CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

This chapter highlights the main issues arising from the refurbishment projects in Singapore. The construction industry in Singapore has undergone transformation in the past ten years. The construction 21 report, which was launched in 1999, had been a blueprint for developing the construction industry in Singapore (Singapore Construction Prospects, 2011). The local construction industry is of a fragmented nature, with numerous small firms. According to BCA's last survey in 1999, there are 13,909 contracting firms in the industry. Of these, more than 70% of the firms have a paid-up capital of less than $ US 0.19 million and an annual turnover of less than $ US 0.39 million. According to BCA's last survey on construction prospects 2011 Singapore, about $ US 0.62 Billion used for upgrading works which is refurbishment projects (Singapore Construction Prospects, 2011).

With most of the physical infrastructure and buildings already in place and the economy entering into the mature stage, the Singapore construction sector is expected to shrink in size. Construction orders are projected to average between $ US 9.32 billion and $ US 11.64 billion per year for the next 10 years. There is a sharp decline from its peak in 1997, which saw total construction demand at $ US 18.94 billion.

The vision for the construction sector in Singapore is to develop into one which will encompass all aspects of the construction value chain, from design to construction to maintenance. The overall vision will have a place for both the big and small players. The economic reality demands that Singapore has world-class winners, with the size,

range and expertise to compete against international players. At the same time, the increasing economic uncertainty warrants that firms are kept lean and nimble, outsourcing where possible in particular specialization or disciplines.

In the remaking of the construction sector, it is envisaged that a few global sized firms, supported by a network of smaller niche specialists, will emerge to take advantage of the global export opportunities. The Construction Working Group proposes a target of 15% of our overall construction demand to be driven by exports in 5 years' time, about $ US 1.55 billion.

The top three recommendations proposed affect to restructuring the industry, upgrading local capabilities through innovation and better skills, and increasing economic pie by venturing overseas.

Singapore continues to face challenges ahead in the efforts to transform the construction industry into one that is professional, productive and progressive. The local industry is very fragmented, with numerous small firms.

According to Ofori, G., Evelyn.T. & Tjandra, I (2011), the construction 21 (C21) report, completed in 1999 has 39 recommendations under 6 strategic thrusts to help achieve the vision of making the industry "a world class builder in the knowledge age. The C21 initiatives focus mainly on transforming the construction industry into knowledge and high-value added industry in the local context, with the aim to:

i. Enhance professionalism of the industry
ii. Raise skills level of workers

iii. Improve industry practices and techniques

iv. Adopt an integrated approach to construction

1.1 PROBLEM STATEMENT

Refurbishment in this study is defined a work on existing building that comprises rehabilitation, modernization, renovations, improvements, adaptation, additions, repairs, renewal and retrofitting; carried out on existing building excludes routine maintenance and cleaning work (Young et al., 1996). Refurbishment project is one of the most risky, complex and uncertain within the construction industry (Egbu et al., 1996; Rahmat, 1997; Rayers and Mansfield, 2001; Ali et al., 2008).

Refurbishment sector is one of the most important sectors in many developed countries such as in Singapore. This sector is becoming an important economic driver in the Singapore construction industry due to existence of high number of ageing buildings and the rapid changes of technology used. However, in recent years, the industry has seen a tremendous increase in the value of refurbishment projects in Singapore.

Refurbishment project is one of the most uncertain among the construction projects (Quah, 1988; Egbu 1997). Okoroh (1992) pointed out that the insufficiency of specification from the architects makes it hard for contractors to classify the scope of work for each element of construction. Boyd and Weaver's (1994) study, titled, "Improving the Management and Operations of Refurbishment Projects' provided evidence that refurbishment projects have more cost and time over-runs than new build projects.

According to Ofori, G. (2005), the level of construction productivity in many countries especially in Singapore has been found to be lagging behind those of other sectors of the economy. According to Economic survey of Singapore (Second quarter 2010), overall performance of economy growth in Singapore showing good results. Government has put in effort in improving the performance of construction sector in Singapore. According to Ofori, G. (2005),, total factor productivity (TFP) is the most comprehensive measure. According to (Mao Zhi; etc, 2002), long-term economic growth is determined by to total factor productivity (TFP) and is defined as a comprehensive industry level productivity measure. From the research done on the estimate TFP growth in the construction industry of Singapore over 1984-1998, TFP in the construction industry is found to be lag behind the rest of economy as the growth went down by 1.53% per annum over this period (Mao Zhi; etc, 2002). Low productivity of construction projects relates to time performance of construction projects. Delays and cost overruns are evidently frequent problems in the construction industries of many developed and developing countries. So, there is a need to have a research to be done on the performance of construction projects. One of reasons contributed to this problem is increase in the physical size of the structure that to be refurbished (Ali, 2008).

The construction has been criticized for its underperformance (Lee et al., 2000; Kagioglou et al., 2001; Smith, 2001). Many researchers highlighted on the importance of embracing the performance measurement methods to improve the current performance of construction industry (Latham, 1994; Egan, 1998). Lin and Shen (2007) concluded that the relevant papers published in regards to performance measurement in construction have greatly increased in recent years. They attributed this increase to

rapid development of application of performance measurement methods in other sectors; the increasing complexity of construction projects; the development of both management and technology in construction. Performance measurement in construction has gained more attention especially time performance.

Project delay is a problem confronting the refurbishment projects in Singapore. The problem can be considered as acute as it had been tabled as lowest productivity sectors in Singapore by the statistic of Monetary Authority of Singapore. George Ofori (2005) pointed out that the major causes of low construction productivity are delays due to compliance with regulations, errors in design, poor worker skills, rework to rectify defects, inadequate pre-project planning, and changes in design. This renders further investigation to be conducted on factors affecting time performance of refurbishment projects in Singapore.

1.2 OBJECTIVES OF THE STUDY

The aim of this study focused on an investigation of factors that affect time performance of refurbishment projects and how they affect the project performance. Therefore, in order to meet this aim, the three research objectives have been formulated as follows:

1. To study on the current condition of time performance of refurbishment projects in Singapore.
2. To identify the factors that affecting time performance during the construction stage of refurbishment projects in Singapore.

   To establish a prediction model on time performance based on identified factors.

1.3 SCOPE AND LIMITATION OF STUDY

Limitations ensure that the research could be covered within the limited time of study. The study set out to examine the effect of complexity variables identified towards time performance of refurbishment projects. Potential solutions needed to be came out to overcome the problem of time performance in refurbishment projects.

The study has been limited to refurbishment projects in Singapore that cover renovation, rehabilitation, restoration, adaptation, conversion, modernization, upgrading and retrofitting works. The study excludes routine maintenance and cleaning works.

In this study, the data will be obtained from all contractors in Singapore, who are registered with the Building and Construction Authority. Respondents of the survey are the project managers who have experience in handling refurbishment projects. The size of refurbishment projects involved based on the contract value, of more than $US 193,350.00. This would provide better view of the uncertainty aspects that affect the time performance of refurbishment projects.

The method of procurement used for the selected refurbishment projects are either traditional or design-and-build. Semi-structured interview results will be used to show the majority of procurement method used by refurbishment project in Singapore. Different types of procurement methods would demonstrate different degree of involvement and participants in a project.

1.4 THE BENEFITS OF THE STUDY

The study contributed knowledge to the issue of delay in the refurbishment projects. There are significant numbers of literature related to the time performance of refurbishment in other countries but only limited numbers of writing specifically dealing with construction delay of refurbishment projects in Singapore. Outcomes from this study are expected to benefit contractors, educators and clients involved in refurbishment work. Identifying the factors contribute to the time performance of refurbishment projects is an initial step in order to find out the appropriate solutions.

This study contributed in the following manner:

- This study analyzed the current level of time performance for refurbishment projects in Singapore and variables that affecting them. Having this identification of variables assisted contractor to have better control of them and help in minimizing the occurrence of delay.
- This study would help to define contractors' roles in delivering good performance for refurbishment projects.
- An overview of reasons for delays based on bringing together the views of different practitioners directly involved in the refurbishment projects and it could provide a wider perspective on the problems.
- This study could contribute to academic organizations, professional bodies and contractor by integrating into the body of knowledge for delivering a complete and accurate design in refurbishment projects.

1.5 THE STRUCTURE OF THE RESEARCH

The summary of the remaining chapters is presented below.

Chapter 2 discusses the general overview of refurbishment industry in Singapore and other countries. It also discussed about the definition of refurbishment, the criteria to success in refurbishment projects and types of delay. At the end of the chapter, the different forms of contract are used to describe the excusable factors in extension of time.

Chapter 3 reviews the literature on the factors affecting to time performance of refurbishment projects. There are nine grouped factors from the literature review such as finance, contractor, designer, client, contractual, skilled labor, material, site, and external related factors.

Chapter 4 explains the research methodology employed in this study. The chapter describes on research design of the study, which uses a quantitative technique. In also includes the methods used for data collection, the selection of respondents, the limitation of the study and the data transformation which is statistical analysis tool that were used during the analysis of the final data.

Chapter 5 presents the findings from the data collection process and discusses their implications. The result of the final questionnaire is described followed by the time performance of the refurbishment projects in Singapore.

Chapter 6 focuses on the correlation tests and discusses their implication. The testes employed non-parametric method, which are Spearman and Kendall tau-b correlation coefficients. It also discusses the reliability scale test and regression model of refurbishment project and its validity.

Chapter 7 presents the overall summary of the objectives, each chapter. The chapter also includes the conclusions and recommendations of the study. The recommendations for the study are derived from the results of the final data analysis. This research also suggests some potential research, which could be concluded in the future, arising from the results of the study.

1.6 SUMMARY

This chapter has highlighted the main issue of the study which is the time performance of refurbishment projects. This chapter includes the scope and limitation of the study and the objectives of the study. Three research objectives were formulated which are investigated in the whole study. This chapter also described the benefits of having this study as it is identified as being the first conducted in Singapore to investigate this problem.

The following chapter, Chapter Two will be discussing the general overview of refurbishment construction industry, types of delay and condition of contracts that related to extension of time.

CHAPTER 2

LITERATURE REVIEW: GENERAL OVERVIEW OF REFURBISHMENT CONSTRUCTION INDUSTRY AND PROJECTS DELAY

2.0 INTRODUCTION

Refurbishment sector is one of the most important sectors in many developed country like Singapore. Refurbishment is becoming an important sector in Singapore Construction Industry as the existence of high number of ageing buildings and rapid changes of technology used. The number of refurbishment projects has been increasing over the last ten years. Ali et al; (2008) described refurbishment projects are in high demand mainly due to the increase number of building physical improvement, extension, and extensive repair works. However, refurbishment projects are more difficult to manage compared to new built projects. Refurbishment is uncertain among the construction projects (Quah, 1988). Majority of refurbishment projects completed with overestimated time and budgeted cost (Ali et al, 2008). Therefore, the identification of factors that contributes to the time performance of refurbishment is required to improve the productivity of construction in Singapore.

A study by the Building Research Establishment (BRE, 2002) has looked at the relative sustainability of refurbishment versus redevelopment. It found that generally, refurbishment solutions are lower both in environmental impact and whole-life costs (over 60 years) compared to comparative redevelopments. The exception was when significant low-energy features, such as natural ventilation, could not be brought into the existing building but built into a new development. In such a case, the

environmental impact of redevelopment can be lower than refurbishment, with the whole-life costs being more-or-less equal.

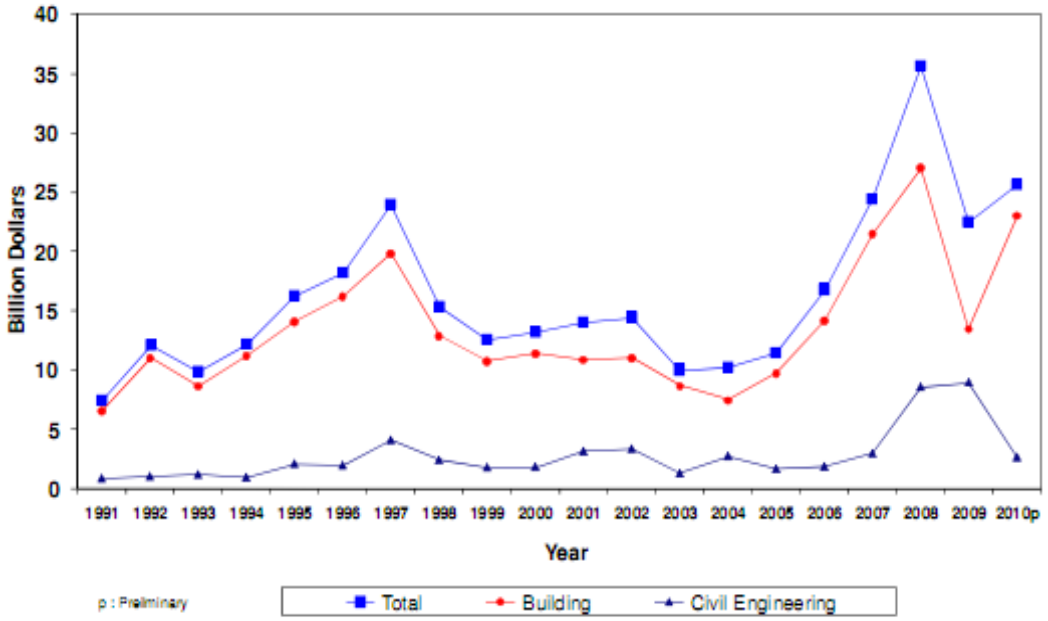

Figure 2.1: Construction Demand in Singapore

Sources: Singapore Construction Prospect (2011)

Quah (1988), Rahmat (1997) and Rayers and Mansfield (2001) stated that refurbishment projects are basically more uncertain than newly built projects. Within the construction industry, refurbishment project has the most uncertainty (Ali, 2008; Quah, 1988). Cost and time variances are always the result of performance for refurbishment projects. Uncertainty of design process could affect the performance of refurbishment projects (Rahmat, 1997). Performance of a project can be related to time, cost and quality. Toufic, M.M. & Wissam. T (1998) listed the effect of delays on time, cost and quality. However, research on performance projects is still lacking. This chapter therefore identifies variables that are appropriate to use in the measurement of time performance.

2.1 DEFINITIONS OF REFURBISHMENT

Quah (1988) argues that "refurbishment" in particular has become a generic, interchangeable term, indistinguishable from other specialist activities. The term cannot be considered as simple meaning, but has become multi- faceted. Many definitions of refurbishment have been used by researchers and professional bodies. The Chartered Institute of Building (CIOB) (1987) defined refurbishment as the work carried out to modernize the existing building while remaining its current usage.

Egbu (1996) considers "refurbishment" to encompass rehabilitation, alteration, adaptation, extension, improvement, modernization and repair work carried out on an existing building to permit its reuse for various specific reasons.

Generally, refurbishment is described as renovation, rehabilitation, extension, improvement, conversion, modernization, fitting out and repair which is undertaken on an existing building to permit its reuse for various specified purposes (Young and Egbu's, 1993).

Refurbishment refers to upgrade, major repairs work, renovations, alterations, conversions, extensions and modernization of existing building, but exclude routine maintenance and cleaning work (Quah, 1988). Compared to other projects, refurbishment is more risky, complex and uncertain in the construction industry (Ali. S.A, Syahrul N. K & Salleh, H. , 2009).

The chartered institute of building in its code of estimating practice supplement number one defines "refurbishment and modernization" as "The alteration of an existing

building designed to improve the facilities, re-arrange internal areas, and/or increase the structural lifespan without changing its original function."

Marsh (1983) defined refurbishment as making use of usable ageing building stock. It involves skillful adaptation of building shells to an updated version of its existing use. The Chartered Institute of Building (CIOB) (1987) defined refurbishment as a work carried out in existing building, it is designed to improve it by using modern standards but at the same time retaining its current usage.

Following this definition, refurbishment work can be generally classified into the following:

1. Alteration –this is work carried out to change the structure of a building to meet new requirement, e.g. changing the internal layout of a building.
2. Adaptation –this is work carried out to accommodate a change in use of a building.
3. Extension-this is work carried out to increase the floor area of a building which includes both horizontal and vertical extensions.

2.2 THE CRITERIA TO SUCCESS IN REFURBISHMENT PROJECTS

Long, al et, (2004a) stated that a construction project is considered successful when it is completed on time and within budget, according to the specification of the stakeholder. Functionality, profitability to contractors, absence of claims and court proceedings and "fitness for purpose" for occupiers, has also been used as measures of project success (Takim and Akintoye, 2002). Sanvido et al (1992) defined that success on a project means that certain expectations for the project team are met.

Sanvido et al (1992) defined project success to be exceeded expectation when compared to the outcome and this is normally observed in terms of cost, schedule, quality, safety, and participant satisfaction.

Definition of project success:

"Project success is frequently discussed and yet rarely agreed upon. The concept of project success has remained dubiously defined. It is a concept which can mean so much to so many different people of varying perceptions, and leads to disagreements about whether a project is successful or not" (Liu and Walker, 1998). Although there are many researchers discussing on the topic of project success, but this section will definitely define a broader set of outcome.

Project success can be defined as achievement of intended outcomes in terms of specification, time and budget. It is recognized that a broader set of outcome measures is generally needed (Erling S.A. et al, 2006).

