



PLANNING & SCHEDULING OF PROJECTS: A CASE STUDY
OF DURATION ESTIMATION & INFLUENCE FACTORS

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ABSTRACT

Although, every planning and scheduling has been carried out perfectly and closely, this will not guarantee that the project will be completed successfully. A project will not be successful if monitoring and controlling process is not being executed according in the implementation of the project. Normally, when it comes to big budget project, no known project was able to complete on time, budget and quality. Due to this, it is important for us to avoid or minimise the problem as much as we can. On the other hand, we need to make a good start by effectively and efficiently planning and scheduling in order to achieve our ultimate goal in the project life cycle. A good starts means a good planning with approximately précised duration estimation and in order to achieve the best planning factors that contribute to the duration estimation process need to be identify. The main objective of this study was to find the procedure in making duration estimation and factors that contribute to duration estimation process at planning stage. Contractors can thus use a project's characteristics, as given in the tender documents, to estimate the actual amount time it would take them to complete the construction works. In this study, factors affecting the duration of a construction project were investigated. Within this framework, duration estimation process and factors influenced were detected and analyses were conducted on data related to three case study of residential construction project around Pahang. This data was obtained from the three selected companies that responsible in the construction of those three case studies. The closeness in estimation of the duration analyses was investigated and finally factors that influence the duration estimation process was obtained. After acquiring the most considerable factor in duration estimation, several suggestions can be created for the development of strategies with the purpose in improving construction planning practices and can be as a guideline for juniors in planning and scheduling.

ABSTRAK

Walaupun, setiap perancangan dan penjadualan telah dijalankan dengan sempurna dan teliti, ini tidak akan menjamin bahawa projek itu akan siap dengan jayanya. Projek tidak akan berjaya jika proses pemantauan dan kawalan tidak dilaksanakan mengikut dalam pelaksanaan projek itu. Biasanya, apabila ia merupakan projek yang mempunyai bajet besar, tidak ada projek yang mampu untuk disiapkan mengikut masa, bajet dan kualiti yang ditetapkan. Oleh kerana ini, adalah penting bagi kita untuk mengelakkan atau mengurangkan masalah ini daripada berlaku. Seharusnya kita perlu membuat satu permulaan yang baik dengan membuat perancangan dan penjadualan yang berkesan dan cekap bagi mencapai matlamat utama dalam kitaran hayat projek. Permulaan yang baik bermakna perancangan yang baik dengan anggaran tempoh yang hampir tepat dan boleh mencapai faktor perancangan terbaik yang menyumbang kepada proses anggaran tempoh perlu dikenal pasti. Objektif utama kajian ini adalah untuk mencari prosedur dalam membuat anggaran jangka masa dan faktor-faktor yang menyumbang kepada proses anggaran jangka masa di peringkat perancangan. Kontraktor boleh menggunakan ciri-ciri projek seperti yang diberikan dalam dokumen tender, untuk menganggarkan jumlah masa yang sebenar yang akan diambil untuk menyiapkan kerja-kerja pembinaan. Dalam kajian ini, faktor-faktor yang memberi kesan kepada jangka masa sesuatu projek pembinaan telah dikaji. Dalam rangka kerja ini juga, proses anggaran jangka masa dan faktor-faktor mempengaruhi dikesan dan analisis yang dijalankan ke atas data yang berkaitan dengan kajian tiga kes projek pembinaan perumahan di sekitar Pahang. Data ini diperolehi daripada tiga syarikat terpilih yang bertanggungjawab dalam pembinaan ketiga-tiga kajian kes terlibat. Keakraban dalam membuat anggaran analisis jangka telah disiasat dan akhirnya faktor-faktor yang mempengaruhi proses anggaran jangka masa telah diperolehi. Selepas memperoleh faktor yang paling besar yang menyumbang dalam anggaran jangka masa, beberapa cadangan boleh diwujudkan untuk pembangunan strategi dengan tujuan dalam meningkatkan amalan perancangan pembinaan dan boleh menjadi sebagai satu garis panduan untuk mereka yang masih baru dalam perancangan dan penjadualan.

