



UNIVERSITI PUTRA MALAYSIA

**DEVELOPMENT OF CONSTRUCTABILITY ACTIVITY SURVEY
FRAMEWORK FOR MALAYSIAN CONTRACTORS**

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**DEVELOPMENT OF CONSTRUCTABILITY ACTIVITY SURVEY
FRAMEWORK FOR MALAYSIAN CONTRACTORS**

**By
EHSAN SAGHATFOROUSH**

**Thesis Submitted to the School of Graduate Studies, Universiti Putra
Malaysia, in Fulfilment of Requirement for the Degree of Master of
Science**

July 2009



DEDICATION

I would like to dedicate this work specifically to my eternal beloved family, although they are often less than appropriately rewarded for their support for me.



Abstract of thesis presented to the senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

**DEVELOPMENT OF CONSTRUCTABILITY ACTIVITY SURVEY
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July 2009

Chairman: Associate Professor Mohd. Razali Abd. Kadir, PhD

Faculty: Engineering

Fundamental studies on constructability concept done in United States, United Kingdom and Australia illustrate the capability of this concept to influence the overall objectives of the construction projects. These studies have shown that contractors' involvement in earlier stages of projects can lead to noteworthy cost and time savings and better final product quality by considering the contractors' construction experience in conceptual planning and design phases. This study becomes much more notable since there has not been enough structured researches on this matter in Malaysia which can clarify and differentiate the constructability activities.

The present research presents the constructability activities in all project phases separately based on the amount of contractors' involvement in each activity and also the amount of gap that exists between the target and the actual effects of each activity on achieving the final objectives of the project



in Malaysia. As the result, some activities are determined as the more critical activities than the others. Then more explorations are done on the critical ones in order to determine the type of contractors, contracts and projects that are involved in these activities. It also aims to find any significant difference in contractors' involvement at each activity among various types of contractors, contracts and projects.

The data needed to conduct this research is obtained from a questionnaire survey spread among Malaysian G7 building contractors. The acquired data is collected and arranged in tables; Then MCT, MD, ANOVA and T-TEST methods are used as descriptive and analytical methods of analysis.

The results of this study show that Malaysian contractors are almost familiar with this term, but based on the barriers of implementing this issue in the projects, they are not able to participate in all of its activities entirely. This reduces the gap between target and actual effects of each activity on gaining the total aims of the project. Then it is found that the critical constructability activities are mostly among the ones in later project phases, which consist of pre-construction and construction phases.

Finally, the amount of contractors' dispersion among various types of contractors, contracts and projects in each critical constructability activity is determined and more explorations to find out the differences among various independent variables are tested.

Abstrak tesis ini dikemukakan kepada senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk memperolehi ijazah Master Sains

**PEMBENTUKAN RANGKA TINJAUAN AKTIVITI
KEBOLEHBINAAN UNTUK KONTRAKTOR MALAYSIA**

Oleh

EHSAN SAGHATFOROUSH

July 2009

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Kajian terhadap konsep kebolehbinaan di Amerika, United Kingdom dan Australia menunjukkan konsep ini mampu mempengaruhi tujuan keseluruhan pembinaan projek tertentu. Kajian ini menunjukkan penglibatan kontraktor di peringkat awal projek boleh menjurus kepada penjimatan kos, masa dan kualiti yang lebih baik terhadap sesuatu penghasilan kerja dengan mengambil kira pengalaman kontraktor semasa di dalam fasa konsep perancangan dan rekabentuk. Kajian ini menjadi lebih bererti memandangkan sehingga kini belum terdapat kajian teratur mengenai subjek ini di Malaysia yang boleh menjelas dan membezakan aktiviti-aktiviti kebolehbinaan.

Kajian ini membentangkan aktiviti-aktiviti kebolehbinaan di dalam semua fasa projek secara berasingan di Malaysia berdasarkan sebesarmana penglibatan kontraktor di dalam setiap aktiviti dan juga sebesarmana ruang

wujud di antara sasaran dan kesan sebenar setiap aktiviti yang akan memberi kesan bagi mencapai tujuan projek tertentu. Hasil kajian mendapati sebahagian dari aktiviti-aktiviti telah dikenalpasti sebagai lebih kritikal dari sebahagian yang lain. Seterusnya kajiselidik yang lebih mendalam telah dilakukan terhadap aktiviti yang lebih kritikal demi untuk mengenalpasti jenis-jenis kontraktor, kontrak dan projek yang terlibat di dalam aktiviti-aktiviti ini. Ianya juga bertujuan mengenalpasti samada terdapat perbezaan yang ketara dari sudut penglibatan kontraktor di setiap aktiviti di kalangan pelbagai jenis kontraktor, kontrak dan projek.

