MINIMISING THE CAUSES OF CONSTRUCTION DELAY VIA IMPLEMENTING LEAN CONSTRUCTION

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ABSTRACT

Over many years, delay has emerged as one of the most significant problems in construction industry, so much so that the causes have been investigated in numerous studies in different developing countries. Poor project management has been cited by a number of investigators as the main reason. However, despite such consensus, there are usually no clear recommendations demonstrating how project management practice could be improved. Moreover, the majority of recommendations made in the existing studies are general in nature and do not lead to a focus on a specific area. None of them are devoted to solving the difficulties associated with particular causes. The work in this article highlights the main causes of delay in construction with an aim to evaluate critically the former studies concerning the delay causes. It is further argued that delays do not arise purely because of tangible causes, as usually assumed in delay studies, but rather the underlying theory of project management may play a role in this regard. Finally, the paper argues that the utility of further traditional studies on delay is limited. Consequently construction industry must adopt innovative management techniques such as Lean Construction in order minimise waste, better productivity improvement, promote team building, and optimise learning process therefore delay causes can be minimised.

KEY WORDS: Delay, Conventional Project Management Theory, Last Planner, Lean Construction, Production Theory in Construction.

INTRODUCTION

A traditional contract document normally identifies the commencement date and completion date for the project. If, however, problems occur during the construction, the project duration is extended beyond the agreed scheduled completion date, and delay arises (Lewis and Atherely, 1996). Delay can be defined as the difference in time between the date of project completion stated in the contract and the date of actual completion. Assaf and Al-Hejji (2006) define delay as the time over-run either beyond the contract date or beyond the date that the parties agreed upon for the delivery of a project.

Over many years, delay has emerged one of the most significant problems in the construction industry, so much so that the causes have been investigated in numerous studies in different developing countries. This paper has been prepared to serve three purposes. The first is to present some analysis and then evaluation of previous studies on delay; and the second is to discuss the causes of delays in the light of the criticisms of the conventional project management theory. The third is to recommend the theory of Lean Construction as alternative production theory in construction and give an example of its best known techniques.

The contents of the paper are as follows. Firstly, the studies concerning the causes of construction delay in developing countries are explored in order to examine what causes have been identified and what solutions have been proposed. Then and acting from the sense that these are controllable factors, attention is given specifically to delay causes related to project management (i.e. poor site management, and ineffective planning and controlling). Secondly, having highlighted the problem, this paper argues that it does not arise purely because of tangible causes, but rather that the underlying theory of project management plays a role in this regard. Consequently, Lean construction theory is recommended as alternative production theory in construction. Thirdly, the paper argues that the utility of further traditional studies on delay is limited. Accordingly, this paper argues that rather than solely explanatory research,

constructive and action research need to be implemented to the construction industry more efficiently.

CAUSES OF DELAY

Studies on construction delay in different developing countries (table 1) have revealed several causes, the most frequent, together with their occurrence, being presented in Table 2. Ineffective planning and controlling is a common feature identified in most studies (87%), with disparities only in the degree of importance from one study to another. Most of the reported investigations have concluded that poor site management (56%) and problems of supply chain and procurement (69%) are considered as other main causes for delay. Delay in materials delivery, damage to materials when they are needed urgently and late procurement of materials, which are all related to poor project management, also worsen the problem. Taken together, these findings indicate that either the fault lies with those responsible for planning and management, or with the planning and management techniques themselves. However, in either case, the important role for the project plan and management system in the attempt to overcome such causes of delay in construction is clear.

Another cluster of problems leading to delays covers labour shortage, problems in material supply and financial difficulties, all related to the immaturity of the economy, financial institutions and labor market in a developing country. These are external factors that have to be taken as given in a project.

Table 1 Previous Studies on Delay in Construction

Study	Number
Assaf and Al-Hajjij, 2006	1
Assaf et al. ,1995	2
Faridi and El-Sayegh, 2006	3
Koushki et al., 2005	4
Odeh and Battinah, 2002	5
Sweis et al., 2007	6
Abdul-Rahman et al.,2006	7
Alghbari et al.,2007	8
Mezher and Tawil, 1998	9
Lo et al., 2006	10
Fimpong and Oluwoye, 2003	11
Mansfeild et al.,1994	12
Kaming et al., 1997	13
Ogunlana and Promkuntong, 1996	14
Arditi et al. 1985	15
Long et al., 2004	16

Table 2: Summary of Delay Causes in Previous Studies (Note. number between brackets refer to previous delay studies, see table 1)

