequate planning/ scheduling"; and" rain" were found to be the top delay factors affecting road construction Kenya.

A number of studies in this field have been carried out in other African countries. Aibinu and Jagboro (2002) surveyed major delays facing Nigerian construction industry. He identified the major client related delays as: "variation orders"; "slow decision making process" and "cash flow problems". He further identified the contractor related risk factors as: "financial"; "material management problems"; "planning and scheduling problems"; "inadequate site inspection"; "equipment shortage problems"; and "shortage of manpower". Extraneous problems, identified were ranked as: "increment weather"; "acts of God"; "labour disputes and strikes". He concluded that cost overruns and time overrun were the most frequent effects of delay in the Nigerian construction industry. Shebob *et al.* (2011) risk study in Libya showed that "low skills workers", "rise in material prices", "delay in material delivery" and "changes in among contractors scope of project" are the critical delay factors in the Libyan construction industry. On owner's point of view the most critical delay factor were identified as: "low skills of manpower"; "delay in delivery of site to contractor"; "modification (replacement or addition of new works)" and "changes in material specification". On the consultant point of view: "delay in making decision"; "slow supervision"; "poor planning"; "slowness in giving instructions"; "poor qualification of consultant engineer staff"'; and "waiting time for approval of drawing and tests samples of materials". Tipili and IIyasu (2014) in their study identified cost overruns and delivery of project within budget as a major challenge in the Nigerian construction industry. Factors affecting projects costs were ranked in order of significance as: "design variation"; "variations by clients"; "price inflation"; "incomplete or inaccurate cost estimate"; and "inaccurate program scheduling". Risk factors related to time in order of significance were: "Bureaucracy of government"; "design variations"; "quality performance"; "tight project schedule"; and "variation of construction programme". Risk factors related to quality in order of significance were: “Tight project schedule”; “design variation”;” lack of coordination between project participants”; “unsuitable contract programme planning”; and “lack of skilled labour”. Risks related to cost in order of significance were: “incomplete or inaccurate cost estimate”; “inadequate program planning”; “variation by the client”; “design variation”; and “price inflation”. Chilesh and Yirenkyi-Fianko (2012) identified 25 major risk factors associated with construction projects in Ghana and have major impacts on issues related to project performance and delivery in relation to cost, time and quality. The five most likely risk factors agreed by clients, consultants and contractors were: “price fluctuations”; “delay in payment”; “inflation”; “quality and performance”; and “poor financial markets”. The important risks in terms of impact on construction objectives were: “delay in payment”; “inflation”; “financial failure and price function” and “quality performance control”.

Risk management has attracted attention of several researchers in other parts of the world. Deviprasadh (2009) identified the most significant risk in the construction industry in India as: Shortage of skillful workers; time constraint; sub-contractors related risks; delays in the project completion from other companies; inflation rate; political risk; legal risks and environmental risks. Mousa (2005) investigated forty four (44) risk factors in Gaza Strip. The most important risk factors identified, on contractors’ point of view were: Financial failure by contractors; dangerous working condition; closure; defective design; delayed payment on contract; segmentation of Gaza Strip; unstable security circumstances; poor communication between involved parties; unmanaged cash flow; and award of design to unqualified designers. On the owner point of view the major risks assessed were: Awarding the design to unqualified designers; defective design; occurrence of accidents; difficult access to site; inaccurate quantities; lack of consistency between bills of quantities, drawings and specifications; working at hot (dangerous) areas; financial failure of the contractors; closures; and high competition bids. Zou, Zhang and Wang (2006) identified and analyzed risks associated with the development of construction projects from stakeholders and life cycle perceptions in China. Out of the total 88 risks assessed 20 key risk factors were identified and were mainly related to contractors, clients and designers with a few related to Government bodies, subcontractors/suppliers and external issues. Among them, in ranking, were: “Tight project schedules”; “design variations”; “excessive approval procedures in administrative government departments”; “high performance standards required”; “unsuitable contractors’ programme planning”; “variation of construction programme”; “low management competency of sub-contractors”; and “variations by the client”.

This paper assessed Kenyan contractors’ opinion on risk occurrence and their impact on project objectives. Through rigorous risk analysis process key risks affecting project delivery in relation to project cost, time, quality, environment and site health and safety were determined.

