Key Performance Indicators for project success on Innovative Building Technology projects

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Abstract

The South African government, through the Presidential Infrastructure Coordinating Commission has resolved to deliver social infrastructure such as schools, early childhood centers, clinics and student accommodation using Innovative Building Technologies (IBTs). IBTs by definition are, "unconventional methods of building, employing the use of unconventional building materials which are not covered by the National Building Regulations and Building Standards Act 107 of 1977. According to this act unconventional building methods can only be deemed to satisfy by way of rational design or Agrèment certification"[1].

Delivering projects through IBTs has introduced a construction environment that has different procurement, supply chain management, building methods and stakeholder management requirement. The technologies employed in an IBT project are not only alternative to brick and mortar, but the certification framework for IBT also impacts the relationships between the various stakeholders of a construction project and this may have an impact on project success.

Because such extensive use of IBTs is a relatively new idea in the South African construction industry, it is not clear whether these projects are successful. The aim of this paper is to provide a model conceptual framework which puts forward Key Performance Indicators (KPIs) that can be used to measure project success on IBT projects.

In order to identify KPIs for measuring project success, literature focusing on the definitions and parameters of project success has been evaluated. The Project Excellence Model was identified as the optimal measure for project success[2]. The model recognizes that in order for any projects to be successful, project success factors-which are termed "key organizational areas"- and project success criteria- which are termed "key result areas"-must be satisfied. The key result areas can be measured upon completion of the project and are standard. However the key organizational areas must be decided upon at the beginning of the project and monitored throughout the project duration.

According to the Project Excellence Model the key organizational area for a construction project is "stakeholder management". A framework for successful stakeholder management is presented in this paper.

[1] CSIR (2013) Innovative Building Technologies: The Value Proposition, Pretoria: CSIR.

[2] Wetserveldt (2003) The Project Excellence Model: linking success criteria and critical success factors. International Journal of Project Management, Volume 21, pp. 411-418.

1. Introduction

Innovative Building Technologies (IBTs) are becoming a popular alternative to conventional brick and mortar in South Africa. Agrèment South Africa has seen a 67% increase in certifications of building systems (CSIR, 2014). The increase in certifications can be attributed to an anticipated increase in demand. This increase in demand is a a result of the government's resolution to adopt the use of IBTs in their social infrastructure construction projects (CSIR, 2013). In 2013 the Presidential Infrastructure Coordinating Commission (PICC) made a resolution that at least 60% of social infrastructure such as schools, early childhood development centers and clinics be delivered with the use of IBTs by the year 2017 (CSIR, 2013). The PICCs resolution was motivated by a CSIR study which revealed that IBTs introduce benefits such as waste reduction, skills improvements and speedy delivery to construction projects.

IBTs introduce various challenges to a construction project which are often a result of the certification framework, supply chain changes and new building methods. An IBT project requires that suitable building systems be selected from Agrèment's database of certified systems (CSIR, 2013). Agrément's database of active certificates provides a list of unconventional building products certified by them as suitable for use and the areas such products can be used. This is in direct contrast to a conventional project where brick, steel or concrete manufactures are readily available.

Upon certification, the conditions of certification stipulated by Agrément outline that the manufacture, erection, design and quality of the final product is the responsibility of the certificate holder.

Once an appropriate building system has been identified on the database, the system must be run through a climatic tool developed by the CSIR to determine whether these systems are suitable for the climatic area in which the project is to take place. The system must also be evaluated from a supply chain perspective where considerations such as whether the system can be transported on the local roads without damage, the labour skill requirement for erection and whether such skill can be sourced from the local community and lastly the lead time for manufacturing. Once all these steps have been undertaken, the most suitable building system will be selected and the certificate holder will be appointed to manufacture, design and erect the building systems in accordance with the conditions of certification (IDT, 2014)

The procurement of the building system and subsequent engagement with the Certificate Holder introduces a new dimension to the project management practice and has ramifications for project success. In this paper the Project Excellence Model will be put forward as a method for measuring project success. The paper will put the problem into context and present the literature review that led to the development of the conceptual framework.

