Modern Environmental Science and Engineering (ISSN 2333-2581)
September 2015, Volume 1, No. 3, pp. 156-163
Doi: 10.15341/mese(2333-2581)/03.01.2015/008
Academic Star Publishing Company, 2015
www.academicstar.us

Risk Reduction on Infrastructure Projects in the Zambian Construction Industry through Integrated Risk Management (IRM) Approach

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Abstract: Construction projects are risk prone and as a consequence projects may have quality shortfalls, disputes, time and cost overruns. Realizing that huge sums are spent by the government in providing infrastructure, the research focused on assessing the feasibility of reducing risks on infrastructure projects through IRM. To achieve this, secondary data was obtained from an extensive literature review while primary data was through the use of a questionnaire survey to consultants and contractors. This revealed that the management of risks in the Zambian Construction Industry (ZCI) on projects is hugely hampered by the over-reliance on the traditional method of procurement in which teams are segregated resulting in adversarial relations. Hence, the reduction of risks on projects cannot be effectively achieved traditionally due to fragmentation of the parties involved. There is needed to change the traditional procurement path as it does not encourage integration of project parties in order to reduce poor performance of infrastructure projects. It is for this reason that IRM, which encourages team work, from inception project to completion, should be adopted to enhance management of risks. An integrated approach enhances communication, and builds relationships that aid collaboration resulting in reduced project risks.

Key words: risk, integration, infrastructure, management, Zambia

1. Introduction

Risks are more widespread in the construction industry than any other industry [1, 24, 31, 33]. The same can be said about the Zambian Construction Industry (ZCI) where contracting parties have repeatedly suffered the consequences of failure to manage risk such as design failure, cost overruns and delayed completion. This makes the management of risks in infrastructure development a very important factor to consider. This is important given that the construction processes involve diverse parties whose aim in a project may not be the same. Unfortunately, in mitigating risks in Zambia, clients usually transfer risks through the traditional risk management process (design, bid and build), particularly in the public sector. Thus, all contracting parties should be concerned with risk management because risks have far reaching consequences beyond the party that fails to mitigate them [22]. Consequences usually include poor project performance characterised by time and cost overruns, poor quality, and tensions [3, 33, 34].

1.1 The Concept and Definition of Risk

According to PMI [16], risk is defined as "an uncertain event or condition that, if it occurs, has a positive or negative effect on one of project objectives". On the other hand, Ward and Chapman [28] argue that the term "risk" is often associated with adversity and focuses more on threats, not opportunities. Hilson [35] defines it as "an umbrella term, with two varieties: 'opportunity' which is a risk

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with positive effects; 'threat' which is a risk with negative effects." Lehtiranta [36] argues that opportunies resulting from risk are rarely seen in project teams. In this research, risk is defined as a probability of occurrence of an event and the magnitude of its consequence [19]. In view of this, risk can be measured using equation 1.1 below:

$$R = P * I \quad (1.1)$$

Where: R = the degree of risk, P = probability/extent of occurrence of a risk factor; I = the consequence or perceived impact on a project.

1.2 Effects of Risks on Infrastructure Development Projects

Risks have an impact on one or more of the project objectives [17]. While several scholars (for example see Akintoye and McLeod [1]; Smith et al. [23]) only give cost, time and quality, Mills [30] adds productivity and performance to the list of objectives. Accordingly, mitigating the occurrence of the risks reduces the negative impact of the risks and enhance where the risks have a positive effect.

1.3 Traditional Risk Management

Realising the drastic effects risks have on infrastructural projects, construction professionals and practitioners apply the following procedure in managing risks;

Risk identification: Risk identification is the basic step of risk management which determines the potential risks by looking at all the project activities and considers possible risks associated with project activities. Correct risk identification ensures effective risk management [25].

Risk analysis: Risk analysis is concerned with assessing the potential impact of a risk. It basically determines the probability and consequences, and combines them to estimate the level of a negative or positive impact [2-6].

Risk evaluation: This step focuses on determining whether a risk is acceptable or needs treatment by considering the probability of occurrence and its tolerance, to provide adequate information for decision making [27].