IV. RESEARCH METHODOLOGY

The research methodology selected for this study comprised of comprehensive literature review, questionnaire to the contractors and a statistical analysis of the survey data. Data was gathered through a questionnaire survey, self-administered to construction companies’ senior managers and construction consultants working in these organizations. The questionnaire consisted of two parts. Part 1 solicited for general information about the respondents. Part 2 of the questionnaire consisted of a total of 45 risks associated with construction projects. It requested respondents to indicate the likelihood of occurrence of these risks as almost certain, highly likely, likely, unlikely or rare and the level of impact on each project objective that would result in as very high, high, moderate, low or very low.

The study targeted contractors registered in Kenya by the National Construction Authority (NCA) in category NCA 5 to NCA 1. A sample of 190 respondents was determined for this study using a formula developed by Cochran (1963). Sixteen (16) of the respondents were from class NCA 1, 12 from class NCA 2, 22 from class NCA 3, 74 from class NCA 4 and 66 from class NCA 5. Stratified random sampling was adopted for this study. According to Kothari (2004), this method of sampling is used where the population embraces a number of distinct categories, the frame can be organized by these categories into separate "strata." Each stratum is then sampled as an independent sub-population, out of which individual elements are randomly selected. Selection of contractors from each stratum was based on simple random sampling. In assessing construction risk the research targeted senior managers, project managers, technical managers, architects, quantity surveyors and engineers employed by the contractors as the sample units.

Prior to disseminating the questionnaire, a pilot study was conducted to try-out the research techniques and methods, and questionnaires. Twenty (20) questionnaires were prepared and self-administered to senior managers and consultants in construction companies. The respondents were not only supposed to complete the questionnaires but also give comments on them. Twelve (12) of these contractors responded. Their comments were well noted to establish whether the questions were clear to them and whether they were comfortable with them. The pilot survey results formed the basis of modifying the questionnaire for the subsequent full-scale survey. Questionnaires were then distributed to the respondents and 21 days were given to complete them before collection. Reminders were sent after the first week of distribution. All the questionnaires were picked after this period of time or within any other agreed date. Ninety eight (98) valid questionnaires were returned.

The survey feedback included two groups of data, risk likelihood of occurrence and the resultant impact on project objectives in terms of cost, time, quality, environment and health and safety. The data provided by the questionnaire was analyzed using descriptive statistic where some measures of distribution, central tendency and dispersion were used. Findings were presented using tables and radar diagram.

With respect to the impact on a particular project objective, a significance score for each risk assessed by each respondent was calculated. Significance index score was then determined for every risk. This is the average score for each risk considering its significance on a project objective. The significant index developed by Shen et al. (2001) was used in this research. This can be described as the function of the two attributes, that is, the likelihood of occurrence of risk and its level of impact on project objective.

$$r = f(\alpha\ \beta) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where; r = risk significance
α = risk probability
β = risk impact

The significance score for each risk assessed by each respondent was calculated as follows:-

$$r^k_{ij} = \alpha_{ij}\ \beta^k_{ij} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where;

r^k_{ij} = significance score assessed by respondent *"j"* for risk *"i"* on project objective *"k"*

i = ordinal number of risk = (1, 45)
k = ordinal number of project objective = (1, 5)
j = ordinal number of valid response = (1, n)
n = total number of valid response to risk *"i"*

α_{ij} = risk probability assessed by respondent *"j"* for risk *"i"*

β^k_{ij} = risk impact assessed by respondent *"j"* for risk *"i"* on project objective *"k"*.

The average score (significance index score) for each risk in relation to the different project objectives was calculated. This was used to rank the risks. The model for the calculation of risk index score can be written as:-

$$R^k_j = \frac{\sum_{j=1}^{n} r^k_{ij}}{n} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where;

R^k_j = significance index score for risk *"i"* on project objective *"k"*.

For the purpose of calculating significance score assessed by the various respondents for the various risks on different project objectives, a numerical conversion for the rating of the scale was applied. Five- point scale was applied for α (almost certain, highly likely, likely, unlikely and rare/remote) and for β (very low impact, low impact, medium/ moderate impact, high impact and very high impact). These scales were converted into numerical scales as shown in the table 1 below.

