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REFINING CONSTRUCTION MANAGEMENT PRACTICE IN Pakistan (Khyber Pakhtunkhwa) WITH THE LAST PLANNER SYSTEM: A Review

Muhammad Atif [1], Muhammad Adil[1], Muhammad Ayaz Khan[1], Engr. Saqib Shah[2], Engr. Fawad Khan2

1(Student, M.S (CEM.), Department of Civil Engineering, Iqra National University, Peshawar, Pakistan.)
2(Lecturer, Department of Civil Engineering, Iqra National University, Peshawar, Pakistan.)

ABSTRACT

Construction management suffers from many problems which need to be solved or better understood. The research described in this paper evaluates the effectiveness of implementing the Last Planner System (LPS) to improve construction planning practice and enhance site management in the Saudi construction industry. To do so, LPS was implemented in two large state-owned construction projects through an action research process. The data collection methods employed included interviews, observations and a survey questionnaire. The findings identify major benefits covering many aspects of project management, including improved construction planning, enhanced site management and better communication and coordination between the parties involved. The fact that the structural work in one of the projects studied was completed two weeks ahead of schedule provides evidence of improvement of the specific site construction planning practices. The paper also describes barriers to the realization the full potential of LPS, including the involvement of many subcontractors and people's commitment and attitude to time.

KEY WORDS: Construction planning, Last Planner System implementation, action research

1. INTRODUCTION

While it is accepted that construction management suffers from many practical problems which need to be solved or better understood (Wing et al., 1998; Love et al., 2002), research in this field tends typically to be descriptive and explanatory, which makes it inappropriate to solve the most persistent managerial problems (Koskela, 2008). One of the most commonly recurring problems in construction is delay. Synthesis of previous studies on delay in various countries reveals that poor project management is one of the main reported reasons for construction delay (Mansfield et al., 1994; Ogunlana and Promkuntong, 1996; Mezher and Tawil, 1998; Al-Momani, 2000; Odeh and Battaineh, 2002; Abdul-Rahman et al., 2006; Assaf and Al-Hejji, 2006; Sweis et al., 2007). In these studies, controllable factors related to poor project management were identified as the most often repeated causes of delay. Such factors included ineffective planning and control, poor site management, poor communication and coordination between the parties involved, delay in materials delivery and late procurement of materials. To improve performance, this research paper argues that the impact of such controllable causes of delay needs to be minimized.

The literature on lean construction and LPS shows no evidence of its practical application within the construction industry in Saudi Arabia. Therefore, to the best of the authors' knowledge, the research reported here is the first application of lean construction in Saudi Arabia. It aims to improve management practice by solving practical problems and create new knowledge. This study is concerned with the application of existing principles (LPS) to a new context and different working environment where commitment and attitude to time make it likely to operate differently. As this study was undertaken to improve the quality of work in practice, to solve practical problems and to contribute to knowledge, an action research approach was employed to facilitate this improvement. Further justification for choosing the action research approach is given in section 4 on research methods.

The research described in this paper is devoted to evaluating the effectiveness of implementing LPS to improve construction planning practice and to enhance site management in the Saudi construction industry. First, the persistent field problem of delay in construction is examined and understood, then practical action to minimize its causes is proposed, by improving the practice of construction management. The main aim of this paper is to contribute to the improvement of performance by making practical endeavors to reduce delays. This contribution is made by identifying the causes of delay that have controllable effects and the extent to which these effects can be minimized in the Saudi construction industry. The proposed solution, LPS implementation, has been tested practically with the aim of examining the utility of the technique in improving planning practice, thus overcoming or minimizing causes of delay.

The paper is organized as follows. First, the problem addressed (delay factors related to poor project management) is explained in detail. Next, there is a brief review of literature on construction project management, lean construction and LPS, followed by a presentation of the primary results of implementing LPS in two large state-owned construction projects with the aim of determining its ability to improve construction planning practice and thus to overcome or minimize delay. There is an account of the action research strategy which was adopted, and the data collection methods employed, including interviews, observation and a survey questionnaire. There is then a presentation of the benefits achieved in terms of improving construction management practice, a discussion of the critical success factors for implementing LPS and an examination of potential barriers to implementation. Finally, the contribution of this study to both practice and knowledge is examined and a general conclusion is offered.

