EFFECTIVE PROJECT MANAGEMENT BASED ON PERFORMANCE INDEX

SITI SYAFINAH AMIRAH BINTI SALLEH

Bachelor of Civil Engineering

UNIVERSITI MALAYSIA PAHANG

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EFFECTIVE PROJECT MANAGEMENT BASED ON PERFORMANCE INDEX

SITI SYAFINAH AMIRAH BINTI SALLEH

Thesis submitted in fulfillment of the requirements
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In the Name of Allah, the Beneficent, the Merciful

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ABSTRACT

The problem of delays in the construction industry is a global phenomenon and the construction industry . the goal of all parties involved in construction projects- clients, Project Manager, Engineering Consulatants and Contractors in either the public or private sector is to successfully complete the project on schedule, within planned budget, with the highest quality and in the safest manner. Constrcution projects are frequently influenced by either success indicators that help project parties reach their goal as planned, or delay indicators that stfle or postpone project completion.

The prupose of this research is to identify success and delay indicators which can help project parties reach their intended goals with greater efficiency. This research extracted six of the most important success indicators according to the literature and six of the most important delay indicators identified by project parties, and then examined correlations between them to determine which were the most influentiatl in preventing project delays.

This research uses a comrehensive literature review to design and conduct a survey to investigate success and delay indicators. A specific survey was contributer to contractors, client, project manager and engineering consultants to examine the most causes delay indicators. A general survey was distributed to examine the correlation between the identified delay indicators and the six most important causes success indicators selected. A consensus of expert opinion using the statistical methos to rank the most needed causes of success indicators for consturction industry especially for the example of project at Cyberjaya.

ABSTRAK

Masalah kelewatan dalam industri pembinaan adalah satu fenomena global dan industri pembinaan. matlamat semua pihak yang terlibat dalam pembinaan projects- pelanggan, Pengurus Projek, Kejuruteraan Consulatants and Contractors sama ada dalam sektor awam atau swasta adalah untuk berjaya menyiapkan projek itu mengikut jadual, dalam bajet yang dirancang, dengan kualiti tertinggi dan mengikut cara yang paling selamat. projek constrcution sering dipengaruhi oleh mana-mana petunjuk kejayaan yang membantu pihak projek mencapai matlamat mereka seperti yang dirancang, atau penunjuk kelewatan yang stfle atau menangguhkan penyiapan projek.

The prupose kajian ini adalah untuk mengenal pasti kejayaan dan kelewatan petunjuk yang boleh membantu pihak projek mencapai matlamat yang dirancang dengan lebih berkesan. Kajian ini diekstrak enam daripada petunjuk kejayaan yang paling penting sesuai dengan sastera dan enam daripada petunjuk kelewatan paling penting yang dikenal pasti oleh pihak projek, dan kemudian diperiksa hubungan antara mereka untuk menentukan yang tidak influentiatl yang paling dalam mencegah kelewatan projek.

Kajian ini menggunakan kajian literatur comrehensive untuk mereka bentuk dan menjalankan kajian untuk menyiasat kejayaan dan kelewatan penunjuk. Satu kajian khusus adalah penyumbang kepada kontraktor, pelanggan, pengurus projek dan perunding kejuruteraan untuk memeriksa yang paling menyebabkan petunjuk kelewatan. Tinjauan umum telah diedarkan untuk mengkaji korelasi antara petunjuk kelewatan yang dikenal pasti dan enam petunjuk punca kejayaan paling penting dipilih. Persetujuan pendapat pakar menggunakan methos statistik untuk menentukan kedudukan punca yang paling diperlukan indikator kejayaan bagi industri consturction terutama bagi contoh projek di Cyberjaya.

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CHAPTER 1

INTRODUCTION

1.1 Background to the research

An examination of the relevant recent literature indicates that construction projects are frequently completed with large cost overruns, extended schedules and quality concerns. Delay is defined as the overruns either beyond the completion date specified in the contract, or beyond the date that the parties agreed upon for delivery of the project. A delay in a construction project may cause losses, or negatively affect some or all of the project parties. The effects of delay may include time overrun, cost overrun, disputes, arbitration, litigation, and total abandonment (Albinu and jagboro 2002).

Some studies directly examine delays and attempt to identify their causes as well as ways to avoid them (Baldwin, 1971)

During the last four decades a number of studies have investigated factors which aid successful completion of projects, particularly those which affect project success more than others. “performance index aspect thus are, for any business, the limited number of areas in which results, if they are satisfactory, will ensure competitive performance (Rockart, 1982)

The concept of success in a construction project can, according to some researchers be evaluated only when the evaluation dimensions are adequately defined. Generally, in any project the evaluation dimensions correspond to the traditional constraints of time, cost and quality parameters defined as, project success as “results better than expected or normally observed in terms of cost, schedule,

quality, safely, and satisfaction". The first study to identify lists of performance index has been undertaken since 1967, and demonstrates the development of information on success indicators based on empirical and theoretical studies (Rom, 1995 Empirical).

This thesis builds on these past studies by investigating the success and delay indicators is identify. This work examines success and delay indicators in an integrated fashion to determine which performance index are most influential in avoiding particular delay indicator. This will provide organizations involved in construction projects with the foundation on which such strategies on how to avoid delays and can be developed in the future.

Once the effective project management is identified, the opportunities for improving project performance are discussed. The research will determine the relevance and applicability of there factors construction project.

In developed and developing countries, the construction industry plays a major role in the economy by contributing significantly to the gross domestic product, employing a sizeable portion of the working population, accounting for about half of the capital formation, and interacting strongly with other sectors of the economy (Hillebrandt 1985).

1.2 RESEARCH OBJECTIVES

The aim of the research is to enhance performance index of project management in the construction industry. The objective of the research are:

- To identify the delay indicator that currently exist in the construction Industry that most common and fundamental problems affecting project delivery performance.
- To identify the critical success indicator which are most influential in avoiding or preventing delay indicator.

- To construct performance index based on the criterion of delay and success indicator as, the most important critical success element for construction project.

1.3 PROBLEM STATEMENT

- Performance of the project need to be analyze because its consist of delay and success indicator are directly affecting the success of the project.
- The performance of the project needs to be study/evaluate to provide means of indicators of project success.
- Performance index to be establish so that the direct impact of the success and delay indicator can be managed effectively for the project batch marking strategy.

These problems all had negative effect on the parties involved by potentially generating significant losses for all. They threaten the general safely of construction projects and eventually affect the economy as a whole. In light of these issues, this research purpose that simply applying performance index or taking the necessary precautions might not be enough to enable project partners avoid delay indicator during construction. Further investigation to examine the correlation between the performance index and the delay indicator will allow contract parties and investors to determine which factors observe the most attention.

To this end, the research questions posed for those research problems are:

1. What are the real causes of project delays in the construction industry?
2. What are the most success indicators in construction site?
3. Based on the project index, how are these delay indicator correlated to success indicator within the construction industry?

1.4 RESEARCH METHODOLOGY

The research methodology adopted for this research comprises three stages as follows:

- Stage 1- literature research to determine the research focus
- Stage 2- this stage consists of two activities as follows:
    - Activity 1- specific survey of stakeholders to analyse the interrelationship between success and delay indicators that governed within project performance in order to help project parties minimize construction project problems.
    - Activity 2- general survey of stakeholder to examine the correlation between the success and delay indicator to allow contract parties and investors make decision on which factors deserve.

1.5 OUTLINE OF THE RESEARCH

The thesis format follows the logical steps of establishing the research questions, developing and methodology, gathering and analysing data and drawing conclusions. The thesis is organized into three chapters as follows:

Chapter 1- discusses the background of the research by highlighting the research problems, research purpose, research objective and purposed methodology and thesis organization.

Chapter 2 -presents a literature review on the delay indicator and success indicator. It examines literature and studies about delay indicator in the construction industry, large building construction projects, fast growing economics and comparative studies of the causes of delays. The literature and studies on success indicator include performance

index for construction projects, a checklist of performance index for construction processes and for stages of project life cycle.

Chapter 3- described the methodology used in the research. This methodology seeks to identify the causes of delays indicator and the ranks the success indicator most

necessary for rising on project performance. This chapter reviews the survey method and the consensus forming methods.

