

DESIGN PROCESS IMPROVEMENT BY INTEGRATING PRINCIPLES OF
CONSTRUCTABILITY KNOWLEDGE TO THE MONORAIL SYSTEM
PROJECT

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*“Al mighty ALLAH, please give blessing to them...
My wife, my children, my parents, my lecturers and my friends
AMIN.”*

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ABSTRACT

The use of constructability analysis is the process of determining that the designers utilize common construction practices that are readily available in the contracting industry to complete a project. The use of constructability analysis provides an opportunity for input from the contracting industry to the design professional to ensure that efficient, economical and quality solutions are reached. The timely execution of a construction project is very important to the client, who makes plans and commitments on the basis of the project's anticipated completion date. Failure of design professionals to consider how a builder will implement the design can result in scheduling problems, contract changes, increase of cost, delay, variations even dispute during the construction process. Many design firms have indulged in constructability program that is launched as early as conceptual planning stage of the project. Hence, the aim of this study is to enhance monorail design process through integration of constructability concept. The objective could be determined by investigating whether any research and study has ever been approached on the implementation of constructability review analysis on any monorail projects in Malaysia. Subsequently to identify whether there is an element of Constructability Review Analysis being implemented to the monorail project in Malaysia. Furtherance to this, a Constructability Review Checklist is to be created specifically for the monorail projects, ensuring its integration into design process. There are three (3) phases of this investigation. Phase one (1) starts with the determining the objective and scope and subsequently research through literature reviews and preliminary interviews. Phase two (2) consist of studying the case study by investigation from the existing and on-going KL monorail project and constructability issues. Phase three (3) comprises of developing and validating on improving the design process and fine tuning the design constructability checklist by interviewing an expert on monorail consultants. Finally, the conclusion was there has been no study and research being approached into the constructability review analysis on any monorail projects in Malaysia. However, it was identified there are elements of constructability review analysis being implemented in the KL Monorail Project. Hence, a constructability review checklist was developed ensuring its integration into the constructability review design process.

ABSTRAK

Penggunaan Analisis Kebolehbinaan adalah proses menentukan bahawa pereka menggunakan amalan pembinaan biasa yang sedia ada dalam industri kontrak untuk menyiapkan projek. Penggunaan analisis kebolehbinaan memberi peluang kepada industri kontrak kepada perekabentuk profesional untuk memastikan kecekapan, ekonomi dan kualiti projek diperolehi. Pelaksanaan yang tepat pada projek pembinaan adalah sangat penting kepada pemilik, yang membuat rancangan dan komitmen berdasarkan jangkaan tarikh siap sesuatu projek. Kegagalan profesional reka bentuk untuk mempertimbangkan bagaimana pembina akan melaksanakan reka bentuk boleh menyebabkan masalah penjadualan, perubahan kontrak, peningkatan kos, kelewatan, variasi pertikaian semasa proses pembinaan. Kebanyakan juru perunding telah menjalankan program kebolehbinaan seawal di tahap perancangan konsep projek. Oleh itu, tujuan kajian ini adalah untuk meningkatkan proses rekabentuk monorel melalui integrasi konsep kebolehbinaan. Objektifnya boleh ditentukan dengan menyiasat sama ada sebarang penyelidikan dan kajian telah dilakukan terhadap pelaksanaan analisis kajian kebolehbinaan pada mana-mana projek monorel di Malaysia. Seterusnya, adalah untuk mengenalpasti samada wujudnya asas-asas analisis kebolehbinaan telah dipraktikkan di dalam projek monorel di Malaysia ini. Lanjutan daripada ini, senarai semakan analisis kebolehbinaan diwujudkan khasnya untuk projek monorel ini untuk memastikan keserasian di dalam proses rekabentuk. Kajian ini terbahagi kepada tiga (3) fasa. Fasa pertama (1) adalah menentukan objektif dan skop dan seterusnya menjalankan kajian literatur beserta dengan temuduga soal selidik. Fasa kedua (2) pula mengkaji kajian kes daripada projek KL monorel dan isu kebolehbinaan. Fasa ketiga (3) pula menyediakan dan mengesahkan penambahbaikan proses rekabentuk senarai semakan kebolehbinaan dengan hasil menemuramah pakar perunding monorel. Akhirnya, kesimpulan yang boleh dilakukan adalah tidak ada sebarang kajian dan penyelidikan yang pernah dilakukan ke atas analisis kebolehbinaan pada mana-mana projek monorel di Malaysia. Walau bagaimanapun, ia telah dikenal pasti terdapat unsur-unsur analisis kajian kebolehbinaan yang sedang dilaksanakan dalam Projek KL Monorail. Oleh itu, senarai semakan analisis kajian kebolehbinaan telah dihasilkan untuk memastikan integrasi ke dalam proses analisis kajian reka bentuk kebolehbinaan.