2. PROBLEM ADDRESSED

A number of studies have examined delay in the Saudi construction industry (Assaf et al., 1995; Al-Khalil and Al-Ghafly, 1999; Assaf et al., 2002; Bubshait and Al-Juwairah, 2002; Falqi, 2004; Assaf and Al-Hejji, 2006; Al-Kharashi and Skitmore, 2009). Factors related to poor project management are seen to be common to most of these studies, although they vary in their importance from one study to another. The most common controllable factors identified are ineffective planning and control, poor site management, material procurement problems, low labour productivity and weak communication and coordination.

For generalization, most of the available literature concerning previous studies of construction delay in developing countries has been examined. An analysis of this body of work shows that the findings on delay causes cluster around two issues: management and project environment

(Alsehaimi and Koskela, 2008). Management-related factors include ineffective planning and control, poor site management, poor communication between the parties involved and unreliable availability of materials. It should be understood that such factors are controllable, and efforts should be directed towards minimizing their impact. Controlling such causes of delay in construction projects can be achieved by improving management practice. In contrast, project environment factors (labor shortage, problems in material supply and financial difficulties), all of which are related to the immaturity of the economy, financial institutions and labor market in a developing country, are external factors that have to be taken as given in any project (Alsehaimi and Koskela, 2008).

3. LITERATURE REVIEW

3.1 CONSTRUCTION PROJECT MANAGEMENT

It has been argued that production management in construction is based on deficient theory, which leads to added costs and the reduction of overall performance (Koskela, 1992; Ballard and Howell, 1998; Ballard, 2000; Koskela, 2000; Koskela and Howell, 2002). Koskela and Howell (2002) contend that current construction project delivery practices fail to provide a solid basis for improvement and are inadequate when projects are complex, uncertain and quick. They cite the simplicity and insufficiency of two underlying theories, 'management as planning' and the 'thermostat model' of control, whose shortcomings are summarized under three headings: 1) the unrealistic role of planning and poor short-term planning; 2) unsystematic management of execution and 3) a narrow view of control as measuring and taking corrective action, rather than as a process of learning. The same authors criticize the traditional construction planning and control system, as described in the PMBOK guide (2004), for the insufficiency of its underlying theories and the ineffectiveness of its techniques (Koskela and Howell, 2002; Howell and Koskela, 2004).

3.2 LEAN CONSTRUCTION

Lean construction is concerned with the holistic pursuit of concurrent and continuous improvements in all dimensions of the built and natural environment: design, construction, activation, maintenance, salvaging and recycling (Howell, 1999). The term 'lean construction' was coined by the International Group for Lean Construction in its first meeting in 1993 (Howell, 1999). This approach presents an opportunity for theory to mix with practical solutions to achieve efficiency in construction and to rethink the way that projects are managed to improve practice.

3.3 LAST PLANNER SYSTEM™

The 'last planner' is the person or group accountable for production unit control, that is, the completion of individual assignments at the operational level (Ballard, 1994). In essence, the Last Planner System enables the collaborative management of the entire network of relationships and communications needed to guarantee effective programmed co-ordination, production planning and project delivery. It was developed to increase the effectiveness of planning and control by making programmed more predictable, thereby improving the chances of delivering projects on time. LPS (Ballard, 2000) works to enhance reliability in three main ways: through 'lookahead

planning' and the 'make-ready' process, in which construction managers make work ready by ensuring that materials, information and equipment are available; by filtering planned activities through the weekly work planning procedure to ensure that the preceding activities have been completed; and by seeking conscious and reliable commitment of labor resources by the leaders of the work teams involved. According to Ballard and Howell (1994), LPS focuses on quality characteristics of weekly work plans by selecting the right work sequence and the right amount of work and by ensuring that the selected work can be done.

4. LPS IMPLEMENTATION

4.1 CURRENT PLANNING PRACTICE

Interviews concerning the current planning practice before implementing LPS revealed that most planning was based on a master plan presented on bar chart issued at the beginning of the construction phase. A systematic review of project planning (and project review in general) was found to be rare or non-existent. The researcher enquired about overall project evaluation, since it is necessary to establish the reasons for shortcomings in project execution. Most informants said that they did not tend to refer to past job records, as these were either non-existent or inadequate. The interviews also revealed an absence of detailed short-term planning and improvement meetings to discuss project progress. As for planning techniques, most of the interviewees stated that their firms used the critical path method. The software packages most commonly employed were MS Project and Primavera.