2. Problem in Context

The adoption of IBTs for more government projects has presented several challenges and opportunities for academics, professionals and other role players in the construction industry. These issues include educating those implementing IBTs on behalf of government on the various innovations and the certification framework. The CSIR has undertaken the task of demystifying IBTs as an alternative to conventional construction through various interventions. These include developing training guides for IBT project delivery, proposed procurement protocols and best practice guidelines.

There is, however an opportunity to understand whether success on IBT projects is being achieved. The CSIR undertook a study where the value proposition for IBTs was put forward. The study investigated the golden triangle aspect of project success which includes the parameters of "time, quality and cost". It was found that these aspects of the project are being achieved and exceed those of conventional construction projects. Mbachu and Nkado (2007) also undertook a study where they evaluated factors constraining successful building implementation in South Africa. These two studies provide a window through which one can begin to gain an understanding of the success of conventional and IBT projects in South Africa. However, the picture provided by these studies is not holistic. The CSIR study provides success measurement from a "Success Criteria" perspective and does not consider whether project stakeholders' objectives were met. Mbachu and Nkado's (2007) study

focused on the client's perspective of critical success factors but did not measure the end result of the project.

Evaluation of project success literature revealed that there is a lack of consensus regarding the parameters and evaluation methods in this area of project management. If there is to be an understanding of project success, variables and indicators of what constitutes project success need to be agreed upon.

Authors such as Chua et al (1999), Alias et al (2014), Chan et al (2004) and Cooke-Davies (2002) have focused on project success factors. These are the conditions that need to be created during the duration of the project in order for the project to be completed successfully. Authors such as De Wit (1987) and Adinyira *et al*. (2012) focus on project success criteria. They maintain that project success can be measured at the end of the project by way of the project management triangle. This refers to the parameters of cost, time and quality. Typically, stakeholder satisfaction is also considered as additional to the project management triangle.

Westervedlt (2003) developed a Project Excellence Model that recognizes that project success factors and criteria must be measured in order to have a holistic view of project success. This paper will discuss the Project Excellence Model and the framework that has been developed for the evaluation of project success on IBT projects.

3. Background to the Project Excellence Model

The Project Excellence Model is developed from the European Foundation for Quality Management EFQM Excellence Model. The EFQM model was designed to help organization improve their outcomes. The Project Excellence Model links project success criteria and project success factors in one coherent model. This model was selected following a literature review which revealed that studies evaluating project success adopted either a "critical project success factors" or "project success criteria" view. These views on project success are one dimensional and do not present a holistic picture of project success. Several authors have agreed that indeed the successful implementation of success factors on a project will result in the achievement of success criteria when the project is completed.
The Project Excellence Model recognizes that in order for projects to be undertaken successfully, key result areas (project success criteria) and key organizational areas (critical success factors) must be focused upon (Westerveldt, 2003; Turner and Zolin, 2012)
Westerveldt (2003) divides the projects into five typological categories. The categories are divided into aspects of organizational and result areas. The areas that are to be the focus of each project are based on the complexity of the project.. The typical construction project is recognized as a "Total Project Management" project. This kind of project requires that the project manager focuses on "stakeholder management" as an organizational area. The following result areas are the focus of a Total Project Management project:

- Project results (cost, quality, time)

Appreciation by some of the stakeholders, namely

- client
- project personnel
- users
- contracting partners

Outside of the project results criteria, the "appreciation" criteria refers to the various project participants' satisfaction that their individual objectives in the project have been met. Objectives are set at the beginning of a project and will vary from stakeholder to stakeholder. According to the model, stakeholders who have met their objectives will consider the project successful. In other words, if stakeholders are satisfied with their subjective outcomes of the project, the project can be considered successful

The model is clear on the key result areas; however it is not clear what the parameters for successful stakeholder management entails. In order to complete the theoretical framework, literature providing definitions and frameworks for successful stakeholder management had to be evaluated.

