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IT-based approach for effective management of project changes: A change management system (CMS)

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ABSTRACT

In a perfect world, changes will be confined to the planning stages. However, late changes often occur during construction, and frequently cause serious disruption to the project. The need to make changes in a construction project is a matter of practical reality. Even the most thoughtfully planned project may necessitate changes due to various factors. The fundamental idea of any variation management system in a building project is to anticipate, recognize, evaluate, resolve, control, document, and learn from past variations in ways that support the overall viability of the project. Learning from past variations is imperative because the professionals can then improve and apply their experience in the future. Primarily, the study proposes six principles of change management. Based on these principles, a theoretical model for change management system (CMS) is developed. The theoretical model consists of six fundamental stages linked to two main components, i.e., a knowledge-base and a controls selection shell for making more informed decisions for effective management of variations. This paper argues that the information technology can be effectively used for providing an excellent opportunity for the professionals to learn from similar past projects and to better control project variations. Finally, the study briefly presents a knowledge-based decision support system (KBDSS) for the management of variations in educational building projects in Singapore. The KBDSS consists of two main components, i.e., a knowledge-base and a controls selection shell for selecting appropriate controls. The KBDSS is able to assist project managers by providing accurate and timely information for decision making, and a user-friendly system for analyzing and selecting the controls for variation orders for educational buildings. The CMS will enable the project team to take advantage of beneficial variations when the opportunity arises without an inordinate fear of the negative impacts. By having a systematic way to manage variations, the efficiency of project work and the likelihood of project success should increase. The study would assist building professionals in developing an effective variation management system. The system would be helpful for them to take proactive measures for reducing variation orders. Furthermore, with further generic enhancement and modification, the KBDSS will also be useful for the management of variations in other types of building projects, thus helping to raise the overall level of productivity in the construction industry. Hence, the system developed and the findings from this study would also be valuable for all building professionals in general.

1. Introduction

In a perfect world, changes will be confined to the planning stages. However, late changes often occur during construction, and frequently cause serious disruption to the project [1]. Great concern has been expressed in recent years regarding the adverse impact of variations to the construction projects. The need to make changes in a construction project is a matter of practical reality. Even the most thoughtfully planned project may necessitate changes due to various factors [2]. Developments in the education sector and the new modes of teaching and learning fostered the need for renovation or extension of existing academic institutions. The change of space in academic institutions is required to cater for the new technology used. The construction of an educational building also poses risks as in the construction of any other large projects. Variations during the design and construction processes are to be expected. Arain and Low [3] identified the design phase as the most likely area on which to focus to reduce the variations in future educational projects. If one were to seriously consider ways to reduce problems on site, an obvious place to begin with is to focus on what the project team can do to eliminate these problems at the design phase [4,5].

Considering the hectic working environment of construction projects, decisions are being made under pressure and cost and time invariably dominate the decision making process [6]. Most forms of contract for construction projects allow a process for variations [5]. Even though there may be a process in place to deal with

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these late changes, cost and time invariably dominate the decision making process. If the change affects the design, it will impact on the construction process and, quite possibly, operation and maintenance as well [1]. To overcome the problems associated with changes to a project, the project team must be able to effectively analyze the variation and its immediate and downstream effects [7,8]. To manage a variation means being able to anticipate its effects and to control, or at least monitor the associated cost and schedule impact [9]. An effective analysis of variations and variation orders requires a comprehensive understanding of the root causes of variations and their potential downstream effects.

In project management, variations in projects can cause substantial adjustments to the contract duration time, total direct and indirect cost, or both [2,10,11]. Every building project involves a multi-player environment and represents a collaborative effort among specialists from various independent disciplines [12]. Because variations are common in projects, it is critical for project managers to confront, embrace, adapt and use variations to impact positively the situations they face and to recognize variations as such [13]. The variations and variation orders can be minimized when the problem is studied collectively as early as possible, since the problems can be identified and beneficial variations can be made [7,8]. The variations and variation orders can be deleterious in any project, if not considered collectively by all participants. From the outset, project controls should take advantage of lessons learned from past similar projects [2].