CHAPTER 2

LITERATURE REVIEW

Increasing uncertainties in technology, budgets and development processes create a dynamic construction industry. Building projects are now much more complex and difficult and the building project team faces unprecedented changes. The study of performance index is a meant of understanding and thereby rising up the effectiveness of construction projects. However the concept of project success remains ambiguously defined in the mind of construction professionals.

One of the objectives of this research is to understand and explain, through a study of the literature, performance index. This chapter defines and describes project delay indicator and success indicator as identified in the literature. The literature review is divided into two parts. The first part summarizes the studies on causes of delays to construction projects, the second part explores critic success indicator.

2.1 DELAY INDICATOR

In the context of the construction industry, delay can be defined as the extra time required to finish a construction project beyond its original (planned) duration, whether compensated for or not. The desire to finish a project on time, under the planned budget, with the highest quality, and in a safe manner is common goals for all contract parties, including the owner, contractor and consultant. Delays usually result in losses of one form or another for everyone. Research indicates the effect of delays as (1) time overrun (2) cost overrun (3) disputes (4) arbitration (5) litigation (6) total abandonment (Murail 2006).

To control this problem and minimize construction project delays, construction parties should identify the causes of delays and the project factors that may facilitate their avoidance.

Delay can be divided into three major types, namely:

1. Excusable and non-excusable.
2. Compensable and non-compensable
3. Concurrent

Non excusable delays are caused by contractors or subcontractors or material suppliers, through no fault of the owner. The contractor might be entitled to compensation from the delaying subcontractor or supplier, but compensation cannot be sought from the owner. Therefore, non-compensable delays usually result in no additional money and no additional time being granted to the contractor (Alaghbari 2005).

Excusable delays, also known as " force majeure" delays, are the third general category of delay. These delays are commonly called " acts of god" because they are not the responsibility or fault of any particular party. Most contracts allow for the contractor to obtain an extension of time for excusable delays, but no additional money. A concurrent delay happens in a situation where more than one factor delays the projects at site same time or in overlapping periods of time (Alaghbari 2005).

Compensable delays are those that are generally caused by the project's owner or their agent. The most common form of compensable delay is inadequate

drawings ad specifications, but compensable delay can also arise from the owner's failure to respond in a timely fashion to request for information or shop drawings, owner changes in design or materials, and owner disruption and/or change in the sequence of work. The contractor is entitled to both additionally money and additional time resulting from compensable delays (Alaghbari 2005).

Responsibility for delay is related to whether the contractor is awarded or is liable for costs and additional time to complete the project said (Ahmad et al 2003).

The categories of responsibility are:

1. Owner responsible- the contractor will be granted a time extension and additional costs (indirect) where warranted.
2. Contractor (subcontractor) responsible- the contractor will not be granted time nor costs, and may have to pay damages/ penalties:
3. Neither party (i.e 'act of god') responsible- contractor will receive additional time to complete the project but no costs will be granted and no damages/ penalties assessed and:
4. Both parties responsible- contractor will receive additional time to complete the project but no costs will be granted and no damages/penalties assessed.

Concurrent delays are more complicated but are also a more typical type of delay. They arise when more than one factor delays the project at the same time or in overlapping periods of time (Alaghbari 2005).

2.1.1 Causes of delay in the Construction Industry

Much research has been undertaken on construction delay. Examine the subject of delays and noticed that large construction projects experienced considerable setback and loss when they encountered any kind of delay. The study included a survey of 75 professionals, with a response rate of 12 project manager,18 contractors, 15 architect and 30 engineers. In spite of the different viewpoints head by each of the groups surveyed, there were definite areas of agreement among them. All these groups felt that weather, labour supply and subcontractors scheduling were the three major causes of delay. Table 2.1 lists the range of delay factors identified by respondents, In order of importance.

Contractors	**Architects**	**Engineers**	**Project manager**
Weather	Subcontractors	Weather	Weather
Labour supply	Labour	Subcontractors	Subcontractors
Subcontractors	Weather	Labour	Subcontractors
Design changes	Manufactured Items	Manufactured Items	Finances
Shop drawings	Finances	Finances	Construction mistakes
Foundation conditions	Material shortage	Foundation conditions	Foundation conditions
Material shortage	Shop drawings	Permit	Material shortage
Manufactured Items	Permit	Material shortage	
Sample approvals	Foundation conditions	Design changes	Design changes
Jurisdictional disputes	Design changes	Shop drawings	Finances
Equipment failure	Construction mistakes	Jurisdiction disputes	Jurisdiction disputes
Contracts	Jurisdiction disputes	Equipment failure	Equipment failure

Construction mistakes	Sample approvals	Construction mistakes	Construction mistakes
Inspection	Building Codes	Inspection	Inspection
Finances	Contracts	Contracts	Contracts
Permits	Equipment failure	Sample approvals	Equipment failure

Table 2.1 Delay Factors In Order of the Importance

The result of this survey identify there inter related categories of construction industry problems in developing economics: (a) problems of shortage or inadequate in industry infrastructure (mainly supply of resources): (b) problems caused by clients and consultants and (c) problems caused by contractor incompetence/inadequate

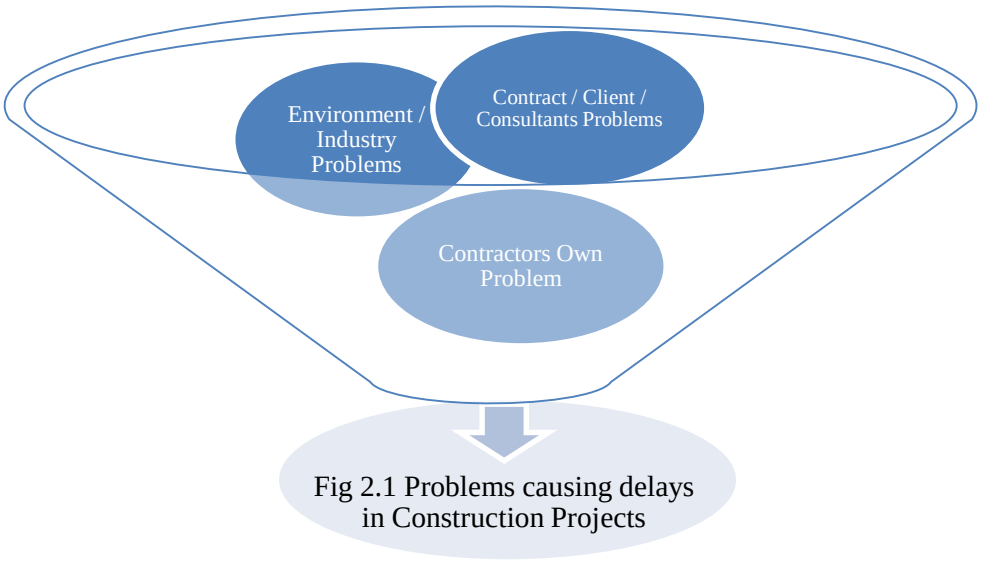

Fig 2.1 Problems causing delays in Construction Projects

2.1.2 Causes of Delay in Large construction projects

In 2004, conducted a survey on time performance of different types of construction projects to determine the causes of delay and their importance according to each of the project participants- 15 owners, 19 consultants and 23 contractors (Assaf and Al-Hejj).

The authors identified seventy three causes of delay (Al-Ghafty 1995).

The study revealed that there were certain interrelationships among the problems. The top ranked problems In terms of occurrence were grouped under five major factors: (1) incompetent designers and contractors. (2) poor estimation and change management, (3) social and technologies issues, (4) site related issue and (5) improper techniques and tools.

The study undertaken by Assaf et al. (1995) consisted of two phases. The first phase included a literature review and interview with project manager, local contractors, and architectural engineers, , where fifty-six causes of delay were identified. These factors were grouped into nine major categories:

- Materials – causes of delay related to shortages, material changes, delivery, damage, and manufacturing of materials:
- Labour – shortages of labour, labour skill, and the nationalities of the labourers:
- Equipment – delay related to failure, shortage, and delivery of the equipment, or the productivity or skill of operators of the equipment:
- Financing – contractors financing requirements and progress payments paid by owners:
- Environment – climatic conditions, social and cultural impact, geological conditions:
- Changes – delays as a result of omissions, errors, and changes of scope by owners:

- Government relations – delay related to permits, labour visa requirements and government bureaucratic procedures:
- Contractual relationship – problems involving the contractual relationship among various parties involved in a project, who have varying and sometimes conflicting interests:
- Scheduling and controlling techniques – poor planning and scheduling practices, lack of management expertise in project control, and poor record keeping and maintenance.