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CHAPTER 1

INTRODUCTION

1.0 Introduction

Large scale projects such as rail infrastructure require huge investment. However it is necessary for the government to provide such infrastructure which could alleviate traffic congestion, enhance economic activities and attract more investments. This study will emphasize to the existing and on-going monorail system project in Malaysia, which is the KL Monorail Systems. KL Monorail is an 8.6 km monorail system aimed at connecting and complementing other urban transportation systems in Kuala Lumpur. It was completed at cost of RM1.18 billion by the KL Infrastructure Group (KL Infra) and became operational on 31 August 2003.

Currently, there are several literatures about constructability analysis in construction projects (Jergeas and Van der Put, 2001), but we haven't seen any formal analysis of the monorail system transportation constructability analysis. However, generally any performance on any construction project can be evaluated by time, cost and quality (Konchar and Sandivo, 1998). Hence, the constructability analysis of monorail project is also involve in time, cost and quality and may have similar approach to the construction projects.

Independent studies (Ireland 1985; ASCE 1991; Russel *et al.* 1993) confirmed that integrating construction knowledge into design processes greatly improves the chances of achieving a better quality project, completed in a safe manner, on schedule, for the least cost. The Construction Industry Institute issued guidelines for implementing constructability programs (CII, 1986, 1987). Attempts were made to develop models to classify constructability knowledge (Hanlon and Sandivo, 1995; Fischer and Tatum, 1997) and to automate the process of constructability reviews (Gray, 1986; Skibniewski *et al.* 1997; Navon *et al.* 2000). Studies were conducted to understand the phenomenon better, to identify the barriers to better constructability and advantages obtained from constructability reviews (CII, 1993; Uhlik and Lores, 1998).

1.1 Problem Statement

In the construction process of monorail system, particularly in Malaysia, which is very new in this construction and transport industry, usually uses the same approach of other normal building construction works, such as for the buildings of monorail stations, guideway beams, depot buildings and other facilities. However the additional work of the monorail system compared to construction are the train or the 'rolling stock', and other electrical and mechanical systems like transformers, switchgears and signaling that developed the monorail systems. The building and construction of the monorail system also are lead by the Architectures and Engineers whom responsibility to develop the design and to be developed and implemented by the contractor and supplier in executing the project, which meets the client's need and expectation. However, by the designer's very nature, they are not very specialize in construction means and methods.

According to Glavinich (1995), most of the designs and specifications that were produced tend to be performance oriented, specifying an end result and materials, while leaves the means and methods for constructing the work to the contractor. As a result, the reality of constructing is that most of the problems encountered in the field are often compounded by inherent design flaws that originated in the design phase. Therefore, it is important to emphasize the constructability during the early stage of design process. Moreover, many research (Paulson, 1976; Glavinich, 1995; Mendelsohn, 1997; Nima *et al.*, 2001) found that integrating constructability knowledge into design processes is the right time to influence project costs, decrease the likelihood of delays, contract change orders due to unforeseen site conditions, legal entanglement and variations.

A research by Nima *et al.* (2001), found there is an acceptance of the majority constructability concepts by the Malaysian engineers from the theoretical point of view. However, they did not apply these concepts in their practices, especially in the design phase. This is due to the current design practices does not incorporate constructability as part of the design process. Hence, there is a need to predetermine the current local design process, especially for the monorail projects, which has never been investigated before on constructability analysis and further proposing design process improvement that integrates constructability concepts.

In the general construction of project management implementation, its project life cycle and the constructability feedback model is shown in Figure 1.1 (Kartam, 1996).