Munns and Bjeirmi (1996) use the concept of project management success. They emphasized on the cost, time and quality objectives and the quality of the project processes or work. These three criteria are the successful outcome and benchmark for the success of a project management. Baccarini (1999) stated that the criteria for measuring project success must be from the beginning, otherwise team members will find themselves heading towards different directions and some of them might even have a wrong perception that the project had failed. He divided project success into two categories, which are project management success and product success. The project success is measured by its cost, time and quality whereas the product depends on its effects. According to Baccarani (1999), the time success can be considered as schedule time or under/overrun, as a percentage of the initial plan. Cost success can be measured

by budget cost or under/overrun, as a percentage of the initial budget. For product success, project goals, project purposes and client needs have to be met.

According to Andersen et al, (2006), success criteria will identify the immediate short term, predefined project goals (completion on time and to budget) as well as the long term contribution to "organizational health" in the form of strategic success, personal success and captured experience. He stated that three project success scales were adapted to cover managerial ability to deliver, project impact and captured experience.

The common thing about clients in the construction industry is that they would want their constructed facilities to be valued for money. The client defines value as time; cost and quality performance and these are the measurements of project success (Meng, 1994).

Westerveld (2003) developed a Project Excellent Model that connects project success criteria and critical success factors into one coherent model which can help to improve the project performance. This model focused on 12 areas of managing a project; project results (budget, schedule and quality), appreciation by the client, appreciation by project personnel, appreciation by users, appreciation by contracting parties, appreciation by stakeholders, leadership and team, policy and strategy, stakeholder management, resources, contracting, and project management (scheduling, budget, organization, quality, information and risks).

Dvir et al. (2003) states that project success could be defined through achievement of three different criterias; meeting planning goals, end user benefits and contractor benefits. Dvir et al. (2003) considered planning as the central element for modern

project management, which can help in the problem of uncertainties and create good project success.

2.3 TYPES OF DELAY IN REFURBISHMENT PROJECTS

According to Singapore International Arbitration Centre, there are a few different perspectives on the definition of delay for contractors and owner. For the owner, delay is when the building cannot be used when it is supposed to, or a delay in receiving income from the asset. The cost of project could increase and this depends on the contractual allocation of risk, the event of delay and the delay that caused the increase in claim by contractor. For the contractor, delay means an increase in overheads such as manpower, resources and facilities, and depending on the reason of delay. Within the construction industry, refurbishment project has the most uncertainty (Ali, 2008; Quah, 1988). Changes in design process will be confined to the planning stages. However, late changes often occur during construction, causing serious disruption to the project (Cameron et al, 2004). Great concern has been expressed in recent years regarding the adverse impact of variations to the construction projects. Uncertainty of construction stage could affect the performance of refurbishment projects (Rahmat. I, 1997). Performance of a project can be related to time, cost and quality.

The major problem faced by management of refurbishment projects is to determine the appropriate level of involvement of various parties at the different stages of the design process (Ali et al., 2008). It contributes to uncertainty in design process which may lead to time delay in the refurbishment project. Lieshmann (1991) presented the consequences of delays in construction, especially from the legal point of view.

Therefore, the identification of factors contributing to time variance in design process of refurbishment is required.

Chalabi and Camp (1984) discussed causes of building project delays in developing countries during the pre-planning and construction stages. These authors found that adequate planning at the very early stages of the project is important for minimizing delay and cost overruns in most projects in developing countries. Delay is generally acknowledged as the most common, costly, complex and risky problem encountered in construction projects. Because of the overriding importance of time for both the owner (in terms of performance) and the contractor (in terms of money), it is the source of frequent disputes and claims leading to lawsuits. Delays occur in every construction project and the magnitude of these delays varies considerably from project to project. Some projects are only a few days behind schedule; some are delayed by over a year. So it is essential to define the actual causes of delay in order to minimize and avoid delay in any construction project (Ahmed et al., 2003).

Study into literature shows that delay can generally be classified into two broad categories (Kriem and Diekmanm, 1987; Scott, 1997; Yogeswaran et al., 1998; and Williams, 2003). They are stated as follows: Excusable delays that lead to claims for delays and non-excusable delay.

2.3.1 EXCUSABLE DELAYS THAT LEAD TO CLAIMS FOR DELAYS

Apart from affecting the completion time, delays can cause other problems on the construction projects. The problems in turn will cause further delay in the completion time. Those delays are not due to contractor's actions or inactions and include

unforeseen events. The events should be out of contractor's control without negligence on their part. Contractor is entitled to a time extension if the completion date gets pushed back. Excusable delays can be classified into compensable and non-compensable delays:

i) Excusable compensable delays are mainly caused by the action and inactions of owner. Contractors are entitled to a time extension as well as monetary compensation if the project faces excusable compensable delays.
ii) Excusable non-compensable delays are caused by unprovoked strikes or any "act of God", so owner and contractor are deemed responsible for it.

The claim is a tool used by contractor to request more time or money. Jergeas and Hartman (1994) and Othman (2006) identified the following reasons for claims:

- Increase in scope of work(changes, errors)
- Inadequate bid information
- Faulty and/or late owner supplied equipment and material
- Low-grade drawings and/or specifications, increase to indistinctness in contract documents requirement
- Insufficient time for bid-preparation
- Work in congested area and overcrowding
- Inadequate investigation before bidding
- Underestimation

A questionnaire survey conducted by Kumaraswamy (1997) involving clients, consultants and contractors in Hong Kong indicated that the top ten reasons of construction claim were:

- Variations due to site conditions
- Variations due to clients changes
- Variations due to design errors
- Unforeseen ground conditions
- Ambiguities in contract documents
- Variations due to external events
- Interference with utility lines
- Exceptionally inclement weather
- Delayed site possession
- Delayed design information

Kumaraswamy (1997) concluded that many disputes can be connected to claims. The recommendation was given to mitigate the problems are collaborative working, teamwork and partnership.

2.3.2 NON-EXCUSABLE DELAYS

Delays are mainly due to contractors and sub-contractor's actions or inactions. As a result of delay, contractor and sub-contractor are not entitled to any time extension or delay damages. However, owner could be entitled to liquidate damages.

Concurrent delays refer to delay situations when two or more delays occur at the same time and would affect the ultimate completion date (Rubin, 1983). Generally, overlapped delays which involve two or more excusable delays will result in a time

extension. When compensable and non-excusable delays are concurrent, a time extension can be issued or the delay can be divided up between the owner and the contractor.

From the analysis of concurrent delays, each delay is assessed separately and its impact on other activities as well as the project duration is calculated. Rubin (1983) suggested the following guidelines for classifying these kinds of concurrent delays:

1) If excusable and non-excusable delays occur concurrently, only a time extension is granted to the contractor.
2) If excusable compensable and excusable non-compensable delays occur simultaneously, the contractor is entitled to time extension, but not to damages.
3) If two excusable compensable delays occur concurrently, the contractor is entitled to both time extension and damages.

The guideline is used to analyze delay and to come to an agreement with all parties involved in a construction by using contract language. Generally, the excusable causes are listed in a clause in the contract and are entitled for extension of time. In the following section, we will then look into problems arising from delays.

2.4 CLAUSES FOR EXTENSION OF TIME UNDER DIFFERENT FORMS OF CONTRACT (GENERAL)

It is important to make comparative analysis on clauses of extension of time (EOT) under different forms of contract. The sole purpose of this section is to look into what is considered as excusable causes of delay by different forms of contract. The claims for extension of time have been a common source of disputes and the purpose of such

claims is to avoid liquidated damages or to establish an entitlement to extra payment. Yogeswaran et al. (1998) conducted a study on 67 completed civil engineering projects in Hong Kong public sector and found out that 85% or 57 of the projects overran the contract period while only 3% (2 projects) finished on time and 12% (8 projects) completed on time. About 76% of the projects which were delayed are excusable while 20% of the projects were due to non-excusable delays. Major categories of claims for extension of time granted were found to be inclement weather, variation orders and delays caused by utility undertakings. In most of cases (82%), the claims for extension of time were due to inclement weather. Each of the other causes listed above had less than 20% occurrence as shown in Table 2.1.

Table 2.1: Occurrence of EOT Claims in Hong Kong based on 57 projects
Source: Yogeswaran et al. (1998)

Code	Description	Number of projects in which EOT was granted	Percentage of projects in which EOT was granted (%)	Frequency Ranking
TC1	Inclement weather	47	82.46%	1
TC2	Hoisting of storm signal No.08 or above	15	26.32%	3
TC3	Instruction to resolve discrepancy	3	5.26%	6
TC4	Variation order	28	49.12%	2
TC5	Substantial increase in quantities	9	15.79%	5
TC6	Delayed possession of site	10	17.54%	5
TC7	Disruption of workers by employer of engineer	4	7.02%	6
TC8	Suspension of work by the employer	2	3.51%	7
TC9	Delay by utility undertaker	13	22.81%	4
TC10	Delay by nominated sub-contractor	1	1.75%	7
TC11	Other special circumstance	10	17.54%	5

2.4.1 CONTRACT ADMINISTRATION GUIDE TO SINGAPORE INSTITUTE OF ARCHITECTS (CONDITIONS OF BUILDING CONTRACT: 9th EDITION)

The 9th Edition of the Articles and Conditions of Building Contract was published by the Singapore Institute of Architects (SIA) in 2009 and is the only standard form widely used in the traditional procurement of private sector projects.

Clauses 23 specify the relevant event causing delays that the contractor may be given a reasonable extension of time as below. The contract period and the date for completion may be extended and recalculated, subjected to the compliance requirements of the next following sub-clause by the Contractor by such further periods. Such further dates may reasonably reflect any delay in completion which, notwithstanding due diligence and the taking of all reasonable steps by the Contractor to avoid or reduce the same, has been caused by:

a) Force majeure
b) Exceptionally adverse weather conditions.
c) Fire storm, lightning, high winds, earthquake or aircraft or aerial objects
d) War, hostilities, insurgency, terrorism, civil commotion, or riots.
e) Industrial action by workmen, strikes, lock-outs or embargoes affecting any of the trades employed upon the works.
f) Compliance of architect's instructions.
g) Contractor not receiving due necessary instruction, drawings, details or levels from the architect.
h) Delays due to shortage of labor resulted from domestic or foreign government actions to ensure completed work on time.
i) Delays due to shortage of goods or materials resulted from domestic or foreign government actions.

j) Any act of prevention or breach of contract by the employer

k) Any other ground for extension of time expressly mentioned in the contract.

2.4.2 CONTRACT ADMINISTRATION GUIDE TO REDAS (DESIGN AND BUILD CONDITIONS CONTRACT: 3rd EDITION)

The 3rd Edition of the Articles and Conditions of Building Contract was published by the Real Estate Developers' Association of Singapore in 2011 and is the only standard form widely used in the design and build of private sector projects.

According to clauses 16 (Grounds for Extension of Time), the contractor may apply to the Employer's Representative for a time extension for any delay after the Date of Completion by any of the following causes:

a) A variation

b) A force majeure event

c) Any act of prevention, breach of contract, delay or impediment caused by employer

d) Ant other ground for extension of time expressly mentioned in the contract documents.

e) Suspension of the works.

A force majeure event can be defined as below:

a) Exceptionally adverse weather conditions

b) Fire, storm, lightning, high winds, earthquake or aircraft or aerial objects (provided and to the extent that any of the same are not due to any act, negligence, default, omission or breach of contract by the contractor.

c) War, hostilities, insurgency, terrorism, civil commotion or riots.

d) Industrial action by workmen, strikes, lockouts or embargoes affecting directly the Works

2.4.3 PUBLIC SECTOR STANDARD OF CONTRACT FOR CONSTRUCTION WORKS

The time within which the works or any phase or part of the Works that is to be completed may be extended by the Superintending officer either prospectively or retrospectively before or after the Time for Completion by such further period or periods of time as may reasonably retrospectively and before or after the Time for Completion by such further period of time. It may reasonably reflect delay in completion of the Works which, notwithstanding due diligence and the taking of all reasonable steps by the Contractor to avoid or reduce such delay, will or might be or has been caused by any of the following events.

a) Force majeure

b) Exceptionally adverse weather conditions the assessment of which shall be in accordance with the relevant provision in the Specifications.

c) Industrial action by workmen, strikes, lock-outs or embargoes affecting any of the trades employed upon the Works or in the preparation, manufacture or transportation of materials or goods required for the Works and provided the same are not due to any unreasonable act or default of the Contractor or any of the subcontractor. Provided that this event shall only apply if the industrial action by workmen, strike, lock-out or embargo causing the delay is in Singapore.

d) One or more of the “excepted risks” referred to in clauses 25.2

e) Compliance with the requirement of any law, regulation, by-law or public authority or public service company as stipulated in Clause 7.1

f) Fire, storm, lightning, high winds, earthquake or flooding.

g) Ordering of test by the Superintending Officer which is not provided by the Contract pursuant to Clause 10.4 and the uncovering or making openings for inspection of any work pursuant to Clause 10.6, unless the test or inspection showed that the plant, materials, goods or workmanship had not been in accordance with the provisions of the Contract.

h) The issue of any instruction for a variation.

i) The issue of an instruction by the Superintending Officer in relation to a Provisional Sum Item but only if and to the extent that such instruction gives rise to a variation of the work described under the Provisional Sum Item.

j) Failure of the Employer to give possession of the Site or any part of the Site to the Contractor in as required by Clause 12.2.

k) Subject to Clause 13.1(2) an instruction by the Superintending Officer to suspend any work.

l) The Contractor not having received from the Superintending Officer within a reasonable time necessary Drawings, instructions or other information in regards to the Works for which notice has been given by the Contractor in accordance with Clause 3.4.

m) Acts or omissions of other contractors engaged by the Employer in executing work not forming part of the contract.

n) Any act of prevention or breach of contract by the Employer not mentioned in this Clause.

o) Any search instructed by the Superintending Officer under Clause 18.4 and such search reveals any defect, shrinkage or other fault for which the Contractor is not liable.

p) Adverse physical conditions which fall within Clause 5.2.

q) Any other ground for extension of time expressly mentioned in the Contract and not mentioned in this Clause 14.2.

Provided always that the Contractor shall not be entitled to any extension of time where the instructions, or acts of the Employer or the Superintending Officer are necessitated by or intended to cure any default of or breach of Contract by the contractor and such disentitlement shall not set the Time for Completion at large.

2.4.4 SUMMARY ON CONDITIONS OF CONTRACT

Reviewing the clauses ruling extension of time from different types of conditions of contract bring to the conclusion as stated:

(i) To preserve a defined time for completion.

(ii) To preserve the employer's right on liquidated damages.

(iii) To keep hold on the contractor's entitlement to claim for extension of time if the work is delayed due to statement in condition of contract.

(iv) All forms of contract require contractor to put in enough evidence and prove that they have taken all possible and necessary action to prevent delay during construction stage. On top of all, contractor fulfills all reasonable requirements by superintending officer. There is an authority for superintending officer or architect to grant a reasonable extension of time. It can be concluded that the contractor is entitled to reasonable extension of time due to delays caused by excusable factors.

Table 2.2: Possible reasons behind the use of EOT Clauses in refurbishment

Source: Othman (2006)

Clauses	**Possible reasons**
Force Majeure	Fire, flood, earthquake, storm, hurricane or other natural disaster), war, invasion, act of foreign enemies, hostilities (regardless of whether war is declared), civil war, rebellion, revolution, insurrection, military or usurped power or confiscation, terrorist activities, nationalization, government sanction, blockage, embargo, labor dispute, strike, lockout or interruption or failure of electricity or telephone service
Exceptionally inclement weather	Excessive rainfall Bad weather Flooding High tide Site under water
Direction given by S.O. Consequential upon disputes with neighboring owners	Problem with local people Squatters problem Interference from neighboring people Difficulty in getting permission to use private road as an access to site
SO's instructions	Variation order Additional works Changes in design
Late in receiving instructions/drawing	Awaiting consultant decision Late in giving approval for change in design Changes in design Delay caused by other agencies
Late in giving possession of site	Delay in possession of site Squatters problem
Delay by other parties engaged by government	Delay in relocating of services Delay in upgrading telecommunication man-hole Delay caused by nominated supplier Delay in getting electrical supply Pending commissioning works
Inability of contractor for reason beyond his control	Delay in electrical supply Difficulty to get generator set for commissioning Fire happen to factory manufacturer for material

2.5 SUMMARY

This chapter has highlighted the general overview of refurbishment industry. It discussed the current refurbishment demand in Singapore, definitions of the refurbishment, the stages of project development, and the criteria to success in refurbishment projects. Types of delay in refurbishment projects were discussed into excusable and non-excusable delays. It also reviewed excusable causes of delay by different forms of contract such SIA, REDAS, PSSCOC. The following chapter, Chapter Three starts with discussion on time performance and nine main factors affecting their delays.

CHAPTER 3

LITERATURE REVIEW: TIME PERFORMANCE

3.0 INTRODUCTION

Construction delay is beyond the control of contractors or clients. Delay can be categorized as excusable, non-excusable, compensable and concurrent. Baldwin et al in 1971 studied on causes of delays confronting the construction industry in the US and it can be considered as the fundamental research in construction delays, many authors to do same research have referred it.

Delays in completion of projects are a problem that faced by construction and engineering projects (Pickavance, 2005). A study conducted by Nuhu and Issaka in 2008, they resulted in significant financial loses to contractors and they also expose employers to serious financial and economic risks, which is due to delay in construction.

