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ScienceDirect

Procedia Computer Science 121 (2017) 732–739

Procedia Computer Science

www.elsevier.com/locate/procedia

CENTERIS - International Conference on ENTERprise Information Systems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies, CENTERIS / ProjMAN / HCist 2017, 8-10 November 2017, Barcelona, Spain

Investigating Schedule Deviation in Construction Projects through Root Cause Analysis

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Abstract

In construction projects delays are not only disruptive but also expensive. Thus, the reasons for schedule deviation need to be identified. The delay factors determined in previous research were predominantly studied through surveys. In these studies, the participants were stakeholders in construction projects, and the reasons for schedule deviation were identified through their point of view. In addition, delay factors are typically considered individually and are presented at the same level. In reality, owing to the complex structure of construction projects and long execution time, non-conformance in schedules occurs by a chain of events. The aim of this research is to investigate the factors causing schedule deviation in construction projects and understand the cause-effect relationships between the events leading to delays. Among various techniques developed to root cause problems, fault tree analysis (FTA) is an established tool. FTA looks deeply into the chain of events leading to a problem to identify its primary cause. FTA was applied to a modular construction project that experienced significant delays. The analysis identified multiple delay factors, and showed how they are linked from the primary causes to the ultimate event. The root of most delays was traced to the inexperience of the project stakeholders.

Peer-review under responsibility of the scientific committee of the CENTERIS - International Conference on ENTERprise Information Systems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies.

Keywords: Construction delay, Delay factor, Productivity, Prefabrication, Root-cause analysis

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1877-0509
Peer-review under responsibility of the scientific committee of the CENTERIS - International Conference on ENTERprise Information Systems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies.
10.1016/j.procs.2017.11.095

1. Introduction

A construction project is considered to be successful when it is completed on time, within budget and all the stakeholders are satisfied with its quality (Gündüz et al. 2013). Completing projects within the contract time is often regarded as an indicator of efficiency (Chan and Kumaraswamy 1997). However, unique features of construction projects, such as long execution period, complicated processes, high sensitivity to environmental influences, the diverse interests of the different stakeholders and the dynamic structure of project teams, often make the delivery of projects on time very challenging (Zou et al. 2007). Indeed, the construction industry generally regards delays to be inevitable (Aibinu and Odeyinka 2006).

In order to control or eliminate the obstacles to complete a project on time, the reasons for construction delays have to be understood. Many studies have been carried out for this purpose, and the methods typically applied are surveys conducted using interviews or questionnaires (e.g. Assaf et al. 1995; Gündüz et al. 2013), and reviews of existing literature (e.g. Chan and Kumaraswamy 1997; Aibinu and Odeyinka 2006; Pethkar and Birajdar 2015). These studies have generally regarded all the causes of non-conformance in construction schedules to be at the same level. In other words, the cause-effect relationships between delay factors are missing. Furthermore, the importance of a delay factor is generally assigned subjectively by the participants to a study based on personal experience. Thus, there is no systematic and objective way of judging how significant a delay factor is.

In reality, lateness in construction schedules results from a chain or sequence of events. Any undesired delay event must be triggered by intermediate events and these in turn are caused by primary events which should be identified, understood and blamed for. Hence, all the delay factors in a construction project are connected not only chronologically but also logically. This is because all the stakeholders in a construction project are interacting dynamically with each other during the whole execution period. Thus, in order to effectively reveal the primary delay causes, a new paradigm has to be implemented.

The aim of this research is to investigate the factors causing schedule deviation in construction projects and understand the casual relationships between the events leading to delays. The research is based on the analysis of a modular construction project. Fault Tree Analysis was used to identify the delay factors and reveal the cause-effect relationships between them.

2. Background

2.1. Identifying delays in the construction industry

Many studies have analysed the reasons for schedule deviation in stick-built construction projects. These investigations were carried out in different countries and on different types of construction projects. Gündüz et al. (2013), investigating the factors causing construction delays in Turkey by literature review and interviews with experts, identified a total of 83 delay factors and categorised them into 9 major groups. Assaf et al. (1995) identified 56 delay factors in large building projects using a survey and a literature review. They then asked the participants to the questionnaire ranking the delay factors based on their severity and frequency. Sweis et al. (2008), evaluating the late delivery of residential projects in Jordan through data collected from published literature and interviews, identified 40 delay factors. In their study, financial difficulties faced by contractors and frequent change orders by owners were found to be the leading causes. Chan and Kumaraswamy (1997) reported 36 delay factors for building projects in Hong Kong by looking into previous studies regarding construction delays. Aibinu and Odeyinka (2006) identified 39 delay factors in construction projects in Nigeria using a literature survey and a postal questionnaire. A literature review and a survey have also been carried out by Sambasivan and Soon (2007) to reveal the delay factors in construction projects in Malaysia. In the same way Zou et al. (2007), Abd El-Razek et al. (2008), El-Sayegh (2008) and Doloi et al. (2012) performed literature reviews to collect common construction delay factors in China, Egypt, United Arab Emirates and India, respectively. Overall it appears that the prevalent methods of studying delay factors are surveys conducted using interviews or questionnaires and reviews of published studies.

Compiling a list of delay factors and categorizing them is one approach to developing understanding of schedule deviation. However, it is important to acknowledge that almost every problem or incident must be caused by another event, especially in an industrial sector such as construction, which is known for its complex and dynamic processes, and long execution time. Thus, a new approach is needed which can not only identify delay factors but it also demonstrates their chronological and cause-effect relationships.