Data-data yang diperlukan untuk melaksanakan kajian ini dikumpul dari soalan-soalan soalselidik yang di kemukakan kepada kontraktor-kontraktor binaan gred G7 di Malaysia. Data yang terkumpul ini disusun di dalam pelbagai jenis jadual : Kemudian kaedah MCT, MD, ANOVA dan T-Test digunakan sebagai analisa berbentuk diskriptif dan analatikal.

Hasil kajian menunjukkan kontraktor di Malaysia kebanyakannya telah biasa dengan istilah ini. Bagaimanapun berdasarkan halangan-halangan bagi melaksanakan perkara ini di dalam projek-projek, mereka tidak dapat melibatkan diri di dalam semua aktiviti secara menyeluruh. Seterusnya ini mengurangkan ruang antara sasaran dan kesan sebenar bagi setiap aktiviti di dalam mencapai tujuan keseluruhan sesuatu projek. Ekoran ini ternyata kebanyakan aktiviti-aktiviti kebolehbinaan yang kritikal wujud di bahagian akhiran fasa projek iaitu fasa pra-pembinaan dan fasa pembinaan.

Akhir kata rupabentuk serakan penglibatan kontraktor di kalangan pelbagai kontraktor, kontrak dan projek di dalam setiap aktiviti kritikal kebolehbinaan telah dikenalpasti dan kajiselidik yang lebih mendalam untuk mengetahui perbezaan di kalangan pelbagai pemboleh ubah tak bersandar juga telah diuji di dalam kajian ini.

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I certify that a Thesis Examination Committee has met on 21 April 2009 to conduct the final examination of Ehsan Saghatforoush on his thesis entitled “Development of Constructability Activity Survey Framework for Malaysian Contractors” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at other institutions.

EHSAN SAGHATFOROUSH

Date: 5 July 2009

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CHAPTER 1

INTRODUCTION

1.1. Research Background

Constructability and Buildability are two terms whose concepts have been used and applied in most of construction projects for a long period of time. There are some literatures available on Constructability and Buildability issues (Adams, 1989; CIRIA, 1983; Construction Industry Institute, 1986, 1993; Nima *et al.*, 2001; O'Connor and Davis, 1988; Tatum *et al.*, 1986) which have defined it separately, but one of the earliest definitions, by Construction Industry Institute (Construction Industry Institute, 1986) was “the optimum use of construction knowledge and experience in the conceptual planning, detailed engineering, procurement and field operations phases to achieve the overall project objectives.”. This definition is also the easiest one to be understood by Malaysian contractors based on the initial interviews which were implemented prior to the main survey.

There have been lots of researches done in different locations mainly in developed countries like the United States, the United Kingdom, Australia and recently Hong Kong, attempting to find various constructability activities to resolve the project barriers in achieving the overall aims of the project. In the United Kingdom, the Construction Industry Research Information Association (CIRIA, 1983) determined 7 concepts for



constructability issue. Then these concepts were increased to 16 by CIRIA itself later. This procedure was followed by more researches in the United States which resulted in 14 concepts based on the research of Tatum et al. (1986) and O'Connor et al. (1986). Further researches done in CII resulted in 17 concepts on 1993. During the same year, The Australian CII published 12 constructability concepts. Trigunarsyah (2004c) broadened the concepts on his published journal paper as the latest version of constructability concepts with 26 detailed activities.

The number of problems in construction phase will be reduced and better project performance will be achieved if the construction experience of contractors is brought to the earlier stages of construction projects (Trigunarsyah, 2004c). "It is essential to consider constructability at an early stage in the total construction process, because the ability to influence project cost, and so value for money, from the client's viewpoint, diminish as the project progresses in time." (Griffith and Sidwell, 1995). The studies have all shown that improved constructability can lead a project in better savings in cost, time, as well as some improvements in final expected quality which are all needed to finalize a project properly. Russell et.al. (1992) had also insisted on the use of constructability in optimizing some elements, and cost and estimates were among them. Figure 1.1 illustrates how implementing constructability activities can influence the total cost of a project. This figure clearly shows that the ability to influence the total cost decreases as the project time passes.

