RISK ASSESSMENT IN INFRASTRUCTURAL PROJECTS

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ABSTRACT

Infrastructural projects presents opportunities of economic growth and social development. These type of projects are normally undertaken by governments and include projects like building major roads, dams, power stations, railway lines, ports and airports. These projects, when completed supports varied economic activities including much needed employment creation. The life cycle of infrastructural projects is characterized by the involvement of various stakeholders who participate at different stages of the project. Projects of this magnitude are associated with diverse risks that include under management, under-financing, cost-overruns, delays, failed procurement, poor scheduling, inadequate designs, human risks, organizational risks and technological risks. The purpose of this research paper is to assess risks that were faced by Company A that is involved with power generation infrastructural projects. In this paper we report on the findings of risks that impacted negatively on the timeously delivery of an infrastructural project.

This paper focusses on assessing risks that are found in infrastructural projects. A case study was carried out on Company A. The case study involved a survey, were 35 valid responses were received and six senior project managers were interviewed.

The research found that planning, execution and delivery of infrastructural projects is very complex. Some of the risks that were noticed in Company A were poor designs, lack of skilled manpower and poorly defined roles between contractors and operators. Undercapitalization was found to be the major risk. To enhance the successful offering of projects companies must have a proactive approach.

This paper builds up on the body of knowledge of risks found in infrastructural projects. To project practitioners the paper highlights the importance of project budgeting, scope creep, and soft issues on human factors such as cohesion among team members.

Keywords: Infrastructural projects, risk, development, economic growth.

INTRODUCTION

According to Beckers et al., (2013) governments carry out huge infrastructural projects as a way of stimulating social development and economic growth. These projects include among others major road construction, building of dams, power stations, railway lines, ports and airports. The motivation to invest huge sums of money into infrastructural projects is to try and stimulate economic activities and avoid economic stagnation caused by underdeveloped infrastructure. A developed infrastructure improves people's lifestyles and attracts investors who help by creating

employment. Beckers, et al, (2013), identified that major infrastructure projects have a history of problems that include cost overruns, delays, failed procurement and unavailability of private financing. Beckers et. al., (2013) went further and argued that "infrastructure projects involve a large number of different stakeholders entering the project life cycle at different stages with different roles, responsibilities, risk-management capabilities". The arguments presented by Berckers et al, (2013) were supported by Cooper et al (2005) who highlighted that the different roles and responsibilities in projects, often brings in conflicting interest. Project managers must anticipate problems that are likely going to come from diverse personnel with varying skills and expectations that will be participating in the project delivery, (Beckers et al., 2013; Zou et al., 2007).

The success of infrastructure projects is based on how best risks have been identified and managed. It is crucial that managers identify project risk factors from project inception to delivery. To improve project success and minimize disruptions it is important for companies to proactively investigate and evaluate any possible risks. Several potential risks that could be anticipated in infrastructural development projects that are a focus of this research are under management, under financing, cost-overruns, delays, failed procurement, poor scheduling, inadequate designs, human risks, organizational risks and technological risks. A questionnaire was used to gather information and data that pertains to infrastructural development projects that were done in Company A.

Belassi and Tukel (1996) reported that "since the 1950s most of the work in project management has focused on project scheduling problems, assuming that the development of better scheduling techniques would result in better management and the successful completion of projects". Munns and Bjermi (1996) argued that "the process of bringing new projects on stream and into the market imposes demands on established organizations and necessitates different management techniques from those required to maintain day-to-day operations". Most previous project management research emphasized on the reasons for unsuccessful project delivery and not on successful projects (Zou et al, 2007). Majority of project managers were guided by targets such as completion time, performance, budget and customer satisfaction (Wan and Hou, 2012). The overall threats to successful project delivery caused by diverse and dynamic environments that infrastructural projects are carried out was not part of the research agenda, (Miller, 2009). While delays in finishing projects are a common phenomenon, most managers try hard to avoid paying penalties caused by not completing the project on time and thereby miss the opportunity to focus on other risks.