TABLE OF CONTENTS**1****Page**

SUPERVISOR'S DECLARATION	ii
STUDENT DECLARATION	iii
DEDICATION	iv
ACKNOWLEDGEMENTS	v
ABSTRACT	vi
ABSTRAK	vii
TABLE OF CONTENTS	viii
LIST OF TABLES	xii
LIST OF FIGURES	xiii

CHAPTER 1 INTRODUCTION

1.1	Introduction	1
1.2	Problem Statement	3
1.3	Aim and Objectives	5
1.4	Scope of Study	6
1.5	Significant of Study	6

CHAPTER 2 LITERATURE REVIEW

2.1	Introduction	8
2.2	Project Planning & Scheduling	9
2.3	Duration Estimation Process	11
2.4	Factors Effecting Construction Duration Estimation	12
	2.4.1 Cost	16
	2.4.2 Cash Flow	17
	2.4.3 Procurement	18
	2.4.4 Project Related Factors	19
	2.4.5 Technology and Methodology of Construction	20
	2.4.6 Experience	21
	2.4.7 Coordination	21
	2.4.8 Weather	22
	2.4.9 Construction Site	23
2.5	Summary of The Chapter	24

CHAPTER 3 METHODOLOGY

3.1	Introduction	25
3.2	Methods of Data Collection	27
	3.2.1 Primary Data Collection	27
	3.2.1.1 Literature review	28
	3.2.2 Secondary Data Collection	28
	3.2.2.1 Case Study	29

3.2.2.2	Interview	31
3.2.2.3	Participants	32
3.3	Analyzing Data	32
3.3	Summary of The Chapter	34

CHAPTER 4 RESULTS AND DISCUSSION

4.1	Introduction	35
4.2	Planning & Scheduling	37
4.3	Duration Estimation Process	41
4.4	Factors Effecting Duration Estimation Process	43
4.5	Summary of The Chapter	47

CHAPTER 5 CONCLUSION AND RECOMMENDATION

5.1	Introduction	48
5.2	Conclusion	49
5.3	Recommendation	52

REFERENCES	54
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APPENDICES

A	Factors That Project Managers Considered in The Process of Duration Estimation	56
B	Microsoft Project for Case Study 1	57
C	Microsoft Project for Case Study 2	58
D	Microsoft Project for Case Study 3	59

LIST OF TABLES

Table No.	Title	Page
4.1	Preliminaries Work Breakdown with Duration Estimated	38
4.2	Structural Work Breakdown with Duration Estimated	38
4.3	Architectural Work Breakdown with Duration Estimated	39
4.4	External Work Breakdown with Duration Estimated	40
4.5	Main Factors	42
5.1	Project Duration	50

LIST OF FIGURES

Figure No.	Title	Page
2.1	Factors Affecting Construction Durations	14
2.2	Factors effecting Construction Project Duration	14
2.3	The Relation Between The Production Rates and Construction Duration According to The Construction Techniques	20
2.4	The Effects of Weather on Productivity of Steel Construction	22
3.1	Research Methodology Flowchart	26
3.2	Case Study Flow Chart	30
3.3	Data Analysis Flow	33
4.1	Duration Estimation Process Flowchart	41

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Planning before construction undertakes is considered as a must nowadays in order to avoid many unpredictable situations from the beginning until project handover. As mentioned by Othman, M. J. (2006), Planning can be thought of as determining "what" is going to be done, "how", "when" by "whom", and "when." In construction projects the "plans" (blueprints) and specifications for the project generally define both the end product and, often, the general time frame in which to complete the project. However, they normally do not specifically identify the individual steps, their order, and the timing followed to achieve the end product. Thus, when we discuss planning in the construction process, we must address the "how" and, therefore, the "what," "when," "where," and "who.