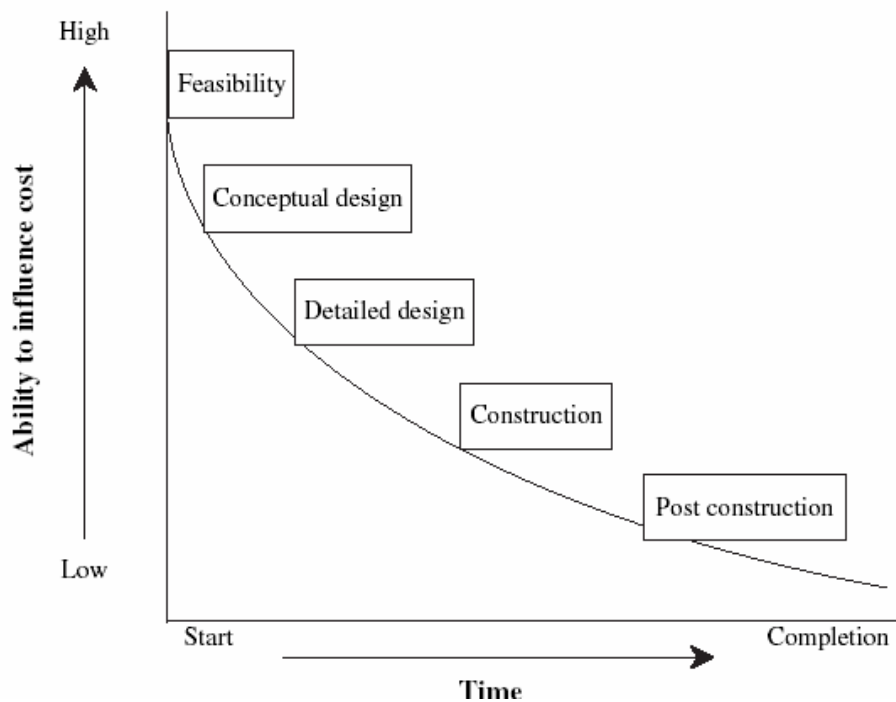


Figure 1.1: The ability of implementing constructability activities to influence the total cost of the project
 (Source: CII 1995)

Trigunaryah (2004c) showed in his research that there are some significant differences in the degree of involvement in some constructability activities among the contractors in different type of projects in Indonesia.

The background of this knowledge in Malaysia is not too archaic. In fact the initial researches have been done by Nima et al. (2001) on constructability term. Rosli (2004) also did some researches especially on design phase a few years later, but all these researches only addressed constructability issues, importance and some of its implementation barriers.

1.2. Problem Statement

Constructability activities, which are all based on construction experience, are not always implemented in projects. The lack of constructability activities during the project phases among all kinds of contractors all over the world and the barriers in implementing these activities on achieving objectives of the projects are some important issues on which more researches are done not only in developed countries, but also in developing countries recently. The importance of constructability matter and the amount of contractors' involvement in various construction project phases are obvious nowadays. The result of Uhlik and Lores' survey (1998) in United States shows that 90% of general contractors did not have any scheduled constructability program, as well as any action to achieve this level of implementation. More researches done in the United States, the United Kingdom, Australia and Hong Kong all show that the lack of constructability implementation among international contractors is still a critical issue, for which more researches are needed. These researches all point at one goal, and it is the need to check the contractors' participation in different constructability activities in various locations of the world, because of the dissimilar results which will be obtained based on the characteristics of any location.

The target and actual effects of constructability activities on achieving the overall objectives of the project are different in various project phases. A general rule says: What we want to achieve and what we achieve finally is

not always the same because of the existing barriers, so there should always be a difference or gap between them. This gap is still one of the unclear points of constructability issue.

The researches and studies of Nima et al. (2001) and also Rosli (2004) show shortage of knowledge in constructability issue among Malaysian construction contractors. Nima et al. (2001) were the pioneers in the study the constructability matter in Malaysia. On one hand, Nima et al. (2001) says: “The problem of absence of constructability is quite evident to the engineers. However, indications regarding the problem of absence of constructability are not yet clear to the Malaysian engineers.” On the other hand, Trigunarsyah (2004c) mentioned the uniqueness of the construction industry in any specific country, so there seems a need not only in Malaysian construction industry, but also in any other country, especially developing countries, to have a review on their performances. They both can show the importance of studying such a unique subject. A few years later Rosli (2004) as another Malaysian researcher focused on beam-design constructability during design phase.

1.3. Research Objectives

1. To identify the Constructability Activities (CAs) based on the highest average amount of contractors’ involvement in each of construction project phases.