In the second phase of the study, a questionnaire was developed that focused on the fifty-six causes of delay. The study found that all three groups generally agreed on the ranking of the delay factors (financing was ranked the highest by all three parties, and the environment was ranked the lowest). Tables 2.2, 2.3 and 2.4 illustrate the most important factors, and their rankings, identified in this study.

Groups of delay	**Causes of delay**
Project related factors	Original contract duration is too short
	Legal disputes between various parties
	Inadequate definition of substances completion
	Ineffective delay penalties
	Type of construction contract (turnkey, construction only etc)
	Type of project bidding and award
Owner related factors	Delay in progress payment by owner
	Delay in furnishing and delivering the site to the contractor by the owner
	Change orders by owner during construction
	Delay in revising and approving design documents by owner
	Delay in approving shop drawings and sample materials

	Floor communication and coordination by owner and other parties
	Slowness in the decision making process by owner
	Conflicts over joint ownership of the project
	Lack of incentive for the contractor for finishing ahead of schedule
	Suspension of work by owner
	difficulties in financing the project
	Conflict in sub- contractors schedule in execution of project
	Re-work due to errors during construction
	Conflict between contractor and other parties
Contractor	Floor size management and supervision
related	Inadequate construction methods
factors	Delays in sub-contractors work
	Inadequate contractors work
	Frequent change of sub-contractors because of their inefficient work
	Poor qualification of contractors technical staff
	Delay in size mobilization
	Delay in performing inspection and testing
	Inflexibility
Consultant	Floor communication coordination between consultant and other
related	parties
factors	Delay in reviewing and approving design documents
	Conflict between consultant and design engineer
	Inadequate experience of consultant
	Mistakes and discrepancies in design documents
	Delays in producing design documents
Design	Unclear and inadequate details in drawings
team	Complexity of project design
related	Insufficient data collection and survey before design.
factors	Misunderstanding of owners requirements by design engineer
	Inadequate design team experience
	Non-use of advanced engineering design software
	Shortage of construction material in market
	Changes in material delivery

	Damage of sorted material when they are neede urgently
Material	Delay in manufacturing special building materials
related	Late procurement of materials
factors	Delay in section of finishing materials due to availability of many types in market
	Shortage of labour
Labour	Unqualified workforce
related	Nationality of workforce
factors	Low productivity level of workforce
	Personal conflict among workplace

Table 2.2 Causes of delay in large construction projects categorized into 8 groups

Type	**Delay factor**	**Rank**
Scheduling	Preparation and approval of shop drawings	1
Financing	Delays in contractors progress payment by owner	2
Changes	Design change by owner during construction	2
Material	Delay due to special manufacture	4
Financing	Owners cash problems during construction	5
Contractual relationship	Slowness of owners decision making process	6
Material	Slow delivery of construction material	7
Changes	Design errors made by designer	7
Scheduling	Waiting for sample material to be approved	7

Table 2.3 Most Important Delay Factors According to Contractors

Type	Delay factor	Rank
Financing	Owner's cash problems during construction	1
Financing	Financing by contractors during construction	2
Contractual relationship	Relationships between different subcontractors schedules	2
Contractual relationship	Slowness of owner's decision making process	2
Financing	Delays in construction progress payment by owner	5
Materials	Changes in type of construction materials	6
Scheduling	Poor judgment subcontractors by general contractors	6
Contractual relationship	Controlling subcontractors by general contractors	6

Table 2.4 Most Important Delay Factors According to Architectural Engineer

Type	**Delay factor**	**Rank**
Changes	Design errors made by designers	1
Government relationship	Excessive bureaucracy in project owner operation	2
Manpower	Shortage of labour	3
Manpower	Labour skill	3
Financing	Financing by contractor during construction	3
Material	Shortage of construction materials	6
Financing	Owners cash problems during construction	6
Changes	Errors committed during field construction on site	6
Contractual relationship	Unavailability of professional construction management	6

Table 2.5 Most Important Delay Factors According to Owner

2.1.3 Construction Delay A Quantitative Analysis

Undertook a study to determine the cause and extent of delays in public projects. The study investigated the cause of delays on 130 projects, including residential buildings, office and administration buildings, schools, medical centres, and communication facilities. The sample population was established by selecting 130 finished public projects in different regions between the years of 1990 and 1997. To investigate why construction delays and overruns occurred, the following data were obtained from the projects records:

- Planned duration of contract
- Actual completion data
- Design changes
- Disputes
- Notifications
- Data of notice to proceed
- Delays encountered during construction
- Conflicts related to the drawings and specifications
- Time extensions
- Late delivery of material and equipment

The study also found that the significant causes of delay were

- Poor design
- Change orders
- Weather
- Site conditions
- Late delivery
- Economic conditions and
- Increase in quantities.

The four main causes of delay were

- Poor design
- Change orders and
- Site and
- Economic conditions.

2.1.4 A Comparative Study of Causes of Time Overruns

Chan and Kumaraswamy (1997) presented the results of a survey undertaken to determine and evaluate the relative importance of the significant factors causing delays in construction projects. The survey investigated 83 previously identified project delay factors from the authors' pilot survey, and interviews with clients, consultant and contractors. The factors were grouped into seven major factor categories: project related, client related, design team related, contractor related, material related, labour related, and plant equipment related. The following is a brief description of these categories.

1. Project related factors include delays related to:
    - Project characteristics
    - Necessary variations
    - Communication among various parties
    - Speed of decision making involving all project teams and
    - Ground conditions
2. Client related factors include those concerned with:
    - Client characteristics
    - Project financing
    - Client variations and requirement and
    - Interim payments to contractors.
3. Design team related factors consist of:
    - Design team experience
    - Project design complexity and

- Mistakes and delays in (producing) design documents.

4. Contractor related factors comprise those related to:
    - Contractor experience in planning and controlling the projects
    - Site management and supervision
    - Degree of subcontracting and
    - Contractors cash flow.
5. Materials factors include:
    - Shortages
    - Material changes
    - Procurement programming and
    - Proportion of off-site prefabrication.
6. Labour factors encompass:
    - Labour shortages
    - Low skill levels
    - Weak motivation, and
    - Low productivity.
7. Plant/Equipment factors include:
    - Shortages
    - Low efficiency
    - Breakdowns, and
    - Wrong selection.

The researchers' analysis of their data concluded that:

1. All three major groups of industry participants felt that poor site management and supervision, unforeseen ground conditions, slow speed of decision making involving project teams, client initiated variations, and necessary variations of work were the five most significant sources of construction time overrun.
2. Despite some differing perceptions as to the relative importance of delay factors suggested by each group of respondents, there was general agreement between the client and consultants on a set of 10 principal factors, but the contractors

claimed that for the most part, the delays were attributable to a lack of contractor experience in planning and monitoring at the sit

2.1.5 Causes of Construction Delay Traditional contract

Odeh and Bettaineh (2002) identified the major causes of delay in the construction industry and assessed the relative importance of these causes for the traditional adversarial type of controls from the viewpoint of construction contractors and consultants. First, a survey questionnaire was developed to assess the perceptions of contractors and consultants of the relative importance of construction delay causes. Second, the questionnaire was distributed to a random sample of contractors and consultants working on large projects. The survey is based on 28 well organized causes of delay to which participants were asked to ascribe levels of importance.

2.2 SUCCESS INDICATOR

A building project is completed through a combination of many events and interactions, planned or unplanned, over the life of a facility, with changing participants and processes In a constantly changing environment. Certain factors are more critical to a projects success than others. These factors are called success indicator. The term success indicator in the context of the management of projects was first used and is defined as those factors predicting success on projects by (Rockart 1982).

Success is defined by Ashley et, al, (1987) as " results much better than expected or normally observed in terms of cost, schedule, quality, safely and participant satisfaction". The investigation of the success indicator of construction projects has attracted the interest of many researchers and many studies have been conducted, with the aim of providing contract parties with valuable insight into how to consistently achieve superior results for their projects. Although construction projects are by their nature repetitive activities, each one has its own characteristics and circumstances. The following section investigates studies that identify success indicator leading to successful completion of projects on time, within a planned budget, in the safest

manner, and with the highest quality. These studies differ in the way they approach the problem and in the way the researchers evaluate success aspects.