This study focused on duration planning for a construction project and factor that contribute to the process of duration estimation. Duration for a construction project is a part of creating a project plan for any project that we are going to manage. It involves estimating how long each activity will take to complete. A duration estimate is the best sense of how long the time needed to actually perform an activity which is in the network diagram. The duration of construction of a project depends on many factors, such as: cost, location, site characteristics, procurement methods, area of

construction, footprint of the building and its height, etc. It is very important to be able to predict these durations accurately in order to successfully complete a project on time. Various construction duration estimation tools have been developed to make accurate predictions, as “time is money.” This research purposed to gain data on how the process of duration estimation and what factors that influence the duration estimation process in the point of view of the selected Project Managers from three construction companies.

The estimate is not based on how long that we want the activity to take or how long someone tells that it must take, the estimate is based on how long we think it really will take. According to Abdul Kadir, M. K. (2006), Time management is on keys of effective project management. They are a few problems effect the time management such as a rework activity, the change of job specification without direct notification, work overload, unreasonable time constraint and etc.

The impact that from poor time management will cause delay or event worst effect mostly on cost as it is correlates to each other. As a solution of this situation the planning and scheduling will be the best method that can be used to overcome with this problem. With the proper planning and scheduling it will assist the project manager in completing the project within the time and meet the aim and objective of the project.

If a project is not completed with the stipulated period then the building contractor suffers losses due to escalated costs and penalties and clients suffer because their time minimization objectives cannot be achieved. Therefore, just as keeping a project within budget and quality is important, so is the accurate estimation of construction duration for the successful completion of a project. Besides a success criterion, estimation of project duration is important for both; contractor and the client. The client can create a financial, cash and material flow plan in a pre-set time and can make optimum funds available to the Project. Moreover, general contractor predicting the construction time accurately and performing the works on time will gain power in the construction market and will take good decisions and take precautions against delays.

Duration estimations in different stages of construction projects, according to the projects data availability and time constraints, are very important for the planning phase of construction. For example, in pre-design stages, forecasting of construction duration is very difficult with minimum design information. The feasibility of construction is a very important step in construction.

Client wants to know the approximate duration and cost of the project. In construction projects, there is most common planning and controlling tools, these are; Bar charts, Critical Path Method (CPM), and Program Evaluation and Review Technique (PERT). One of the most common disadvantages of these techniques is that they can be used properly after a fully detailed construction projects are prepared and it requires a period to implement.

Therefore, to form a reliable and practical estimation process without using these techniques depends on the planners' experiences and knowledge and planning process becomes an intuitive and subjective process. This study was initiated with the aim of to find the factors that contribute to duration estimation process at planning stage of housing constructions. Contractors can thus use a project's characteristics, as given in the tender documents, to estimate the actual amount of time it would take them to complete the construction works.

1.2 PROBLEM STATEMENT

Although, every planning and scheduling has been carried out perfectly and closely, this will not guarantee that the project will be completed successfully. A project will not be successful if monitoring and controlling process is not being executed according in the implementation of the project. Nowadays, the construction industry in Malaysia is facing critical problem especially delays in the completion of project. And even though the project has already been completed, there still exist the problem of safety, quality and aesthetic values.

Normally, when it comes to big budget project, no known project was able to complete on time, budget and quality. Due to this, it is important for us to avoid or minimise the problem as much as we can. On the other hand, we need to make a good start by effectively and efficiently planning and scheduling in order to achieve our ultimate goal in the project life cycle.

The Activity Duration Estimating process requires us to estimate the amount of work effort required in completing the schedule activity, the assumed amount of resources to be applied to complete the schedule activity, the assumed amount of resources to be applied to complete the schedule activity, and the number of work periods needed to complete the schedule activity. By only assuming all the duration regarding to all the resources stated, there is risk associated duration of the activities necessary to reach project completion. Delay is one of the risks that will be a common problem in construction projects.

There is an increase in the number of construction projects experiencing extensive delays leading to exceeding the initial time and cost budget. As stated by Ramanathan et al., (2012), in his research, they review 41 studies around the world. The main purpose of this paper is to review research which has categorized the causes responsible for time delays and cost overruns in projects.

Completing projects on time is an indicator of efficiency, but the construction process is subject to many variables and unpredictable factors, which result from many sources. The sources are the performance of parties, resources availability, environmental conditions, involvement of other parties, and contractual relations, and the completion of a project within the specified time is rare (Assaf, 2006, as cited in Ramanathan et al., 2012).