Construction delays have become an international issue faced by many countries worldwide. According to Othman (2006), since the study of Baldwin (1971), advanced construction technologies and introduction of more effective management techniques have solved the problem of delays, but the problems of delays are still predominant in many parts of developing as well as developed countries.

3.1 TIME PERFORMANCE

Neely et al. (2002) defined performance measurement as the process of quantifying the efficiency and effectiveness of past actions. Performance measurement in construction emphasizes more on project performance in terms of time, cost and quality (Ward et al., 1991; Kagioglou et al., 2001). Lin and Shen (2007) categorized time performance as one of the aspects of the papers. Time performance is important to all construction parties especially clients. It concerns the completion date, the sequence of work. In this study, time performance can be scoped by the owners' perception towards the actual construction time when compared with original planned time at the start of the project. The actual construction time is less than the planned construction time, the project is adjudged to be successful. Time performance index for each project can be defined the schedule time for construction project over actual time of construction project with extension of time. The table 3.1 shows the time performance index of building works in Singapore from 2000 to 2010.

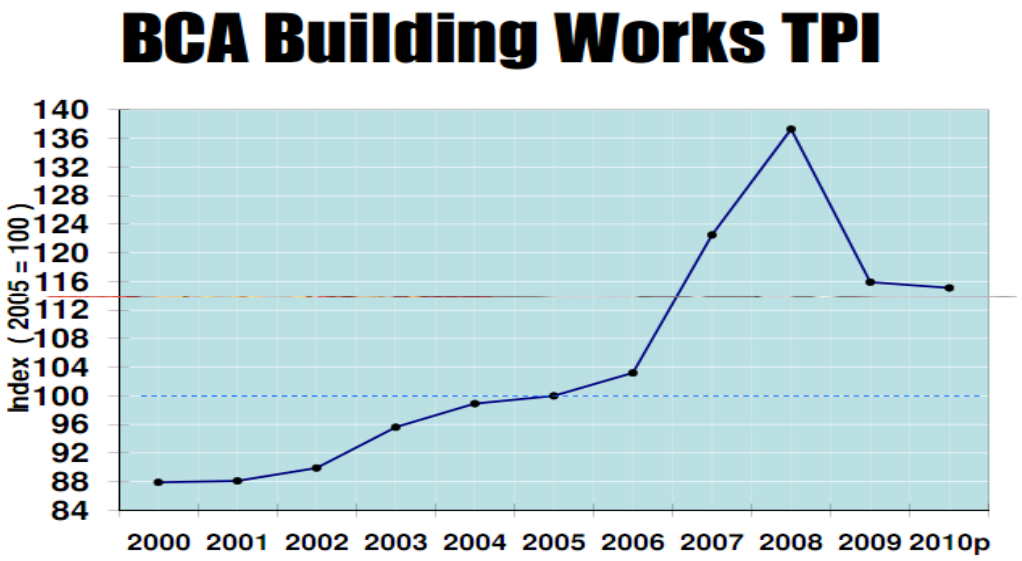

Figure 3.1: BCA Building works TPI

Source: Business development division, Building and Construction Authority, Construction Prospects, 2011

Refurbishment projects are described by taking more time than estimated. It is mainly due to its complexity and uncertainty of the refurbishment projects. New information is often discovered during the period of construction. As a result, contractors have to do additional work, which requires more time to complete.

Time performance is introduced to describe differences between scheduled times and actual times for activity and project performance (Robert, 2000). Similar to cost, time performance index is normally measured by the ratio between scheduled time for refurbishment and actual design time taken to complete the construction stage. Similarly, McKim et al. (2000) used time variance as an indicator for measuring projects performance. Bassioni et al. s (2005) study on business performance measurement highlighted that time variance was an indicator of the measurement of project performance. The literature shows that it is essential to use time performance as an indicator to measure any differences between scheduled and actual time in construction stage.

The measurement is normally converted into ratio figure instead between the actual and planned construction completion period. Rush (1996) mentioned that most of the criteria would be measured based on achievement against intention, and Yetton et al. (2000) maintained that the project time and budget could be measured using the variances between actual and planned figures.. For time performance index (TPI), a figure greater than 1.0, it indicates that the time spent for the construction process of the refurbishment projects was exceeded.

The majority of refurbishment projects suffer from delays and escalating cost during the construction stage. This happens due to a high degree of uncertainty in defining the scope of work especially when handling a building that is badly damaged due to war or fire (Daoud, 1997).

3.2 FACTORS AFFECTING TO TIME PERFORMANCE OF REFURBISHMENT PROJECTS

A review of the literature has concluded that some factors in construction need to be mitigated (Hashim, 2004; Jaafari, 2001; McKim et al., 2000; Rayers & Mansfield, 2001; Rahmat, 1997). There are significant problems in refurbishment projects are due to existence of complexity and uncertainty in managing refurbishment projects in Singapore. However, the factors that contribute to the time performance of refurbishment are still vague in Singapore. Hence, a study of literature has identified dominant factors that are affecting time performance of refurbishment projects. The factors are:

a) Contractor's finance related factors
b) Contractor related factors
c) Designers related factors
d) Client attributes
e) Contractual relationship related factors
f) Skilled labor related factors
g) Material related factors
h) Project or site related factors
i) External factors

3.2.1 CONTRACTOR'S FINANCIAL RELATED FACTORS

Money is always the problem for every stage of construction (Hashim et al., 2003). According to research done by (Othman, 2006), there are five variables underlying these factors, and they are:

i. Improper management of funds by contractor.
ii. Inability for contractor to keep materials due to cash flow problem.
iii. Delayed payment by main contractor to subcontractor or suppliers.
iv. Lack of working capital.
v. Non-payment of salary to workers causing slow down.
vi. Low design fee for consultant causing error in design thus delaying the project.

The quantity surveyor is the one who is responsible for the costing of the whole stage of construction. During the tendering stage, the quantity surveyor would need to have proper management on cash flow. Improper management of funds by contractor can result in poor cash flow control or improper way of contractor using payment received on other things which not related to the project. This may result in the delay of payment by main contractor to subcontractor or suppliers.

For the groundwater project in Ghana, cash flow is listed as the top ten factor causing delay (Frimpong et al., 2003). Mezher and Tawil (1998) conducted a survey on cash flow from the owners, contractors and consultant firms; it concluded that the cash flow is the top ten factors out of 64 causing construction delay in Lebanon. Hashim et al. (2003) suggested the need of requirement fort forecasting cash flow during tendering stage as the cash flow may be the major cause of project's failure. Besides that, having

experience in forecasting the cash flow is highly required for the quantity surveyor so as to achieve proper management fund. Cash flow is important and it is a guideline in the project - to allocate the fund accordingly.

According to Othman (2006), cash flow problem is mainly due to the result of lack of working capital. Poor estimation by the contractors on the requirements of working capital can contribute to cash flow problem as Hashim et al., (2003) claimed that estimation of minimum working capital was not common practice in Malaysia. Normally, small contractor firms have difficulty securing loans from bank thus causing the lack of working capital (Shen and Song, 1998). This is supported by Arditi et al. (2000) who stated that large and long established contractor firms easily secure loans from the financial institutions , they do not usually face the problem of cash flow and lack of working capital comparing to small firms. Trust between subcontractor, supplier and contractors are very important to a project and it is mainly due to the track record of payments. All the financial problems as stated above are factors affecting the time performance of a refurbishment project.

Low consultant fee would also affect the quality of design documentation in a construction project. Daoud (1997) pointed out that the performance of refurbishment project is being affected due to underpayment of consultant services. It does show the work force allocation for the projects, affects the productivity of design works. Low design fee results to low payment of salaries, which could demoralize the designers. Error done by the designers may thus result in project delay and according to Love et al. (2000) one of the reasons the error of the design was contributed is the low fees. Tilley

and Mcfallen (2000a) discovered that low design fee contributed to reworking in construction projects.

To minimize error in design, Coles (1990) recommended that reasonable consultant fee should be given. Some of the factors must be taken into account when determining the consultant fee such as the complexity and uncertainty of refurbishment project. Some of the clients decide to pay their consultant fee based on the initial contract amount. The majority refurbishment projects are full of variation due to its nature of complexity and uncertainty. The increase of workload should come together with the increase in the salaries. The payment of consultant fee should be more flexible. The Malaysia Architects Act 1967 and Rules (2004) mentioned that the highest fee for architect falls under the category of refurbishment projects. This reflects the difficulty of refurbishment projects.

3.2.2 CONTRACTOR RELATED FACTOR

Contractor related factors appear to be significant to affecting of the time performance. Among factors underlying this factor is:

a) Lack of experience in the nature of work.

b) Poor planning and management.

c) Mistakes during construction.

a) LACK OF EXPERIENCE IN THE NATURE OF WORK

Lacking of experience in the nature of work is found to be significant in the study of Othman on 2006. Wang and Huang (2006) pointed out that the criteria of project success are significantly related to owner, supervisor, and contractor's performances. Contractor's performance is very important to a project success. Every refurbishment is different from one another, due to the uniqueness of the projects, (Daoud, 1997; Rahmat, 1997). Therefore, past experience in handling many refurbishment projects is needed for contractors to gain better understanding about the projects. The experience of contractors can help minimize the mistake during construction especially when deficiency and discrepancy in the drawing occurs. However, the contractor could think of approaching managing refurbishment the same as managing new-build projects. Refurbishment projects differ in many areas compared with new build projects (Quah, 1988; Egbu, 1994; Daoud, 1997). The failure to identify the problem during refurbishment may affect the time performance of projects.

b) POOR PLANNING AND MANAGEMENT

The definition of planning and management is a process of deciding what to do and how to do it before an action is required (Koontz, 1972). The term planning is still debated. (Widaavsky, 1973; Mintzberg, 1981; Synder, 1982 and Duncan, 1996). Laufer et al. (1994) described planning as a mentally demanding and complicated process. Construction planning is difficult and it has to be done under constant changing conditions with insufficient and incomplete information.

Poor planning and management is hardly to have a complete sequence and schedule in a logical manner. During planning and management, the total time of a project can be estimated. Poor planning and management from the contractors' side can cause wrong estimation of construction sequence and resource. Material and equipment cannot be integrated into the construction. Poor planning and management could cause the project delay due to the mistakes made on site.

Improper planning and management was stated as one of the topmost causes for construction delay in Jordan due to the contractor unwilling to invest in planning and control especially in scheduling technique as well as lack of professional construction managers (Odeh and Battaineh, 2002). In Malaysia, the set-up of the organization for contractor could contribute to poor planning and management. The research done by Othman, 1997, stated that bigger class of contractors deliver better construction time as the TPI values decrease proportionately with the contractor size.

c) MISTAKES DURING CONSTRUCTION

Mistakes during construction are referring to the error and discrepancies from the drawings and specifications which are not clarified during tendering stage. This problem occurs when it comes to decision making during construction stage. Defective design is defined by Andi & Minato (2003b) as the design does not come to the acceptable level of quality as required by owner or codes and regulations. This statement includes errors, changes, and revisions during construction stage. Arditi and Gunaydin (1997) pointed out the inconsistencies from drawings and specifications. If

the poorly coordinated project faces many design errors and discrepancies in contract drawings and specifications, it would cause serious problem and delay at project site. Kumaraswamy (1997) highlighted that unhealthy conflict and dispute can cause misunderstanding and even more claims and further disputes and thus lengthening the project completion date.

Manavazhi and Xunzhi (2001, 2004) pointed out that more changes are made during construction stage than the design documentation stage. In their study, most of the changes occur during construction stage due to the liking of client, designer's error, changes of regulations and site condition. The changes that made during the construction stage would affect the overall performance of the project especially in terms of the time.

Andi and Minato (2003a) asked 150 designers opinion about factors to kick off the design deficiencies in construction projects. The result showed that changes or mistakes made during construction stage were the topmost factors to design deficiency. Burati et al. (1992) used changes made on site as an indicator to measure the performance in design and construction for both new build and refurbishment projects.

Due to complexity and uncertainty of refurbishment projects, mistakes from construction occurred and caused time delay to reconstruct the correct items. In the refurbishment project, the incomplete and uncertain information in the tendering stage causes the contractor difficulty to produce estimates accurately and also make mistakes very easily when it comes to limited time for decision making. Besides that, contractors are required to put in more effort to gather the information before they start work on

site. It would lengthen the construction period as it takes time putting on collecting information.

In conclusion, mistakes made during refurbishment projects are very common due to the nature of the projects which are full of complexity and uncertainty. Contractors have to put in more time to gather information, clear uncertainty and complexity thus would cause the project delay at the end. Mistakes during construction are a factor affecting time performance of refurbishment in Singapore.

3.2.3 DESIGNER RELATED FACTORS

The design process has been selected as the area of study because of its influence on the project performance (Baldwin et al., 1999; Chua et al., 2003; Manavazhi & Xunzhi, 2001). The management of design process of refurbishment often faces the problem of uncertainty, which contributes to poor project outcomes. Refurbishment projects are characterized by taking more time than estimated during the design stage (Daoud, 1997). So, the designer plays an important role in refurbishment and the study below is to analyze the role of designer that affects the time performance.

i. Slow decision making or frequent change of decision which affect the progress of work
ii. The state of completeness of design before the refurbishment project commenced on site.
iii. Lesser experience of designer on refurbishment project.

a) SLOW IN DECISION MAKING OR FREQUENT CHANGE IN DECISION WHICH AFFECT THE PROGRESS OF WORK

Laufer (1992), Laufer and Shapira (1993), Laufer et al(1994) and Shapira et al(1994) and Rahmat (1997) pointed out the involvement in the decision-making of construction projects varied among the various participants. The designer is one of them who make decisions during the designing and construction stage. The large number of designers who contributed to the decision-making process reflects on the existence of differentiation in the construction process which would affect the time performance of refurbishment in Singapore. Slow decision making happens during the construction stage when it comes to variation or discrepancy on drawings, contract documents. Designers have to make a decision on the design to proceed on construction site. The decision relates to cost and time implication which causes the designer to make a slow decision. Besides that, Galbraith (1977), Simon and March (1958) and Cyert and March (1963) suggested that much of what goes on in organization is decision-making and information processing. A large number of people involved in decision-making reflect the limited authority and ability to process information. The larger the number of people involved in decision-making, the slower decision will be made. Walker (1989) recommended greater integration of decision-making among the key participants is the best way to manage the complexity and uncertainty of construction projects. Okoroh (1992) described it would make the contractor hard to define the exact scope of work while the inadequacy of specifications and design information and changes made by designers as the work progresses. Therefore, the time will vary from original targets.

Slow in decision-making or frequent changes in decision-making are caused by the designers' failure to commit to the design changes and wanting to take responsibility of

making wrong decision. It could be lack of experience for the designer in refurbishment projects. From Rahmat on 1997, it indicated 51.5% to a large/very large extent of design changes during construction stage due to the state of completion of design up to 60% when the commencement work on site. Changes in design give implication to opportunistic behavior. The contractor would claim for higher variation orders or extension of time. Therefore, quick response from the designer when it comes to decision making is required so as to cut down any time and cost implication to the refurbishment project.

b) LESS EXPERIENCE OF DESIGNER ON REFURBISHMENT PROJECTS

Every refurbishment project is different from another due to the uniqueness of the project (Dauod, 1997; Rahmat, 1997). Therefore, experience from previous projects is very important for the architect to gain great understanding about the project. Job experience for designers can help to minimize deficiencies in their design. This is supported by Egbu (1997) and Friedman and Oppenheimer (1998) who mentioned that the refurbishment of projects are mainly site driven, requiring the architect to learn from on-the-job training of refurbishment. Hughes and Gray (1994), Graves (1993), Spiegelman (1989), Yetton at al. (2000) and Ling (2003) who pointed out the importance of having experience in design work. From the study of Ali on the year 2008, the architects' job experience was measured by the number of refurbishment projects handled. The result indicated more than 80 percent of the respondents had experience in handling at least 5 refurbishment projects.

c) THE STATE OF COMPLETENESS OF DESIGN BEFORE THE REFURBISHMENT PROJECTS COMMENCED ON SITE

Rahmat, 1997; Winch 1989 mentioned that rehabilitation work as the most prone to the complexity and uncertainty. Ismail Rahmat, 1997; Pin, 1991 pointed out that the nature of refurbishment with the unknown condition of existing building is the result of poor documentation of information.

Young et al. (1996) found that in 66.6% of those from refurbishment, 50% of designs were complete, in contrast to the 80% from ship refurbishment. This indicates refurbishment starts work with a higher degree of uncertainty. From the study of Rahmat on 1997, the respondent were asked about the state of completion of design before commencement of refurbishment work which received 50% of refurbishment projects commenced work on site with only 60% of design being complete.

Table 3.1: The state of completion of design before refurbishment work commences

Sources: Rahmat (1997)

The state of completion	**Refurbishment Projects (N=64)%**
More than 80%	20.3
61% - 80%	29.7
41% - 60%	16.8
21% - 40%	24.4
Less than 40%	7.8

The incompleteness design before work commences, the more important for good communication is required. It indicates that the high degree involvement between client and designers. Refurbishment work requires fast decision making from contractors. The

situation is even worse if the state of completeness of design before the refurbishment projects commenced on site and thus causing project delay.