2.2.1 Determinants of Construction Project Success indicator

Ashley et al. (1987) offer insight into aspects that influences construction project effectiveness through interviews with construction project personnel and a literature review of relevant studies. Researchers started with a list of approximately 80 success indicator from previous studies and construction management personnel interviews, which they reduced to a 75 success indicator grouped into 5 major categories, as follows:

1. Management organization, and communication
2. Scope and planning
3. Controls
4. Environmental, economic, political and social
5. Technical

In order to identify which of these factors had the most significant influence on construction project success, input from several construction project personnel was obtained. Easy aspects was subjectively rated using a range from no influence (rated with a value of 1) to major influence (rated with a value of 5). From these ratings the top 15 factors were grouped by their respective categories. From this list, 11 factors were chosen for further analysis. These are:

1. Planning effort
2. Project manager goal commitment
3. Project team motivation and goal orientation
4. Scope and work definition

5. Project manager capability and experience
6. Safety
7. Control system
8. Design interface management
9. Risk identification and management
10. Technical uncertainty
11. Legal political environment.

Interviews were conducted to identify factors which:

- Showed difference between average projects and outstanding projects
- Identified the principal measures of the project success
- Identified factors showing a strong correlation to project outcome.

The individuals surveyed were experienced in project management covering a wide range of project types.. Individuals were selected who had extensive experience with the project.

Response data from these interviews were analysed and the researchers found that the first seven factors were the most significant in determining project success. The others showed less distinction between average and outstanding projects, and therefore were probably not as important in determining the successfulness of a project.

Likewise, success criteria were comparatively rated for average and outstanding projects, revealing that the most important criteria for gauging the success of a construction project were:

1. Budget
2. Schedule
3. Client satisfaction
4. Functionality
5. Project manager/ team satisfaction
6. Contractor satisfaction

A final analysis of the correlation between particular factors and their influence on the successfulness of a construction project was conducted. Results showed that differences in construction and design planning efforts best explained the delineation between average and outstanding projects. Interpretation of the results further showed that the following factors are most significant in determining projects successfulness:

1. Construction and design planning effort
2. Scope and work definition
3. Project manager goal commitment
4. Project team motivation goal orientation
5. Project manager capabilities and experience
6. Safety
7. Control system

Most of the critic successfulness aspects identified are human related factors. The study on project successfulness aspects in large construction projects, among 20 success indicator researched, 5 critical success that were identified, and this is fully supported by Nguyen et al (2004).

1. Competent project manager
2. Adequate funding until project completion
3. Multidisciplinary/competent project team
4. Commitment to project
5. Availability of resources

The study also grouped the successfulness aspects into one of four components:

1. Comfort
2. Competence
3. Commitment
4. Communication

‘Comfort’ means ensuring that resources, efforts and leadership are well aligned for the implementation of projects. ‘ Competence’ requires having appropriate technology, experience, and specialties available for the project. ‘Commitment’ ensures that all

parties concerned with the project and all levels in the management hierarchy of each participating organization are willing to manage, plan design, construct and operate the facility harmoniously. “Communication” helps clarify and disseminate all necessary project information and status to all internal and external project stakeholders.

2.2.2 Critical Success Indicator for Construction Projects

By reviewed previous works on empirical studies from seven major management journals to develop a conceptual framework on critic successfulness aspects. Five major groups of independent variables were identified as crucial to project achievements. These are shown in Table 2.6

Factors affecting project success	**Variables**
Project related	Type of project
	Nature of project
	Number of floors of the project
	Complexity of project
	Size of project
Procurement related	Procurement method
	Tendering method
Project management related	Communication system
	Control mechanism
	Feedback capabilities
	Planning effort
	Developing an appropriate organization structure
	Implementing an effective safety program
	Control of sub-contractors works
	Overall managerial actions.
	Clients experience

	Nature of client
	Size of clients organization
	Clients emphasis on low construction cost
	Clients emphasis on high quality construction
	Client emphasis on quick construction
	Clients ability to approve
Project participant	Clients ability to define roles
related (client	Clients contribution to design
contractor,	Clients contribution to construction
contractor, sub-	Project team leaders experience
contractor,	Technical skills of the project team leaders
suppliers,	Planning skills of the project team leaders
manufactures)	Organizing skills of the project team leaders
	Motivating skills of the project team leaders
	Project team leaders commitment to meet cost, time and quality
	Project team leaders early and continued involvement in the project
	Project team leaders adaptability to changes in the project plan
	Project team leaders working relationship with others
	Support and provision of resources.
	Economic environment
	Social environment
External related	Political environment
	Physical environment
	Industrial relations environment
	Technology advanced

Table 2.6 Factors affecting the success of construction projects

2.2.3 Checklist of Critical Success indicator for Building Projects

Sanvido et al (1992) defined as the achievement of construction projects as the degree to which project goals and expectations are met. These goals and expectations may include technical, financial, educational, social, and professional aspects. The study was covered all the researchers identified the successfulness criteria list for each of the contract parties: owner, designer, and contractor. Some of the owner achieve criteria included being on schedule, being on budget, and return on investment. Examples of the designer success criteria were client satisfaction, quality architectural product, well defined scope, and social acceptability. Finally contractors criteria for measuring success included meeting the schedule, profit, safety, and client satisfaction.

Therefore, a questionnaire was developed to facilitate data collection by the researchers and to ensure consistency in the elements examined. The study selected eight pairs of projects: the two projects in each pair were similar in scope and proposed by the same sponsor or company. One project was successful in the eyes of the sponsor and the selected projects and interviewed the principal engineers. the interviewee was asked to rank how successful the project was, and whether the function (such as facility team, experience, external constraints, resources, etc) had either positive or negative effects on the project's achievement. They were also asked what the effect was, what lessons were learned from the project, and what had been done implement those lessons in subsequent projects

The results of the research indicated that the following four factors were hectic:

a) A well organized, cohesive facility team to manage, plan, construct, and operate the facility.
b) A series of contract that allowed and encouraged the various specialists to behave as a team without a conflict of interest or differing goals.
c) Experiences in the management, planning, design, construction and operations of similar facilities.
d) Timely, valuable optimization of information from the owner, user, designer, contractor, and operator in the planning and design phase of the facility.

2.2.4 Success indicator in the Construction Process.

The research identified several aspects for the construction process as follows:

- To state clearly the expected end result, with consultation with the related parties. Although each party might have different specific goals in mid for the project, they must spell out their goals.
- To state the communicated and defined goal to all parties.
- To state the clarified time and cost objectives.

Scope of project

- To state the general direction and define the clients requirement.
- To present a clear design brief with minimal subsequent changes. A brief must be exact and owned by the client at the highest strategic level within the client and project organizations.

Project manager

- The Project manager is the key person in the project. They must demonstrate multi-dimensional abilities including interpersonal, technical and administrative skills.
- The most important element is that the project manager must clearly understand their role as project leader, clearly defining their extent of involvement, and the authority and control they exercise over personnel.
- Personality- the Project manager must have a personality which encourages respect from team players, associates and peers.
- Leadership- the project manager should have a leadership skills and be able to apply competent managerial skills. The project manager should have the ability to persuade other members of the group to their view and be able to resolve conflict between parties.
- Organizing- the project manager should be responsible for organizing, selecting and defining the responsibilities of the project team.

- Coordinating- the project manager should identify interfaces between the activities of the functional departments, subcontractors, and other project contributors.
- Controlling- should be responsible in monitoring, solve the problems, communicating the status interfaces to contributors, and initiating and coordinating corrective action.

2.2.5 Critical Success indicator over the stages in the project life cycle

1. Project Mission – the initial clarity of goals and the general direction

2. Top Management Support- willingness of top management to provide the necessary resources and authority/power for project success.

3. Project Schedule/Plan- A detailed specification of the individual action steps required for project implementation.

4. Client Consultation- communication, consultation, and action on behalf of all impacted parties.

5. Personnel- recruitment, selection and training of the necessary personnel for the project team.

6. Technical Tasks- availability of the required technology and expertise to accomplish the specific technical steps.

7. Client acceptance- the act of 'selling' the final project to its ultimate intended users.

8. Monitoring and Feedback- timely provision of comprehensive control information at each stage in the implementation process.