Table 1: Numerical conversion scale (Risk probability and risk impact)

α (Risk probability)		
Scale (Rating attributes)	**Meaning**	**Numerical conversion**
1	rare (remote)	0.2
2	unlikely	0.4
3	Likely	0.6
4	highly likely	0.8
5	almost certain	1.0

β (risk impact)		
Scale (Rating attributes)	**Meaning**	**Numerical conversion**
1	very low	0.2
2	low	0.4
3	medium/ moderate	0.6
4	high	0.8
5	very high	1.0

Table 2 shows a risk matrix constructed for the calculation of the risk significance index by combining both the risk probability and impact numerical scales. The index score calculated was used to rank risk factors to determine the key risks that affect the construction project objectives.

Table 2: Risk analysis matrix- risk significance index

		RISK IMPACT (β)				
		Very Low (0.20)	Low (0.40)	Moderate (0.60)	High (0.80)	Very High (1.00)
RISK PROBABILITY (α)	Almost certain (1.00)	0.20 (M)	0.40 (H)	0.60 (E)	0.80 (E)	1.00 (E)
	Highly likely (0.80)	0.16(M)	0.32 (H)	0.48 (E)	0.64 (E)	0.80 (E)
	Likely (0.60)	0.12 (L)	0.24 (M)	0.36 (H)	0.48 (E)	0.60 (E)
	Unlikely (0.40)	0.08 (L)	0.16 (M)	0.24 (M)	0.32 (H)	0.40 (H)
	Rare (Remote) (0.20)	0.04 (L)	0.08 (L)	0.12 (L)	0.16 (M)	0.20 (M)

calculation and level of risk.

Key:

E (Red): Extreme risk 0.48 - 1.00
M (Yellow): Moderate risk 0.16 – 0.31
H (Orange): High risk 0.32 - 0.47
L (Green): Low risk 0.00 – 0.15

V.RESULTS AND DISCUSSION

A. Response rate

Out of the 190 questionnaires distributed to respondents, 100 feedbacks were received in which 2 of them were identified as invalid by reason of being incomplete or invariable answers. This represents an overall valid response rate is 51.58% which according to Rubin and Babbie (2009) is considered adequate for analysis and reporting. Table 3 presents this response information in relation to NCA category and sample distribution.

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Table 3: Response rate

NCA Category	Sampled	Responded (Valid)	Percent of sampled (%)
NCA 1	16	7	43.75
NCA 2	12	11	91.67
NCA 3	22	19	86.36
NCA 4	74	27	36.49
NCA 5	66	34	51.52
Total	190	98	51.58

Source: Researcher`s field survey

B. General Information

The study sought to establish the profile of the respondents in terms of the highest level of education, professional qualification, position held in the Construction Company and experience in the construction industry. The study also sought information on Construction Company in terms of NCA registration. The information gathered was described using frequencies and percentages.

- ***Highest level of education of respondents***

Table 4 shows distribution of respondents according to the highest level of education attained. The table shows that approximately 6 percent of the respondents had certificates (artisans). Approximately 33 percent of the respondents were diploma holders and was second majority respondents after degree holders at 50 percent. The least were post graduates with approximately 11 percent and were largely master degree holders.

Table 4: Highest Level of Education

	Frequency	Percent	Valid Percent	Cumulative Percent
Certificate	6	6.1	6.1	6.1
Diploma	32	32.7	32.7	38.8
Degree	49	50.0	50.0	88.8
Post graduate	11	11.2	11.2	100.0
Total	98	100.0	100.0	

Source: Researcher`s field survey

- ***Professional qualification***

Table 5 shows the percentage distribution of the respondents in terms of professional qualification. The table shows that approximately 14 percent of the respondents were project managers. Engineers were the majority at approximately 29 percent. These were mainly civil engineers, electrical engineers and mechanical engineers. Quantity surveyors and architects were approximately 9 percent and 14 percent respectively.

Table 5: Professional Qualification

	Frequency	Percent	Valid Percent	Cumulative Percent
Project manager	14	14.3	14.3	14.3
Engineer	28	28.6	28.6	42.9
Quantity surveyor	9	9.2	9.2	52.0
Architect	14	14.3	14.3	66.3
Others	33	33.7	33.7	100.0
Total	98	100.0	100.0	

Source: Researcher`s field survey

- ***Position held in the construction company***

Table 6 presents the frequency and the percentage distribution of the respondents according to position they hold in construction companies. The table shows that about 36 percent and 16 percent of the respondents were directors and senior managers respectively. These were the majority groups. The table also shows that both technical managers and engineers were at approximately 12 percent each. Quantity surveyors and architects are approximately 4 percent and 8 percent respectively. The table further point out that approximately 8 percent of the respondents are employed as project managers while approximately 3 percent do other jobs other than directors, senior managers, technical managers, engineers, quantity surveyors, architects and project managers.