Delay Causes	**SA** (1,2)	**UAE** (3)	**Kuwait** (4)	**Jordan** (5,6)	**Malaysia** (7,8)	**Lebanon** (9)	**Hong Kong** (10)	**Ghana** (11)	**Nigeria** (12)	**Indonesia** (13)	**Thailand** (14)	**Turkey** (15)	**Vietnam** (16)	**No. of Occ.**
Poor planning and controlling	**	*	*	**	*	*		*	*	*	*	*	*	**14**
Poor site management	*	*		*	**	*	*	*					*	**9**
Labour shortage and productivity		*		**	**		*		*	*				**8**
Material Supply chain and procurement	*		*	**	**		*	*	*		*	*		**11**
Financial difficulties	**			**	**				*		*	*		**9**
Change in design	*			**	*	*	*				*	*		**8**
Sub-cont. related problem	*				*	*	*							**4**
Poor commun. and co-ordinati.				*	**		*	*			*			**6**
Weather	*			*	**		*		*		*			**7**
Others	**	*		*	*		*	*	*		*			**9**

Table 3 Summary of Recommendations from Previous Delay Studies (number between brackets refer to delay studies see table 1)

Recommendations	**SA** (1)	**SA** (2)	**UAE** (3)	**Kuwait** (4)	**Jordan** (5)	**Jordan** (6)	**Malaysia** (7,8)	**Lebanon** (9)	**Hong Kong** (10)	**Ghana** (11)	**Nigeria** (12)	**Indonesia** (13)	**Thailand** (14)	**Turkey** (15)	**Vietnam** (16)	**No. of Occ.**
Improve planning and controlling	*	No recommendations	*	*		No recommendations	*		*	No recommendations					No recommendations	**5**
Improve site manag. & supervision	*		*				*						*			**4**
Minimise design change	*			*			*									**3**
Improve financial support	*			*			**		*		*					**6**
Improve materials supply and procure.											*	*		*		**3**
Improve productivity							*					*				**2**
Improve human resource manag.			*		*		*	*	*				*			**6**
Improve commu.& co-ord.							**	*	*		*		*			**6**
Adopt new manag. techniq.								*						*		**2**
Adopt new approach to contract award					*											**1**
Others	*		*	*	*		*					*				**6**

CRITICAL EVALUATION OF DELAY STUDIES

Different recommendations have resulted from these studies (Table 3). Recommendations where made are: only 31% of studies mention improving planning and controlling, and only four studies out of sixteen (25%) recommend improving site management. Improving human resource management has been recommended by 37.5% of the examined studies. Other recommendations such as improving communication and collaboration between the parties involved, improving financial support, and minimising design changes were made by 37.5%, 37.5% and 19% of studies respectively.

In the following, previous delay studies are criticised regarding three aspects. First, not all studies made recommendations. Second, as ineffective planning and controlling was to be found common factor on the majority of the studies, it is expected that recommendations produced to overcome its impact but unfortunately this did not happen. Thirdly, even few studies have recommend improvements; they have not proposed the necessary tools to facilitate such improvements.

Recommendations not made

From table 3, it can be shown that not all studies made recommendations; 25% of the studies did not recommend solutions to the problematic causes of delay. Different reasons for this may be given, such as that the aims of the respective research were limited to finding or causes or the funding of the research problem was limited. However, it can be hardly argued that a delay study would have other motivations than to facilitate the removal of those delays, and from this angle, the failure to discuss solutions to delay problems is disappointing.

Recommendations do not match findings

In the majority of the studies, it can be noticed that recommendations derived do not match the findings. Figure 1 shows the frequency of delay causes and corresponding recommendations in delay studies. Returning to Table 1, let's consider one particular factor, ineffective planning and controlling, as an example. It is interesting to note that fourteen cases out of sixteen (87%) mention this, thereby indicating that this factor should be focused on and recommendations produced to overcome its impact. Another example, the problem with supply chain and procurement, was found to be mentioned in 69% of studies, giving the impression that this is a particularly problematic area. The third example, poor site management, was cited in 56% of studies, featuring as the third main cause of delay, yet few studies proposed solutions to improve site management.

Recommendations do not contain practical advice

Although a few studies have recommended improvements, they have not proposed the tools to facilitate such improvements, and how the recommendations could be implemented. The following are some examples.