9. Communication- the provision of an appropriate network and necessary data all key actors in the project implementation.

10. Trouble shooting- ability to handle unexpected crises and deviations from plan

2.3 CONCLUSION

2.3.1 Delay Indicator

The literature review of the delay indicator was used to build a comprehensive list of delay causes. These grouped into nine major groups: projects related factors, owner related factors, contractor related factors, consultant related factors, design team related factors, material, equipment, labour and external factors. Based on the preliminary studies and discussion with project manager, contractors and engineers, some of the delay factors listed are not common, not applicable, have a rather low effect on project duration and were not seen as a determinant factor of project delay in construction industry.

Odeh (2002) identified the major causes of delay in construction industry building projects using 28 recognized construction delay factors. These causes were categorized into the following eight major groups: client related factors, contractor, consultant, material, labour, and equipment, contract, contractual relationship and external factors. Firstly, Odeh identified the major causes of delay in the construction industry and assessed the relative importance of these causes for the traditional adversarial type of contracts. Secondly, the factors identified by Odeh are more common to building construction processes. The study is also supported by other researchers such as Nguyen et al (2004). The 28 causes of delay were seen to fit this research study as the research is focused on the building construction process for the traditional adversarial type of contracts. These delays are also common to construction industry.

2.3.2 Success Indicator

Ashley et al. (1987) complied 2000 success aspects based on informal interviews of construction professionals. The list was reduced to 48 factors and grouped into 5 major categories. These are: management, organization, and communication: scope and planning: controls: environmental, economic, political and social: and technical. A further analysis by construction project personnel to identify which of these aspects had the most significant influence on construction projects achievement that reduced the list to 11 factors. A final analysis identified the 7 most significant Aspects in determining project success.

There are number of studies on success aspects in the construction industry. It can be seen that success indicator have been predominantly contributing towards effective project management and achievement of projects.

Due to its comprehensive detailed description, and because much of the other research was based upon it in some way. The seven most significant achievement aspects in determining project success identified by Ashley et al (1987) have been chosen for further investigation in this study. These success aspects are:

1. Organizational planning effort
2. Project manager goal commitment
3. Project team motivation
4. Project manager technical capabilities
5. Scope and work definition
6. Control systems
7. Safety.

CHAPTER 3

METHODOLOGY

This chapter investigates current research approaches with a vies to selecting the most appropriate methodology for the current research project, including the research strategy and justification of the methodology, the procedure used, and sample selection. This research study:

- Requires a methodology to investigate variables and scales to represent happenings.
- Uses statistical analysis knowledge through the scientific search for cause and effect.
- Seeks to discover knowledge the scientific search for cause and effect.

The nature of this research suggest a quantitative methodology is most appropriate based on the above research requirements. A quantitative methodology also aligns with the fact that the majority of the research undertaken in construction management, engineering and property uses quantitative methodology.

3.1 RESEARCH STRATEGY

The term research refers to the development a new body of knowledge. Scientific research refers to the systematic controlled, empirical and critical investigation of a hypothetical proposition about a presumed relation in order to find the solution to a problem or discover and interpret new knowledge (McCuen, 1996).

Scientific research describe as being the investigation of phenomena via practice consistent with the method of science.

Scientific investigation and the verification of belief about real world phenomena involve empirical research based on the belief that all knowledge originates in experience (Stone, 1978).

The research presented in this thesis deals with facts that have objective reality, and based on this empirical research is the process used in this study. The empirical scientific research cycle (McCeun, 1996) in Figure 4.1 shows the basic steps for the empirical study of a phenomenon.

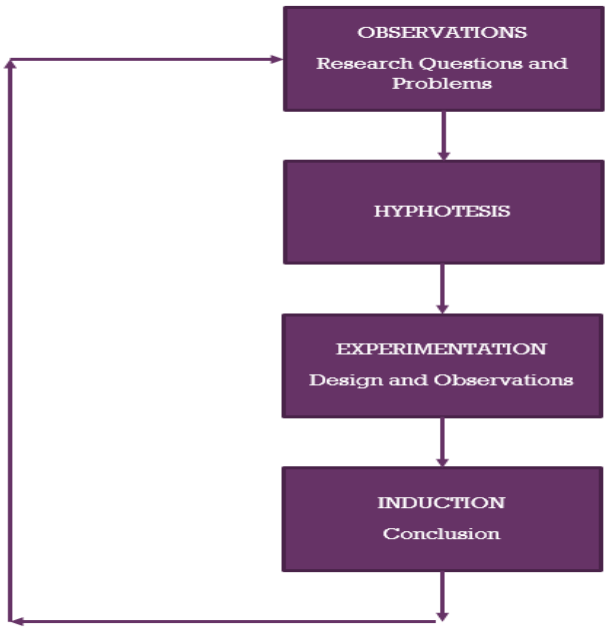

Figure 3.1 *Sources: The Empirical Scientific Research Cycle (adopted from McCuen 1996 and Stone 1978)*

- Observation: an informed and critical questioning of an existing phenomenon leading to a problem statement and the research question.

- Hypothesis : a formal expression of a preconceived factual relationship which provides a tentative explanation or solution to the problem.
- Experimentation : the design of a study leading to a systematic and controlled testing of the hypothesis.
- Induction : a generalization of the experimental results to a formal statement of the theory.
- Empirical research has a number of different approaches to research strategies.

The research questions for this study are:

1. What are the real cause of project delays in construction site?
2. What are the most success indicator in construction site?
3. Based on the project performance, how are these delay factors correlated to success indicator?

The type of research question and the variables involved in the research will differentiate the various strategies available to the researcher. Table 4.1 shows the conditions for various strategies.

Historical research is concerned with historical events or an approach to contemporary events or problems. Historical research can also be used to help solve problems through an examination of what has happened in the past (Bennet,1991).

The case study examines contemporary events, especially when the relevant behavior of the phenomenon being studied cannot be manipulated, as it can experiments. Unlike historical research, the case study has two sources of evidence: direct observation and systematic interviewing.

Strategy	Form of research question	Requires control over behavioural events	Focuses on contemporary events
Experiment	How, why	Yes	Yes
Survey	Who, what, where, how, many, how much	No	Yes
Archival analysis (eg, economic study)	Who, what, where, how, many, how much	No	yes/no
Historical	How, why	No	No
Case study	How, why	No	Yes

Relevant Situations for Different Research Strategies (Source: adopted from Yin, 2003)

The case study was identified to be the most appropriate methodology to answer the research questions identified in Chapter 1. This is due to its ability to deal with a variety of evidence such as artefacts, observations, documents and interview. To conduct the research, the data collection method selected is the survey, which will identify the delay indicator and examine the correlation of the critical success indicator and the delay indicator.

3.2 THE RESEARCH PROCEDURE

The research procedure for this thesis includes the following:

- A clear definition of the problem being studied
- The research objectives of the study
- Justification of the research and description of the research

- Identification of issues relating to the research investigations
- Study of the components and elements that comprise the investigation.
- Description of methodology for the research investigation.

3.2.1 Stage 1: Review Literature

The aim of the literature review is to examine previous research and identify the gaps in current knowledge. This review determined the context of the research study and positioned this week relative to previous research. It also assisted in the conceptualization of the research arrears sufficiently to develop the main focus of the research, influence the research design and generate specific hypotheses to be tested.

The activities included in this stage are:

- To develop a clear understanding of the research study
- Identify and describe the problem being studied
- To consolidate and extract information from a preliminary literature review for the main arrears of investigation including critical delay indicator, critical success indicator, building construction, construction in developing countries and policies.
- Formulate the study questions based on the problems identified and create a description of the research questions and objectives. The sources of information for collection of data for this activity include journal publications, books, magazine articles, international agendas and reports.
- Develop the methodology for the research.

3.2.2 Stage 2: Data Collection and Survey

The second stage of the research will investigate the delay indicator in construction projects. It will also investigate the correlation of the delay indicators with the success indicator found in the literature. This includes the assessment from

the knowledge gained from an extensive literature review and the data collection from the survey.