Risk identification and analysis is a continuous planning activity throughout the life-span of a project. Wan and Hou (2012), identified a list of critical factors from practice of project management, and assigned project participating members to which these factors would impact on. The critical factors were grouped into five areas as shown in the Table below.

Table 1: Critical factors in project management: Source: Wan, J.P.and Hou, J.J. (2012)

Project aspect	Risk Factors
The project itself	• Size and value • Uniqueness of project activities • Life cycle • Urgency

Project aspect	Risk Factors
Project leader	• Ability to delegate authority • Ability to tradeoff • Ability to coordinate • Perception of his role and responsibilities • Competence • Commitment
Team members	• Technical background • Communication skills • Commitment
The organization	• Top management support • Project organizational structure • Functional managers' support • Project champion • Inadequate financing
External environment	• Political environment • Economic environment • Social environment • Technological environment • Nature • Client • Competitors • Sub-contractors • Regulations

RESEARCH OBJECTIVES

This paper has the following objective:

- To evaluate how Company A assesses risks found in infrastructural projects.

LITERATURE REVIEW

Project Management

Munns and Bjermi (1996) defined project management, "as the process of controlling the achievement of the project objectives". This is achieved through the utilization of existing organizational structures and resources. Projects are managed by applying a collection of tools and techniques, without adversely disturbing the routine operation of the company (Schuyler, 2001).

Project management is orientated towards planning and control. This is the context of the short-term life of the project development and delivery. When project delivery is completed the management, as it relates to planning and control of the development and delivery, will cease (Munns and Bjeirmi 1996).

Zou et al., (2007) described the function of project management as, “defining the requirement of work, establishing the extent of work, allocating the resources required, planning the execution of the work, monitoring the progress of the work and adjusting deviations from the plan”. Project management is concerned with on-time delivery, within-budget expenditures and appropriate performance standards (Schuyler, 2001). Key performance indicators (KPIs) of project management success include completion to budget, satisfying the project schedule, adequate quality standards (Miller, 2009), and meeting the project goal, Zou et al., (2007). To achieve these KPIs project managers must show dedication to finish the project; recruit and appoint qualified project team members; must fully describe the project; properly plan the tasks in the project; (Zou et al., 2007), ensuring accurate and acceptable information flows; altering activities to take care of ever-changing environments; helping employees achieve their targets with performance and payments; and adopting new strategies when errors have been noticed (Munns and Bjeirmi, 1996).

Risk Management

Beckers, et. al, (2013) defined risk management as, “a system which aims to identify and quantify all risks to which the business or project is exposed so that a conscious decision can be taken on how to manage the risk”. Risk management is an important step in project success (De Landa et al., 2003). Zoul et. al., (2007), reported that there is a direct correlation between project achievement and effective risk management since risks are evaluated by their A direct relationship between effective risk management and project success is acknowledged since risks are assessed by their probable effect on project objectives. Zoul et. al., 2007, further stated that, “risk management is the process of identifying, classifying, analyzing and assessing of inherent risks in a project. While risks cannot be totally removed, successful projects are those where risks are efficiently managed (Zou et al. 2007).

Sufficient risk management may lead the project manager to numerous advantages such as identification of different course of action, improved chances of delivering projects in time, enhanced chances of accomplishment, less mistakes, more accurate approximations (through reduced uncertainty), few repeated efforts (through team attentiveness. Cooper et. al., (2005), summarized the objectives of risk assessment as:

- It gives an outline of the overall forms of risk that may impact negatively on the project.
- It helps management to focus more on would be major risks.
- It assists with decision making on type of actions needed and gives an opportunity to prepare action for upcoming activities.
- It expedites the provision of resources to support management’s action decisions

Zou et. al., (2007), perceived project risk as, “the potential for unwanted or negative consequences of an event or activity”. Schuyler (2001) stated that, “in business, the risks and uncertainties reflect the unknowns and variability in nature, materials, and human systems”. Webber, (2008), identified three phases linked to a risk as, “ (i) the loss associated with the event; (ii) the likelihood that the

event will occur; and (iii) the degree to which event consequences may be changed**".** Mobey and Parker (2002) stated that "to increase the chances of a proposed system succeeding it is necessary for the organization to have an understanding of potential risks, to systematically and quantitatively assess these risks, anticipating possible causes and effects, and then choose appropriate methods of dealing with them". De Land et al., (2003), reported that "projects essentially have a fixed scope which they are required to deliver within this ever-changing environment, which naturally poses risk to the project". Mobey and Parker, (2002), suggested that once risks have been identified, they can be reduced, removed, avoided or accepted.