More detailed and quality information is necessary at the early stage of refurbishment projects. The involvement of experienced contractors would improve the quality of information obtained at design stage. Inadequacy of information makes it difficult for contractors to produce proper method statement and programmers in refurbishment projects and thus affecting the time performance of projects.

3.2.4 CLIENT ATTRIBUTES

Clients are defined as public developer, public owner-occupier, private developer or a private owner-occupier (Akinsola et al., Alistair & John, 2001). High performance of the project outcome is the aim for clients. Limand Ling (2002), Kometa et al. (1994), Chern and Bryant (1984) noted that the quality of the client's attribute would affect the project performance. The client who lacks ability to provide faster decisions often creates problems to the projects. Coles (1990) noted that slow authorization of the clients or indecisiveness due to poor knowledge in construction and lack of communication skills would probably cause consequences of delay. Odeh and Battaineh (2002) found that slow decision making in clients are the topmost factor that affects the time performance in construction projects.

In order to have faster decision making, to avoid any delay in construction project, flexibility and sufficient authority is needed to give to client's representative (Kometa et al., 1994; Bellassi, 1996; Barrett & Stanley, 1999; CABE, 2003). The clients' representative should be a person at senior position with experience, knowledge and authority to coordinate with contractors and come out with a decision (CIRIA, 1994) it would help to avoid any unnecessary delay. Architect and consultant should be able to advise client in decision making. From the study of Ali (2006), it showed that majority of planning managers' agreed that involvement of client in decision-making during pre-construction and construction influence the performance of the project. Since the refurbishment projects are contracted, the risks would have been handled by contractors. The involvement of client could only become a hindrance due to lack of technical expertise on site problems. Ali (2008) noted that client interference from clients is considered to cause more problem and disruptions to the contractors' works. From the semi-structured done by author, client interference is one of the factor added by contractor and that it should be included in which causing the slow decision making and the consequence of delay in project.

3.2.5 CONTRACTUAL RELATIONSHIP RELATED FACTORS

For the factors related to contractual relationship, there are few areas that can be discussed:

a) Poor coordination between different parties who are involved in the projects
b) Conflicts / disputes between contractor and superintending officer
c) Lack of communication between superintending officer and contractor
d) Lack of teamwork among the different parties working on project
e) Occupancy in a refurbished building.

Poor coordination between different parties who are involved in the projects, conflicts or disputes between contractor and superintending officer, Lack of communication between SO and contractor and lack of teamwork among the different parties working on the project are closely linked factors to each other. Different parties have different objective which relates directly to their roles and businesses. For consultant, he is looking for a level of professional development and professional satisfaction among his employees as well as meeting the fee goals. For contractor, profit is high priority issue while the owner is interested to know if the project functions and whether it is free from long term defects and maintenance problems. Objective cannot be achieved due to poor communication, poor coordination and lack of teamwork. Ward et al. (1991) pointed out the importance of the client to set clear objectives and make it known to the parties involved clearly to avoid conflict.

In the absence of teamwork and communication, time performance of refurbishment will be affected. According to Mustapha and Naoum (1998), project team could not work around with incomplete drawings and changes in program will lead to unavoidable delays. From the study of Saram and Ahmad (2001), it indicates the importance of construction coordination activities involving contractors in Hong Kong and Singapore. It divulged that the respondents considered identifying strategic activities and potential delays as the most significant activity to get construction coordination. Walker (1995) shows that communication management and decision making between the construction and design team are the significant factors that affects the building construction time performance in Australia.. Dainty et al. (2003) mentioned in order to achieve project goals, project team needs to communicate not just through written, verbal but also the transfer if knowledge to others in an open and effective way.

Rahmat (1997) described co-ordination devices as involvement of key participants in decision-making, which could reduce the communication gap in refurbishment project organizations. Four major co-ordination devices from the study of Rahmat (1997) are lateral relations (meetings and direct contacts), Construction Company planning, controlling procedures, communication skills and knowledge of the key participants, information technology. Coordination devices are important to reduce conflicts in refurbishment projects which will help the project team perform better output. Zaneldin et al. (2001a. 2001b) and Hegazy et al. (2001) noted that the lack of coordination among project participants is a major problem in the construction industry. This would lead to unnecessary cost and time variations in the construction projects.

Construction process is a function of the interaction of a number of individuals over a period of time. Therefore, it is important to have a good relationship among the project participants to avoid any communication breakdowns. In addition, the amount of work involved in design and construction activities is substantial (Mitropolous and Tatum, 2000).

Lack of coordination, teamwork and poor communication can cause more conflicts between S.O and contractor which led to project delays. Gardiner and Simmons (1992) recommended that conflict can be resolved by improving communication between parties in the project. Conflict between contractor and superintending officer is common in construction industry as they are the key person for design and construction process. They do not have a good relationship.

From the research done by Ali on 2008, it indicated almost 5 percent of the respondents (superintending officer) rated their relationship with contractors as poor or very poor relationship. Around 1 percent rated their relationship with the client as poor but not with other consultants. The resistance did occur among three parties although the percentage is small. The strained relationship between contractor and superintending officer happens when contractors do not perform what was required by superintending officer. They did not carry out the work according to the drawing specification given. During tender stage, contractor may have deficiency in the pricing of refurbishment project as they are not familiar with this kind of project. The amount of provisional sum and contingency sum may not be enough also. As a result, contractor tries to cut the construction cost by using low quality materials which do not follow the specification.

The relationship between contractor and superintending become very tense and it does affect time performance when the key participants are not working towards the same goal as to perform progressively. Due to uncertainty and complexity of refurbishment project, contractors need more cooperation with superintending officer compare with new build project. The contractor may face problems in finding material, skill labor, and structural work of existing building that need superintending officer to decide faster in order to work progressively. Contractor focuses more on constructability aspect of the project and the cost of installation while superintending officer focus on aesthetic value and the progress of work. They have different objective in refurbishment thus resulted to project delay as the team members are not heading towards same direction.

Daoud (1997) stated that simultaneous operation done by building users would disturb the overall flow of refurbishment projects. When there is occupancy in a refurbished

building, it is very difficult to determine the sequence of work as the occupants and project team will be in the building together. This creates the difficulty for the contractor to bring in big equipment to carry out the work that would bring noise disruption to the surrounding occupants. Some of the mechanical and electrical service system forms an integrated network which runs to the various part of a building. The installation of the services would become very complicated for refurbishment when the certain part is only available at particular time.

Before contractor start planning the sequence of work on site, they need to investigate the building condition. CIRIA (1994) mentioned that occupancy cause significant problems to the contractor.

Quah (1988) mentioned that refurbishment work in an occupied building should not hold up the normal usage of the buildings. Occupants cannot escape from the disturbance during construction work that is carried out in the occupancy building (Ali, 2008). A temporary services need to provide for existing users to avoid any disruption. In this situation, contractor has to spend more time to do more works to ensure the connected load is sufficient to run existing services systems. In addition, this approach would extend the total refurbishment period. Bloomberg (1992) and CIRIA (1994) stated that occupancy could cause the project delay during design process of refurbishment projects. The client needs to assign a knowledgeable and experience contractor to synchronize the operation of the services while refurbishment work is carried out.

In conclusion, the occupancy in a building would affect the productivity of the refurbishment process. It is very difficult for contractors to carry out work which could bring to project delay if they do not have full possession of the site. However, the experience and knowledge of contractor is very important to minimize the inconvenience to the building occupants and reduce the time disruption to minimum during refurbishment work is being carried out.

3.2.6 SKILLED LABOUR RELATED FACTOR

In the study of Rahmat (1997), the difference between refurbishment and new building project is more obvious in the degree of intensity of site operations. Quah (1992) described that refurbishment projects consist of small labor intensive operations scattered around the existing building. The construction industry is labor intensive and it affects the progress of project directly. Othman (2006) found that lack of skilled labor significantly affected the project performance and it becomes top ten causes for project delay. BRE (1990) pointed out that refurbishment works require quick solution as in technical problems. The techniques and methods used for every building tend to be different and the work is certainly more difficult and need more workers.

Table 3.2: Labor Productivity by Industry

Source: Singapore Department of Statistic and Manpower Research & Statistic Department, Ministry of Manpower

LABOUR PRODUCTIVITY BY INDUSTRY[1] [TABLE A2.2]

					2009				2010				2011
	2007	2008	2009	2010	I	II	III	IV	I	II	III	IV	I
	Percentage Change Over Corresponding Period Of Previous Year												
TOTAL[2]	0.1	-7.5	-3.4	10.7	-13.6	-4.1	0.9	3.5	13.9	15.3	6.2	7.8	4.5
Total[2] (excluding construction)	0.2	-6.9	-2.9	11.0	-13.3	-3.4	1.8	4.0	14.8	15.7	6.1	8.0	4.4
Goods Producing Industries	-3.1	-12.1	-2.4	24.5	-22.9	0.6	9.0	6.3	32.3	37.2	11.3	19.6	10.9
Manufacturing	-3.1	-10.9	1.6	31.9	-23.5	5.6	17.2	11.3	44.3	47.4	13.8	25.7	13.9
Construction	4.0	-0.8	4.0	2.9	4.5	4.1	0.9	6.7	3.9	7.0	4.4	-2.8	1.5
Services Producing Industries	1.4	-4.0	-4.2	5.4	-9.4	-6.2	-2.8	2.1	7.3	6.9	4.5	3.2	2.1
Wholesale & Retail Trade	1.9	-1.9	-7.7	12.1	-14.9	-11.2	-6.2	2.3	14.8	15.8	11.1	7.2	0.7
Transport & Storage	6.9	-3.6	-9.3	4.7	-15.9	-12.6	-8.6	0.6	7.8	7.7	3.1	0.6	1.1
Hotels & Restaurants	-4.9	-9.0	-5.0	3.9	-11.5	-8.0	-1.6	1.4	5.5	8.0	2.0	0.5	-0.2
Information & Communications	-4.1	-1.1	-3.2	-3.4	-4.7	-3.9	-2.1	-2.1	-1.1	-3.0	-4.5	-5.1	-5.7
Financial Services	0.1	-7.1	2.3	3.2	-8.7	1.5	6.2	11.0	12.6	1.3	-0.7	0.5	2.8
Business Services	0.6	-5.8	-0.4	-0.9	-2.3	-1.3	0.6	1.5	1.2	0.0	-2.0	-2.6	-1.6
Other Services Industries	-2.1	-3.4	-0.4	8.9	-0.5	-1.4	0.0	0.4	1.4	11.2	11.8	11.0	10.2

The table below shows that the statistic for labor in Singapore from 1994 to 2009. From the result, it shows that the decrease of labor starting from year of 1994.

Table 3.3: Statistic for labor in Singapore from 1994 to 2009

Source: Singapore Department of Statistic, 2011

Year	Construction
1994	10.00
1995	-3.70
1996	-2.20
1997	-3.80
1998	-2.90
1999	-2.20
2000	2.30
2001	1.60
2002	-3.80
2003	1.20
2004	-0.40
2005	0.00
2006	-3.50
2007	4.30
2008	-0.80
2009	3.20

From the figure 3.2, it shows that graph of average monthly recruitment and resignation rates in Singapore. From the graph, it indicates that the instability of the labor supply in Singapore construction industry.

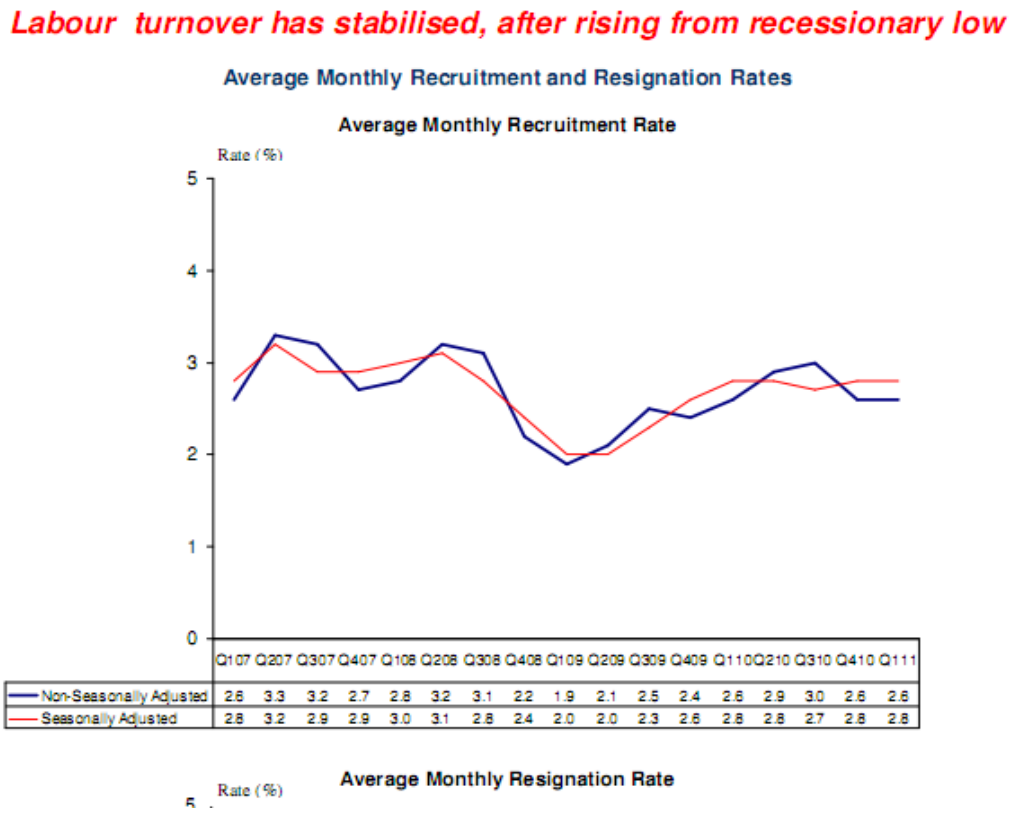

Figure 3.2: Average Monthly Recruitment Rate

Sources: Singapore Department of Statistic, 2011

MBAM (2003) reported that repatriation of foreign workers since the end of the amnesty period for illegal foreign workers on July 31, 2002 and it brings the result of delay in construction completion projects. Small contractor firm normally faces the shortage of skilled labor as they have difficulty maintaining them as permanent when they are out of projects. This explains why so many projects are lack of skilled labors which explains the project delay in refurbishment project in Singapore. Assaf et al. (1994) found out that labor shortage was an important cause of delay in Saudi Arabia.

In conclusion, the shortage of skilled labors is the factor that affecting time performance of refurbishment in Singapore. There is a need for main contractor to rely on the use of subcontractors in order to overcome the availability of labor.

3.2.7 CONSTRUCTION MATERIAL

Materials related become the top five ranked which contribute to the probability of project delays from the study of Othman (2006). Shortage of construction materials becomes the factor affecting the refurbishment project. Shortage of construction materials, escalation of price of materials, difficulty in obtaining imported materials and slow delivery to site are closely related to each other. These problems occurred to be a norm in developing countries as noted in number of studies (Chalabi and Camp, 1984; Ogunlana et al., 1996; Elinwa and Joshua, 2001; Frimpong et al., 2003). This is confirmed by the study done by Ogunlana et al. (1996) who compared causes of delay between UK and developing countries. The result showed that material problems received a lower rating in the UK. In other meaning, Singapore also faces this problem of materials because it is a developing country. From the study done by Othman (2006), shortage of materials was ranked as one of top ten causes. This may be due to local manufacturer cannot supply enough materials to the demand of construction market.

Majority construction materials in Singapore are imported from foreign country. Escalation of price in materials can be due to variation in foreign exchange (Ofori, 1991).Shortage and increase in price for construction material can affect the efficiency of refurbishment in Singapore. Slow delivery of materials to site can be result of

shortage of construction materials, escalation of price of material or difficulty in getting imported material.

The complexity and uncertainty of refurbishment projects could be resulted from the project environment. The Chartered Institute of Building (1987) cited the problems of aesthetic when they want to match new work with old that need designs and materials. It is very hard to get the materials which can match exactly with existing building. The existing building was built for many years, so it is very difficult to find back the old materials. The selection of materials in refurbishment projects is one of the important factors that need to be considered. In refurbishment projects, the selection of new material that is similar to existing one is tough for contractors (Ali, 2008). The Chartered Institute of Building (1987) noted the problem of matching old and new materials. The problem of matching old and new materials is very common in refurbishment project and it is a difficult for contractors to search for it and it would bring the effect of delay to the projects. Some of the material cannot be found in the market which requires the contractor to outsource from outside market. More time is needed to source for similar material, It would affect the time performance of refurbishment projects as in the sequence of work. Similarly, Bennett (1983), Dauod (1997) and Harris (2006) pointing out that many refurbishment projects performed out of normal sequence. It is probably due to the difficulty of searching the new material that similar to existing material. Daoud (1997) pointed out the difficulty faced by contractor for matching material from the original building in the new design, even though it can minimize the cost and solve the problem of getting imported material.

For the study done by Ali (2008), the availability of material is not a major concern in the majority of refurbishment projects as it would not affect the planning performance of projects. Ali (2008) pointed out that the problem of availability of material tends to be related to economic conditions, rather than inherent in refurbishment projects. From his study about the availability of material, almost 80 percent of refurbishment project did not have problems with the shortage of construction material in Malaysia.