Stage 2 includes the following activities:

- Further investigation of literature relevant to the research.
- Collection of data.
- Identification of delay indicators.
- Piloting: conduct a pilot survey in the early stages of the study in order to verify the quality and effectiveness of the questionnaire for both specific and general surveys. These pilot surveys intend to get feedback that could help the researcher improve the data collection strategy and also measure the exact time required to complete all questions or identify any other problematic issues with the survey format. The feedback received from the pilot survey is used to improve the final product.
- Conduct the specific survey. A targeted survey was designed to obtain the recollections of field experiences from the engineers. the target population for this survey are project manager, contractor, architect, engineer.
- Identify critical delay indicator.
- Conduct the general survey. A general survey was created to gather options from experienced project managers and project teams. The general survey will examine the correlation between the critical success indicator and critical delay indicator. The target population are project manager, contractor, architect and engineer.
- Analyse the results using the Pearson Correlation Coefficient.
- Identify the critical success indicator according to their priority.

3.2.3 Stage 3: ranking and validating

The activities for stage 3 include the following:

- Plot the questionnaire with experienced project manager for their evaluation.
- List and discuss the results of the rankings
- Discuss the conclusions and suggestions for further research.

As a result of the following three steps:

- The results of the extensive review of the literature in stage 1
- Collection of data from stage 2
- Specific surveys on delay indicators and general surveys on the correlation of delay indicators and critical success indicators.

Lists of success indicators will be proposed for improvement of building construction projects.

CHAPTER 4

RESULTS AND DISCUSSION

The objective of this research is to identify the causes of delay in the building construction industry and to assess the relative importance of these causes from the viewpoint of the parties involve, contractor, project manager, consultants engineer and client. The current level of project success in the construction industry is very poor. This research investigates one building construction projects that encounters delays in order to understand the reasons for these failures, and to make recommendations that will help industry achieve its vision for development of its construction sector in the future.

A survey was conducted to assess the relative importance of causes of delays. A questionnaire was developed based on 29 well recognized causes of delay identified by Odeh and Bettained (2002).

4.1 Research Question One

“ What are the real causes of project delays in the construction industry?’

The target population for this survey were contractors, project manager, consultants engineer, and clients who were required to be members of projects teams in order to get necessary technical data. The projects selected for this survey were projects that were nearly completed or completed within the 1/5 years. A questionnaire was developed to assess the perceptions of the contractor, project manager, consultants engineer and clients on relative importance of causes of delay in construction industry.

Part one

Part one collects information to evaluate the validity of the project for this study. This part of the survey gathered information on demographics such as information about the employed. For the purpose of conducting a follow-up if required, participants were also asked to voluntarily provide contact information. The types of questions asked in part one of the survey included: name of the project owners (in most these were agencies): and type of organization.

Part two

Part two of the survey focused on causes of construction delay. The respondents were asked to indicate their responses to categories established form 28 well- recognized construction delay causes as identified by Odeh and Bettaineh (2002). A pilot study on the survey among the contractors, project manager, consultant's engineers and clients confirmed that they agreed on the causes of delays as identified, and no modification to this list was required. These causes were categorized into te following six major groups:

1. Unrealistic project schedule by Project Manager.
2. Impractical design by designer
3. In availability appraisal, cost data used for estimating purpose
4. EOT and TOC
5. Poor leadership on part of the Project Manager
6. Too many scope changes

4.2 Research Question Two

Part of the survey focused on causes of construction success. The respondents were asked to indicate their responses to categories. A pilot study on the survey among the

contractors, project manager, consultant's engineers and clients confirmed that they agreed on the causes of success as identified, and no modification to this list was required. These causes were categorized into the following ten major groups:

1. Financial-Profitability
2. Successful Tender rate
3. Communication
4. Development and management of a schedule
5. Good planning Project Manager
6. Involvement by key staff and resources
7. Financial- Reliability of financial performance
8. Customer- Competitive Price
9. Internal Business Efficiency
10. Business Safety

4.3 Performance Index based on the criterion in question no 1, and 2.

Part of survey that is needed to construct performance index based on the delay indicators and success indicators. Performance index to be establish so that the direct impact of the success and delay indicator can be managed effectively for the project batch marking strategy.

4.4 Statistical Method

4.4.1 relative importance index

The Relative Importance Index (RII) is a statistical method to determine the ranking of different causes. As this survey was designed to determine the relative importance of various causes of delays, the method was adopted in this study within various group (i.e. contractors, project manager, consultants engineers and clients).And for the ranking from

was adopted and transformed the relative importance indices (RII) for each indicators as follows. Where W is the weighting given to each indicator by the respondents, N is the total number of respondents. The RII highest the value of RII, the more important was the causes or effect of delays.

The RII was used to rank the relative importance index of the different causes. These rankings made it possible to cross-compare the relative importance of the indicators as perceived by the five groups of respondents which is, contractors, engineering consultants, project manager and clients. Each groups causes RII, as perceived by all respondents, was used to assess the general and an overall ranking in order to give an overall picture of the causes of construction delays and success indicators in construction industry.

The statistical analysis procedures that were used for each part of the survey questionnaire first, project information. Which is the frequency and percentages are used to summarize responses. Second, project evaluation indicators, to get the relative importance index are used to rank delay indicators by respondent (contractor, engineering consultants, project manager, and clients).

Some of the equation is used to find the percentage of every indicators at construction industry. The purpose to find out the percentage is to determine the correlation between to indicators which is success and delays, and form the percentage we can contribute one of the performance index, and from the performance index, we can get the correlation between the criterion on delay and success indicators. Therefore, the method how to find the percentage by using a several equation is,

$$Percentage = \frac{weighted}{total\ of\ respondent}\ x\ 100\%$$

To construct performance index based on the success and delays indicators, we need to use another one equation, which is,

$$(-ve)Delay + Success(+ve) = performance\ index$$

4.5 Results And Analysis

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Causes of Delay	Contractor	Engineering Consultants	Project manager	Clients	Total Weighted	Rank
Unrealistic Project schedule	2	2	X	X	4	5
Impractical design	6	5	1	1	13	1
Poor leadership	1	1	X	X	2	6
Viability appraisal cost data	X	6	X	X	6	4
Delay EOT TOC	6	X	1	X	7	3
To many scope changes	4	2	1	1	8	2
Total	19	16	3	2	40	-

Table 4.5.1 Ranking of key performance of delay indicators at construction site.

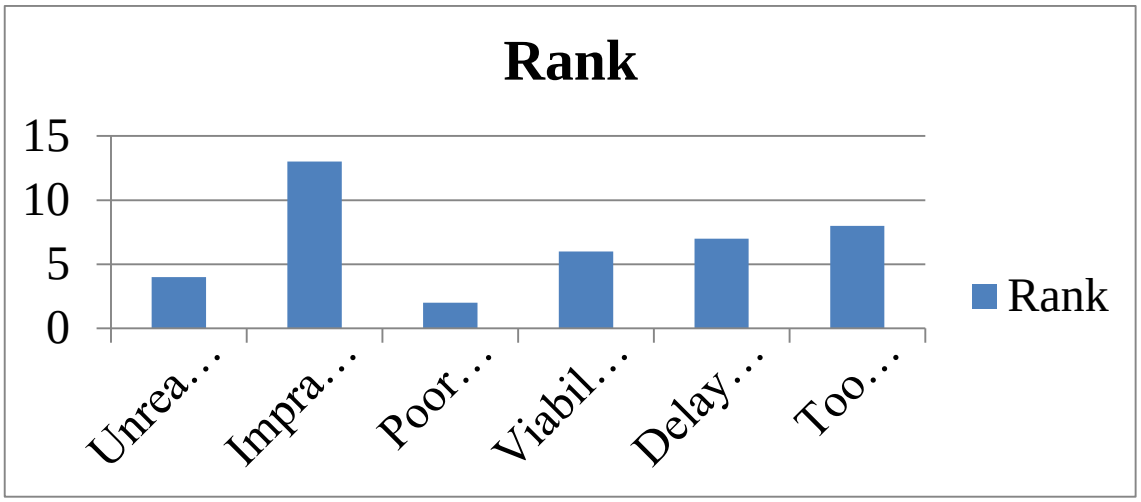

Figure 4.5.1 Ranking for delay indicator results

Ranking based on importance of performance for every construction industry on table expectations representing 13.2 weighted is impractical design, 8 too many scope changes, 7 delay in EOT & TOC, 6 is viability appraisal cost data, 4 unrealistic project schedule, and 2 were ranked for poor leadership. Therefore, these are most important causes of delay. And based on these indicators, they were answer by the entire respondent which is parties involved.