Human Risks

Human factors relate to the interpersonal abilities of the people involved with the project – individual skills to work as a team toward a shared goal, in the face of conflict, competition, turf and status, (Burke et al, 2001). In reality the attainment or failure of any project rests on the capability of the leaders involved to manage the "human factors" of the project, (Webber, 2008). Burke et al, (2001) stated that "many opportunities are lost in system implementations because the people involved refuse to view the implementation as an opportunity to evaluate current processes and look for better ways of working". Henderson (2008) suggested that "even when the direct source of risk seems to lie in the operation of a process or from a structure, people are likely to be involved to some extent because it is people who design, own and operate structures and processes".

In putting together a project implementation team, project leader needs to assess her/his individual ability and then pull in individuals with complementary talents (Burke et al, 2001). They need to honestly look for, "recurring patterns of thought, feeling or behavior", to determine if an individual possesses a particular talent. Burke et. al., (2001) further reported that "in any project implementation, who plays what roles must be based more on the talents an individual brings to the table than his or her position".

In the dynamic and ever changing world of projects management, communication remains as one of the most desired skill for managing projects (Henderson, 2008). Krahn and Hartment cited in Henderson, (2008) found that listening and verbal competencies were rated by experts in the top 10 of a list of 50 competencies important for project managers to be successful in today's organizational environments. The major objectives of communication is to encourage a sense of ownership for the project on the part of everyone in the institution. This strengthens the idea of joint ownership for the project, and supports buy-in from the larger community as well. One thing that is not expected is for people to be surprised and/or develop the wrong set of expectations (Burke et al, 2001). The research by Henderson (2008) shows that project managers' capability in interpreting messages is significantly and positively related to the team members' contentment and throughput.

Henderson, (2008) defined human factors as, "individual, project team and organizational factors, which influence the behavior of people and the climate at work, in a way which can increase or decrease productivity of a construction project". This definition classified human factors into main groups which are further divided into 3 sub-categories Henderson (2008. These are as follows:

- *Individual factors* – competency, understanding and abilities, stress, enthusiasm, passionate and cultural.

- *Project team factors* – management, information sharing and coordination, task and supervision.
- *Organizational factors* – systems and processes, guidelines and standards.

Henderson, (2008) argued that managing human factors is vital for project success. It includes all progressive and undesirable aspects of human nature including competition, expertise, motivation, dependability and retaliation, and is not noted for its unpredictability.

Organizational Risks

Miller (2009) stated that "as part of an interdependent system, organizations, society, and the natural environment are both necessary and threatening to one another. As the complexity of a constructed sociotechnical system increases, so do the resulting challenges associated with risk assessment and management". Miller (2009) went on to argue that "an organization-environment dichotomy masks the role of organizations in creating and controlling environmental uncertainty". According to Dorner cited in Miller (2009), the main challenges associated with complex systems are (1) their many interdependent factors, which must be understood holistically, rather than in isolation, (2) their dynamics, which make change relentless and limit the timeframe for interventions, and (3) observability of certain elements in the overall system. In a complex system, actions can have unanticipated consequences, and feedback effects can produce nonlinear outcomes. Risk arises not from singular causes but from interactions at the systemic level. System dynamics and agent-based computer simulation modeling are possible methods for understanding the risk implications of complex systems and potential interventions to mitigate risk (Miller, 2009).

Organizations involve diverse stakeholders with distinct perceptions of organizational risk and its implications Miller and Bromiley cited in Miller, (2009). Organizational decisions and actions affect the distribution of exposure to risk among stakeholders. Although stakeholders may demand compensation for their exposure to organizational risk, their contracts never fully anticipate all possible contingencies affecting an organization's ability to honor its explicit and implicit commitments. In the absence of compensation for risk bearing, stakeholders may hesitate to make firm-specific investments (Wang et al. 2003). As such, societal arrangements to manage and allocate risk have implications for wealth creation, as well as wealth distribution (Miller, 2009).