Risk treatment: This involves selecting and implementing one or more options for treating risks such as avoidance, changing the likelihood of occurrence, changing the consequences, sharing risk and retaining risk [6]. In general, like in any other industry, the following options are used:

- Avoidance: The team changes the project plan to eliminate the risk or to protect the project objectives from its impact. The team might achieve this by changing scope, or adding resources.
- Transference: The team transfers the financial impact of risk by contracting out some aspect of the work. Transference reduces the risk only if the party is capable of handling the risk.
- Mitigation: The team seeks to reduce the probability or consequences of a risk event to an acceptable threshold.
- Acceptance: The team may decide to accept certain risks. They do not change the project plan to deal with a risk but agree to address the risk if it occurs [14-26].

Monitoring and review: Risks need to be monitored to ensure that the changing environment does not alter risk priorities and that the risk management process is effective. If not, other effective measures must be put in place [11].

Communication: Communication is a vital in the risk management process. Effective risk management is effective communication, from top to bottom and bottom to top [37].

2. Construction Process and Key Participants in the ZCI

The briefing stage is often the early stage in the construction process during which the client's requirements are written down in a formal document [5]. This gives a fixed reference point for the subsequent design of the building. At the design and procurement stage the architect will produce the

architectural design, and the engineers will produce the engineering design according to the client's requirements from the briefing stage [15]. Based on the traditional procurement approach the key participants in a building project are the client/financier, contractors, and designers consisting of architect(s), engineers (structural, civil and service engineers) and quantity surveyor(s). These form a temporary organization to undertake the project.

2.1 Types of Risks in the ZCI

Early identification of risks is important for risks to be mitigated successfully [15-18]. There are different types of risks at various stages of a construction project and can be classified broadly into the following groups:

• Construction Risks in Project Undertakings: These happen during the construction phase in a project life cycle [12]. Examples include delayed site possession, equipment breakdown, design failure, poor inventory management, poor quality and lack of labour [7].

• Environmental Risks in Construction Project: Most of these types of risks fall under uncontrollable risks called force majeure (acts of God) such as inclement weather, floods and landslides [15]. Others may include ecological damage and topographic limitations [9-10].

• Legal — Contractual Risks in Construction Project: These include liability to others, local law and codes, suppliers, conditions of contract and government regulations [10-28].

• Financial and Political Risks: Financial risks include unavailability of funds, inflation, exchange rate fluctuation, under-pricing and changes in interest rates [9-10] while political risks range from changes in law, revolution, civil disorder, availability of labour, customs and export restrictions and procedures [7].

2.2 Shortfalls of the Traditional Risk Management in the ZCI

Traditional risk management in the ZCI is organized into "camps" with diverse interests that sometimes converge and other times do conflict; owner, consultants and contractor. As a result, traditional projects have organizations that resemble silos or chimneys, with each camp organized vertically and separated from each other by contractual walls [8]. Evidently, the traditional approach does little in effectively managing risk due to fragmentation of the parties. Hence the industry needs a more innovative integrated approach.

3. Integrated Risk Management (IRM) Process and Benefits

The IRM is a risk management approach which encourages all key parties involved in a project to focus on the best outcome of the project at the best final cost [10]. At the beginning of every project, a team is established by the selection of different partners, and these are based primarily on the needs of the project [4-20]. The team is comprised of the client, consultants, contractors and suppliers. This team then works in a group to accomplish the best project possible for the client [21].

The owner benefits most of all, with new assurance that the project will be built on time and within budget. This is by bringing parties together from the early stages of the project, allowing them to develop a much higher level of common understanding of the project. This breaks down traditional silos and connects each team member to the entire building process [8]. Importantly, the consultants and contractors develop a closer, more productive relationship as they work, solving problems together and gaining insight on the other's works [28). Each member of the integrated team is chosen based on many factors such as experience, commitment and technical competence. This reduces on the effects of avoiding, transferring and mitigating risks [24].

3.1 IRM and Traditional Management Processes Contrasted

Knowledge of the differences between IRM and other systems is imperative in understanding the preparedness of an industry for its integration. Table 1

presents a comparison between an integrated delivery process and a traditional method which also has a bearing on how risks are mitigated.

3.2 Objectives of Integrated Risk Management

The effectiveness of IRM is hinged on the following objectives;

Goal Driven: Lovins [20] states that the primary goal of an integrated risk management is a successful project, but with explicit subsidiary goals, objectives and targets set as a means to get there.