Causes of Success	Contractor	Engineering consultant	Project manager	Clients	Total weighted	Rank
Effective Project management	5	4	3	X	12	1
Effective scheduling	6	2	X	2	10	2
Communication Skill	4	4	X	X	8	3
Successful Tender rate	1	5	X	X	6	4
Management Involvement	3	X	X	X	3	5
Financial management	X	1	X	X	1	6
Total	19	16	3	2	40	-

Table 4.5.2 Ranking of key performance of success at construction site

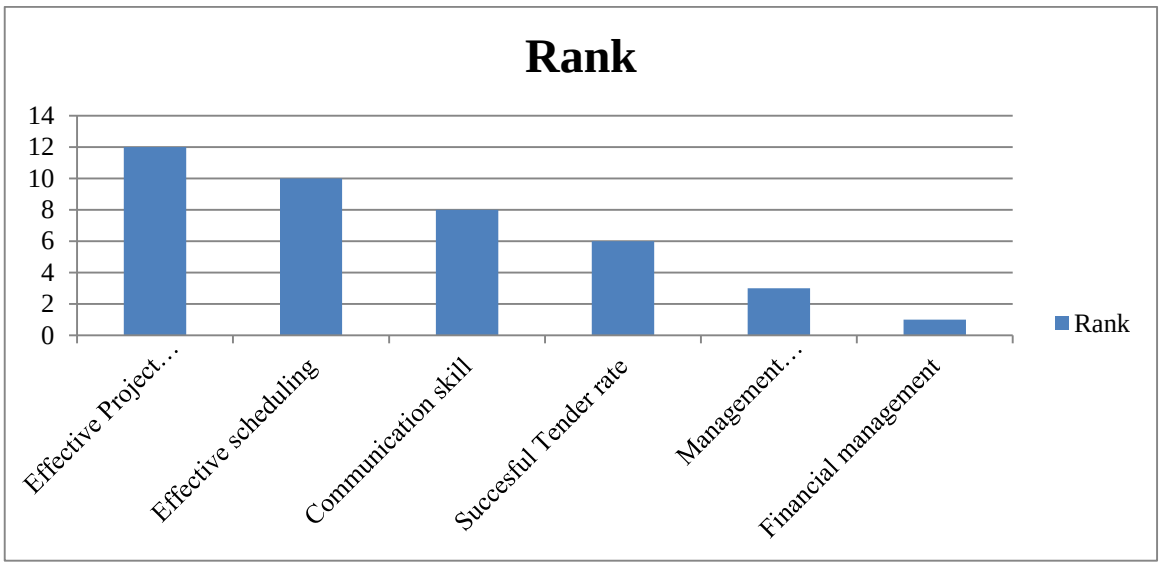

Figure 4.5.2 Ranking for success indicator

Ranking based on importance of performance for every construction industry in table 4.5.2 expectations representing highest of the success indicators is effective management with 12 weighted, second highest effective scheduling with 10 weighted, 8 communication skills, 6 successful tender rate, 3 management resources, and last is financial management is 1, were ranked most important causes of delay.

Delay indicator	Weight	%
Too many scope changes	13	32.5
Impractical design	8	20
Delay EOT & TOC	7	17.5
Viability appraisal data cost	6	15
Unrealistic schedule	4	10
Poor leadership	2	8

Table 4.5.3: Shows the percentage of parties involved in success indicators at construction industry

Table 4.1.3 shows the frequency of project delays based on the parties involved. The results revealed that the most causes of delays have the highest frequency representing 32.5%, for the too many scope changes respectively. However the frequency of impractical design came second represented by 20%, while, delay EOT & TOC came third with percentage ranges 17.5%. The other causes of delays such as viability appraisal data cost, unrealistic schedule and poor leader ship percentage ranges between 15% - 8% for causes of delays.

Success indicator	Weight	%
Effective project management	12	30
Effective sheduling	10	25
Communication skill	8	20
Successful Tender rate	6	15
Management Involvement	3	7.5
Financial management	1	2.5

Table 4.5.4: Shows the percentage of parties involved in success indicators at construction industry

Based on the table 4.5.3 and table 4.5.4, the table shows that, between the success and delay indicators can get the percentage. Indirectly, from the performance index (PI) success and delays, and it can construct the performance index.

From the table 4.5.3 and 4.1.4, the total of weight is 40. 40 is the total of respondent, which is, 19 of contractors, 16 from engineering consultants, 3 project manager and 2 is a clients. And the total of percentage for both indicators is 100% for each.

-ve	%	+ve	%	P.I
1	-32.5	1	30	-2.5
2	-20	2	25	+5
3	-17.5	3	20	+2.5
4	-15	4	15	±0
5	-10	5	7.5	-2.5
6	-8	6	2.5	-5.5
	100		100	-3.0

Table 4.5.5 The performance Index based on the criterion delays and success indicator

From the results above, -3.0 is the final indicator for batch marking to performance index. If it is less than -3 it consider as fail and not perform well or nil. If it is more than -3, meaning that, the performance index for both indicators based on the project example at construction industry, still can considering pass and the project still can going well.

The ranking from the expert panel identified that the most important critical success indicators for construction industry are:

1. Financial-Profitability
2. Successful Tender rate
3. Communication
4. Development and management of a schedule
5. Good planning Project Manager
6. Involvement by key staff and resources

After reviewing the literature on the success indicators in the previous sections, several success criteria relevant to the above critical indicators for construction processes are identified and, listed as follows. Future research is suggested to investigate in detail the relevance of these criteria.

The ranking from the expert panel identified that the most important critical delay indicators for construction industry are:

1. Unrealistic project schedule by Project Manager.
2. Impractical design by designer
3. In availability appraisal, cost data used for estimating purpose
4. EOT and TOC
5. Poor leadership on part of the Project Manager
6. Too many scope changes

After reviewing the literature on the success indicators in the previous sections, several success criteria relevant to the above critical indicators for construction processes are identified and, listed as follows. Future research is suggested to investigate in detail the relevance of these criteria.

Delay Indicator	Percentage %	Checking	Success Indicator	Percentage %	Percentage %
Too many scope changes	-32.5	Yes	Effective Project Management	30	Yes
Impractical Design	-20	Yes	Effective Scheduling	25	Yes
Delay Eot & Toc	-17.5	Yes	Communication Skill	20	Yes
Viability Appraisal data cost	-15		Successful Tender Rate	15	
Unrealistic Schedule	-10		Management Involvement	7.5	
Poor Leadership	-8		Financial Management	2.5	
	100	-70		100	7.5

Table 4.5.6 Example Project at Shoplots/Cyberjaya

CHAPTER 5

CONCLUSION

5.1 Research Conclusion

The objective of this research is to identify the delay indicator that currently exist in the construction industry that most common and fundamental problems affecting project delivery performancet and. To identify the critical success indicator which is most influential in avoiding or preventing delay indicator and to construct performance index based on the criterion of delay and success indicators as, the most important critical element for construction project. This has been pursued through the examination of the relationship between the critical success indicators identified in the literature, and the delay indicators identified in the construction process. Six success indicators and delay indicator were chosen for further analysis to determine which of the critical success indicators had the most influence in avoiding the delay indicators, thereby addressing a gap in current research, and providing construction managers with information that could lead to more successful project delivery. Finally, six of the most influential success indicators were ranked by a panel of experts. These were identified as the most necessary success indicators to take into account when considering how to improve project performance in construction industry.

5.2 Study Conclusion

The research identified the delay indicators in the construction process for building construction projects in Shoplots Cyberjaya projects. Delay indicators which were identified are too many scope changes, impractical design and Delay in Eot Toc .

The similarity of several findings regarding delay indicators in this research compared to previous research findings from other developing countries confirmed that

project stakeholder in different developing countries face similar problems in spite of different natural, economic, political and social backgrounds. (Ogunlana and Olomaiye – 1989).