Over a decade ago in Nigeria, Ogunulana et al. (1996) proposed that owner associations, designers, contractors, suppliers, finance houses, educational institutions, manufacturers and the government should co-operate to provide the infrastructure necessary for efficient project management. However, the research fell short of determining the nature of such infrastructure, and the question therefore, remains, as to what constitutes this, and how to adopt it within the construction industry.

Two years later in Lebanon, Mezher and Tawil (1998) stated that the construction industry must adopt innovative management techniques, team building and value engineering, in order to become more efficient and effective. However, the researchers did not specify their understanding of innovative management techniques, nor did they offer examples of techniques that could be used to improve team building.

In a similar vein, in Jordan, Al-Momani (2000) argued that the findings presented in his study provide good guidance for managerial intervention, but did not specify what kind of intervention, in what area of project management, and how this intervention could be put in practice on a construction site.

More recently, in Saudi Arabia, Assaf and Al-Hejji (2006) recommended contractors to consider planning and scheduling as continuing processes during construction, and to match these with the resources and time to develop the

work to avoid delay, cost over-run and disputes. This necessitates some clarification as to how this could be carried out and what kind of planning tools might assist in achieving this recommendation.

And in the same year, in Hong Kong, Lo et al. (2006) recommended that comprehensive strategies need to be formulated to minimise variations, whether client-initiated or consultant-initiated, wherever possible. A clear and thorough client brief is considered the most useful strategy for reducing variations. Contingency allowances may be incorporated for inevitable variations. The question that arises here is what kind of methods could help minimising variations? Figure 1 shows the frequency of delay causes and corresponding recommendations derived from the different studies.

Discussion

To sum up, from the recommendations (Table 3), it can be clearly stated that the majority of suggestions do not contribute to problem-solving. For instance, they are neither specific to a particular problem, nor to particular causes. It can be clearly concluded that the majority of these studies did not recommend practical solutions or methods to improve the situation. Moreover, they did not explore the reasons for the causes. For example, a common delay factor is ineffective planning and controlling, yet none of the researchers examined the reasons behind this cause, which could be just one, or several, since planning may be ineffective because of inadequate planning tools and techniques and/or because of incompetent/untrained people with responsibility for formulating and facilitating the plans.

Given that problems with management in general, and planning and controlling specifically, were identified, it is to be expected that recommendations in these areas would be made, but unfortunately, the majority of studies do not provide any. Taken together, the findings from all these studies are that the problems in construction projects are either management problems or related to environment of the project. Consequently, these management problems in particular, should be understood and efforts directed towards developing solutions and more efficient methods of operation. In the next section, we consider the possibility of a deficient theory of project management, which has been largely overlooked in conventional delay studies aiming to introduce the concept of Lean construction as alternative management theory. Then, selected case study examples demonstrating the implementation of Last Planner system (the best known Lean Construction technique) will be cited. The interested readers may consult the original references.

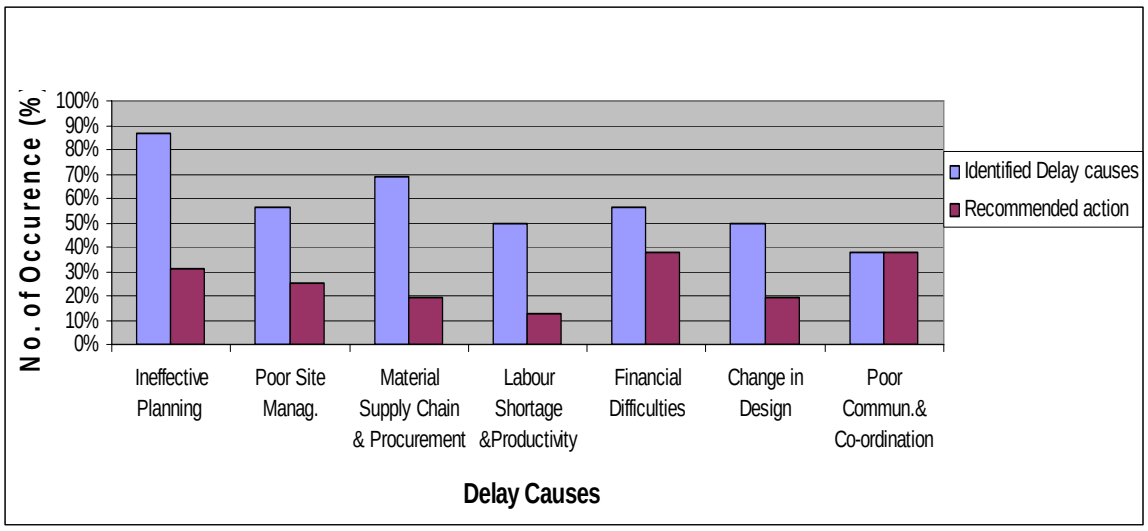

Figure 1 Frequency of Delay Causes and Corresponding Recommendations in Delay Studies