Structure: According to Zimmerman [29] IRM is structured in a way that it incorporates everyone on the team and each participant gets to have the full involvement of the project. It forms a working culture where everyone has a chance to inquire and advise where necessary to reduce on certain risks and encourages participants to look at the interest of the project rather than their own [8].

Clear decision-making: Meetings are held from the start of the project and are called for time and again when matters arise to have a full involvement of participants. This helps to prevent conflicts and disputes during the construction stage in terms of how something ought to have been handled [10].

Table 1 Comparison between Integration and Traditional Project Delivery

Traditional Project Delivery		Integrated System
Fragmented	**Teams**	Integrated team, assembled early , collaborative
Linear, distinct, segregated	**Process**	Concurrent, early contributions of knowledge and expertise, open
Individually managed, transferred	**Risk**	Collectively managed, appropriately shared
Individually pursued: first-cost based	**Reward**	Team Success tied to project success; value-based
Blame, exploiting loopholes	**Culture**	Learning, continual improvement,
Separated from work	**Decisions**	Integrated with work: based on data
Budget output, activity	**Measures**	Focuses on capability and variation
Functional, silos fragmented, based	**Organization design**	Based on demand, value and flow: open, integrated team
Hoarded in silos	**Knowledge**	Shared openly & early

Source: Adapted from American Institute of Architects, 2009

Inclusive: The IRM includes everyone who has a role to play on a project from the client right through to the architect and the sub-contractors. This motivates participants as they will realize their value on the project [20].

Non Traditional expertise and Sharing of risks: Other non-buildings-related expertise may be helpful. Their knowledge and experience in certain areas are crucial for the success of the project [29]. Further, risks are evenly distributed amongst team members in accordance with best placed party to handle a particular risk. This reduces on having too many contingencies on the budget as knowledge on mitigating that risk would have been shared [29].

Holistic and systematic thinking: The goal is to optimize the performance of buildings by considering all the building components and subsystems together and their interactions [29]. When this is done right, the end product is greater than the sum of the parts, and it may even be cheaper [21].

Iterative: The traditional phases of the building design process do not disappear in Integrated Risk management Process. Lovins [20] describes the intermediate workflows as being “iterative loops”. The team continuously reviews and refines ideas to resolve problems at whatever scale is appropriate, at each phase of design.

4. Research Methodology

The research adopted both qualitative and quantitative methods in collecting data. This involved the desk survey (literature review) which is an

essential aspect of the research since it sets the pace for the development of knowledge on the area of interest [13]. Therefore, literature in form of books, journals and professional magazines were used for secondary information collection. Primary data was collected through a questionnaire survey were questionnaires were administered to clients, consultants and contractors.

4.1 Sample Design

The professionals involved in the survey included Architects (23), consulting Quantity Surveyors (22) Building Contractors (71) and Civil Engineers (20). A non-probabilistic sampling method (convenience sampling) was used to select the professionals for the survey since the technique allowed targeting of individuals with the required expertise [13]. Lusaka and the Copperbelt Provinces were selected due to the availability in the two provinces of a higher number of construction projects and construction professionals compared to the other provinces.

5. Research Findings

5.1 Types of Projects Undertaken

From the survey, 44% of the respondents were involved in general building and housing projects, 22% in general civil engineering projects, 24% were involved in road and earth works and 10% were involved in electrical and telecommunications projects. The survey thus showed that vital infrastructure projects are being undertaken in the ZCI which by their nature are susceptible to risks. This highlights the need for risk mitigation in the ZCI.

5.2 Causes of Risks and Their Impacts

All the professionals interviewed indicated cost variation as a major impact on infrastructure development. Considering the scarcity of resources for financing infrastructure, the need for managing risks through integration cannot be overemphasized. This is vital since the professionals indicated that poor project team relationship and communication amongst participants, unforeseen mistakes and discrepancies in design document are also encountered.

5.3 Type of Procurement Methods Common in the ZCI

The survey revealed that 38% of the respondents used the traditional procurement, 33% used the design and build method of procurement, 19% used management contracting, 3% used project management and 7% used construction management. This confirms that traditional system is still the most used procurement system in the country despite its limitation in risk management.

5.4 Success in Mitigating Risks of the Traditional Procurement Method

The traditional system which is mostly used in the Zambian Construction Industry indicated a success rate of 11% in managing risks whilst design and build and management approaches indicated 44% and 45% of success, respectively. The traditional method was thought to be ineffective due to its adversarial relationships and self-aimed goals amongst project team members. Research also revealed that risks are usually allocated to one party and when they fail no one else from the project team takes them up consequently projects are abandoned or delayed.