Investigation into current practice established an overview of the status of the planning process followed by the two organizations and suggested a direction for improvement. Following the interviews, the application of LPS and its implementation strategy were discussed in detail and examples from previous studies were considered. As part of these discussions, the weaknesses of the current planning practices were observed, and thought was given to how LPS could enhance practice and support existing efforts.

4.2 LPS IMPLEMENTATION STRATEGY

In each case, LPS was implemented half way through the project. The research plan was to undertake the implementation process (facilitated by the first author) in four phases, with an evaluation at the end of each phase. This strategy was agreed upon after a discussion among participants and review of the advantages and disadvantages of previous strategies of LPS implementation. Incremental implementation of this kind is believed to gradually stabilise the elements of LPS, to minimise resistance to change and to have the additional advantage of providing an opportunity to evaluate each phase, allowing lessons learned to be carried to the next one. Figure 1 shows the LPS implementation strategy adopted in both cases, followed by explanations of the phases and the tasks carried out during each one.

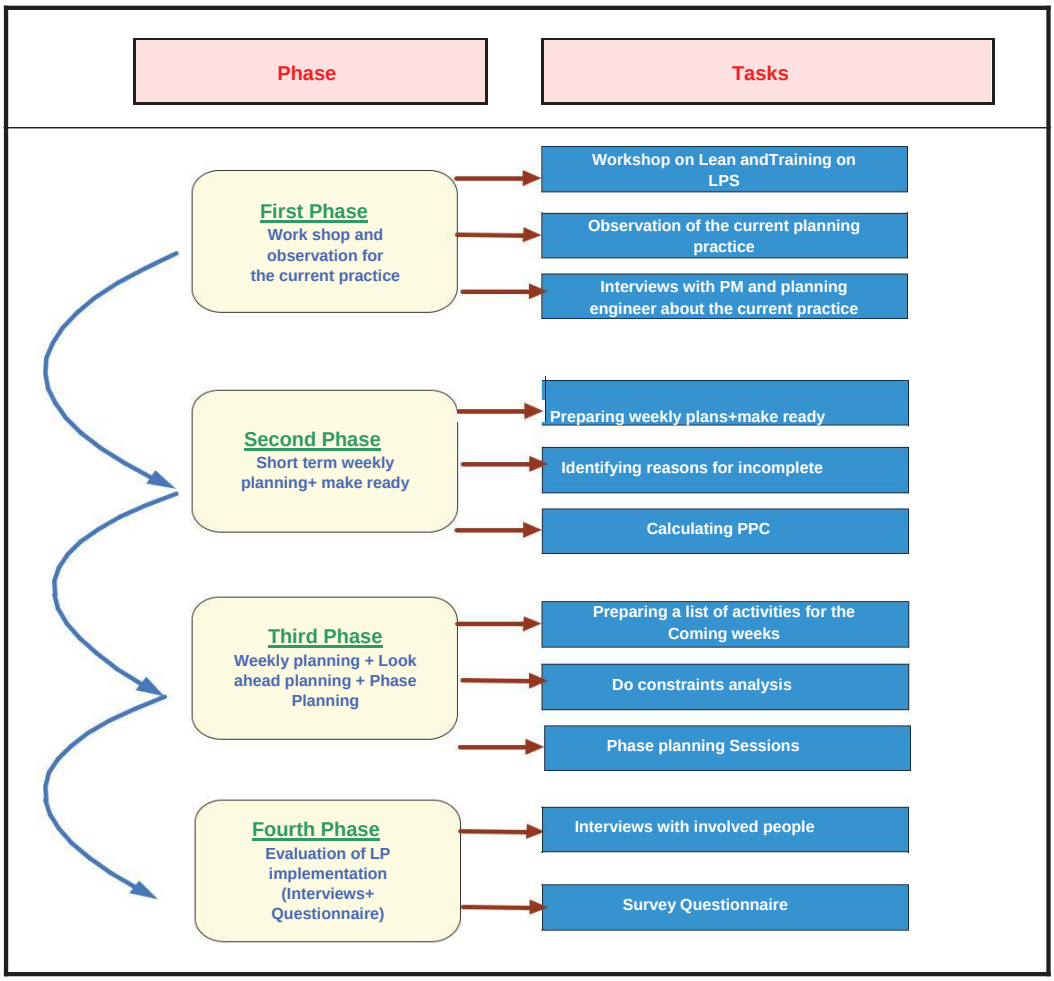

Figure 1: LPS implementation strategy in the studied projects

First Phase

In the first phase, a workshop on Lean and training on the use of LPS were provided to highlight the benefits and to discuss the perceived advantages of Lean and LPS. After this workshop, there was a two-week observation period to monitor the current planning practice, to interview the participants and to make notes. In addition, this phase aimed to train the team in how to calculate the PPC, identifying reasons for failure during these two weeks, but this is not included in the data, as LPS was not implemented during this phase.

Second Phase

It was agreed that PPC and reasons for incomplete assignments would be traced and recorded weekly for five weeks, in an attempt to help the team in driving improvement and to see how LPS would improve planning practice. In this phase, the focus was on short-term planning and make-ready, while little attention was directed to lookahead planning. Two weekly meetings were held with the involvement of all project parties (contractor's team, client representatives, consultant engineers). Data (PPC and reasons for incomplete assignments) were collected during the summer,

which is a very hot season in Saudi Arabia; in the year of the study, the temperature reached 52 °C. Furthermore, data collection coincided with the month of Ramadan, when Muslims fast during daylight hours. Taken together, these factors significantly affected labor productivity and hence assignment completion.

THIRD PHASE