In construction, delay could be defined as the time overrun either beyond completion date specified in a contract, or beyond the date that the parties agreed upon

for the delivery of a project. It is a project slipping over its planned schedule and this is a common problem in construction projects (Ramanathan et al., 2012). In order to reduce many problems related to duration in construction project, a research should be carry out to make a better understanding in how the construction project duration being determined.

1.3 AIM AND OBJECTIVE OF STUDY

These days, a lot of construction project run to fulfill the current needs. The most important phase before any construction works begin is planning and scheduling. In order to complete a schedule we first must have a better planning. Planning and scheduling will involves three main things which are time, cost and quality. Among all that three important things, to estimate cost, time or duration need to be estimated. Estimating durations vary for each construction work and person who estimates the duration. As folks said that duration estimation always been done according to previous experienced.

The main aim of the objective is dependent on several minor objectives. Besides that, setting objectives is essential to guide and basis for make sure the main research can be carried out and did not deviate from the true objective. Three minor objectives have been assorted to achieve the main objective as stated below:

- Aim
 - i. To find the factors that contribute to duration estimation process at planning stage of three (3) different housing constructions.
- Objectives
 - i. To identify how Project Managers do estimation in duration estimation process.
 - ii. To find the factors that contribute in duration estimation process based on findings (i).

1.4 SCOPE OF STUDY

The scope of study is to focus on the process of duration estimation that contributes to successful in a construction project. This study includes observation in how a construction company does the duration estimation together with their planning and scheduling for a particular project. This research will carry out careful study based on short interview to gather data. The interview will be carried out with Project Manager from the selected companies.

To achieve the objectives of the study, the scope of work for this study should cover the following aspects:

- i. This research is focuses on planning and scheduling process in housing construction project around Pahang.
- ii. Duration estimation in planning stage of construction data that obtained from Project Manager of the selected company.
- iii. Do analysis from data obtained.

1.5 SIGNIFICANT OF STUDY

Construction planning and scheduling is one of the important tool in a construction project. Every construction project involve with a lot of activities which need to be planned and schedule properly to ensure the completion of the project. Duration estimation for a construction project is a part of creating a project plan for any project that we are going to manage. It involves estimating how long each activity will take to complete. Therefore the study on construction planning and scheduling in estimating the activity duration together with the factors that influence the duration estimation process must be conduct to provide knowledge on this topic. The purposes of the study are:

- i. To know exactly how Project Manager in construction industry do their planning & scheduling for a particular project.
- ii. To get a clear view on how this duration estimation process be implement theoretically and in the real case of construction project.
- iii. To acquire the most considerable factor in duration estimation for inexperienced.
- iv. To create suggestion for the development of strategies for improving construction planning practices.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This literature review is based on how to do duration estimation for a construction project and factors affecting construction duration estimation. In the first section, process in performing duration estimation is discussed. Then the factors affecting construction durations in estimating construction durations are defined.

There are many definitions of construction duration. Bokha, (1998) stated that the time frame given by the owner for the contractor to complete the project under normal work conditions, normal practice of construction, and based on the minimum costs. It starts when the contractor receives the instruction to proceed and ends at the completion of construction works on site. It also includes delays caused by unanticipated circumstances, e.g. alteration of works (changed conditions and change orders), extra works, and supply of materials, location, weather, and site work conditions. Major changes that after the scope of work significantly is not included.

Construction duration estimations are made after either detailed design phase or pre-design stages. Both are required for different purposes. This estimation process is

very important or the planning phase of construction. There are most common planning and controlling tools: Bar charts, CPM and PERT (which uses three time estimates optimistic, most likely and pessimistic to achieve expected time for an activity) techniques. One of the most common disadvantages of these techniques is that they can be used after detailed designs.

These methods follows known steps, such as; work break down structure, logical relations between activities, durations of work packages, the quantity of materials, productivity rates. These techniques require a lot of information and a big effort and they consist of many errors and accuracies. On the other hand, these techniques can also be used at the pre-design stages. However, accuracies of these estimates depend on the estimators' experiences. Therefore, it could be said that this process is intuitive. The initial step for duration estimation is searching for the factors affecting construction durations.