3.2.8 PROJECT OR SITE RELATED FACTORS

Project or site related factors appeared to be the second most significant factor contributed to project delays identified through logistic regression as can be found from the study of Othman (2006).

i. Uncertainty and complexity of the project
ii. Difficulty to gain access to site and existing building
iii. The structural work of existing work
iv. Variation or additional works

a) UNCERTAINTY AND COMPLEXITY OF THE PROJECT

Complexity and uncertainty are two terms that many management writers use interchangeably even they are denied differently (Rahmat, 1997). Complexity and uncertainty are natural in all construction regardless the size of the project (Thompson and Perry, 1992; Smith, 1989 and Gorgone, 1992).

Many construction management writers pointed out that refurbishment projects are more risky and complex than new-build projects and it brings the result to difficult management (Boyd & Weaver, 1994; Brothroyd & Emmett, 1996; CIRIA, 1994; Egbu, 1994, 1995, 1996, 1997, 1998, 1999; Teo, 1990; Flanagan & Norman, 1993; Hashim, 2004; Holm, 2000a, 2000b; Holm & Brochner, 2000; Johnstone, 2001; Koehn & Tower, 1982; Lees & Smith, 1984); McKim et. Al., 2000; Mazzolani & Ivanyi (2003); Quah, 1988, 1992a, 1992b, 1998; Rahmat, 1997; Rayers & Manfield, 2001; Summer, 1985; Teo & Scott (1994); Young et al., 1996).

From the study of Rahmat on 1997, the size of refurbishment project can affect the level of complexity and uncertainty of the project. As the size increases, the complexity and uncertainty tend to increase. Larger construction is described to have insufficient information to plan in details during the construction period. The effectiveness of information flow controls the outcomes of the project including the time performance. The bigger project has high degree of uncertainty and complexity which would affect more on time performance during refurbishment.

Due to uncertainty and complexity of the refurbishment project, contractor have difficulty gaining information, design information and changes made by the architect, it would cause the contractor to have difficulty to define the exact scope of work. There would be greater tendency for time varies from original targets. From the study of Rahmat on 1997, it indicated that changes made during construction stage of refurbishment project, with 51.5% to a large or very large extent. It considered 60% of design being completed only when the refurbishment commence on site. In a conclusion, the complexity and uncertainty of the refurbishment projects can lead to project delay.

b) DIFFICULTY TO GAIN ACCESS TO SITE AND EXISTING BUILDING

Rahmat (1997) pointed out that the works of refurbishment projects have to be carried out in sensitive premises such as embassies and government offices. If contractor take up a refurbishment work in such premise, they need to take extra precautions to ensure the security of the documentation. In addition, the client and occupants may restrict labors access from certain part of the building. If refurbishment work cannot be done smoothly in the situation above, time performance will be affected.

Quah (1992) maintained that refurbishment operations should not interfere with the normal usage of the building. Contractor need to take precautions to provide dust and noise protection and to ensure that everything is under good management and supervision. The CIOB (1987) cited that the level of uncertainty of refurbishment projects increase when the level of difficulty to access to refurbishment projects sites. The uncertainty of the projects would bring the effect to the time performance of refurbishment as the contractor need to take time to verify the uncertainty design. The refurbishment works which are done inside the building such as shopping mall, contractors have to set the limit of available working time to work when is after business hour at night. The client or the owners may set the limit of working space available to work and to store material. The provision for access to the site has to take into consideration of the availability of occupant and their day-to-day activities are not interfered with. In order to minimize disruption, some refurbishment projects have to be undertaken on fast track. The contractors have to make good planning and management on accessibility to work on existing building without bringing any disruption to the occupants within the given short period.

From the study of Rahmat (1997), the result shows 42.8% of the refurbishment projects face difficulty in accessing to the site. This indicates that it is not unusual for refurbishment projects to face difficulty to access the site and it might bring delay to the projects if contractor do not have a good planning and control process. According to Ismail Rahmat(1997), the work has to be carried out in small batches and fragments, the " Just-in Time" approach may beneficial in refurbishment projects and communication between the site, head office, the subcontractors and clients are needed.

Table 3.4: The difficulty of access to refurbishment projects site

Sources: Rahmat, I. (1997). The planning and control process of refurbishment projects, PhD thesis, University College London, UK.

Access	**Refurbishment projects N=67%**
Very easy	19.40%
Easy	22.40%
Neutral	16.40%
Difficult	24.90%
Very difficult	17.90%

In conclusion, the difficulty to gain access to site and existing building is the factor affecting time performance of refurbishment as it restrict the contractor the working space to work and bring in big equipment into site as it would interrupt the normal usage of occupants.

c) THE STRUCTURAL WORK OF EXISTING WORK

Slaughter (2001) described the structural work is important to refurbishment projects. The study indicated that almost two-third of the buildings being renovated required the

changes to the structural system and almost 90 percents of the building being renovated required new structural alterations. As a conclusion for the statement above, structural modifications is a part of refurbishment work.

According to Beckmann and Bowl (2004), Clancy (1995), structural refurbishment is more complicated than new build projects. Ann and Bridger (1998), CIRIA (1994), Friedman and Oppenhiemer (1998) refurbishment that involve structural work required installation of shoring and temporary supports which are sensitive and difficult task for contractors. The use of temporary support would affect the time performance of the project as it involves many procedures of investigation such as probing and destructive testing. The responsibility of contractor to ensure the new structural design and temporary supports used are sufficient to accommodate the necessary loading during the construction process. Friedman and Oppenheimer (1998) noted that the difficulty in structural change could affect the architectural work in refurbishment project and it brings to the result of delay. Structural work in refurbishment needs more coordination among the contractor, engineer, and the designer. Coordination is important to avoid any missing information that could cause the delay to the project performance. The important information is concerning the history of the structural system in the existing building.

Ali (2008) pointed out that the construction progress could be even more difficult if the scope of work involves demolition and stabilizing of the existing structure. The structural work affects the construction progress of refurbishment. There could be much unknown information connected with existing structural elements. According to structural interview, contractor thinks that they can only discover all the information of

structural work in existing building after the commencement work. Ali (2008) stated that designers need to use accurate design information when dealing with structural alteration during the pre-condition survey to avoid any mistake when comes to commencement work. One of the methods to obtain accurate structural information is to conduct appropriate testing of the structural elements. This supports the view of Friedman and Oppenheimer (1998) and Highfield (2000) who recommend the testing of structural part of buildings. The information about the structural building of existing building is needed to be confirmed before commencement work because it is difficult to connect structural work of existing building and new building. It can affect the time performance of construction progress if any mistake happens in connecting the structural work of existing and refurbished building. The literature review has shown that the content of structural works in refurbishment could affect the time performance. This requires high degree of coordination between consultants and contractors to ensure a smooth construction process without any project delay.

d) VARIATION OR ADDITIONAL WORKS

Variation or additional works is the factor that affecting time performance of refurbishment. Variation or additional works were often initiated by the superintending officer to suit site conditions or to enhance constructability (Othman, 2006). Variation or additional works is due to the changes in design during the construction stage and the design cannot suit to the existing plan. Manavazhi and Xunzhi (2001, 2004) mentioned that a greater number of changes are carried out during the construction stage compared to during the design documentation. In their study, most changes occurred in the construction stage due to changes by client, designer's error, changes of regulations and

change of site conditions. All the necessary changes on site would become variation and additional work to contractors and they are out of the contractor's plan and working sequence. The high degree of uncertainty in defining the scope of work in refurbishment projects has cause the contractors need to do additional work which require more time to complete. This could affect the time performance of refurbishment. Kumaraswamy and Chan (1998) stated that variation orders in general was the most common time overruns as identified in their survey involving 111 construction projects in Hong Kong. Contractors involved in the Mezher and Tawil (1996) study on the construction delay and found out that the design change is the most common source of delay. Variations were also found to be a topmost significant factor that affected time overruns in two different surveys in Nigeria an the respondents were architects, quantity surveyors, engineers and builders conducted by Okpala and Aniekwu (1988) and Elinwa and Joshua (2001). All the variation and additional works bring the effect to time performance. Kaka and Price (1991) argued that significant variation should change the contract duration period. It is not surprising to see variation in refurbishment projects bring the effect to time performance which due to high uncertainty of refurbishment projects. A study conducted by Abdul Rahman et al. (2006) in Malaysia the major causes of delay during construction is changes or additional works.

Another issue that always occurs during construction stage which would cause to variation on site is the degree of compatibility of original design with existing site condition. Andi and Minato (2003a) explained that the degree of compatibility of the original design with existing site conditions was the problem happened in Japanese construction industry. In some cases, the design is impossible to build on site as related to constructability of the design (Griffith & Sidwell, 1995; Gray, 1983; Tatum 1987;

Zin et al., 2005). The construability of the design only can be found out during construction stage and variation has to be come in and it cause project delay at the end.

In refurbishment, the designers are the person who develop a design and match it to the existing building. The design cannot match with existing building as the design do not match with the existing column, beam, opening, services during the construction stage. The refurbishment design needs to be compatible with the existing condition. It needs inspection on site condition before design stage in order to avoid to any unnecessary variation to site during construction stage and it would not affect the time performance of refurbishment.

3.2.9 UNPREDICTABLE WEATHER CONDITION

The comparative analysis on clauses of extension of time (EOT) under different forms of contract as stated in Chapter two. The purpose of doing the study on different forms of contract is to look into the excusable causes of delay. The common clause can be found from these three different forms of contract are the event of causing delays that contractor may be given a reasonable extension of time.

Among all the possible excusable factors that can be entitled to extension of time, weather condition is one of the topmost significant factors affecting time performance of refurbishment projects in Singapore due to the rainfall. Exceptionally adverse weather can be found from preliminary of the contract. The contractor's attention is

specially drawn to the fact that rainfall records are received monthly from the Meteorological Service Stations at Singapore Power Building, Tengah, Seletar, Paya Lebar and Changi. The average rainfall obtained from these five stations shall be taken as the basis for assessing the adverse weather conditions prevailing for the whole of the island of Singapore and her neighboring islands. The contractor shall not be allowed for any extension of time due to adverse weather conditions occur in excess of the following average figures of "wet-day" returns for the last ten years.

According to national environment agency, there is no distinct wet or dry season in Singapore. Rain falls every month of the year. There are two rainfall peaks, which are northeast monsoon month of December, and the inter-monsoon month of April. Singapore received an average annual rainfall of 2342.2 mm a year. From the report given by national environment agency, it shows that rainfall in Singapore is not avoidable.

Table 3.5.: Average rainfall in Singapore

Sources: Guide to Singapore's Weather, National Environment Agency (2007)

Rainfall

Month	Mean total raindays[4]	Occurence of highest hourly mean[5] (hrs)	Monthly mean[6] (mm)
January	11.3	1500	247.7
February	6.9	1700	106.6
March	10.3	1500	162.1
April	11.6	1800	150.2
May	10.8	1300	166.9
June	10.1	0800	132.6
July	10.5	1300	152.8
August	11.2	1300	143.4
September	10.8	1400	157.4
October	12.3	1400	155.6
November	14.8	1600	255.7
December	16.5	1700	327.3

[4] *Calculated by averaging the total number of raindays for each month for the 25 year period (1982-2006)*
[5] *Time of day for which the mean rainfall occurs for each month for the 25 year period (1982-2006) is the highest*
[6] *Calculated by averaging the monthly total rainfall for each month for the 25 year period (1982-2006)*

The content of preliminary of every project includes the maximum rainfall day for every month in Singapore. It becomes a guideline for contractor to claim for extension of time. From the semi structured interview, the respondents concluded that unpredictable weather has long been the cause of delay in Singapore construction projects. From the study of Othman (2006), the finding indicated the importance of inclement weather to the time performance of irrigation and flood mitigation project. Yogeswaran et al. (1998) analysed 67 completed projects in Hong Kong and the extension of time occurred from inclement of weather. One of the significant causes of delay in groundwater projects in Ghana is bad weather (Frimpong et al., 2003). Al-Momani (2000) found that 16 out of 130 public projects surveyed in Jordan mainly due to bad weather for project delay. From the study of Othman (2006), it shows that government engineers ranked unforeseen ground conditions and unpredictable weather condition as top ten causes of delay in public projects.

Young et a. (1996) also discovered the impact of weather on the refurbishment projects was the least significant among the four uncertainty variables. Young et al (1996) finding is confirmed, as the impact of weather is low in 57 percent of the refurbishment projects surveyed. In fact, many refurbishment works carried out within existing shells. The coverings are put around the building to reduce the effect of inclement weather.

As a conclusion, the factor of unpredictable weather condition becomes the least significant variables that affecting time performance of refurbishment in Singapore. It cannot be avoidable as Singapore is in monsoon location. Contractors try to use alternative way to continue the progress as they put covering to reduce the effect of rainfall to the refurbishment works.

3.3 SUMMARY

Chapter 3 specifically reviewed on the time performance. Factors affecting to time performance of refurbishment in a number of earlier studies were examined. There are eight main related factors which are contractor's finance, contractor, designers, client attributes, contractual relationship, skill labor, material, project or site and external related factors.

The following chapter, Chapter Four starts with discussion on a general overview of research methods. Methods adopted in a number of studies related to construction delays and time performance will be reviewed. It ends with the research methodology and method of data collection that were adopted in this study.

CHAPTER 4

RESEARCH METHODOLOGY

4.0 INTRODUCTION

This chapter presents the research method used in the present study. The methodology selected should be able to lead the research findings to valid conclusions. The methodological procedure is to ensure that the information obtained is relevant for scientific evaluation.

Sekaran (2003) defined research as an organized, systematic, data based, critical, investigation into a specific problem, and carry out the research with a purpose to find out the solution to it. Sekaran (2003) stated research is a process of finding solutions to a problem after through study and analysis of the situational factors.

This chapter will review the various approaches to data collection. This study used mixed method approach, which combined quantitative and qualitative data collection methods, where quantitative as a main data. The first stage was a literature review, which was validated in a semi-structured interview to verify the project characteristic variables. This was followed by a second stage of data collection involving final questionnaire survey.

Quantitative method is the main data in this research. Quantitative research is "objective" in nature. It is defined as an inquiry into a social or human problem, based

on testing on a hypothesis or a theory composed of variables, measured with numbers, and analyzed with statistical procedures, in order to determine whether the hypothesis or the theory hold true (Creswell,1994). Quantitative data is, therefore, abstract, they are hard and reliable; they are measurements of tangible, countable, sensate features of the world (Bouma and Atkinson, 1995).

The main objectives of this chapter are as follows:

a) To discuss the method of data collection used
b) To discuss the data collection process
c) To describe the statistical techniques used for data analysis

4.1 RESEARCH PROCESS

Nachmias and Nachmias (1991) described the research process as scientific activities that can produce knowledge or it is a paradigm of scientific inquiry. Nachmias and Nachmias(1991) categorized the research process into seven principal stages which are problem, hypothesis, research design, measurement, data collection, data analysis and generalization.

According to Bailey (1978), there are some basic stages of research project is being studied.

i. Choosing the research problem and stating the hypothesis
ii. Formulating the data
iii. Gathering the data
iv. Coding and analyzing the data
v. Interpreting the result to test the hypothesis.

Sekaran (2003) described 11 steps of research process.

i. Observation- Research interest is identified
ii. Preliminary data gathering
iii. Identification of problem
iv. Theoretical framework
v. Research design
vi. Data collection, analysis and interpretation
vii. Deduction
viii. Report writing
ix. Report presentation
x. Managerial

From the study of Nachmias and Nachmias (1991) and Sekaran (2003), it is important to have re-examination or re-evaluation the research process to avoid the rejection of the tentative hypothesis which might not due to its invalidity but to deficiencies in performing research operations.

4.2 METHOD OF DATA COLLECTION

Casley and Kumar (1988) described the two types of data collection methods as qualitative and quantitative. Quantitative method is used to produce numerical data while qualitative method result is described in words. Sekaran (2003) categorized data into primary and secondary. Primary data is defined as the information obtained directly that relates to the variables on the research whereas secondary data refer to existing sources. Example of primary data are data from questionnaire and interview while

secondary data can be obtained from company records, government publications, reference books, journal, magazines and websites. The three main data collection in survey research mentioned by Sekaran are conducting interviews, administering questionnaires and observing people and phenomena. The interview can be structured or unstructured. Sekaran (2003) defined structured interview as an interview where the setting of questions with planned sequence to be asked in order to get the needed information. As for unstructured interview, the interviewer does not need to be at the interview setting.

Data can also be gathered through case studies. According to Copper and Schindler (1998) case studies place more emphasis on a full contextual analysis of fewer event and conditions. Sekaran (2003) suggested that case studies provide qualitative rather than quantitative data for analysis.

Sekaran (2003) suggested that multi methods and multiple sources should use in collecting data. According to him, if the responses collected from interviews, questionnaire and observation are correlated, the data would be reliable. Babbie (2003) pointed out that there would be strength and weaknesses in each method of research. Hence, data is more reliable when more than one research method is carried out.