Table 6: Position Held

	Frequency	Percent	Valid Percent	Cumulative Percent
Director	35	35.7	35.7	35.7
Senior manager	16	16.3	16.3	52.0
Technical manager	12	12.2	12.2	64.3
Engineer	12	12.2	12.2	76.5
Quantity surveyor	4	4.1	4.1	80.6
Architect	8	8.2	8.2	88.8
Project manager	8	8.2	8.2	96.9
Others	3	3.1	3.1	100.0
Total	98	100.0	100.0	

Source: Researcher`s field survey

- ***Experience in the construction industry***

Table 7 shows the frequency and the percentage distribution of the respondents according to their years of experience in the construction industry.

Table 7: Years of Experience

	Frequency	Percent	Valid Percent	Cumulative Percent
1 Year or less	1	1.0	1.0	1.0
More than 1 year - 5 year	18	18.4	18.4	19.4
More than 5 years - 10 years	27	27.6	27.6	46.9
More than 10 years - 15 years	23	23.5	23.5	70.4
More than 15 years	29	29.6	29.6	100.0
Total	98	100.0	100.0	

Source: Researcher`s field survey

Approximately 30 per cent of the respondents have more than 15 years of experience in the construction industry whereas about 23 percent and 28 percent had experience of 10 to 15 years and experience of 5 to ten 10 years respectively. The table further shows that approximately 18 percent of the respondents had experience of between 1 and 5 years. Only a minority of 1 percent had experience of less than 1 year.

- ***NCA Registration of the respondents' construction company***

Table 8 presents the frequency and the percentage distribution of the respondents according to their organization NCA registration. Approximately 7 per cent of the respondents had their construction companies registered in category NCA 1 whereas about 11 percent and 19 percent were registered in categories NCA 2 and category NCA 3 respectively.

Table 8: NCA Registration

	Frequency	Percent	Valid Percent	Cumulative Percent
NCA 1	7	7.1	7.1	7.1
NCA 2	11	11.2	11.2	18.4
NCA 3	19	19.4	19.4	37.8
NCA 4	27	27.6	27.6	65.3
NCA 5	34	34.7	34.7	100.0
Total	98	100.0	100.0	

Source: Researcher`s field survey

The findings further indicate majority of respondents, approximately 28 percent and 35 percent, were registered in categories NCA 4 and NCA 5 respectively. Majority of the respondents, approximately 34 percent, were from other professional groups. This included land surveyors, accountants, land economists and business administrators. This indicates that there are several proprietors who are in construction business though their training background is not construction related.

- ***Summary of respondents' information***

Majority of respondents are learned with approximately 61 percent having a first degree and above and the rest with either a diploma or a certificate in a technical area. This indicates that these are people who understand the questions contained in the questionnaire. They also appreciate the operations in the construction industry.

It is apparent from the findings that majority of respondents were Engineers, Architects, Construction project managers or Architects whom constitute a total of approximately 66 percent. Thirty five percent (35%) of the respondents are directors and approximately 16% were senior managers. These are people with technical and managerial background in construction and therefore understand the procedures and operations related to it. Also majority of the respondents (over 80%) have experience of over five (5) years in the construction industry. Professionalism coupled with long experience in the industry supports the belief that the respondents had sufficient knowledge of issues related to risk likelihood occurrence and the degree of impact on construction projects objectives. This discussion show that the data was collected from reliable sources and therefore results of this research can be relied on by contractors in their effort to improve on risk management.

It is apparent that majority of the respondents' organizations are registered in category NCA 4 and NCA 5 but when compared with the sample distribution the response was highest with the respondents in category NCA 2 followed by NCA 3. Response in other categories, that is, NCA 1, NCA 4 and NCA 5 was average. These are contractors who are active in the industry handling big projects, with qualified personnel, adequate equipments and strong financial standing. The good response with these categories is a pointer that the information provided is highly reliable in laying down strategies to manage construction risks.