2.2 PROJECT PLANNING AND SCHEDULING

Laufer, Shapira, Cohenca-Zall, and Howell's study (as cited in Cindy L. Menches et al., 1998) construction planning has been defined as that stage of planning that begins after a project has been awarded but before construction has been executed. Therefore, construction planning is not pre-project planning, pre-bid planning, or during-construction planning. Gibson, Kaczmarowski, and Lore's study (as cited in Cindy L. Menches et al., 1998) pre-project planning is, by definition, the process of gathering sufficient information on potential risks versus probable success so that the owner can determine whether the project should proceed or be cancelled.

Pre-project planning is an owner-driven process and has been extensively studied by Gibson's (as cited in Cindy L. Menches et al., 1998). Pre-bid planning is performed by contractors to prepare for the submission of a bid stated by Cohenca-Zall,

Laufer, Shapira, and Howell's (as cited in Cindy L. Menches et al., 1998) while during-construction planning typically takes place once the project has been fully executed. In general, pre-construction planning includes identifying written procedures that prepare the project team to execute an efficient job. Yet, what these specific procedures are, how much time and resources should be expended for a given level of complexity and uncertainty, and which processes have been effective at improving efficiency are all questions that have remained unanswered. The current research attempts to address these issues by focusing on pre-construction planning practices in the electrical construction industry.

Project planning is the process of determining appropriate strategies for the achievement of predefined project objectives. In construction projects, the objective of planning is the completion of a prescribed amount of work within a fixed time, at a previously estimated cost, and to specified standards of quality. Cohenca et al., (1990), Research studies have indicated, however, that construction planning efforts usually fail to achieve their objectives. There is therefore a need to examine construction planning practices and develop strategies for improving construction planning effectiveness.

Success in a construction project has typically three aspects including, completing the project on time, meeting the budget, and assuring quality required. To meet the "on time" requirement of a project, first of all, a project manager needs to prepare a well-organized project schedule that includes appropriately defined activity relationships and properly estimated activity durations. According to Othman, M. J. (2006), When we discuss scheduling, we are usually interested in some aspect of the time element of the plan. In essence, a schedule is a timetable of activities, such as of "what" will be done or "who" will be working. Such a timetable can be looked at in two ways: the first is focusing on an activity, such as determining "when" a certain task will be performed relative to other activities.

Construction projects are too complex in nature for a project manager to easily meet the targets. Uncertainty involved in project conditions such as weather change, site

conditions, material delivery conditions, and management quality influence the completion time of a project. As being mention by Ramanathan et al., (2012), there is an increase in the number of construction projects experiencing extensive delays leading to exceeding the initial time and cost budget. This paper reviews 41 studies around the world which has surveyed the delay factors and classified them into Groups. The main purpose of this paper is to review research which has categorized the causes responsible for time delays and cost overruns in projects.

A number of researchers have claimed that construction planning efforts usually fail to achieve their schedule objectives. The time scheduling also is the major factor that lead to the delayed or the uncompleted of the project. The construction company is facing a tough challenge in the time planning of the project because without the proper planning the time factor will cause the lost of the profit to the company. All of the construction company have planning and scheduling the time first before starting the project and some of the company did not follow well the time constraint of the project and this situation will lead the delayed of the project (Abdul Kadir, M. K., 2006).

2.3 DURATION ESTIMATION PROCESS

The process of estimating schedule activity durations uses information on schedule activity scope of work, required resource types, estimated resource quantities, and resource calendars with resource availabilities. As said by Heldman, (2009), the estimate activity duration process attempts to estimate the work effort, resources, and number of work periods needed to complete each activity. The activity duration estimates are the primary output of this process. These are quantifiable estimates expressed as the number of work periods needed to complete a schedule activity. Work periods are usually expressed in hours or days. However, larger projects might express duration in weeks or months. Work periods are the activity duration estimates, and they become inputs to the develop schedule process.