CAUSES OF DELAY AND PROJECT MANAGEMENT THEORY

Scholars (Koskela, 1992; Ballard and Howell, 1998; Santos, 1999; Koskela and Howell, 2002) argue that the theory of production control in construction is based on a deficient theory and this leads to added costs and the reduction of overall performance. Thus, in the light of the causes of delay, this paper argues that the problems are not only related to the reported causes themselves, but also to the theory of project management. Hence, the causes of delay identified in previous studies will be discussed according to the two main criticisms of the traditional theory of project management, which are: firstly, that project management theory is based on management as a planning function and not management as an organising function, and secondly, that project management theory focuses on the transformation concept without considering the flow concept.

First: Project Management Theory is based on Management-as-Planning

Construction project planning is the key aspect in managing and controlling construction projects. It is considered by many in the construction industry, as the core competence of the discipline of project management (Callahan, 1992; Harris and McCaffer, 2006; Mawdesley et al, 1997; Chitkara, 1998; Laufer, 1990; and others). Thus, for a project to be successful there is a need for effective project management, which implies better planning and control over the project.

Acting from the sense that planning is crucial; the focus here will be on the two causes of delay: ineffective planning and controlling and poor site management. The question that arises is what are the reasons behind these causes?

The PMBOK Guide divides project management processes into initiating, planning, execution, controlling and closing processes. Howell and Koskela (2004) show that the core processes of planning, execution and controlling form a closed loop (Figure 2): the planning processes provide a plan, that is realised by the executing processes, and variances from the baseline or requests for change lead to corrections in execution or changes in further plans. In other words, the emphasis is firmly on planning, and little guidance is provided on executing.

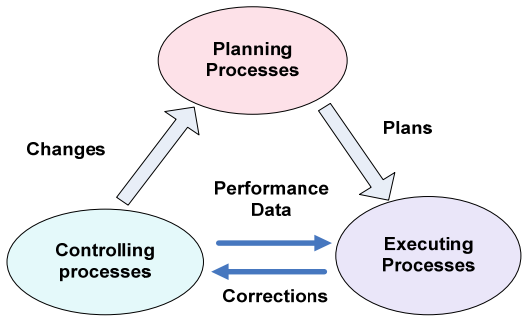

Figure 2: The Closed Loop of Managerial Processes in Project Management according to the PMBOK Guide (Howell and Koskela, 2004).

Howell and Koskela (2004) argue that the present approach to project management, as described in the PMBOK Guide, is based on two underlying theories: management-as-planning (for planning and execution) and the thermostat model (for control). They perceive the main weakness of this approach to be that it is insufficient from the viewpoint of project management reality, and argue that the practice suffers from three shortcomings:

- The role of planning is not logically defined, and short-term planning is normally poorly carried out or simply neglected.
- Execution is not managed efficiently. In other words, action is taken for tasks to be pushed by the plan without considering the real conditions as higher level plans are translated into short-term plans and then into action.
- Control is too narrowly seen as measuring and taking corrective action, rather than as a process of learning.

These claims are in agreement with Laufer and Tucker (1987), who two decades ago, pointed out that the primary internal motivation for planning is often control, rather than execution. Thus, the significance of control is corrupted by the separation of execution from planning, and in practice planning becomes a way of explaining what has happened and trying to find a way to recover.

Hence, it can be claimed that projects are delayed because of not being implemented using a theory that emphasizes control over the plans on construction sites. Poor site management may results from absence of effective short term planning and management which considered as one of the key components of site management. The difficulty is not in producing plans but in their execution, control and in keeping them up-to-date. It is the fact that plans are not properly implemented, that renders them ineffective. For example, a plan becomes ineffective when tasks are pushed by it without considering the availability of all resources. The availability of tools (i.e. Lean Construction tools including Last Planner system) would be reasonable approach to tackle this issue. The successful implementation of such tools will assists in:

- Making tasks ready before they start which could be achieved by means of look ahead plan with an emphasis on tasks flow.
- Minimising interruption in the weekly planning caused by unplanned tasks which could emerge and affect planned tasks.
- Checking of task completion and percentage planned completed weekly as well as investigating reasons for non-completions.