C. Risk Significance Index Score (RSIS) and Ranking of risks

Essentially all the risks observed in the questionnaire can happen to any construction project. The main purpose of this investigation was not only to identify a list of risks but also to ascertain the key risks that can significantly influence the delivery of construction projects in Kenyan. RSIS represent the relative importance of risk from the contractors' perspective. Risks are ranked in accordance with their RSIS in relation to project cost; time; quality; environment; and health and safety. To determine the key risks affecting the different project objectives, only the top ten ranked ones are chosen as key risks. The results of this analysis are shown in table 9.

- ***Significant Cost related risk***

Table 9 shows that "Delayed payment by the employer" has the highest RSIS of 0.5514 and a standard deviation of 0.2457. This is followed by "Cost under estimation" with RSIS of 0.5356 and a standard deviation of 0.2643.

Other important cost related risks, in order of significance, as presented in table 9 are: "Design variations required by clients" (RSIS of 0.5322 and Standard deviation of 0.2760), "Lack of consistency between the BQs, drawings and specifications" (RSIS of 0.5265 and Standard deviation of 0.2461), "Actual quantities different from contract quantities" (RSIS of 0.5245 and Standard deviation of 0.2388), "Information unavailability-details, drawings, sketches" (RSIS of 0.5106 and Standard deviation of 0.2559), "Exchange rate fluctuations and inflation" (RSIS of 0.5037and Standard deviation of 0.3115) , "Excessive approval procedures in administrative government departments" (RSIS of 0.5000 and Standard deviation of 0.2456), "High performance or quality standard to meet" (RSIS of 0.4981 and Standard deviation of 0.2621) and "Inadequate/ defective specification" (RSIS of 0.4957 and Standard deviation of 0.2164).

- ***Significant Time related risk***

Table 9 shows that "Delayed payment by the employer" has the highest RSIS of 0.5849 and a standard deviation of 0.2505. This is followed by "Excessive approval procedures in administrative government departments" with RSIS of 0.5641 and a standard deviation of 0.2832.

RSIS for other time related risks in order of significance are: "Information unavailability-details, drawings, sketches" (RSIS of 0.5527 and Standard deviation of 0.2703), "Design variations required by clients" (RSIS of 0.5474 and Standard deviation of 0.2851), "Adverse weather conditions" (RSIS of 0.5347 and Standard deviation of 0.2454), "High performance or quality standard to meet" (RSIS of 0.4924 and Standard deviation of 0.2645), "Delays in supply of utilities i.e. electricity and water" (RSIS of 0.4898 and Standard deviation of 0.2177), "Financial failure of the contractor" (RSIS of 0.4878 and Standard deviation of 0.2193), "Lack of consistency between the BQs, drawings and specifications" (RSIS of 0.4857 and Standard deviation of 0.2291) and "Financial failure of the sub-contractor" (RSIS of 0.4833 and Standard deviation of 0.2281).

- ***Significant Quality related risk***

Table 9 shows that under the quality related factors, "Information unavailability-details, drawings, sketches" has the highest RSIS of 0.5188 and a standard deviation of 0.2817. This is followed by "High performance or quality standard to meet" with RSIS of 0.4983 and a standard deviation of 0.2792

RSIS for other quality related risks as presented in table 9 are: "Inadequate/ defective specification" (RSIS of 0.4825 and Standard deviation of 0.2318), "Defective work" (RSIS of 0.4657 and Standard deviation of 0.2483), "Inadequate supervision and supervision team" (RSIS of 0.4631 and Standard deviation of 0.2294), "Lack of consistency between the BQs, drawings and specifications"(RSIS of 0.4567 and Standard deviation of 0.2475), "Technical complexity and design innovations requiring new construction methods and materials" (RSIS of 0.4532 and Standard deviation of 0.2519), "Lack of coordination between project participants (RSIS of 0.4474 and Standard deviation of 0.2391) "Cost under estimation"(RSIS of 0.4400 and Standard deviation of 0.2594) and "Inadequate or insufficient site information (site investigation report)" (RSIS of 0.4342 and Standard deviation of 0.2350).