2.4 FACTORS EFFECTING CONSTRUCTION DURATION ESTIMATION

The reliability of preliminary scheduling at the very initial stage of planning phase (before design starts) is primarily affected by the 'project details determined at the time of planning', 'specific characteristics of a construction project', 'experience of the planners', and 'retention of historical databases of the similar projects'. Most of the preliminary schedules are prepared with limited information and details. However, the planning process may require this preliminary schedule to be equipped with a capability of analyzing what-if scenarios, even including estimates for materials and labors.

Construction project planning has a significant impact on the ability of construction firms to achieve success in the implementation of construction projects stated by Syal et al., (as cited in Olusegun O. Faniran et al., 1999). Nevertheless, although researchers in construction management and practitioners in the construction industry realize the importance of construction planning, there is a divergence of opinion on how much effort should actually be invested in construction planning activities and how construction planning efforts should be organized to achieve success in the performance of construction projects. Findings from some research studies have indicated that construction planning effectiveness, and hence construction project performance, can be improved by increasing the amount of resources invested in construction planning activities said by Faniran et al., (1999). However, other studies suggest that investing in construction planning activities beyond an optimum point results in an increase in overall project costs by Neale's study (as cited in Olusegun O. Faniran et al., 1999).

An informal survey of the scheduling practices adopted by local precast plants in Singapore identified many of the key production scheduling constraints and the manner in which these constraints were met in order to construct good, feasible production schedules. The processes used by the planners were largely manual and guided by experience and intuition. A survey of the production planning practices in the United

Kingdom by Dawood and Neale's study (as cited in W. T. Chan and Hao Hu, 2002) revealed that the planning practices employed were still fairly basic and depended greatly on experience and subjective approaches.

Starting from the early 1970s, there are many researches into the factors influencing construction durations across various categories of projects for many reasons. The researcher either studied on only the factors affecting construction durations or developed duration estimation models by using these factors. Moreover, all findings of these researchers were summarized in Figure 2.1 under seven main headings as: cost, client related, project related, environment related, construction site related, management related factors, and other factors. The research findings affecting construction duration were summarized in Figure 2.1 under seven headings:

- i. Project Cost
- ii. Client or client representative related factors
- iii. Environment related factors
- iv. Construction site related factors
- v. Project related factors
- vi. Management related factors
- vii. Other factors