4.2.1 REVIEW OF RESEARCH METHODS ADOPTED IN OTHER RELATED STUDIES

Time performance and delay are closely related. In other words, factors affecting time performance are similar to the cause of project delay. This section is specifically

discussing some of methods used by previous studies which the method would be useful in this research as reference.

a) METHOD ADOPTED BY WALKER (1995)

In 1955, Walker studied the method on construction time performance based on 33 building projects in Australia involving 100 construction managers. Walker gathered data from the questionnaires and used them in a multiple regression model to predict construction duration. The model predicts time from the following variables:

i. Construction cost
ii. The ratio of extension of time granted to actual construction period
iii. Work type (new works, refurbishment, mixture construction)
iv. The data from objective of client's representative for high quality workmanship
v. The data for the communication management used in project team
vi. The date for effective use of information technologies

The model that produced by Walker to predict construction time for 33 projects under the case study. Time performance index was established for every project where:

$$\text{Time Performance Index} = \frac{\text{Actual Time}}{\text{Predicted Construction Time}}$$

Walker used TPI as independent variable for statistical analysis. Correlation analysis was used to test hypothesis and data were ordinal, Spearman Rank correlation was used to construct a correlation matrix. Walker managed to identify factors that affect time

performance while correlation helped to determine relationship between variables. Based on Walker's research, a good construction time performance was highly dependent on the aptitude of the construction manager in overcoming problems related to communication breakdown.

b) METHOD ADOPTED BY Chalabi and Camp (1984), George et al. (2000)

Chalabi and Camp (1984) conducted a study on causes of delays. Chalabi and Camp (1984) regarded delay as deviation from the original bid and contract schedules. There are three different perspectives of investigating the delay causes. Firstly, delays can be separated by origin and responsibility. Secondly, study the phase of study. Thirdly, categorize delays into excusable and non-excusable. This method was based on qualitative and descriptive method where no statistical analyses were provided.

$$\text{Schedule Performance Index, SPI} = \frac{\text{Actual Duration}}{\text{Planned duration}}$$

SPI was calculated for every project and the result indicated that for various projects SPI ranged between 102.9% and 123.2%, indicating on average a schedule delay occurred in each phase of the project.

4.2.2 METHOD ADOPTED IN THIS RESEARCH

There are many research techniques that have been applied by academic researchers in the performance measurement studies. Many studies on time performance and construction delays have previously been conducted. A number of those studies employed qualitative and quantitative methods. Among questionnaire survey and

interviews are most commonly used. Studies that have been conducted using this method were studies by Chan and Kumaraswamy (1996), Ogunlana et al. (1997), Assaf et al. (1995), Nkado (1995), Mezhel and Tawil (1998), Elinwa and Joshua (2001) and Frimpong et al. (2003).

Othman (2006) mentioned that a number of investigations on delays and time performance were based on objective data involving data on original construction duration, actual construction duration, and extension of time, initial project cost, final project cost, and other data that could be obtained from project record. This type of research was found to be adopted by Diekmann and Nelson (1985), Kaka and Price (1991), Georgy et al. (2001), Al-Momani (2000), Mc Kim et al. (2000). Chan (2001) and Gransberg and Buitrago (2002) as discussed.

The author considered research that uses both objective and subjective data more comprehensive and conclusive. Objective data that come from official sources may have a high degree of credibility. Objective data can avoid the problem of bias as compared to subjective data which is subjected to respondents' bias in answering as stated by Nkado (1995) and Kaming et al. (1997). Subjective can be considered as equally important and useful as the respondents possess working experience and information provided is reliable as suggested by Chan and Kumaraswamy (1997 and 1998), Ogunlana et al. (1996), Walker and Vines (2000), Nkado (1995) and Walker (1995). Data obtained through a mailed questionnaire and semi-structured interview for this research were considered as subjective data.

4.3 THEORETICAL FRAMEWORK

From the literature review, time can be influenced by excusable and non-excusable delays. All factors that affecting time performance of refurbishment are shown in the theoretical framework. The theoretical framework shows the relationship between dependent and independent variables. Sekaran (2003) described theoretical framework as identifying all factors affecting to the problems.

According to Sekaran (2003), the dependent variable is the primary interest to the researcher which the goal needed to be understood and describe the dependent variable, explain the variability or to predict it. The independent variable is the one that influences the dependent variable. Nachmias and Nachmias (1991) explained that the variables expected to explain change in the dependent variable as independent variable. In other words, the independent variable is the explanatory variable. In this research, the time performance is considered as the dependent variable where all possible variables that could affect on it are project variables.

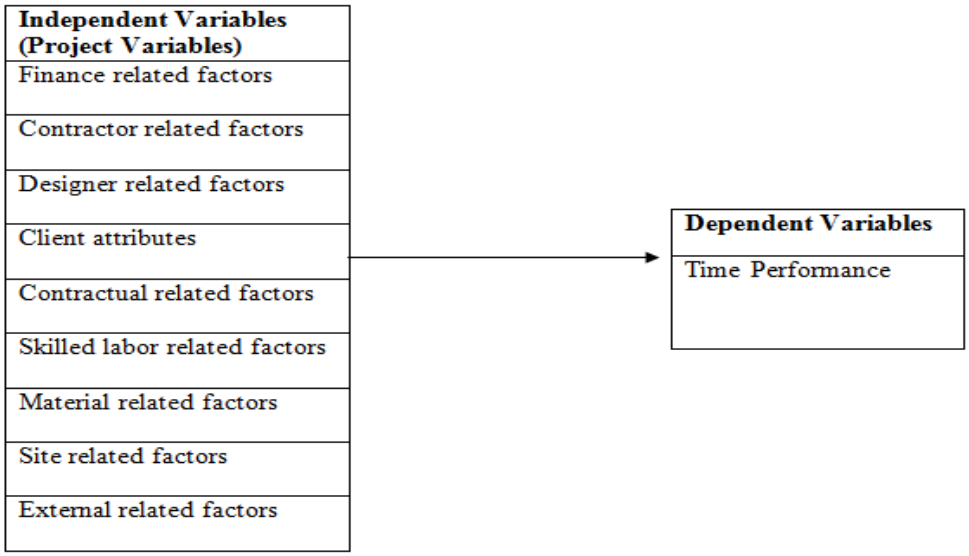

Figure 4.1: Theoretical Framework

4.4 RESEARCH DESIGN

After indentifying the factors affecting time performance and develop the theoretical framework, the next step is to design the research. Research design is a process of focusing your perspective for the purposes of a particular study. Krippendorf (1980) defined a research design is a procedural network of analytical steps through which information is processed. The purpose of research design is to determine the observation for data and perform analysis on it. It provides a guideline on what should be done on data collection as it should be the evidence to support the research objectives set out in the early part of study. Sekaran (2003) highlighted six basic aspects of research design: purpose of study, types of investigation, and the extent of researcher involvement, study setting, and unit of analysis and time horizon of study.

Having identified the variables in a problem situation and developed the theoretical framework, the next step is to design the research in such a way that the requisite data can be gathered and analyzed to a solution. The present study is designed mainly based on methodology implemented by Rahmat (1997), Hashim (2004), followed by Ali (2006) who investigated in the area of refurbishment.

Generally, quantitative approaches involve making measurements in collecting data. The three main important points in conducting quantitative method are : asking questions of respondents by questionnaires and interviews; carrying out experiments; and 'desk research' using data collected by others.(Liu, 2008) Leary (1991,2004) gives the example of testing the effect of caffeine by using quantitative method.

According to Sarantakos (1988), quantitative research refers to research which based on quantitative measurement and the use of statistical analysis. The objective of employing a quantitative method is to minimize personal prejudice or bias and ensure that the research can present social reality. Quantitative method needs true value, applicability, consistency and conformability (Guba and Lincoln, 1989).

There are two major sources of data collected which are primary and secondary data. In general, the primary sources were obtained from the questionnaire survey. While on the other hand, secondary data collection was sourced from textbooks, referred journals, web sites, seminar and conference papers and official census reports. The present study was designed to examine whether the project variables in refurbishment projects had a direct effect on the time performance and investigate the time performance index for refurbishment projects in Singapore. Three stages of data collection as shown in figure 4.2 were used implement this research and achieve its objectives as shown in figure 4.3:

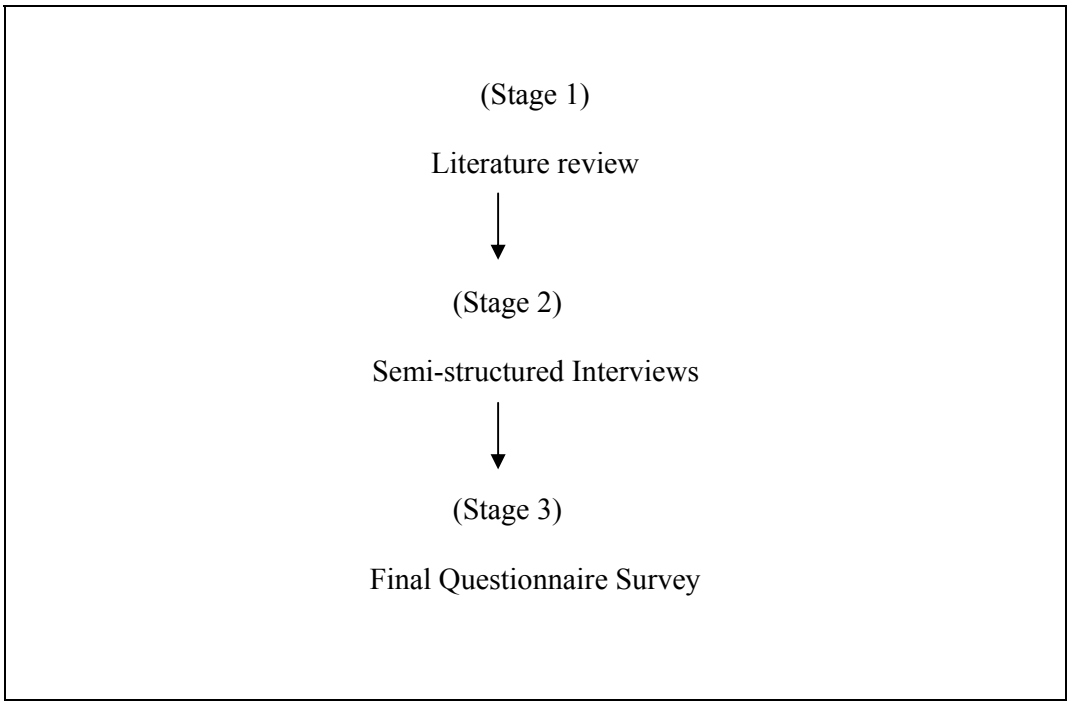

Figure 4.2: Flow of Three Stages of Data Collection

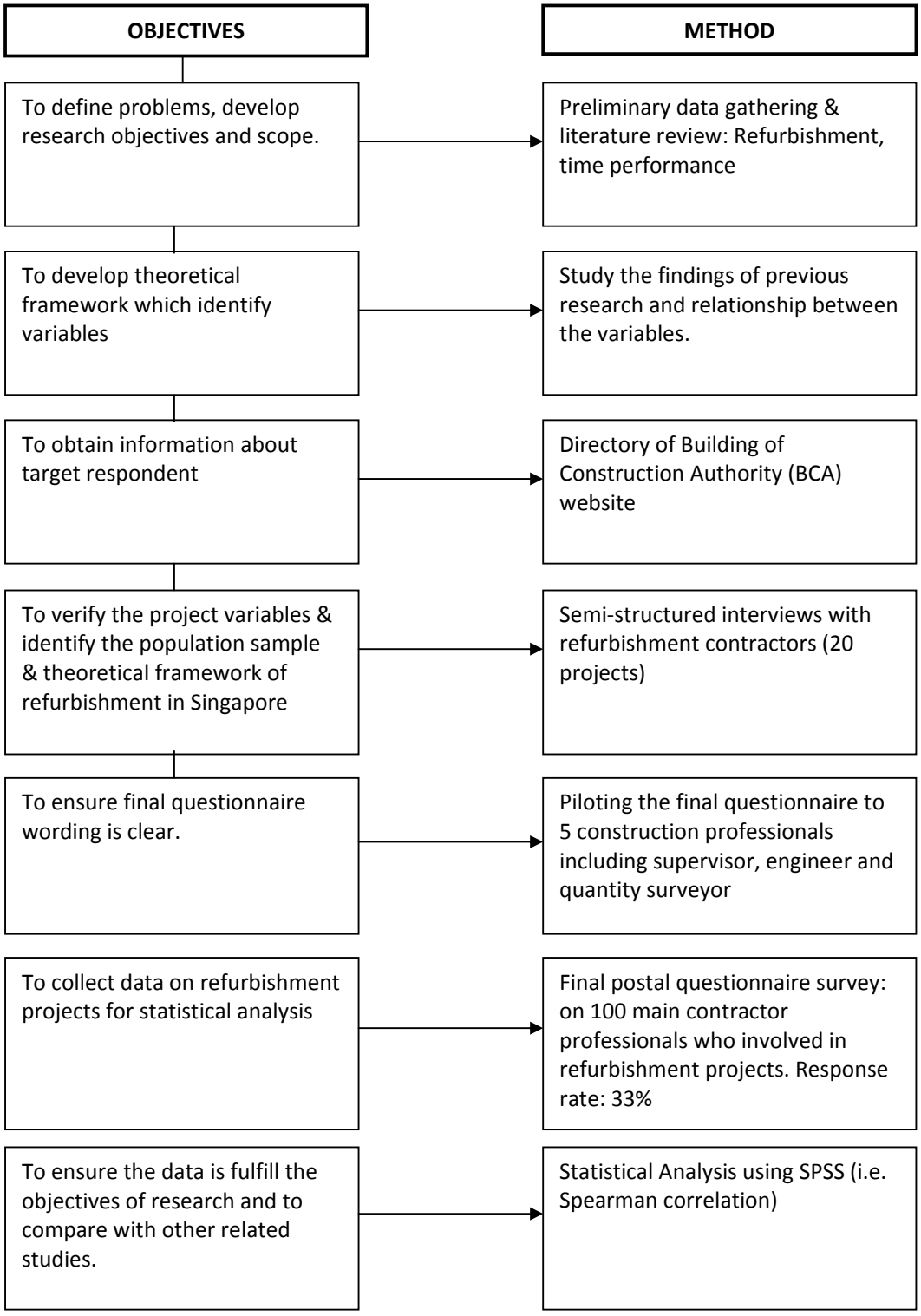

Figure 4.3: Flow of Research Methodology

4.4.1 STAGE ONE –LITERATURE REVIEW

The first stage of the study started with the identification of secondary data. The literature review generally focused on the areas of refurbishment, time performance, and refurbishment. Types of materials, including both published and unpublished studies were used in the literature reviews survey. The research problem and variables were identified through literature search. Due to insufficient supportive literature review in the area of the refurbishment in Singapore, semi structured interviews are needed to verify the variable of refurbishments projects in Singapore. Researcher builds up the theoretical framework of the study after examining the variables through the literature review. The validation of the theoretical framework was carried out by means of the semi-structured interview.

The review of literature helps to identify the critical elements while working out on semi-structured and questionnaire survey. Sekaran (2004) summarized the benefits of reviewing the literature in the social science research process as follows:

1. To ensure all the variables for the research are not counted out.
2. To identify the significant variable that helps the development of the theoretical framework.
3. To avoid of doing duplicate research on the same specific area.

4.4.2 STAGE TWO - SEMI-STRUCTURED INTERVIEW

The second stage of the study is semi-structured interview. The literature of the refurbishment in Singapore is limited, so there is a need to carry out semi-structured interview to verify the factors affecting refurbishment as stated in the literature. The objective of carrying out semi-structured is to verify the characteristic variable and

problems of refurbishment in Singapore. Besides, author can obtain more understanding about the problems faced by contractors while handling the construction process of refurbishment projects and how contractors normally respond to overcome the problems. It was important to obtain understanding before the final questionnaire could be designed. The author can then have a clearer picture of the actual implementation of construction. The final questionnaire can very much focus on the actual problems in Singapore. Mahdzan (1992) pointed out that interviews could help to have in-depth discussions on the scope and framework of the final questionnaire survey and to gather any other additional information, which had been overlooked during literature review stage.

Richard & Anita, 2008 defined semi-structured interviews as vary in form quite widely, from a questionnaire-type with some probing, to a list of topic areas on which the respondent's view are recorded. It is defined as an interview that has no strict guideline to follow. The benefits of having semi-structured as data collection are (Beger et al., 1989; Mahr, 1995; Sarantakos, 1988; Sekaran, 2004)

1. High response rate from interview
2. Complete answers for all the questions set.
3. Flexibility of asking the question which can meet the objective of research.
4. Involvement of more complex answer because it is easier to express using interview.

Before the commencement of interview, guideline questions were designed to be used during interview. The questionnaire is designed not to more than one hour for the respondents to answer. A sample guideline is shown in Appendix B.

Mock interviews were conducted by researcher with two potential interviewees in order to make sure the interview run smoothly. According to Sekaran (2004), proper rehearsal training is needed in order to maximize data collection during the interview.

Twenty interviewees from contractors firm were chosen to involve in this semi-structured interview. The selection criteria of the respondents for the interview were as follows:

i. The size of contractor firms based on the grade listed by Building and Construction Authority (BCA).
ii. Experience in construction industry, based on the numbers of years of involvement.
iii. Experience in the refurbishment project, based on the number of years of involvement.