5.5 Contractor Involvement in the Construction Process

From the contractors' responses, only 11% of the respondents indicated that they have in the past been engaged at inception while 18% have been involved at feasibility stage. It therefore suffices to say that there is low contractor engagement at the identified stages. This can be attributed to the contractual arrangement of the traditional system which does not allow full participation of all team members at all stages. It can be argued that this contributes to the poor management of risks in the ZCI.

5.6 Mitigation of Risks among Construction Team Members

Sharing of risks in the ZCI is rarely done, yet it has been acknowledged by the respondents as being the best way of mitigating risks. This can be seen from the survey which revealed that 35% of the respondents preferred risks to be transferred, while 41% of respondents preferred sharing risks which shows that respondents see the need of integrating participants on a project to help contribute knowledge, experience and build trust and strong relationships to effectively deliver projects. Another 17% of participants suggested avoiding the risks which occur as not being effective because the client will be left unsatisfied. Only 7% were willing to accept the risk.

5.7 Risk Distribution among Construction Team Members

The survey indicated that 75% of risks are allocated to contractors whilst the design team had 25%. Contractors stated that any delay or departure from the signed construction contract will lead to breach of contract and hence failure to execute the desired needs of the client. On the other hand, Architects stated that they are exposed to risk as they mainly deal with design related risks. Once the design is complete it is up to the contractor to manage all the works and constructability.

5.8 Factors for Implementing a Successful Risk Management

The survey showed the following key success factors; open communication 38%, knowledge sharing 20% collaboration 13%, risk sharing 9%, mutual trust 8% and understanding each others' objectives and equitable and clear allocation of risks 7% and 5% respectively. This confirms that the involvement and the use of all stakeholders throughout the project lifecycle can result in a successful project.

5.9 Feasibility of Integrated Risk Management in ZCI

The majority (73%) of the respondents stated that IRM is feasible in the ZCI with 27% indicating that it is not feasible. Organizations such as the National Housing Authority have a similar arrangement of integrating project team members and this has helped them in reducing risks on their projects. This offers a stable base for the implementation of IRM in mitigating risks.

5.10 Risks That Can Be Mitigated Using Integrated Risk Management

The respondents acknowledged that risks can be effectively managed through IRM. However, it was noted that only a selected number of risks can be fully mitigated through IRM. Some of these risks are shown in Table 2.

5.11 Challenges in Adapting Integrated Risk Management in the ZCI

From the survey, 74% of the respondents indicated that they could adopt Integrated Risk management except that they were not very certain on its outcome, added costs, possibility of bringing all team members at once. Willingness to collaborate was also advanced. The traditional method of procurement was noted as a major challenge.

Table 2 Risks that Can Be Mitigated by IRM

Item	Risks
1	Conflicts amongst construction team members and adversarial relationships
2	Communication and coordination amongst construction team members
3	Contractor disregards quality of material in the way to get profit
4	Variation of works by client
5	Mistakes and discrepancies in design documents
6	Delay in completion of construction project
7	Lack of consistency between bill of quantities, drawings and specifications
8	Insufficient information in the contract specification, drawing and design
9	Delay in payments by consultants

6. Conclusion

Like any other construction industry, the ZCI is faced with numerous risks in delivering its infrastructure projects. However, there has been a lack of knowledge on the various risk mitigation methods to minimize cost overruns, poor quality, late completion, and tensions which may lead to abandonment of projects. This is due to the fact that relationships amongst team members are adversarial due to the contractual arrangement. Further, in terms of relative comparison, the design and build system seems to be more effective largely owing to the fact that it is based on teamwork which is the basic underlying principle of IRM. This shows that IRM which encourages teamwork will enhance successful delivery of infrastructural projects in the ZCI when effectively applied. It is therefore important that design and construction should be integrated so that contractors can be involved to offer their knowledge at an early stage. This will also strengthen team relationships and avoid the blame game when risks materialize and encourage parties to combine their efforts in ensuring that the whole team wins. It is therefore recommended that the industry adopts Integrated Risk Management and its principles such as mutual trust and respect, sharing of risks, early involvement of key participants, and sharing of experiences and knowledge in risk management.

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