Table 9: Top 10 ranked risks as per their significance in relation to project objective

RISK FACTORS	RSIS	STD DEVIATION	RANK
COST RELATED			
Delayed payment by the employer	0.5514	0.2457	1
Cost under estimation	0.5356	0.2643	2
Design variations required by clients	0.5322	0.2756	3
Lack of consistency between the BQs, drawings and specifications	0.5265	0.2461	4
Actual quantities different from contract quantities	0.5245	0.2388	5
Information unavailability-details, drawings, sketches	0.5106	0.2559	6
Exchange rate fluctuations and inflation	0.5037	0.3116	7
Excessive approval procedures in administrative government departments	0.5000	0.2456	8
High performance or quality standard to meet	0.4981	0.2621	9
Inadequate/ defective specification	0.4957	0.2164	10
TIME RELATED			
Delayed payment by the employer	0.5849	0.2505	1
Excessive approval procedures in administrative government departments	0.5641	0.2832	2
Information unavailability-details, drawings, sketches	0.5527	0.2703	3
Design variations required by clients	0.5474	0.2851	4
Adverse weather conditions	0.5347	0.2454	5
High performance or quality standard to meet	0.4924	0.2645	6
Delays in supply of utilities i.e. electricity and water	0.4898	0.2177	7
Financial failure of the contractor	0.4878	0.2193	8
Lack of consistency between the BQs, drawings and specifications	0.4857	0.2291	9
Financial failure of the sub-contractor	0.4833	0.2281	10
QUALITY RELATED			
Information unavailability-details, drawings, sketches	0.5188	0.2817	1
High performance or quality standard to meet	0.4983	0.2792	2
Inadequate/ defective specification	0.4825	0.2318	3
Defective work	0.4657	0.2483	4
Inadequate supervision and supervision team	0.4631	0.2294	5
Lack of consistency between the BQs, drawings and specifications	0.4567	0.2475	6
Technical complexity and design innovations requiring new construction methods and materials	0.4532	0.2519	7
Lack of coordination between project participants	0.4474	0.2391	8
Cost under estimation	0.4400	0.2594	9
Inadequate or insufficient site information (site investigation report)	0.4342	0.2350	10
ENVIRONMENT RELATED			
Lack of compliance with environmental requirements	0.4208	0.2536	1
Lack of compliance with safety and health requirements on site	0.3984	0.2457	2
Adverse weather conditions	0.3849	0.2136	3
Inadequate or insufficient site information (site investigation report)	0.3820	0.2081	4
Inadequate labour and equipment productivity	0.3637	0.2059	5
Impact of construction project on surrounding environment	0.3514	0.2223	6
Unhealthy working condition for workers	0.3439	0.2237	7
Defective work	0.3371	0.2394	8
Inadequate/ defective specification	0.3363	0.1844	9
Wastage of materials on site by workers	0.3255	0.2062	10
HEALTH AND SAFETY RELATED			
Lack of compliance with safety and health requirements on site	0.4746	0.2824	1
Unhealthy working condition for workers	0.4499	0.2592	2
Adverse weather conditions	0.3902	0.2228	3
Lack of compliance with environmental requirements	0.3858	0.2205	4
Unstable security circumstances	0.3383	0.2233	5
Inadequate or insufficient site information (site investigation report)	0.3363	0.2034	6
Defective work	0.3363	0.2367	7
Inadequate/ defective specification	0.3352	0.1907	8
Tight project schedule	0.3090	0.2164	9
High performance or quality standard to meet	0.3072	0.1801	10

Source: Researcher`s field survey

- ***Significant Environment related risk***

Table 9 shows that under the environment related factors, "Lack of compliance with environmental requirements" has the highest RSIS of 0.4208 and a standard deviation of 0.2536. This is followed by "Lack of compliance with safety and health requirements on site" with RSIS of 0.3984 and a standard deviation of 0.2457.

RSIS for other environment related risks as presented in table 9 are: "Adverse weather conditions" (RSIS of 0.3849 and Standard deviation of 0.2136), "Inadequate or insufficient site information (site investigation report)" (RSIS of 0.3820 and Standard deviation of 0.2081), "Inadequate labour and equipment productivity" (RSIS of 0.3637 and

Standard deviation of 0.2059), "Impact of construction project on surrounding environment" (RSIS of 0.3514 and