The third phase was the longest, lasting for eleven weeks in each project, during which, in addition to weekly planning and make-ready, two main components of LPS were introduced: lookahead planning and phase planning. Phase planning allowed activities to be pulled through by reverse team planning and for resources to be optimized in the long term. In the first project, there were two lookahead windows, one covering four weeks and the other six weeks, whereas in the second case, only the four-week lookahead window was feasible. A possible explanation is that the involvement of many subcontractors made it difficult to produce six-week lookahead plans. Lookahead planning was extracted from the master plan zone by zone, then coordinated in the Last Planner sheets. Phase planning sessions were held throughout the project phases (structural, finishing and mechanical). All planning levels were linked, since lookahead plans were connected to the phase plans, which were connected to the master plan. Practically, during the all-day phase planning sessions, sticky notes were used to show the names, durations, prerequisites and locations of individual tasks on the project map. Each session was dedicated to a certain type of activity, aiming to provide certain goals in each phase and then work backwards from the target completion date to achieve the proposed milestones. In practice, phase planning allowed better visualization of the flow of work, assisting all parties to negotiate deadlines for the planned work.

FOURTH PHASE

During the fourth phase a survey questionnaire was administered to evaluate the process of LPS implementation. It aimed to allow all participants including the project team, client representatives, consultant engineers and subcontractors' managers to report the benefits, CSFs and barriers to LPS implementation in their projects. Respondents were given sufficient time to read the questionnaire, think about it and ask any questions they wished. Most answered in informal discussion groups in the presence of the first author, who explained the questions, provided any necessary clarification and asked participants to choose the answers they believed to be the most appropriate.

5. OUTCOMES AND FINDINGS

5.1 WEEKLY PERCENT PLANNED COMPLETED

Generally, there was a gradual increase in weekly PPC over the implementation period, as shown in Figure 2. This indicates improvement in the planning practice and management process (Koskela and Ballard, 2006). In the first project, PPC increased from 69% in the first week to 86% in the last week, peaking at 100% in the first week after the introduction of lookahead planning and then stabilizing at 86% for the last two weeks of the project. In the second project and over the same period, PPC rose from 56% in the first week to 82% in the last week, reaching a peak of 84% in the middle of the period and stabilizing above 80% for the last five weeks. Figure 2 facilitates the comparison of results for the two projects, showing that for most of the time, PPC was slightly higher for the first than for the second.