4. Relating Stakeholder Management to Project Success

IBTs inadvertently introduce an entire group of new stakeholders to a construction project (CSIR; 2013). As such, in an IBT project it becomes paramount for the project management fraternity to understand and prioritize stakeholder management.

Stakeholder management is defined by Olander (2007), Newcombe (2003), Brynson (2007) as "*The management of groups or persons with a vested interest in the success or failure of the project*".

The management of stakeholders must result in the minimization of conflict for the duration of the project. The activity is one similar to that of risk management, as it involves predicting certain behaviors (risks) and ensuring that they do not negatively impact on the objectives of the project (Yang et al, 2010).

The framework for successful stakeholder management was proposed by Yang et al (2010). The framework provides an outline of the factors that should be present in order to manage stakeholders successfully and is presented in Figure 1.

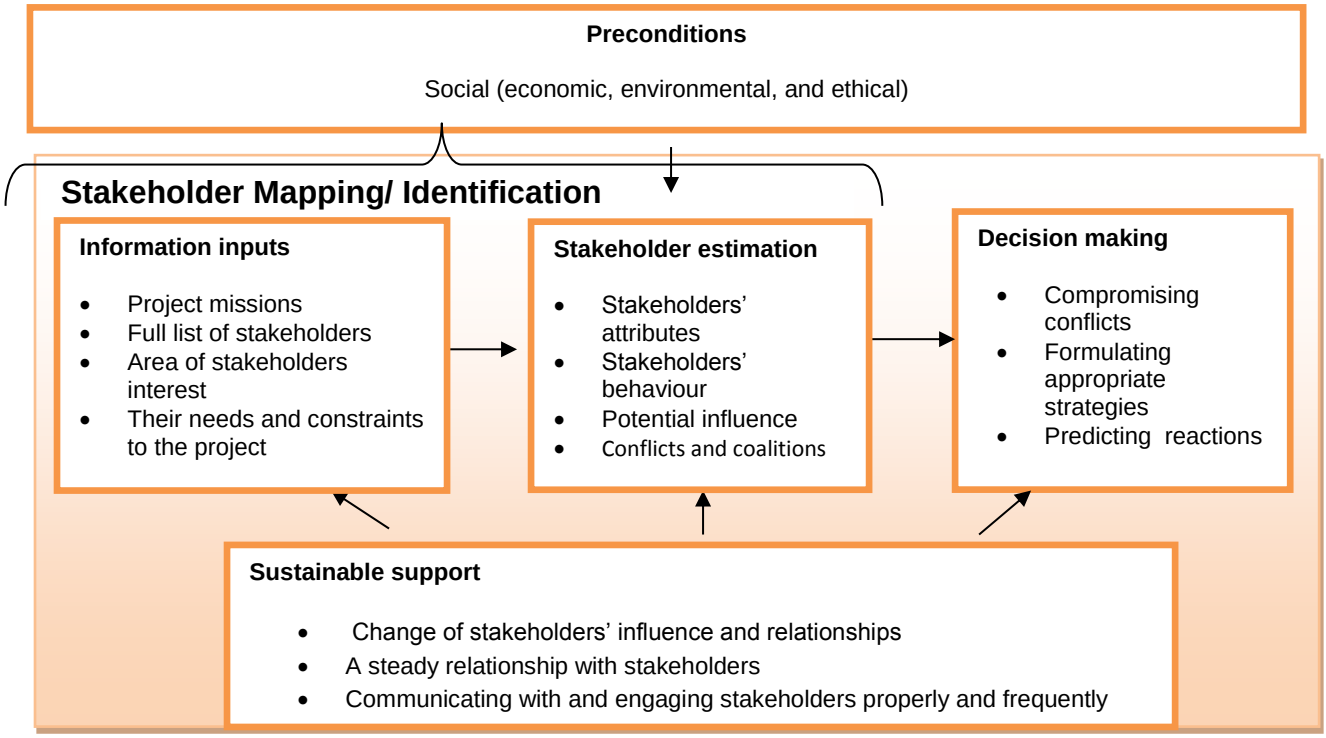

Figure 1: A framework for successful stakeholder management in construction projects. Adapted from Yang *et al.* (2009)

Figure 1 illustrates the factors that need to be present in order for stakeholder management to be considered successful. The first consideration will be whether the project is well within the parameters of social acceptance. This means that in the case of social infrastructure, the economic considerations must be in line with the community and the government's objectives. Further to this, the projects should not endanger the environment and must have the interests of the community. This could be job creation (community interest) or having a sound environmental management plan. These preconditions must be evaluated in the undertaking of the study.