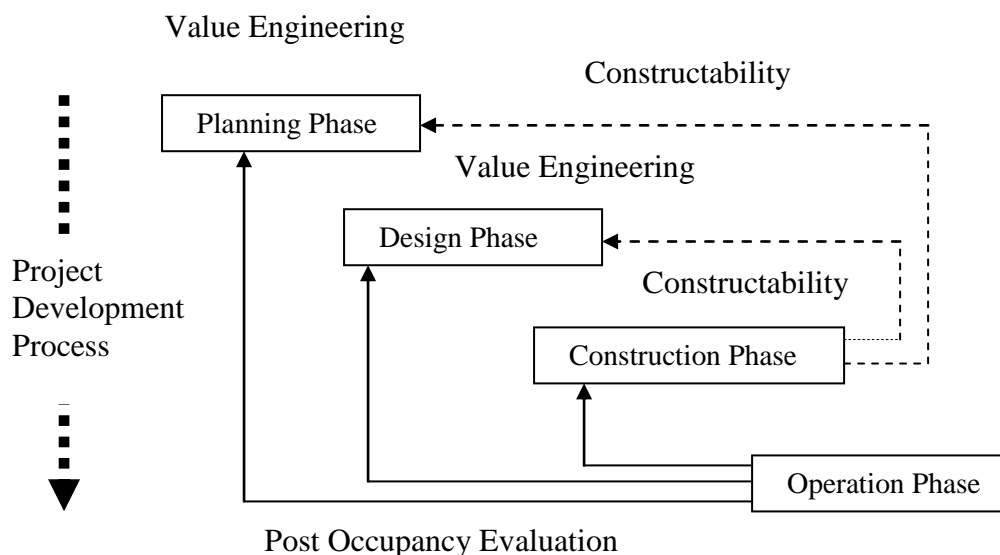


Figure 1.1: Feedback of constructability in construction project life cycle

This kind of knowledge and lessons learned may have their genesis in any phase of project's life cycle. Similarly these lessons may be applicable to one or more phase of the project life cycle as described in Figure 1.1 above. Each loop has its functionality in the role of constructability from others (Kartam, 1996).

Implementation of constructability principles can be adopted at the design stage on several methods. A few researchers have developed tools that can be used to enhance the constructability of project designs (Anderson *et al.*, 2000; Arditi *et al.*, 2002; Navon *et al.*, 2000; Soibelman *et al.*, 2003; Pulaski and Horman, 2005). However the level of formality of those methods varies. Nonetheless, constructability improvement tool in the form of checklist is considered to be comprehensive in terms of the concept covered (Rosli, 2004).

Presently, there is only one monorail system operation in Malaysia that operates for urban transportation. Furthermore, a research or investigation need to be carried out to identify whether there is an element of Constructability Review Analysis being implemented, specifically to the monorail project in Malaysia. This was supported by the experts and consultants, which will be elaborated in following

sections. Subsequently, a Constructability Review Checklist has to be created for the monorail projects in Malaysia. These studies address these needs through formalizing the Constructability Review system and knowledge to the monorail project.

Based on the findings and preliminary investigations above, it could be concluded that, there is a need to study and research, on the investigation of the implementation of constructability analysis in monorail projects, with suitable constructability review checklist ever existed for the monorail construction, locally. Therefore, it is essential to develop a constructability review checklist for checking the design work for assurance of efficient, economical and timely completion of monorail projects without any additional cost.

Hence, the detail explanation above could be summarized, for the problem statements on this study, as follows;

- a) Monorail Construction Industry is a new phenomenon and new technology developing in Malaysia. Hence, whether any research or study has ever been approached or investigated on the implementation of element of constructability analysis, in the monorail project, specifically in Malaysia, need to be conducted.
- b) From the investigation, to identify whether the element of Constructability Review approached in this project has the basic concept approach of constructability review of the monorail construction in Malaysia.

- c) Currently, there is no Constructability Review Checklist has ever been created specifically for the monorail construction, particularly in Malaysia.

1.2 The Aim and the Objectives

The aim of this study is to enhance monorail design process through integration of constructability concept.

In determining the aim above, the objectives of this study could be described as follows;

- a) To investigate whether any research and study has ever been approached on the implementation of constructability review analysis on any monorail projects in Malaysia.
- b) To identify whether there are elements of Constructability Review Analysis being implemented, specifically to the monorail project in Malaysia.
- c) To develop a Constructability Review Checklist specifically for the monorail project, ensuring its integration into constructability review design process.

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