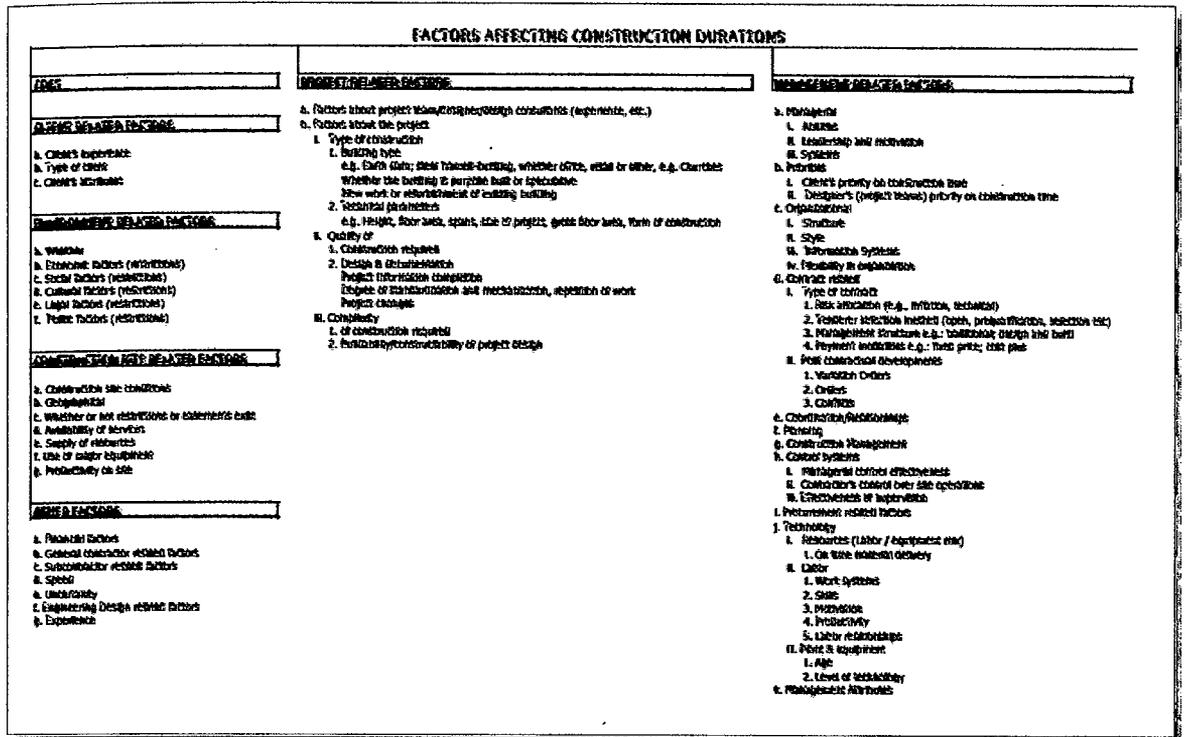


Figure 2.1: Factors affecting construction durations. (Chan and Kumaraswamy, 2002)

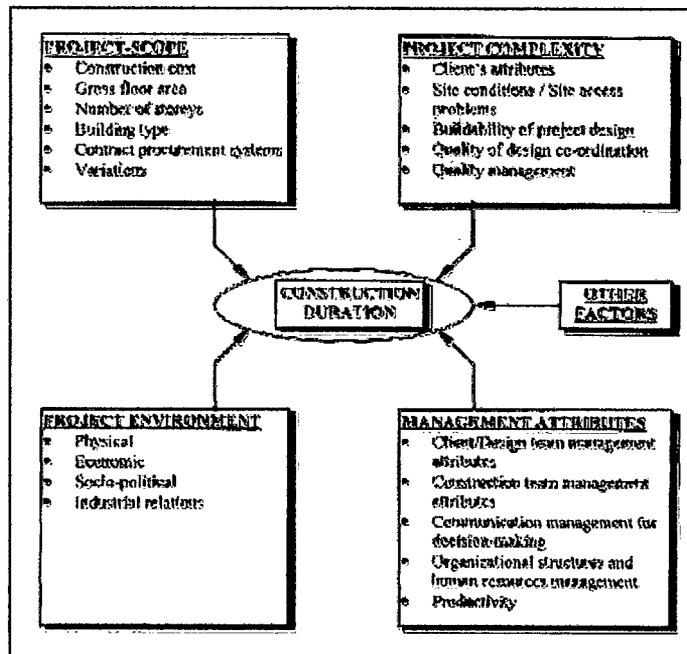


Figure 2.2: Factors effecting construction project duration. (Chan and Kumaraswamy, 2002)

Chan and Kumaraswamy's (as cited in Elvan Odabaşı, 2009) classify time-influencing factors into four major factor categories, which are; project scope, project complexity, project environment; and management-related attributes. These factors are listed as in Figure 2.2.

Saraç's (as cited in Elvan Odabaşı, 2009) explained the reasons of completion ahead of the schedule, although this situation exists rarely. These are summarized factors affecting construction duration also as follows:

- i. The urgency from the client's side
- ii. The bonus announced by the client
- iii. Higher safety factor in the allocation of time
- iv. Procurement of material on or ahead of schedule
- v. Previous experience in similar projects
- vi. Use of modern machinery
- vii. Employment of more than the estimated number of skilled workers
- viii. The number of workers employed was the same as that of estimated one, but the level of skill was higher than average.
- ix. The number of workers employed was less that of the estimated one, but the level of efficiency was much higher
- x. The size of the project was reduced
- xi. The design and drawings were simplified before or during construction
- xii. Effective coordination of different activities
- xiii. High motivation due to harmonious supervisor and worker relationship

That eleven factors affecting construction duration shown as the most significant ones in literature were selected. These factors were listed and explained as follows:

- i. Cost
- ii. Cash flow
- iii. Productivity of on-site