After potential respondents had been identified, a letter (Appendix A) was sent to each firm requesting their consent to be interviewed. A follow-up call is made to arrange and confirm the interview. The interviews were conducted on the site as the researcher can visit the site to obtain more information. From the 40 selected respondents, only 20 contractors agreed to allocate their time for the interview. Some of them were unavailable for interview due to packed schedule or unwillingness commit for the interview.

According to Berg (1989), the number of respondents for interview should be in between 20 to 40 in order to have sufficient information. However, Rahmat (1997) and Hashim (2004) conducted the interviews with only 15 and 14 respondents respectively

because the answers received from the respondents became almost similar and predictable.

Interviews were carried out over a period of two months, from September 2010 to October 2010. The minimum duration for the interview was 30 minutes and the maximum duration was one hour and twenty minutes. The interviews revealed the factors affecting time performance of refurbishment in Singapore. The last section of the interview, the respondents were given the opportunity to give the opinion and recommendations on the factors which are not listed in the literature review and semi-structured interview. Respondents recommended the contract sum to be above $US 193,350.00 in order to get the better picture of time performance index. It is because the refurbishment project which have contract sum less than this amount would have less complexity and uncertainty. It helps the researcher to get the actual scenario of refurbishment works in Singapore.

However, Rahmat (1997) and Hashim (2004) conducted the interviews with only 15 and 14 respondents respectively because the answers received from the respondents became almost similar and predictable. Therefore 20 respondents form this research can be considered sufficient to obtain an average opinions and answers in the area of study. During the semi-structured interview, the author noticed the answers given by respondent have reached to saturated level after 15 interviews. The interview has gone to 20 as it can help to substantiate the information as shown in table 4.1.

Table 4.1: Result of semi-structured interviews between first 15 interview and last 5 interviews

ITEM	FACTORS	RESULT OF FIRST 15 SETS OF QUESTIONNAIRE					RESULT OF LAST 5 SETS OF QUESTIONNAIRE					TOTAL
		RATE DEGREE OF IMPORTANCE					RATE DEGREE OF IMPORTANCE					
		1	2	3	4	5	1	2	3	4	5	
a)	**Contractor's finance related factors**											
i	Improper management of funds by contractor.	2	9	3	1			3	2			20
ii	Inability of contractor to keep materials due to cash flow problem.	1	11	2	1			2	2	1		20
iii	Delayed payment for main contractor to subcontractor or supplies			1	5	9				3	2	20
iv	Lack of working capital			1	6	8				2	3	20
v	Non-payment of salary to workers causing slow down				8	7					5	20
vi	Low design fee for consultant causing error in design thus delaying the project.		5	4	5	1	2	1	2			20
b)	**Contractor related factors**											
i	Lack of experience in the nature of work.			3	4	8					5	20
ii	Poor site planning and management.			4	2	9				1	4	20
iii	Mistakes during construction.		3	6	5	1	1	1	1	2		20

Table 4.1 Continued: Result of semi-structured interviews between first 15 interview and last 5 interviews

c)	**Designers related factors**											
i	Slow decision making or frequent change of decision which affects the progress of work.			2	7	6					5	20
ii	The state of completeness of design before the refurbishment projects commenced on site.			2	6	7				1	4	20
iii	Less experience of designers on refurbishment projects.		3	7	5			2	3			20
d)	**Clients attributes**			2	6	7				1	4	20
e)	**Contractual relationship related factors**											
i	Poor coordination between different parties who are involved in the projects.			3	5	7				1	4	20
ii	Conflicts/ disputes between contractor and superintending officer.				7	8				2	3	20
iii	Lack of communication between superintending officer and contractor.	1	4	8	2			3	2			20
iv	Lack of teamwork among the different parties working on project.			2	4	9			1	1	3	20
v	Occupancy in a refurbished building.			1	5	9				1	4	20
f)	**Skilled labor related factor**			2	5	8					5	20
g)	**Material related factor**			2	5	8					5	20

Table 4.1 Continued: Result of semi-structured interviews between first 15 interview and last 5 interviews

h)	Project or site related factors											
i	Uncertainty and complexity of the project			1	7	7			1	4		20
ii	Difficulty to gain access to site and existing building			4	3	8					5	20
iii	The structural work of existing work		2	4	9		3	1	1			20
iv	Necessary variation or additional works			1	6	8				2	3	20
i)	**Unpredictable weather condition**				8	7				1	4	20

4.4.3 STAGE THREE –FINAL SURVEY QUESTIONNAIRE

The final stage of data collection was the questionnaire survey. An online questionnaire survey method was utilized to gather all required data in the study. In the process of the final stage of the data collection, Quantitative Statistical Analysis package software was used to as a tool to garner all the essential information. The reasons for using online survey being the best method for final data collection are as follows:

1. The questionnaire could be completed in anytime to avoid any inconvenience
2. Questionnaires are standardized stable and it is easy to retrieve for data analysis.
3. Questionnaire can avoid biasness or human errors caused by the prejudice of respondents.
4. An online questionnaire is at a relatively low cost and easy to handle.

4.5 THE STRUCTURE OF THE FINAL QUESTIONNAIRE

The final part of the questionnaire comprised of two main sections

Section A – Factors affecting time performance of refurbishment works.

Section B – Recommendation from expertise of refurbishment.

From the studies of Krejcie & Morgan in the year 1970, the population size and sample size are mentioned. The population size of refurbishments is calculated from the website of Building and Construction Authority Singapore which shows the completed refurbishment projects. From the project listing in between January 2010 to December 2010, the 203 completed refurbishment projects are calculated.

From the semi-structured interviews, the respondents have given the range of contract value for refurbishment projects that suitable to be taken for final questionnaire as the respondents agreed that $US 193,350.00 is the suitable contract value to determine the factors affecting the time performance index in Singapore due to its complexity and uncertainty of the projects varies with the contract value. The size of the project reflects the degree of complexity for a project. The population size of refurbishment project which meets the criteria in this research are chosen which the contract value is more than $US 193,350.00 and the number is 140 as the data shown on the website of Building and Construction Authority for project listing. The purpose of the following table is to determine the answers received are precise, consistent and reliable. The number of questionnaire to be conducted is 103 times according to the table by Krejcie & Morgan (1970) as shown. However, 100 numbers of completed refurbishment project which more than $US 193,350.00 are chosen as the sample size of this research.

Table 4.2: Table for determining sample size from a given population

Source: R.V.Krejcie and D.W. Morgan (1970)

N*	S†	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	100000	384
*N	is the population size								
†S	is sample size								

When the online questionnaire was completed, it was piloted to 5 people who were involved in the construction field such as lecturer, supervisor, quantity surveyor and engineer. Sarantakos (1988) stated a pilot survey is a rehearsal of the main study that helps to identify any problems related to the study instrument. It is beneficial to conduct a pilot questionnaire before commencing the real questionnaire. Some of the comments from pilot questionnaire can help to improve the final questionnaire to be of a better quality and produce a more conscientious result.

The online questionnaires as appendix C are sent out with cover letter through emails to the main contractor. The online questionnaire is set up by using the software created by Kwek Online Survey and it could be opened simply by clicking on the link code

attached with the cover letter. A sample of the email sent out could be referred from the appendix.

Two weeks later, 20 completed questionnaires were returned by replying through online system. A set of reminder questionnaires were sent to respondents who had not replied. One week after the reminder was sent, the number of questionnaire increased from 20 to 33. The percentage of answered questionnaire is 33% from 100 questionnaires. Author did not manage to get back the standard number of response due to unavailability and unwillingness of contractor to involve in the questionnaire. The questionnaire was based on the each project involved by contractor but not according to the number of contractor firm.

4.6 PRIMARY DATA COLLECTION

Postal questionnaires survey is a method used in quantitative methodology. A questionnaire survey was conducted to support the limited literature in the first stage of the data collection process. The mail survey will be used as data collection. The mail survey was not only the easiest approach to obtain research data, but also due to the size of population and the limited budget for this research, this method was ideal for the usage of the first stage of data collection.

The questionnaires will only be sent to contractors who have experience on refurbishment project for more accurate results. The contractors must be registered under Building and Construction Authority, Singapore. The questionnaire will be limited to the managing level such as project manager, contract manager. Preliminary

questionnaires will be focused on procurement method used in Singapore and refurbishments which have contract value more than $US 193,350.00 in local contractor firm.

For data transformation purposes in the preliminary questionnaire survey, the Software Package of Social Science (SPSS) version 13.0 was used for data analysis. Descriptive statistics methods such as frequency tables and cross tabulation tables were used for the purpose of data analysis.

4.7 IDENTIFICATION OF RESEARCH POPULATION AND CRITERIA FOR SELECTING RESPONDENTS

It is important to identify a research population that can reflect the real picture of the research. The research concerns on the construction stage of refurbishment projects so the appropriate profession for this research would be main contractors. The respondents are the professionals who have been working in main contractor firm with experience in the area of refurbishment.

Respondents for the present study are main contractors registered with Building & Construction Authority (BCA) Singapore. 100 main contractors who involved in refurbishment projects could be considered for the survey. However, the list could not identify contractor who had experience in refurbishment projects. Considering the number was too large, the list of contractors who were involved in refurbishment

projects was chosen by using telephone call and company website to find out all the relevant information of the contractors.

The study is limited to registered contractors in refurbishment projects. Main contractors were selected as the suitable respondents in this study for the following reasons.

1. Main contractors play important roles as the construction leaders who control all stages of construction activities for refurbishment projects.
2. All the required information could be acquired from main contractors.

4.8 REFURBISHMENT PROJECT PARAMETERS IN THE QUESTIONNAIRE SURVEY

The parameter or limitation of a questionnaire survey can determine the findings of the study (Sekaran, 2004). It is important to have limitation in the questionnaire survey in order to ensure the scope of study is not too broad or out of track. The limitations elements are used in the study:

1. Minimum size of refurbishment project in contract value.
2. Type of procurement methods used

The respondents were asked to select the completed refurbishment that satisfy the contract value of the project must more than $US 193,350.00 and the procurement system must either traditional or design and build.

The first parameter that needs to be considered is the size of refurbishment projects that reflect the degree of complexity for a project and it does affect the time performance. The semi-structured interview revealed that the size of refurbishment affect the time performance of refurbishment in Singapore. According to the respondents from semi-structured, refurbishment projects with a contract value of more than $US 193,350.00 are most common in Singapore.

The method of procurement used for the selected refurbishment projects is important because it is commonly used in Singapore based on the semi-structured interviews. The selected projects were required to have used either traditional or design-and-build method.

4.9 DATA TRANSFORMATION

In the present study, author used Statistical Package for the Social Science (SPSS) software, version 11.5. The data entered into SPSS must come from responses to a questionnaire. In the research of quantitative, researcher do the planning after setting up the objectives. Research need to ensure the research design, size sampling, and the method of collecting data. Method used for data analysis by using SPSS was confirmed before data collection.

4.9.1 FREQUENCY DISTRIBUTION AND DESCRIPTIVE STATISTICS

The method used for frequency distribution could present the profile of the responses obtained in the final survey. The data are shown in tables and graphic forms which are

in term of percentage to present the overall view of profile. From the studies of Hong (2005), Liaw and Goh (2002), Naoum (1998), it indicated that the descriptive analysis could provide general overview of research finding.

Goh (2006) stated that the research is used to describe variable in phenomena and they were stated logically. Three methods were used to describe the characteristics of variable.

1. Measuring central tendency
2. Measuring the rasp
3. Standardizing data

To rank some of the factors affecting time performance, calculation of central tendency using the mean was carried out.

4.9.2 BI-VARIATE ANALYSIS

Bi-variate analysis refers to the correlation test of two variables in the present study. It is one of the simplest forms of the quantitative statistical analysis. Spearman's rank correlation coefficient technique is used in the present study.

a) SPEARMAN'S RANK CORRELATION COEFFICIENT TECHNIQUE

The Spearman's rank correlation coefficient is one of the correlation coefficients that express a relationship between two variables (Ruyon, 1977; Lind et al., 2003). It is a non-parametric method of correlation coefficient. Correlation analysis is used as a statistical tool to describe the degree to which one variable is related to another (Levin, 1997). Spearman's rank correlation is a non parameter test which is used to measure the relationship between the independent variables of ordinal types and TPI. The Spearman's rank correlation is used to express the relationship between two variables (Ruyon, 1977; Lind et al., 2003).

i) RELIABILITY SCALE TEST

It is important to use the reliability test in this research. Reliability is the consistency of the measurement which measures the same way each time under the same conditions (Pallant, 2001). The purpose of using this method is to check the consistency of the scale and the connection to the answers obtained. A method used to check on the consistency is by using Cronbach's Alpha coefficient test. It is a sensitive test which allows a reading of more than 0.70 (Pallant, 1996; Nunnly, 1997). In the present study, Crnbarch's Alpha coefficient showed a reading of 0.78, which indicates that the scale and data obtained is reliable as shown in table 4.3.

Table 4.3: Reliability Analysis-Scale (Alpha)

Scale Mean of Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Alpha If Item Deleted
66.2727	30.7045	.2933	.7794
66.8788	28.6723	.5999	.7549
67.0303	29.0928	.4821	.7636
66.5152	28.6326	.5341	.7591
66.5758	27.6894	.5867	.7535
65.6061	29.4962	.4941	.7633
65.6970	30.0303	.4365	.7678
65.8182	29.9659	.4777	.7651
65.8788	30.9848	.4426	.7693
66.5152	29.0076	.4889	.7630
66.1212	32.6098	.1507	.7864
66.2424	30.7519	.4481	.7684
65.5152	33.4451	.0263	.7948
66.6667	32.1042	.2378	.7809
66.1818	33.3409	.1473	.7840
65.4848	33.8201	.0029	.7918
66.1212	33.8409	.0282	.7881
66.2424	30.1667	.3447	.7753

Reliability Coefficients

a) Cases=33

b) Alpha=.7833

c) N of Items=18

4.9.3 THE GENERAL REGRESSION MODEL

Regression analysis is a group of statistical methodology in regards to a response of "y" to a set of independent, or predictor, variables x_1, x_2,…,x_k… According to Mendenhall, and Sincich (2003) the purpose of using multiple regression analysis is to build a good model, a prediction equation relating to y for given values of x_1, x_2,…,x_k… and to do so with a small error of prediction and it is called regression model. Huan Yang, etc al. on the year of 2010 pointed out that regression analysis and various descriptive statistics are used to analyze data in performance measurement. Although multi regression is able to provide meaningful interpretation of the data, there is a major limitation in the number of simultaneous inputs and outputs that needs to be carefully handled (Vromen, 1995). Furthermore, regression analysis inherits the assumptions that all observers combine their input factors in the same way (Huan Yang etc al., 2010). It should be noted that multiple regression analysis not only measures but also predicts the performance of the projects. Ahadzie et al. (2008a, b) established a regression model to calculate the effect of the project manager's performance on the output of the project, in which the output is based on the environment, safety, customer satisfaction, quality, cost, and time. It is found that this research also calculate the factors impact of contractor's view on time performance of refurbishment projects. Pillai et al. (2002) stated that performance measurement on projects can evaluate the overall performance of a project at any point of time during its life cycle. In this research, time performance of refurbishment projects is being focused.

The general model of regression involving 46 independent variables (38 variables related to project characteristic and 8 related to EOT) in the analysis:

$$Y= \beta0 + \beta1\ x1+ \beta2\ x2 + \ldots\ldots\ldots\ldots..+ \beta48\ x48$$

Where

Y is the dependent variable which is Time Performance Index (TPI)

β0 is the y intercept of the line.

β0 ……. B48 regression coefficients.

X1 …….X46 independent variables.

Yeung et al. (2007) developed a partnering performance index to measure performance of construction projects in Hong Kong. Multiple regressions are a family of techniques that can be used to explain the relationship between continuous dependent variables and a number of independent variable (Pallant, 2002). Multi regression is based on correlation with sophisticated exploration of the interrelationship among a set of variables. In order to address a research question, multi regression can be used. The results of multiple regression analysis run using SPSS Version 11.5 will be discussed in the following paragraph. These contributions provide an innovative and useful approach to defining the time performance measurement in the refurbishment projects, which can be of great use for both research community and industrial practitioners.

4.10 SUMMARY

In conclusion, formulation of the research design is an important element in social science research. In order to produce high quality of research, it is essential for one to have a good understanding of basic social science. The present study used quantitative techniques in the research methodology. The quantitative technique used was sufficient to get the required information that could be used to build up theoretical framework by using statistical analysis. Three stages of data collection were used including literature

reviews, semi-structured interview and final questionnaires. The semi-structured interview provided a response of 20 interviewees from contractor firm, followed by 33 responses (33%) from final questionnaires. Due to limitations of each stage of the methodology, interrelated aspects of the survey, the statistical techniques were chosen for data analysis. This methodology may be useful for further research on the construction projects because the problem encountered was lack of secondary data and of identifying the target population.

The following chapter, Chapter Five will present the result of the analysis of the quantitative data obtained. This chapter discusses the results based on descriptive statistic which are based on final questionnaire.

CHAPTER 5

RESEARCH FINDINGS: DESCRIPTIVE ANALYSES

5.0 INTRODUCTION

This chapter presents the results of the analysis of the quantitative data obtained in the present study. The results of the analysis would be useful for verifying the theoretical framework. This chapter discusses the results based on descriptive statistic. The results are based on the final questionnaire survey.