The difference is found in the priorities of the most important indicators for delay. This indicates that there are special problems that generate delays in construction in terms of the culture environment and political situation of the country.

5.3 Contribution of the research

The present study will contribute to the field by integrating knowledge about success indicators, as well as what is known about delay indicators. By learning which success indicators are perceived as most influential in avoiding or preventing delay indicators, this study can lead to better performance within construction industries. Although the research study resented here was based in Cuberjaya, it is anticipated that these results would be broadly applicable to other developing countries.

A unique strength of the present study, aside from being the first to investigate the relationship of critical success indicator identified in the literature, and delay indicators identified in building construction process, is that it collected data from clients, contractors, project manager, and engineering consultants on the correlation of the delay indicators and success indicators, based on their general experience. Consensus expert opinions were used to identify the most needed critical success indicates when considering how to improve project performance in construction industry.

Finally, this research can be used for further studies that examine critical success and delay indicators relationship. The identification of the success factors for the construction process investigated in this research formed an empirical study for further research on critical success indicators in the building construction industry.

5.4 Recommendation for future research

Future studies examining the effects of success indicators to avoid or prevent delay indicators in the construction industry should consider the following suggestions:

Further research needed to investigate potentia improvemnets in the implementation of project management systems in construction industry. The success indicators in this study can be used to investigztate this. Effecient project management would result in tangible outcomes for all aspects of planning, scheduling and monitoring control of time, cost and specification of projects. Implementing effiecient mangement methods will overcvome politicial, organisational and cultural obstacles.

The success indicators found to be most influential in this tsudy could be utilized in future work which examines different situations and environments. For example one could look specifically at industrical facilities or private sector projects. The same scientific methodology can be used to rank the correlation of the success indicators and delay indicators.

It is recommeded that the methodology used in this research should be applied to other countries, thereby increasing the data available for future comparisons of different delay causes and success indicators. This will identify the criteria of each of the success indicators for relevance and adaptability to develop and developing countries.

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APPENDIX A

Appendix A1- Letter of acceptance

DATO' ZULKEFLI BIN MOHD ZAIN
NO.6, JALAN P10 C/3, PRECINT 10, 62250 W.P.PUTRAJAYA

DCC/MVSB/LA-neocyber/13/01

8th July 2013

MECCA VENTURES SDN. BHD.
No. 4-2, Jalan 4/4C
Desa Melawati
53100 Kuala Lumpur
(Attn : En. Mohd Azizi Abdul Aziz)

Dear Sir,

CADANGAN PEMBANGUNAN BERCAMPUR YANG MELIBATKAN :-
PERINCIAN DARIPADA LOT KOMERSIL KEPADA 2 UNIT KEDAI PEJABAT DI ATAS LOT 44028, NEOCYBER, PERSIARAN CYBER POINT SELATAN, CYBER 12, MUKIM DENGKIL, DAERAH SEPANG, SELANGOR DARUL EHSAN
- Letter of Acceptance

We are pleased to inform you that **DATO' ZULKEFLI BIN MOHD ZAIN** has agreed to appoint your company as the Contractor for the above mentioned works for the sum of **Ringgit Malaysia : TWO MILLION ONLY (RM 2,000,000.00)** with fixed completion period of **TWELVE (12)** months.

The salient points on the terms and conditions of your appointment are as follows :-

1. **Contract Agreement**

   You will be required to execute in due course a formal Contract Agreement. However, until the formal Contract Agreement is executed, your tender together with this Letter of Acceptance shall constitute as binding contract between your company and **DATO' ZULKEFLI BIN MOHD ZAIN**

   You will be informed when the Contract Documents are ready for your signature. However, before the signing of the Contract Document, your prices and the rates in the Bills of Quantities shall be scrutinized and adjusted as to their reasonableness but the Contract Sum as mentioned shall remain unaltered.

2. **Site Possession and Date of Completion**

   The Date of Possession of Site and the Date of Completion shall be the date to be determined and agreed upon by both parties.

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Source : Project Shoplots Cyberjaya Development.

APPENDIX B

Appendix B1- Construction Programme

3. Construction Programme

Within two (2) weeks from the date of possession of site you are to submit two (2) copies of a detailed Work Programme in the form of bar-chart. The Work Programme shall be sufficiently detailed to permit week-by-week comparison between the work activities as programmed and the actual progress of works. The Work Programme shall incorporate all activities involved in the construction, completion, testing and commissioning of the works including all temporary works, procurement and works under prime cost and provisional sums included in the contract.

4. Condition Precedent

As a condition precedent to the commencement of the Works, you are required to deposit with Dato' Zulkefli Bin Mohd Zain the following:

a) Insurance of Workmen's Compensation for the amount equivalent to ten percent (10%) of the Contract Sum. The period of coverage shall be the Contract Period plus twelve (12) months Defects Liability Period.

b) Contractor's All Risk Policy that cover for the full value of the Works and an amount of 5% to be added to cover for Professional Fees and to produce for inspection the receipt for premium paid. The period of coverage shall be effective from the Date of Site Possession until the Scheduled Date of Completion plus Twelve (12) months Defects Liability Period.

No work under this Contract shall commence unless and until you have complied with the above provisions.

6. Liquidated and Ascertained Damages

Any delay in completion shall be subjected to a Liquidated and Ascertained Damages of **Ringgit Malaysia : THREE HUNDRED ONLY (RM 300.00)** per day.

7. Mode of Payment

Payment shall be made upon completion of the works as certified by the Architect as follows:-

a) Period of Honouring Certificate
30 days from the date of receipt of Architect's Certificate

b) Percentage of Certified Value Retained
10% of the Value of Works done and up to limit of 5% of Contract Sum.

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APPENDIX C

Appendix C1- Cost Breakdown

CADANGAN PEMBANGUNAN BERCAMPUR YANG MELIBATKAN : PERINCIAN DARIPADA LOT KOMERSIAL KEPADA 2 UNIT KEDAI PEJABAT DI ATAS LOT 44028, NEOCYBER, PERSIARAN CYBER POINT SELATAN, CYBER 12, MUKIM DENGKIL, DAERAH SEPANG, SELANGOR DARUL EHSAN

COST BREAKDOWN :-

ITEM	DESCRIPTION	AMOUNT (RM)
A	**Building Works (including Piling Works)**	
	i. Piling	295,500.00
	ii. Work Below Lowest Floor Finish	147,370.50
	iii. Frame	144,020.00
	iv. Upper Floor	106,787.60
	v. Roof	97,622.80
	vi. Staircase	63,446.30
	vii. External Wall	44,296.90
	viii. Internal Wall	41,283.10
	ix. Doors	51,649.60
	x. Windows	73,350.00
	xi. Internal Wall Finishes	91,859.10
	xii. Internal Floor Finishes	19,070.00
	xiii. Internal Ceiling Finishes	32,060.40
	xiv. External Finishes	91,023.40
	xv. Sanitary Fittings	23,610.30
	xvi. Builder's Works in Connection with Services	6,650.00
	Sub-Total Building Works :	**1,329,600.00**
B	**Mechanical and Electrical Services**	
	i. Internal Electrical & Telephone Installation	62,100.00
	ii. Cold Water Supply	47,100.00
	iii. Soil and Waste System	47,100.00
	iv. External Mechanical and Electrical Works	22,100.00
	Sub-Total Mechanical and Electrical Works :	**178,400.00**
C	**External Works**	
	i. Site Clearance	3,000.00
	ii. Bin Compartment	5,000.00
	iii. Sewerage Reticulation	13,000.00
	iv. Water Reticulation	14,300.00
	v. Interlocking Paver	16,500.00
	vi. Surface Water Drainage	15,000.00
	x. Make Good Existing Kerb	18,200.00
	x Landscape	25,000.00
	Sub-Total External Works :	**110,000.00**
D	**Provisional Sum**	
	i. Professional Fees	100,000.00
	ii. Local Authorities Charges	50,000.00
	iii. Site Supervisor	50,000.00
	Sub-Total Prime Cost Sum and Provisional Sum :	**200,000.00**
	Total Building, Mechanical and Electrical Services and External Works :	**1,818,000.00**
E	**Preliminaries** @ Say	**182,000.00**
	TOTAL ESTIMATED COST :	**2,000,000.00**

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APPENDIX D

Appendix D1- Lack of Design drawing