Technological Risks

Man (2002) reported that "when organizations become increasingly technology-dependent; they become highly vulnerable to risks of IT failure". Mobey and Parker, (2002) also stated that "most noticeable risk during system implementation is technology failure in terms of performance or reliability". Canon (1994) further argued that "system complexity can also hinder success, compounding poor knowledge-technology fit, i.e. the gap between the knowledge level of potential users and complexity of the system". This supports the necessity for prototypes and pilot tests.

To enhance successful implementation of the system it is important that users take part in the development and implementation stages of the system. Attitudes and perceptions can be improved through participation; users' can understand how the system functions including its technical features (Lin and Shao, 2000). Lassila and Brancheau, (1999) argued that "the degree of system-related training is an important factor for successful implementation".

Risk Models

Meredith, (2010) reported that "risk management is the systematic process of identifying, analyzing, and responding to project risks". Larson (2008) stated that "models have been developed that are being used to identify risks beforehand, assess their consequences early on, and plan ways to render them harmless to the objectives of projects". Cannon (1994) supported these ideas by stating that "the goal is the management of events that could have an adverse impact on the project". Risk models are used to come up with strategies that are helpful in identifying interactions and dependences of projects (Larson, 2008). However this paper dos not cover risk models, but will analyze if Company A follows any risk model in assessing risks associated with its infrastructural projects.

METHODOLOGY

A case study, approach was adopted for this paper (Yin, 2009). The case study had a mixed method approach. The study consisted of a detailed literature review on project risks. From literature a questionnaire on infrastructural project risks was developed, (Wan and Hou, 2012). The questionnaire had a 4 point Likert scale from strongly disagree to strongly agree. The questionnaire focused on finding out how risk management practices are currently being done in Company A. The questionnaire had five sections namely Project Management, Risk Management, Human Risks, Organizational Risks and Technological Risks. A sample of the questionnaire is attached as Appendix 1. An analysis of these risks sections is discussed below. The responses were analyzed as percentages of agree and disagree to the nearest integer value.The questionnaire was distributed to project managers at Company A. Semi-structured interviews were arranged with senior project managers, (Yin, 2009).

FINDINGS

A total of 45 questionnaires were distributed amongst infrastructural project managers of Company A. 38 responses were received, 3 questionnaires had incomplete information, hence only 35 responses were used. 6 senior project managers were interviewed.

Company A follows an internally developed model similar to one developed by Larson, (2008) when carrying out risk assessment. The company further identifies project risks through brainstorming sessions and use of experts. This qualitative exercise attempts to identify risks related to the project plan, stakeholders, resources, the organizational environment and the external environment (Zou et al., 2007). Identified risks are then documented with each risk's condition, cause and consequence clearly explained. Mojtahedi (2010) further reported that "potential risks are then assessed in group decision making process were participants are selected on their familiarity with the risk categories on the agenda". Larson (2008) argued that "two parameters that are looked into include the probability of the risk occurring and the corresponding impact the risk will have on the project objectives and organization". Wang et al., (2003) reported other factors that are also considered and these include the risk impact on time frame and risk tolerance of the project constraints of costs, schedule, scope and quality.

Identified project risks are then prioritized according to their potential implications for meeting the project's objectives (Mojtahedi, 2010). Company A prioritizes risks through the use of a probability

and impact matrix, and this agreed with the work of Mojtahedi, (2010). Senior project managers or hired experts are the ones that rank the risks into "high", "moderate", or "low". Numeric scales are assigned by using "similar to traffic light" system were colours such as red, amber, blue and green are assigned against predetermined value ranges. Below is an example of a risk matrix used by Company A.