2. To identify the CAs with the largest gap between the target and actual effects on achieving the overall objectives of the project in each project phase, and then to determine the Critical Constructability Activities (CCAs) among the G7 building contractors in the Klang Valley area.
3. To assess the CCAs among the G7 building contractors in order to find out the differences in their involvement in each activity among independent variables which consist of various types of contractors, contracts and projects.

1.4. Significance of Study

CIDB (CIDB, 2000) announced in one of its workshops in the year 2000, that Malaysia is obviously ready to move forward towards knowledge industry. This is parallel to the long-term progress that Malaysian government has decided to achieve in the year 2020 which is well-known as Vision 2020. Construction industry is one of the biggest and most expensive industries in Malaysia. Preventing any additional costs in construction industry will cause lots of savings in government's overall budget. As Griffith and Sidwell (1995) mentioned earlier, lower cost of remedial and repeated works are one of the benefits of good constructability. CII (1986) reported achieving 6% to 10% savings in projects' total price via implementing constructability activities. O'Connor and Davis (1988) also estimated 8% to 40 % increase in project performance via obeying constructability activities during any construction project phase. "This will

minimize problems that are encountered during construction due to design deficiencies and thus facilitate ease of construction.” (Rosli, 2004). As there are a lot of construction projects in Malaysia in achieving Vision 2020, any attempt to ease the construction process can save a lot of money from the total project cost.

“Modern construction clients expect their projects to be completed on time, within the anticipated budget, and to be of good quality; this is, they demand inherently a high quality of service and value for money.” (Griffith and Sidwell, 1995). In fact, it is completely clear that construction time and cost will be decreased via reducing the constant costs like in-situ equipments and etc; however, it should be noted that spending more money and time on some earlier investigations initially in projects, in spite of being time consuming and costly, can save more money than the previous methods that have been used by the owners, via preventing the conceptual planning and design phase mistakes. As an example, starting the project without any preliminary study on possible probable mistakes during design phase will cause unwanted modification costs during construction phase. Exploring the constructability concept in any project earlier to its construction allows the owners to choose better methods for planning, design, construction and even to use the final product. This helps the owner to spend less throughout the duration of the project. This study illustrates its awareness toward the contractors at earlier project phases. It helps the designers to consider the construction phase experiences of contractors in their designs. As the result of fewer mistakes in designs and planning, there will be fewer modification

costs and finally better quality in less cost and time which is the overall goal of the constructability concept. This can clearly be seen in the following figure which shows the level of influence in different project life cycle adapted by Hassan (1997):

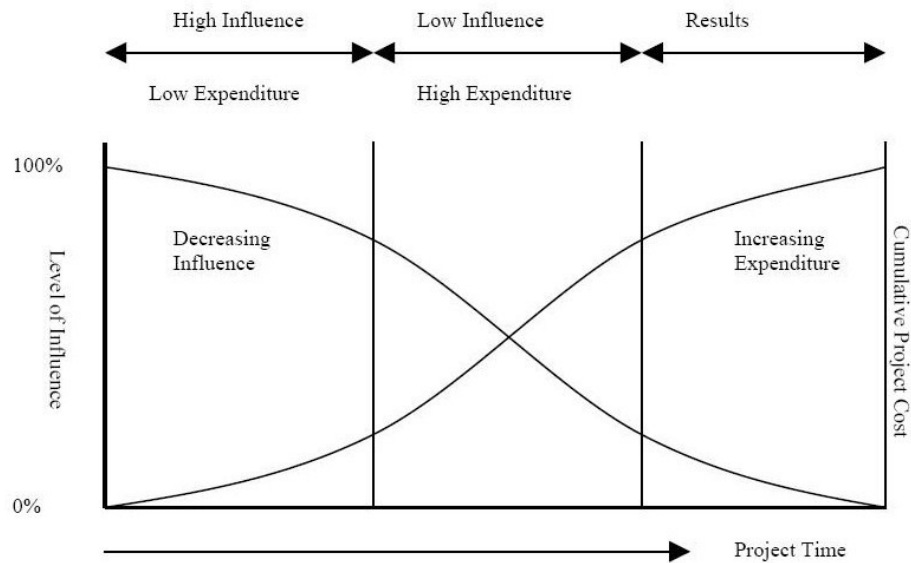


Figure 1.2: level of constructability issue influence in different project life cycles
(Paulson, 1976)

As shown, if the contractors are more involved in early periods of project time, they can be more effective in influencing the project value.

1.5. Scope and Limitations

As it is mentioned in CIDB website, contractors in Malaysia are divided into 7 grades from G1 to G7, based on the three main criteria of tendering capacity, financial capacity and availability of human resources. G1 contractors are the smallest scale companies and in contrast the G7