The integration of construction knowledge and experience at the early design phase provides the best opportunity to improve overall project performance in the construction industry [12]. To realize this integration, it is not only essential to provide a structured and systematic way to aid the transfer and utilization of construction knowledge and experience during the early design decision making process, but also to organize these knowledge and experience in a manageable format so that they can be inputted effectively and efficiently into the process.

Decision making is a significant characteristic that occur in each phase of a project. In almost every stage, decision making is necessary. Often, these decisions will, or can affect the other tasks that will take place. To achieve an effective decision making process, project managers and the other personnel of one project need to have a general understanding of other related or similar past projects [14]. This underscores the importance of having a good communication and documentation system for better and prompt decision making during various project phases. If professionals have a knowledge-base established on past similar projects, it would assist the professional team to plan effectively before starting a project, during the design phase as well as during the construction phase to minimize and control variations and their effects. The current technological progress does not allow the complete computerization of all the managerial functions or the creation of a tool capable of carrying out automatically all the required management decisions. To insure the success of this important management function, it is believed that human involvement in this process remains essential. Thus the decision support system (DSS) approach for this kind of application seems to be the most natural idea [15].

Information technology has become strongly established as a supporting tool for many professional tasks in recent years [16]. Computerized decision support systems can be used by project participants to help make more informed decisions regarding the management of variations in projects by providing access to useful, organized and timely information [15,17]. As mentioned earlier, project strategies and philosophies should take advantage of lessons learned from past similar projects from the inception. It signifies the importance of an organized knowledge-base of similar past projects. The importance of a knowledge-base for better project control was recommended by many researchers [2,15,17,11,16].

A knowledge-based decision support system is a system that can undertake intelligent tasks in a specific domain that is normally performed by highly skilled people [15]. Typically, the success of such a system relies on the ability to represent the knowledge for a particular subject. Computerized decision support systems can be used by project participants to help make more informed decisions regarding the management of variation orders in projects by providing access to useful, organized and timely information. The objective of this study is therefore to develop a theoretical model for CMS for better management of variations in educational building projects in Singapore. The system would assist the professionals in learning from past projects for reducing potential variations in the educational building projects.

This is a timely study as the programme of rebuilding and improving existing educational buildings is currently under way in Singapore; it provides the best opportunity to address the contemporary issues relevant to the management of variation orders. The CMS framework would be helpful in developing a knowledge-based decision support system (KBDSS) that eventually would assist professionals in taking proactive measures for reducing potential variations in educational building projects. The knowledge-based system should present a comprehensive scenario of the causes of variations, their relevant effects and potential controls that would be helpful in decision making at the early stage of the variations occurring. The KBDSS would assist project management teams in responding to variations effectively in order to minimize their adverse impact to the project. Furthermore, the CMS will enable the project team to take advantage of beneficial variations when the opportunity arises without an inordinate fear of the negative impacts.

2. Scope of research

The government of Singapore initiated a major program of rebuilding and improving existing educational buildings to ensure that the new generation of Singaporeans would get the best opportunities to equip them with the information technology (IT) available. A total of about 290 educational buildings will be upgraded or rebuilt by a government agency over a period of seven years, at an estimated cost of S$4.46 billion from 1999 to 2005 (Note: at the time of writing, US$1 is about S$1.80). Developing a change management system will contribute towards the better control of variations through prompt and more informed decisions. Therefore, this research concentrated on the educational building projects under this major rebuilding and improvement programme in Singapore. The number of completed educational projects is 80. Furthermore, the interviews were restricted to the developers (governmental agency), the consultants and contractors who have carried out these educational projects.

3. Background

The issue of managing variations has received much attention in the literature. Despite many articles and much discussion in practice and academic literature, the issue of learning from the past projects for making timely and more informed decisions for effective management of variation orders was not much explored in the literature. Many researchers have proposed theoretical models for managing variations. Krone [18] presented a variation order process that promoted efficient administrative processing and addressed the daily demands of changes in the construction process. The contractual analysis technique (CAT) found that early notification and submission of proposals helped to maintain management