	RISK FACTOR	RSIS	RANK
15	Delayed payment by the employer	0.5849	1
36	Excessive approval procedures in administrative government departments	0.5641	2
6	Information unavailability-details, drawings, sketches	0.5527	3
1	Design variations required by clients	0.5474	4
39	Adverse weather conditions	0.5347	5
19	Cost under estimation	0.5356	6
8	Lack of consistency between the BQs, drawings and specifications	0.5265	7
29	Actual quantities different from contract quantities	0.5245	8
18	Exchange rate fluctuations and inflation	0.5037	9
23	High performance or quality standard to meet	0.4983	10
5	Inadequate/ defective specification	0.4957	11
14	Delays in supply of utilities i.e. electricity and water	0.4898	12
16	Financial failure of the contractor	0.4878	13
17	Financial failure of the sub-contractor	0.4833	14
43	Lack of compliance with safety and health requirements on site	0.4746	15
21	Defective work	0.4657	16
33	Inadequate supervision and supervision team	0.4631	17
41	Unhealthy working condition for workers	0.4499	18
22	Technical complexity and design innovations requiring new construction methods and materials	0.4532	19
35	Lack of coordination between project participants	0.4474	20
4	Inadequate or insufficient site information (site investigation report)	0.4342	21
42	Lack of compliance with environmental requirements	0.4208	22
30	Inadequate labour and equipment productivity	0.3637	23
40	Impact of construction project on surrounding environment	0.3514	24
44	Unstable security circumstances	0.3383	25
11	Tight project schedule	0.3090	26

Standard deviation of 0.2230), "Unhealthy working condition for workers" (RSIS of 0.3439 and Standard deviation of 0.2237), "Defective work" (RSIS of 0.3371 and Standard deviation of 0.2394)," Inadequate/ defective specification" (RSIS of 0.3363 and Standard deviation of 0.1844) and "Wastage of materials on site by workers" (RSIS of 0.3255 and Standard deviation of 0.2063).

- ***Significant Health and safety related risk***

Table 9 shows that under the health and safety related factors, "Lack of compliance with safety and health requirements on site" has the highest with RSIS of 0.4746 and a standard deviation of 0.2824. This is followed by "Unhealthy working condition for workers" with RSIS of 0.4499 and Standard deviation of 0.2592.

RSIS for other health and safety related risks as presented in table 9 are: "Adverse weather conditions" (RSIS of 0.3902 and Standard deviation of 0.2228), "Lack of compliance with environmental requirements" (RSIS of 0.3858 and Standard deviation of 0.2205), "Unstable security circumstances" (RSIS of 0.3383 and Standard deviation of 0.2233), "Inadequate or insufficient site information" (site investigation report) (RSIS of 0.3363 and Standard deviation of 0.2034), "Defective work" (RSIS of 0.3363 and Standard deviation of 0.2367, "Inadequate/ defective specification" (RSIS of 0.3352 and Standard deviation of 0.1907), "Tight project schedule" (RSIS of 0.3090 and Standard deviation of 0.2164) and "High performance or quality standard to meet" (RSIS of 0.3021 and Standard deviation of 0.3072).

D. Key risk affecting project delivery among contractors in Kenya

Key risk are determined through ranking of risk factor according to their relative importance expressed as relative significance index score (RSIS). In total 50 risks were believed to be able to influence the project objectives, with 10 factors related to each of the project objectives. It is apparent that a number of the 50 risks are repeated among the five grouping (see that in table 9). For example, "Delayed payment by the employer can influence both cost and time; "Lack of consistency between BQs, drawings and specifications" can influence cost, time and quality. With the repeated ones filtered, a total of 26 factors are highlighted as key risks to influence the achievement of the project objectives.