Risk Assessment Matrix

Consequenses	A	B	C	D	E
6	III	II	I	I	I
5	III	II	II	I	I
4	IV	III	II	I	I
3	IV	III	II	II	I
2	IV	IV	III	II	II
1	IV	IV	III	III	III
	Likelihood				

Priority	Suggested timing of treatment	Authority for continued toleration of residual risk
I	Short term. Normally within 1 month.	Managing Directors, Chief Executive and Board
II	Medium term. Normally within 3 months.	Managing Directors, Senior General Managers and General Managers
III	Normally within 1 year	Senior General Managers, General Managers and Managers
IV	Ongoing control as part of a management system.	All staff

Figure 1: An example of a Risk Assessment Matrix, Source: Mojtahedi, (2010)

Project Management

Three areas were noted as areas of concern. The created project schedules were viewed to be unrealistic and not achievable. This is due to lack of efficient control of project schedules. Risk associated with this is that projects can run over the planned duration resulting in additional costs such as penalties, (Cooper et al., 2005; Beckers et al., 2013). Project funding was also a major concern for most project managers. 60 % of the project managers indicated that project funding was always not adequate. Undercapitalization of projects is a major risk, (Beckers et al., 2013). Closer analysis revealed that undercapitalization was due to inaccurate cost estimates and exchange rate variability (Wang et al., 2003).

Figure 2: Project Management Risks

Risk Management

The results in figure 3 show that project risk management strategies are in place. Risk management is effective with clear risk identification, assessment and strategy planning, (Cooper et al., 2005). There is a strong sense of project ownership and support from senior managers including other functional managers who are important stakeholders, (Webber, 2008). Commitment and support from senior managers helps in keeping the project teams motivated, (Mobey and Parker, 2002). Project governance was found to be good for most projects. Major concern was found to be scope creep. Project managers indicated that they ended up addressing maters that were not originally included in the original scope of the project, (Burke et al, 2001). Projects were running out of schedule in many cases. Reasons for scope creep were found to be ill defined scope, (Berckers, 2013), resulting from poor designs that were generated from inexperienced staff, (Burke et al 2001)