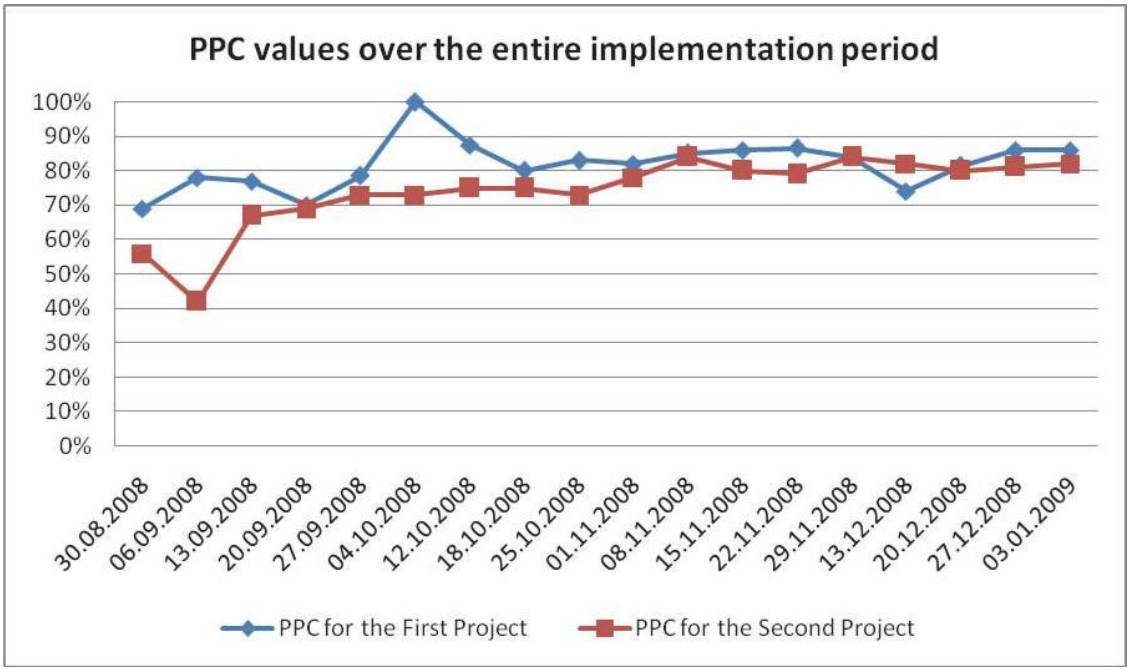

Figure 2: Weekly PPC values over the entire implementation period for both projects

5.2 REASONS FOR INCOMPLETE ASSIGNMENTS

Figure 3 plots and compares the various reasons for non-completion of assignments, which can be seen to vary in the number of occurrences between the two projects. Prerequisite work was the main reason for incomplete assignments in the first project. This is perhaps due to the nature of the stage that the project had reached, where most activities, including architectural ones, were entirely dependent on structural assignments being completed. In the case of the second project, labour supply was the main reason for incomplete assignments. It was clear that the project was always struggling to keep pace with the weekly and lookahead plans, because the available workforce was insufficient to meet needs. Most of the subcontractors appear to have exceeded their capabilities in their commitment to supply labor. The underlying cause was believed to be the persistently high demand for skilled labor at a time when the country was passing through an unprecedented construction boom: multi-billion-dollar projects were under way in both the public and private sectors, with many more in the planning stage.

The second main reason for non-completion encountered by the two projects was the restricted availability of materials, which occurred because of several factors. Firstly, the approval procedure required by the client was time-consuming and caused delays. Secondly, suppliers did not always deliver the materials on time. Sometimes the wrong materials might be delivered, mostly because the supplier was confused by the use of different block types and sizes. In other instances (specifically during the last phase, in relation to some of the mechanical materials) key deliveries were not made as scheduled.