Table 10: Key risks that influence project delivery among contractors in Kenya

Source: Researcher`s field survey

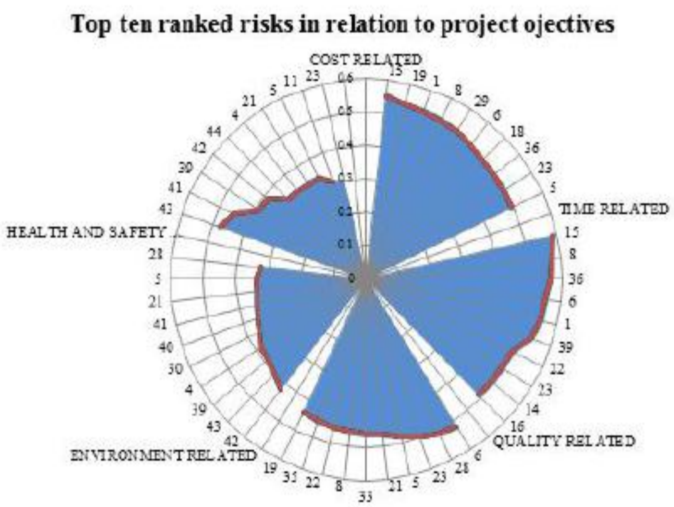
Table 10 gives these risks together with their RSIS and their rank. "Delayed payment by the employer" appears to be the most influential risk affecting all the project objectives. It has its highest level impact on time and cost at RSIS of 0.5849
and 0.5514 respectively. This risk can influence all the project objectives but significantly the project cost and time. The second ranked risk is "excessive approval procedures in administrative government departments". This risk also has its dominant influence on both time and cost at RSIS of 0.5641 and 0.5000 respectively. It's good to note that this is ranked as the second significant risk affecting project time. "Information unavailability-details, drawings, sketches" is the third ranked risk. The risk has a significant impact on all the project objectives. It also emerges to be the risk most affecting the project quality having RSIS of 0.5188. The risk has its highest impact on project time (RSIS of 0.5527) where it is ranked third and also a significant impact on cost where it is ranked sixth. "Design variations required by clients" comes out as being a very influential risk on both time and cost having RSIS of 0.5474 and 0.5322 respectively. The risk is ranked third impacting on cost and forth on time.

Table 9 and Table 10 show "Adverse weather conditions" as a very dominant risk among contractors in Kenya. It has its highest impact on time having RSIS of 0.5347 and ranked fifth. The risk is also a significant risk in both environment and health and safety where it is ranked third and fourth respectively. "Cost under estimation" emerges as another important risk factor with dominant impact on cost and quality. It is ranked as second in relation to cost and ninth in relation to quality having RSIS of 0.5356 and 0.4400 respectively. "Lack of consistency between the BQs, drawings and specifications" is ranked seventh with a significant impact on cost, time and quality. It emerges to be the forth influential on cost with RSIS of 0.5265 and sixth and ninth on quality and cost respectively.

Another significant risk in the list is “Actual quantities different from contract quantities” with a dominant impact on cost and ranked fifth having RSIS of 0.5245. “Exchange rate fluctuations and inflation” has also a notable impact on project cost with RSIS at 0.5037 and ranked as seventh factor influencing this project objective. “Lack of compliance with safety and health requirements on site” ranked fifteenth in the list is the risk having the highest impact on health and safety with a RSIS of 0.4746.

Figure 1 is a graphical presentation of key risks in relation to the different project objectives. This does not only help to understand how many project objectives each risk can influence but also help to visualize the magnitude of the significance of different risks on a particular project objectives. Figure1 is an alteration of table 9 and it is apparent from both presentations that both cost and time are objectives most vulnerable to risk with slightly higher impact to time than cost. It is evident that RSIS for all the risks influencing both the objectives are between 0.48 and 1.00 indicating they can be regarded as extreme risks as per risk analysis matrix (Figure1). Project quality is also not safe from risks; half of the ten key risks influencing it are extreme and the other half being high. Risks impacting on project environment range between 0.32 and 0.48 meaning they are high.

Figure: 1 Key risk and their influence project objectives



Source: Research data

Generally most index scores are located between 0.32 and 1.00 with only one risk with RSIS below 0.32. This implies that almost all risks contained in this list are either high or extremely high indicating that the identification of the 26 key risks is valid.

VI. CONCLUSION

This research endeavored to identify key risks associated with the achievement of project objectives by contractors in terms of cost, time, quality, environment and health and safety. After a comprehensive analysis of the data collected from contractors, key risks influencing project delivery were identified. A total of 26 risks were highlighted as key risks inhibiting the achievement of project objectives. Table 10 gives these risks together with their RSIS and their rank. The identification of the twenty 26 key risks was found to be valid because 25 of the risks are either high or extremely high and only one risk is moderate.

The research also showed that key construction risks have their highest impact on either project cost or time. All the key risks impacting on these two objectives are extremely high. Risks influencing project quality are either extreme or high in impact. Environment and health and safety are established to be the project objective least vulnerable to risks. However, eight of the key risks have high impact on them with only one risk which is medium in impact.

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