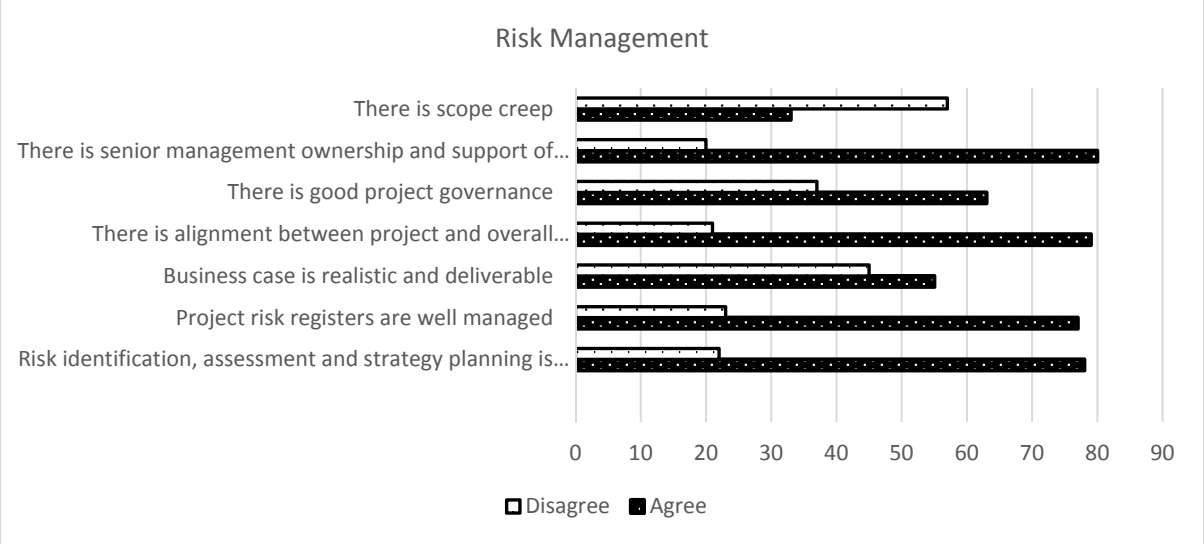

Figure 3: Risk Management Factors

Human Risks

Most human risk factors were found to be supportive of a smooth running of infrastructural projects. However two factors were identified as major risks, namely resistance to change and project team members not having a common understanding. 60 % of project managers indicated that they normally experienced some resistance to change, (Miller, 2009). Interviews revealed that most changes were caused by schedules and budgets that are continually extended. This had a negative impact on stakeholders who felt that most projects were missing their original targets, (Wang et al., 2003). The research also established that some of the resistance to changes were caused by poor change management processes followed by Company A, this led to team members not showing much dedication . Some managers felt that non-essential changes were prioritized, impacting on critical schedules. There is no change control board, (Beckers et al., 2013), in Company A despite them managing large infrastructural projects.

Most project managers indicated that project team members had no shared understanding of what the team is expected to achieve. This was also supported by the responses on roles and responsibilities of team members which were found to be very weak. These risks impact negatively on project success, (Larson, 2008). The required skills set were found to be lacking. There seems to

be a high level of staff turnover in Company A. Poor stability in personnel results in poor quality of work and also a negative attitude towards work, (Lin and Shao, 2000).

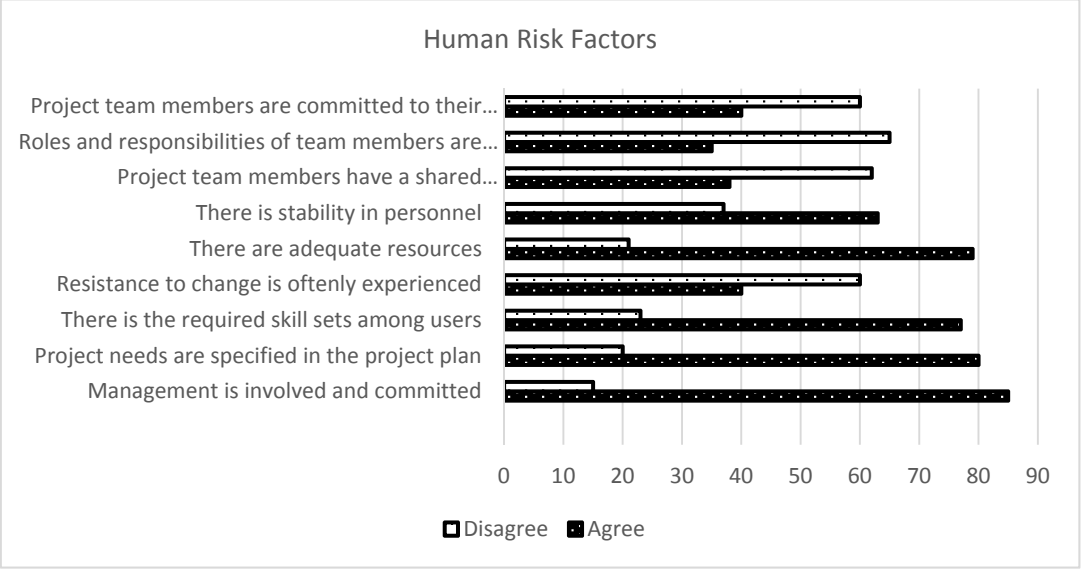

Figure 4: Human Risk Factors

Organisational Risks

Organisational risks faced by Company A were lack of cohesion between team members, lack of empowerment and no contingency measures in case of staff turnover. Project goals were found to be in line with organisational goals, (Burke et al., 2001). Project organisational structure was found to be appropriate. Senior management support was also found to be satisfactory. However project managers indicated that there were minimal contingency plans in case of staff turnover. This had a moderate risk of failing to deliver quality projects on time, (Wang et al., 2003). Lack of cohesion of project teams was also noted as was done in previous sections. Project team members also felt that there were not properly empowered. Lack of empowerment causes risks such as lack of morale (Miller, 2009).

Figure 5: Organisational Risk Factors

Technological Risks

The research established that most of the technology used in Company is imported. Most managers indicated that they were familiar with the technology that they are using. One area of concern was that the technology used by Company A is not scalable. The company seems to be following factors identified by (Burke et al, 2001), that are trust, training, good communication in implementing new technology.