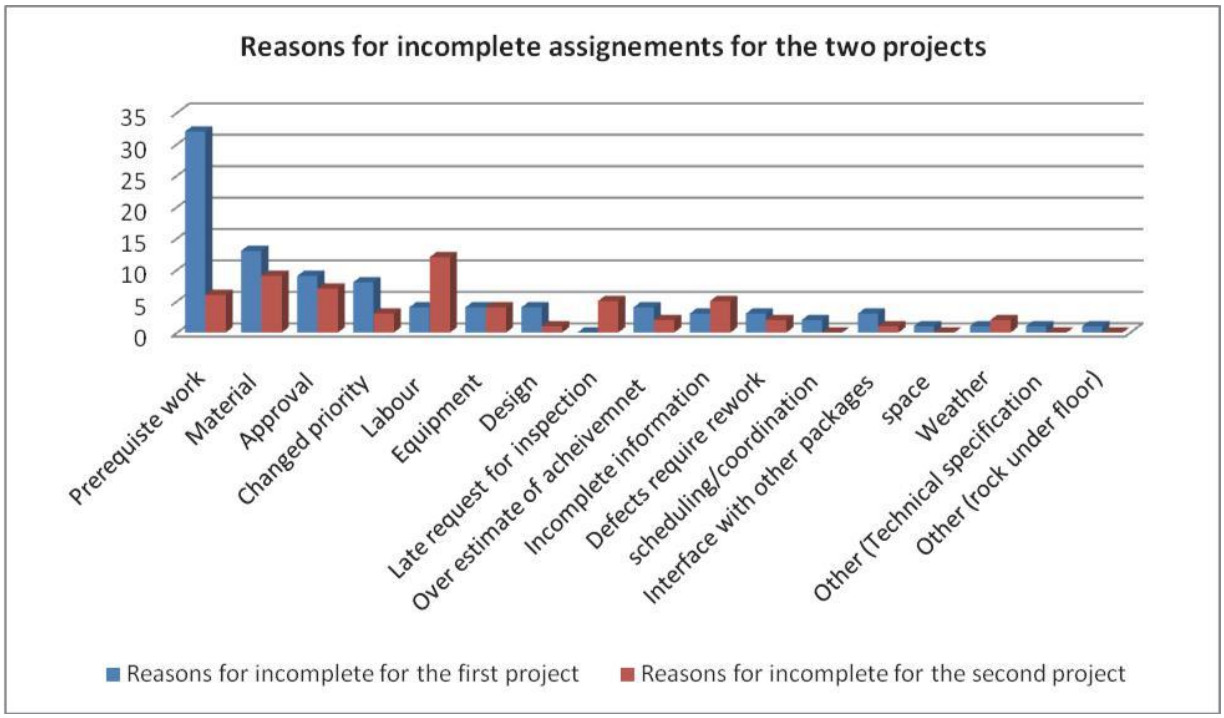

Figure 3: Reasons for incomplete assignments over the whole period in the two projects

The third reason for incomplete assignments in the two cases related to approval. The client's approval system was subject to bureaucracy and the overuse of paper-based communication, causing significant delays in decision making and in agreeing the purchase of materials. There was also an issue with requests being submitted too late for decisions to be made in time for the scheduled start of activities. This factor perhaps differentiates public projects from private ones, since the approval of materials and decision making needs to go through a certain process between consultant and client.

The fourth most common reason for incomplete assignments in the first project was a change of priorities, which mostly affected architectural activities, as they were not always sequence dependent. However, in some cases there was a need to change priority because of factors including the redistribution of labor between zones, confusion in sharing resources and the availability of professionals such as builders and carpenters. In the second project, the fourth reason for non-completion was prerequisite work, which again applied mostly to structural and architectural activities.

The fifth reason for incomplete assignments for the first project was labor, while for the second project it was late or incomplete information. The sixth factor in the first project was equipment problems, which occurred with the same frequency in the second project.

6. CONCLUSION

The work reported in this paper is limited to two case studies intended to improve construction planning practice. Although this was the first opportunity to use lean techniques for operational purposes in both projects, major benefits were achieved in terms of improving management practice. The LPS technique proved that it could enhance various aspects of construction management practice and bring major advantages. The benefit adding most value was that by

means of implementing LPS via action research, factors underlying the various causes of delay could be discovered and dealt with. LPS has proved to be a very proactive approach to reorganizing the planning process, promoting better coordination of field operations among project participants, assisting in collaborative planning and providing forward information for control. LPS enabled site teams to be more organized, effective and productive, which resulted in significant improvement to overall project management practice. Moreover, the learning process improved by means of continuous assessment and evaluation.

Besides its contribution to improving project management practice in the companies being studied, this study has made a valuable contribution to construction management practice in Saudi Arabia and added to the theory of lean construction and LPS. The outcomes of the case studies can be generalized to the extent that each of the construction organizations involved had a good quality record and a good reputation nationally. The first was classified among the top six construction contractors and ranked 80th among Saudi firms, while the second was well known and very active in construction work, particularly in the western region of the country. Given these attributes, the research findings can safely be generalized beyond the chosen sample and used as a reference for organizations seeking to improve their managerial practice, while the benefits of the study can be extended from Saudi Arabia to other countries in the region. The outcomes will be translated into Arabic and published in local journals and construction magazines.

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