If the preconditions are satisfied, the first steps to successful stakeholder management are "Information Inputs" and "Stakeholder Estimation". These two activities in the framework are in line with stakeholder literature and are referred to as stakeholder mapping or identification.

Stakeholder mapping and identification results astakeholder estimation parameter which is termed the "Stakeholder Impact Index" which affects decision making strategies and the type of support offered to stakeholders.

Stakeholder impact (or Influence) is given by the equation (Olander, 2007; Nguyn et al, 2009):

$$SII = ViII * A * Pos \quad (1)$$

Where:

SII= Stakeholder Impact Index

ViII= Vested Interest Impact Index which is a measure of the probability of impact (*v*) and the interest impact levels (*i*). (Olander, 2007; Nguyn et al, 2009). It is given by the equation:

$$ViII = \sqrt{v * i/25} \quad (2)$$

A= Stakeholder Attribute is the sum of all stakeholder attributes such as Power, Legitimacy, Urgency, Knowledge and Proximity to the project. The sum of weighted attributes is equal to 1. Nguyen et al (2009) refers to this as I (Impact). Olander (2007) only considers the attributes of Power(P), Legitimacy (L) and Urgency (U) in his study. However, Nguyn et al (2009) note that Knowledge and Proximity to the project are also important attributes. However, in his study Nguyn (2009) does not factor Impact into the overall SII equation. For purposes of this study Knowledge (K) and Proximity (D) will be included in the Attribute variable. Each attribute will be given an equal weighting of 0.2 because both Nguyn (2009) and Olander (2009) agree that attributes will likely have similar impact. Therefore A can computed as follows:

$$A = P + L + U + K + D \quad (3)$$

Pos= Stakeholder Attitude which can be numerically assessed as active opposition (Pos=-1), passive opposition (Pos=-0.5), not committed (Pos=0), passive support (Pos= 0.5) and active support (Pos= 1) (Olander, 2007; Nguyn et al, 2009)
The total stakeholder impact for the project is given by SIIproj= ΣSIIi (Olander, 2007)

The first hypothesis is that if ΣSII is negative then key result areas will not be met.
The second condition for project success on an IBT project relates to the other two components of the framework. If the factors of sustainable support and effective decision making are not present during the project, then the key result areas of The Project Excellence Model will not be met.

The stakeholders of an IBT project have been identified according to the categories given by Turner and Zolin (2012). In an attempt to standardize stakeholder identification Turner and Zolin (2012) identified “groups” of stakeholders from literature and recognizes all the relevant parties who have a vested interest in the project. The stakeholder groups identified were as follows:

I. The Owner/ Investor: Provides financing for the project and becomes the ultimate custodian of the finished product. Their objectives will revolve around time, cost and quality
II. The Project Sponsor: Recognizes the need for a product or project and garners financial and political support from the project owners or supporters. They are typically employed by the owner or user organization
III. The Consumer: The person who buys or will benefit from the finished product.
IV. The Operator or the User: Operates the product on behalf of the owner. They are usually employees of the Investing/ Owner entity
V. The Project team/ Project Manager: This group is consists of individuals who are assembled to perform activities that will result in the completion of the project. They are typically appointed by the owner or investor either as employees in the organization or on consultative basis. Their interest revolves around time, quality and cost. They are also concerned with the career prospects with having been involved in the project. Career prospects include issues such as learning, future moves and personal wellbeing.
VI. The Senior Supplier: this is senior management in the lead contractors company or a consultant, managing or prime contractor usually appointed by way of a standard agreement such as FIDIC. This group is usually interested in time and cost and the profit made from the project. They will also be concerned with safety and risk record of the project

VII. The Other Suppliers also fall under this group. They are responsible for supplying the goods, materials, works or services during the project. An example of an "Other Supplier" would be the ready-mix company. Their concern is completion of the project on time so that they can receive prompt payment as well as the profit they are making from the project

VIII. The Public: Their concern with the project will typically revolve around the social and environmental impact the project has.