The research established that staff were exposed to sufficient and intensive training. The company provides resources that enables staff to undergo various continued development through conference attendance and workshops administered by experts outside their workplace. The section in charge of technology development and implementation keeps staff appraised of new trends. The company follows a framework that covers planning, strategy and communicates desired goals long before they reach the implementation phase of a project (Mojtahedi, 2010)

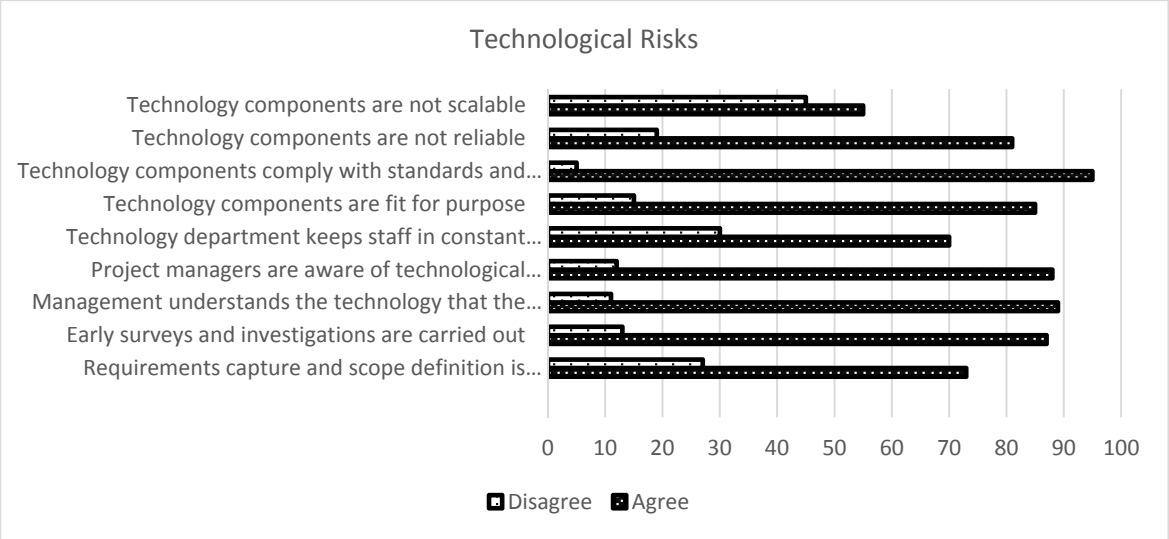

Figure 6: Technological Risk Factors

CONCLUSION

Company A uses a structured way of managing risks in its infrastructural projects. Both the qualitative and quantitative methods are being applied in the management of risks. The few concerns that were raised by project managers, (lack of skilled manpower, undefined roles between contractors and operators and undercapitalisation) must be addressed by top management if the company is to successfully implement its projects. The importance of risk management in project management is an important aspect that facilitates the successful completion of projects. Project managers must always use information collected during the risk analysis phase to make decisions on how to improve on the chances of project success and on how the project can meet its performance objectives. The research found that Company A had no contingency responses to some of its risks like staff turnover. Senior managers in Company A were encouraged to scan the external environment routinely to guard against external risks such as changes in funding models, economic recession and new legislations. Senior managers were also encouraged to create right conditions that assists openness and transparency that will result in good team building and better cohesion of team participants.

APPENDIX 1:

Questionnaire of Infrastructural Projects Risks

Project Management: 1-Strongly disagree; 2-Disagree; 3-Agree; 4-Strongly Agree

Risk Aspect	1	2	3	4
Project scope is clearly defined				
Project cost budgeting is realistic				
Project schedules are realistic				
Project funding is adequate				
Quality requirements are well defined				
Quality control is implemented effectively				
Written and verbal communication is clear				
Project documentation is satisfactory				

Similar tables were prepared for the other risk areas namely Risk Management, Human Risks, Organizational Risks and Technological Risks.

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