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Management and planning under complexities of metro construction

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Abstract

Nowadays, the majority of construction projects can be considered as complex and ambiguous endeavours. Each kind of construction project has its own characteristics and complexities whereas then specific management approaches and solutions are needed. Regarding the rapid development of cities, underground constructions at urban regions, such as metro construction, have been largely used for extending daily human life into underground spaces. Therefore, the recognition of the complex elements of a metro construction can play a significant role in its management and planning. The aim of this study is to investigate these complexities in subway construction. This may develop the possibility of high predictability for these challenges. As metro projects are also urban underground projects, both internal and external issues are studied and their impacts on project management are discussed. It is concluded that exceptional differences in the managing and planning of these constructions is that combined internal and external complexities are carried out simultaneously.

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Keywords: Complexities; construction management; construction planning; metro construction; underground construction.

1. Introduction

The variety of construction projects around the world is growing all the time along with changing human life styles and technologies. However, the complexities of new projects provide challenges for project planning and management. According to Baccarini (1966), all construction projects can be categorized as complex projects. This is caused by the direct relation between complexity and involving a variety of interrelated parts which should be managed regarding differentiation and interdependency conditions. New various technologies and methods are used in different types of construction. Each kind of construction project has its own characteristics and complexities

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which lead to related specific ambiguousness. This addresses that being successful in a type of project requires managerial solutions that are selected and fine-tuned according to its complexities.

Therefore, the recognition of the effective and challenging elements of each project in advance can play significant role in successful project planning and management. "There is no doubt that construction projects are becoming increasingly complex undertakings. This may be attributable to clients' demands and other technological developments" (Mouchi et al., 2011). Regarding the rapid development of cities, underground constructions at urban regions such as metro construction have been largely used for extending the human daily life into underground spaces. Metro rail systems are known as convenient underground transportation solutions amongst citizens. However, those require large investments and take considerable time to be designed and constructed for realising all expected social and regional or even national benefits. Such underground constructions are one of the most vulnerable engineering projects (Leijten, 2009).

This vulnerability should be identified and considered as it can be a significant threat for public trust. As public citizens are the ultimate consumers of all the funded projects either publicly or privately, every construction project can change the level of trust among the society members (Greiman, 2013). Furthermore, a metro system is usually designed to be utilized for crowded area of cities. The process of this construction obviously interrupts civilian daily life. These illustrate the importance of adequate management and planning over whole process of metro project to be delivered on time and on budget with high quality and efficiency. Therefore, the aim of this paper is to explore specific complexities in the construction of an underground metro rail system. Those can be sources of issues for the management and planning of such projects. In this study, the challenges are divided into internal and external complexities as well as the influences of both of them are investigated. The paper and its results are based on the qualitative and quantitative data obtained from the certain real world projects and from the experts of underground construction.

2. Internal complexity

Internal complexities in this study can be seen as issues which are caused by the participants in design and construction processes of a metro rail project.

2.1. Changes in construction phase

Design and engineering phases of a typical construction project produce considerable amount of details and specifications. Designers try to consider all relationships between components and related conditions for presenting details as accurate as possible. However, literally coordinating between hundreds of thousands pages which contain different details of a project specifications is impossible (Callahan, 2005). This leads to expecting some mistakes which will be found in construction phase and must be corrected. As countless details alterations usually are needed after just one change, the ambiguities, gaps and conflicts of each project are expected to be discovered with some kind of change process (Callahan, 2005). In a metro rail system project, many stations and tunnels must be designed in detail. Furthermore, designing a huge project requires so larger human forces to prepare details and maps whereas finding conflicts may not possible. This complexity can rise when different parts of a project are designed by different companies. Due to the variety of needed expertise in metro design, it is necessary that different companies take part in design phase of this wide skill project.

Moreover, metro rail system utilizes highly technology oriented construction delivery with its electrical and mechanical devices and equipment being crucial for the performance of the system itself. Technology is developed every moment and new updated devises and equipment are produced and proposed by inventors and companies to users. Mostly newer products have more productivity in task performance with less energy consumption and higher quality. This may encourage clients, even consultants, to change some designed equipment and devices into newer ones which may require some specific prerequisites to be considered and built. These replacements in construction phase, even in initial steps, can be another cause of changes.

On the other hand, some of the designed performance methods might be infeasible or unrealistic. Some