Second: Project Management Theory is based on the Transformation Concept and Neglects the Flow and Value Concepts

It has been well documented that construction is managed according to the transformation concept (Santos, 1999; Koskela, 2000; Koskela and Howell, 2002), in which management efforts are centred on task management. However, task management is not implemented systematically across all phases, resulting in added variability. Even where there is an intention to implement systematic task management, it corrupts, due to the high level of inherent variability, to become unsystematic management. Thus, bad control (i.e. deficient attention in control to the principles of production) across all phases, results. Koskela and Howell (2002) criticised production based transformation for its mistaken assumption that the inputs to a task and the resources to execute are ready at the time of authorisation to start it.

According to Koskela (1999), the transformation concept is helpful in discovering which tasks are needed in a project; thus, it is perfectly possible to realise projects based on this view. However, the transformation concept is not especially helpful in deciding how not to use resources unnecessarily. Instead, the principles of the flow view explain how, for example, the variability of production impacts on resource use. Koskela (2000) suggested that production could be conceptualised from three points of view: transformation (realize value-adding activities efficiently), flow (reduce the share of non-value-adding activities) and value (improve customer value). Table 4 shows the new theoretical foundation of project management which considers transformation, flow and value. Moreover, it considers management as planning, execution and control.

Table 4: Ingredients of a New Theoretical Foundation of Project Management (Koskela and Howell, 2002)

Subject of theory		Relevant theory
Project		Transformation, Flow, Value generation
Management	Planning	Management-as-planning, Management-as-organising
	Execution	Classical communication theory, Language/action perspective
	Control	Thermostat model, Scientific experimentation model

On the light of former discussion, it can be argued that in addition to the reported causes of delay, project management itself, if it follows the prescribed theory, also plays a role in project delay. This argument has been verified by evidence from the practice point of view (practical problems) and from a research perspective (criticisms of the conventional project management theory by various scholars). Thus, project management theory should consider the transformation, flow and value concepts which represent the basic fundamental concept of Lean Construction theory. This is in agreement with Koskela's argument; the Transformation, Flow, and Value (TFV) is the most acceptable theory of production available (Koskela, 2000).

DISCUSSION

Based on findings from previous delay studies, it can be concluded that there are two arising important issues:

1. Poor implementation of the existing project management methods and practices in developing countries due to lack of development and training.

2. Existing project management methods and practices contended to lead to self-inflicted problems because they stand on inadequate theory.

Such above findings suggest several courses of action for planning practice in construction. The most significant is that there is a definite need for tools or techniques that take into account the two strands of criticism against the conventional theory of project management (management-as-planning and not as organising and focusing on the transformation concept and neglects flow). In this respect, Howell and Koskela (2000) stated that “in the present big, complex and speedy projects, traditional project management is simply counterproductive; it creates self-inflicted problems that seriously undermine performance”. Accordingly, addressing these two criticisms to project management provides for one possible starting point for improvement. As this paper argues that the utility of further traditional studies on delay is limited, it recommends that rather than solely explanatory research, constructive and action research (Jarvinen, 2007) need to be implemented to the construction management more efficiently. This can assist in achieving the following purposes (Alsehaimi and Koskela, 2008):

- To explore the industry problems such as delay causes, low productivity and others and then working to overcome such problems.

- Such research methods may help in improving the practice and tackle some of the managerial problems.

- Contribution could be made to improve the practical concerns of people in practice and the theory of construction project management.

Evidently, the implementation of some Lean Construction techniques such as the Last Planner approach to construction planning in different developing countries (Junior et al., 1998, Fiallo and Revelo, 2002, Thomassen et al.2003, Lim et al, 2006) can be pinpointed as examples of such constructive and action research.

CONCLUSION

In this paper, a simple quantitative analysis of the findings and recommendations in different studies of delay has been carried out. The outcome of this analysis shows that the findings on causes revolve around two issues, management and project environment, and that recommendations only in a rather limited way contribute to problem solving. In addition, the recommendations do not match the findings. Moreover, it is contended that delay studies do not reach one of the root causes to problems, namely that the theory of project management is inadequate. Thus, it can be argued that the utility of conducting more traditional studies on delay is limited, as their contribution to knowledge and practice is modest at best. In this context, this paper recommends that rather than solely explanatory studies, Lean Construction techniques could be successfully implemented in non-traditional research approaches such as constructive and action research to enhance the performance of the practice, contribute to knowledge and tackle some of the persistent managerial difficulties in construction.

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