5. Methodology

Following the literature review, a research methodology for evaluating project success KPIs on IBT projects must be developed. The KPIs are an amalgamation of the successful stakeholder management framework and the project excellence model.

Stakeholders of a typical IBT project were evaluated against those of a conventional construction project from the CSIR (2013) study and the IDT (2014) training manual. The evaluation was done in light of Turner and Zolin's stakeholder categories. It was found that the stakeholders facing the greatest shift as a result of IBT projects fall under the "The project team/ Project Manager, Senior Supplier and Secondary Supplier Categories". These categories include professional consultants, contractor, certificate holder, licensees, and senior management in the client organization.

Because of the extensive scope of stakeholders in any construction project and the limited time in which the study is to be completed, the groups most affected by the implementation of IBTs will be the focus of the study.

The study will employ a mixed method approach where quantitative and qualitative data will be collected in order to determine whether KPIs as identified in the literature review are met on an IBT project.

A government department that has completed social infrastructure projects as per the PICC resolution will be approached to provide historical data about the project. This will be in the form of procurement or contractual arrangements, the extent to which the the parameters of cost, quality and time were satisfied, as well as the environmental and social targets set at the onset of the project. The data will be used to determine the following information:

- Project results (cost, quality, time)
- Appreciation by the client
- Project stakeholders and their areas of interest
- Project missions
- Established pre-conditions as per the framework for successful stakeholder management

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A questionnaire issued to stakeholders will seek to evaluate the stakeholder impact (SII). This will require that participants rank stakeholders attributes, impact of interest and attitudes. The outcome of remaining factors not contained in the Impact equation in the "successful stakeholder management" framework will also be interrogated on a scale that will provide quantitative data which will provide a full picture regarding the presence of critical factors for successful stakeholder management

Stakeholders will also be asked whether their objectives in the project have been achieved in order to test the hypothesis:

"If *SII* is negative, then the key result areas of the Project Excellence Model will not be satisfied". Key result areas will be evaluated from the perspectives of the participants to the study.

6. Discussion

The aim of this paper was to provide an overview of KPIs identified for successful IBT projects. As the study is ongoing, an overview of the research methodology is provided.

A literature review revealed that research in the areas of project success focused on one area of project success. Researchers typically focussed on the factors or criteria aspects of project success. However, it is not clear whether critical factors to project success lead to the achievement of project success criteria. The project excellence model maintains that satisfying key project organisational areas (factors) will lead to the achievement of result

areas (criteria) and presents a more holistic view of project success. As such the model will be adopted in the study as a method that can be used to evaluate project success.
The KPIs put forward by the model include overall stakeholder satisfaction, cost, time and quality as key result areas. Satisfaction is a measure of the stakeholder achieving their objectives on the project.
The model also argues that for a project as complex as a construction project, stakeholder management is the key organisational area. However, the definitions were not provided and had to be inferred from further literature review. The successful stakeholder management framework was selected as it measured factors.
The factors include pre-conditions, information inputs, sustainable support and decision making.

These KPIs will be tested on completed social infrastructure projects undertaken by a government body. It is expected that IBT projects that do not satisfy the stakeholder management KPIs will not meet the key result areas KPIs

7. Conclusion

It is expected that the study will provide a holistic view of the achievement of project success and the constraints to project success on an IBT project from the perspective of the Project Excellence Model. The study should culminate in KPIs that are suitable for IBT projects. These KPIs can be applied to IBT projects to determine if they are adequate. This body of knowledge will add to CSIRs endeavours in developing best practice guidelines for IBT project guidelines

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