5.1 FINAL DATA COLLECTION FOR TIME PERFORMANCE OF REFURBISHMENT PROJECTS

The pie chart indicates that the majority of respondents contained 9% of managing director, 12% of contract manager, 15% of operational manager, 6% of construction manager, 39% of project manager, 15% of engineer and 3% of quantity surveyor. The designations of the respondents were important to indicate their relevance and being the key person in refurbishment projects.

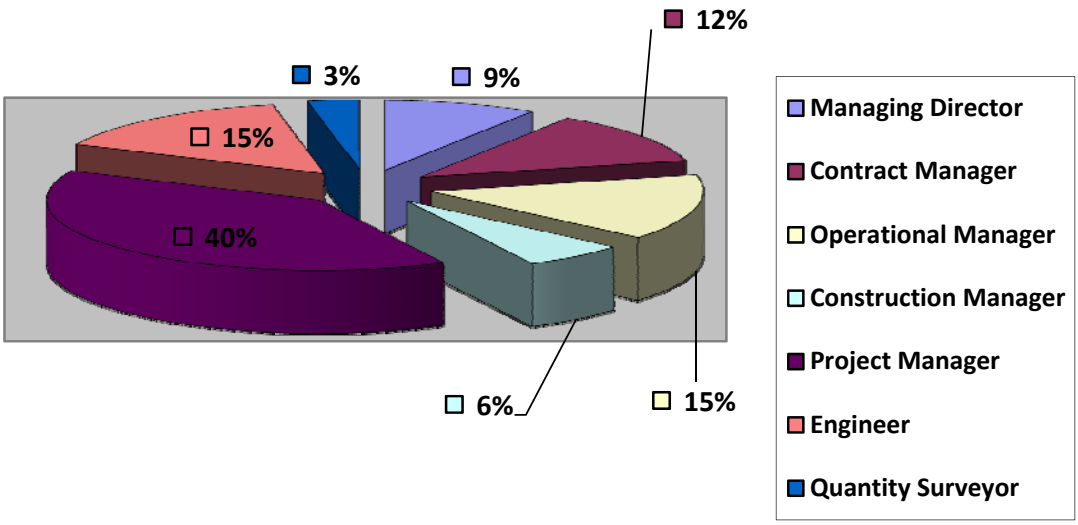

Figure 5.1: Job title of the respondents (n=33)

Figure 5.2 shows the number of year respondents have been involved in construction industry. Total respondents are 33 people. The graph shows that 61% of respondents have more than 20 years experience in construction industry, 15% of respondents have 16-2- years experience, 9% of respondents have 11-15 years, 9% of respondents have 6-10 years and 6% of respondents have less than 5 years experience in this industry. The result implies that the respondents have broad experience in construction industry.

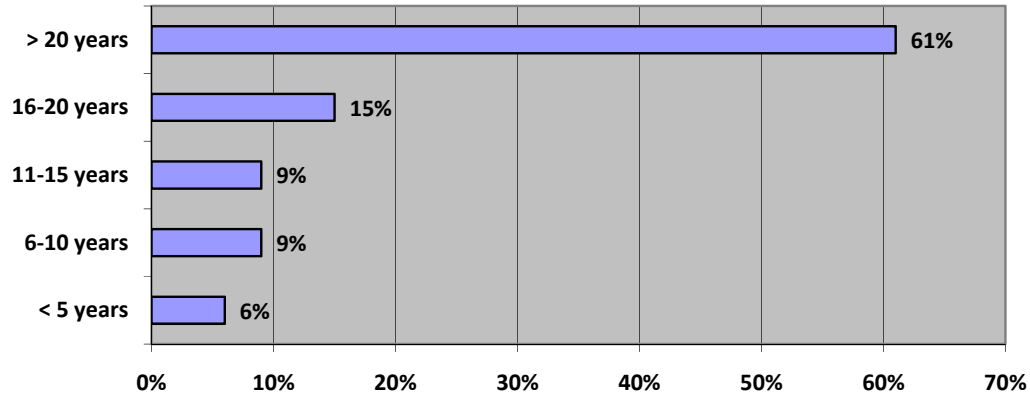

Figure 5.2: Number of years involved in the construction industry

Figure 5.3 shows the number of year respondents have been involved in refurbishment projects. The graph shows that 42% of respondents have more than 20 years experience in refurbishment projects, 9% of respondents have 16-2- years experience, 18% of respondents have 11-15 years, 18% of respondents have 6-10 years and 12% of respondents have less than 5 years experience in refurbishment area. The result implies that the respondents have broad experience in construction industry.

From the result, it indicates that more than 50% of respondents have more than 15 years experience of refurbishment works in Singapore and implies that the respondents have sufficient experience and knowledge in the area of refurbishment projects. From the respondents' profile, it could be concluded that the data obtained from questionnaire survey are rather reliable due to the background and experience of respondents.

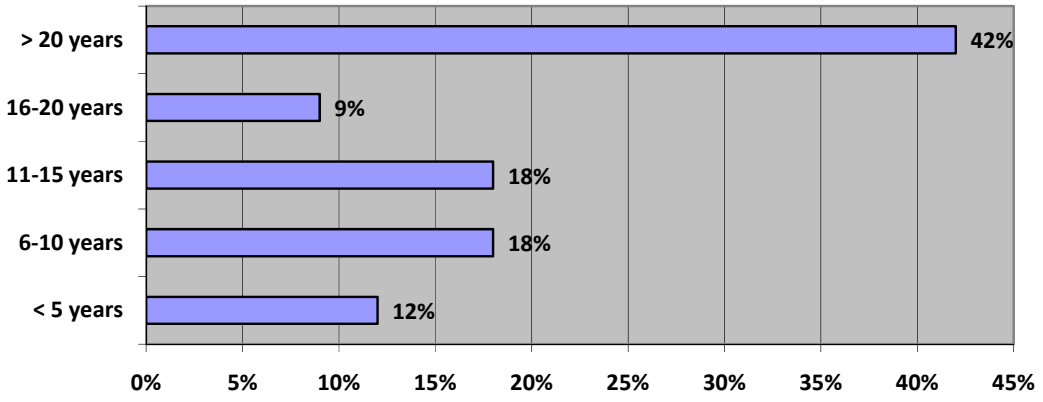

Figure 5.3: Number of years involved in refurbishment projects

5.2 TIME PERFORMANCE OF REFURBISHMENT PROJECTS IN SINGAPORE

In this session, 18 significant factors were tested during the questionnaire survey to know the relationship between project variables and the time performance of refurbishment projects in Singapore.

5.2.1 FINANCE RELATED FACTORS

The result suggests that the lack of working capital to start work (on the part of the contractor) is the topmost significant factor that affects the time performance of refurbishment projects.

Table 5.1: Finance related factors

Finance related factors	Mean, (N=33)	Percentage : Significant and extremely significant
Lack of working capital on part of contractor to start work	3.76	63.7
Delayed payment by main contractor to subcontractors and supplier which interrupt the progress of work	3.15	24.3
Nonpayment of salary to workers causing slow down	3.00	21.3

Money is a cascading resource encountered at various levels within the project implementation (Hashim et al, 2003). At the beginning of the project, cash flow problems stemmed from the lack of working capital. It could be due to poor estimation by the contractors on the requirement of working capital, with Hashim et al. (2003) noting that the estimation of minimum working capital was not a common practice done

by contractors. Lack of capital for some contractors could be due to the difficulty in securing loans from local banks (Shen and Song, 1998). This notion was further supported by Arditi et al. (2000) who hypothesized that large and established firms had a better chance of being supported by financial institutions and hence had fewer capital, cash flow and payment problems compared to smaller and newly established firms. Contractors' less renowned reputation and lacking track record in timely payments, led to their difficulty in gaining trust from suppliers and sub contractors. Due to insufficient working capital, contractors who are unable to make prompt payments will find it difficult to deal with subcontractors in the future, hence resulting in delay in their projects. Delayed payment by main contractors to subcontractors and suppliers can affect the projects' progress as capital is needed to buy materials and labor. Suppliers and sub contractors need to pay for material and labor fees in cash or are given a short period to do so. According to a respondent from semi structured interview, nonpayment of salaries is a form of impediment to progress. Abd. Majid and McCaffer (1998) found that delayed payments to suppliers and contractors as one of the most frequently quoted causes of non-excusable delay in literatures. It is important for contractors to emphasize on time performance, maintain and form a stable and long term relationship with suppliers and sub contractors, in order to improve their overall performance.

5.2.2 CONTRACTOR RELATED FACTORS

The result suggests that the lack of experience in the nature of work is a factor that affects the time performance of refurbishment, which is the percentage of significant and extremely significant that is recorded the highest among the contractor factors.

Second factors among the contractor related factors, is poor site planning and management.

Table 5.2: Contractor related factors

Contractor related factors	Mean, (N=33)	Percentage : Significant and extremely significant
Lack of experience in the nature of work.	3.52	48.5
Poor site planning and management.	3.45	36.4

Based on the feedback obtained from the semi structured interview, contractors indicated that many projects which were completed without delay had good and experienced construction team. Lack of experience could cause poor site planning and management (Okpala and Aniekwu, 1988). Three out of twenty respondents from the semi structured interview indicated that working experience is very important to refurbishment projects due to the projects' uncertainty and complexity. Mustapha and Naoum (1998) claimed that construction managers with more years of experience can manage the project more effectively, with project completion time being used as an important measure of effectiveness.

Chan and Kumaraswamy (1997) attributed poor site management and supervision to the deficiency of site planning and organization on part of the contractor. According to the NEDO report which was published in 1988, completing a construction project on schedule realistically reflected the contractor's ability in organizing and controlling the site operations, such as allocating resources and managing the flow of information between the designer and subcontractors. Poor contract management was one of the most important causes of delay in Nigeria as reported by Okpala and Aniekwu(1988).

Poor contract management could result in the incompletion of contractor planning which entailed cost control and overall site management. Poor contract management could be due to lack of experience and training at the top management level, inadequate technical personnel as well as low level productivity. Improper planning and management also appeared to be one of the important causes of construction delay in Jordan. This was attributed to the contractor's poor scheduling techniques, their unwillingness to invest in planning and control, as well as lack of professional construction managers (Odeh and Battaineh, 2002).

Therefore, the experience of contractors in the refurbishment projects is very important in the measurement of the overall performance of projects. Such experience is especially critical in ensuring timely completion since skills like good site planning and management to minimize the uncertainty and complexity are required.

5.2.3 DESIGNERS RELATED FACTORS

The result suggests that all the factors related designers are significant variable identified through the percentage of significant and extremely significant. The factor related to the state of completeness of design before the refurbishment projects commenced on site is the topmost significant variable identified from the TABLE 5.3.

Table 5.3: Designers related factors

Designers related factors	**Mean, (N=33)**	**Percentage : Significant and extremely significant**
Slow in decision making or frequent change in decision which affect the progress of work.	4.42	90.9
The state of completeness of design before the refurbishment projects commenced on site.	4.33	91.0

Andi and Minato (2003b) said that one of the attributes of design documents quality is the completeness of design. Ali (2006) stated that the availability and completeness of design documents are important because they provide most of the information. However, Andi and Minato (2003b) discovered that measuring the completeness of design based on perception is difficult. Designers are rarely willing to accept the fact that their designs are incomplete. On the other hand, the contractors are more likely to push the responsibility of poor performance to the designers, citing their design as incomplete. Hence, when the perceptions of the contractors were measured, it was found that the design for refurbishment work was generally to be incomplete. (Rahmat, 1997 ; Andi and Minato, 2003b).

The state of completeness of design before the refurbishment projects commenced on site is one of the topmost factors in affecting time performance of refurbishment projects in Singapore. Rahmat, 1997; Pin, 1991 mentioned that it is the nature of refurbishment with the unknown condition of the existing building that brings about the poor documentation of information. Rahmat (1997) found that majority of the refurbishment projects in UK were estimated to have 60 percent of design completed before work commencement on site. However, these studies were conducted in the UK. There is no published statistics for the completeness of design of refurbishment projects in Singapore. Ali (2006) found that measurement on the degree of completeness of refurbishment design was needed because it reflected the degree of uncertainty and the complexity of refurbishment projects. A project which has a lot of uncertainty is largely due to insufficient amount of information. Hence, the designers may find it hard to accomplish the design. Friedman and Oppenheimer (1998) discovered that the information which could be gained by designers for refurbishment projects were the history of the building, the structural system and the damage in the existing building.

This implied the importance of having sufficient information for commencing a refurbishment project. Without such information, the final design document cannot be completed as required.

Sufficient information is required to produce a complete design, before work commences on site. A good designer should be able to gather all needed information to complete the accurate design. Georgy et al. (2005a,b), Andi and Minato (2003b) argued that the completeness of design had an the effect on the performance of the projects.

From the result above, it suggests that the factors like slow decision making or frequent changes in decision make affect the progress of work and are of the same percentage with the factor of less authority of designers in decision making which stemmed from client interference. Both variables are closely related to each other. Feedback from the semi-structured interview with contractors indicated that slow decision making by designers is often the source of project delay. This problem which comes from the designer can hardly be solved by the contractors. Rahmat (1997) stated that refurbishment work necessitated a shorter communication time between sources of information held by the decision-makers and the implementers. The decision-makers, who are the designers, play an important role in fast decision making in order to avoid any delay in progress. Designer should know their authority in decision making and not be affected by client interference.

Okoroh (1992) noted that the inadequacy of specifications, design information and design changes made by the architects as the work progresses; made it difficult for

contractors to define the exact scope of work. Therefore, there is a greater tendency for completion time to vary from the original targets.

Slow decision making or frequent changes in decision lead to delays in refurbishment projects. Manavazhi and Xunzhi (2001, 2004) mentioned that during construction, a greater number of changes are found out compared to those found during design documentation. Most of the changes occurred in the construction stage are mainly due to change of preferences by the client, designer's error, change of regulations and change of site conditions. The inefficiency of the design process due to changes in construction stage influenced the overall performance of the projects.

Love et al. (1999) and Chapman (1998, 1999, 2001) maintained that the degree of change is one of the factors used in measuring defective design, which affects projects performance. Andi and Minato (2003a) surveyed 150 designers' opinions about the factors instigating design deficiencies in construction projects. The result showed that the design change was the most common factor contributing to design deficiencies. Similarly, Burati et al. (1992) used changes as an indicator to measure quality deviation in design and construction for both new-build and refurbishment types of projects. The result implied that the changes in design would affect the time performance of project.

In conclusion, slow decision making or frequent changes in decisions made which affect the progress of work, were very likely one of the topmost factors that affected time performance of refurbishment projects. This notion was proven in previous research and present studies, through the result from the final questionnaire and the semi structure interview. The state of completeness of design implied the importance of

having sufficient information for the commencement of refurbishment projects. Without it, the overall performance could be affected.

5.2.4 CLIENTS RELATED FACTORS

The result indicates that client's attributes is the topmost significant, identified through the percentage of significant and extremely significant. From the point of view of contractors in Singapore, client's attributes is the topmost significant factor affecting time performance of refurbishment project as it is shown as result in table 5.4.

Table 5.4: Clients related factors

Clients related factors	Mean, (N=33)	Percentage : Significant and extremely significant
Client's attributes	4.21	90.9

The client who lacks the ability to provide fast decision making, often creates problems for the projects. Client's indecisiveness of during the construction stage may affect time performance. It has been affirmed by Coles (1990) that slow authorization of the clients or indecisiveness due to a poor knowledge in construction and lack of communication skills would probably cause delay.

From the literature as stated, Lim and Ling (2002), Kometa et al. (1994), Chern and Bryant (1984) noted that the quality of client's attribute affected project performance. Ali (2008) noted that client interference was considered to cause more problems and disruptions to the contractors' works. High performance in project outcome is the aim for all clients. The objective of clients is different with contractors in that they want to have a building which is free from defect and is of high quality building. When it comes to decision making during the construction stage, construction knowledge is needed to construct more practically. The lack of knowledge of the clients may cause wrong

decisions to be made or is hinder decision making, hence causing project delays. The client's attributes affected mostly on refurbishment projects, compared to new building projects as uncertainty and complexity of refurbishment projects needed a longer and more detailed decision making during the construction stage.

5.2.5 CONTRACTUAL RELATIONSHIP RELATED FACTORS

The result suggests that the factor of poor in coordination between different parties involved in projects recorded the highest among the contractor factors. It is the percentage of significant and extremely significant.

Table 5.5: Contractual relationship related factors

Contractual relationship related factors	**Mean, (N=33)**	**Percentage : Significant and extremely significant**
Poor in coordination between different parties involved in projects.	4.15	90.9
Conflict / disputes between contractor and superintending officer.	3.52	54.6
Occupancy in a refurbished building.	3.91	75.8
Lack of teamwork among different parties working on project.	3.79	75.8

Coordination is the communication that involved decision making amongst key participants in the construction projects. Galbraith (1977) said that the greater the uncertainty of the task, the greater the amount of information that has to be processed during the execution of the task. It takes more coordination for execution of tasks in refurbishment projects. Coordination of refurbishment projects is not only concerned with performance, but also with efficiency. The project organizations need to filter the

method of implementing the coordination devices. They must be suited to the needs of the projects and the needs of the long-term objectives of the construction firms.

The co-ordination devices could be used to co-ordinate the decision making of key participants in decision-making, which could also help reduce the communication gaps in refurbishment project organizations. Poor coordination between different parties involved in projects could bring delay in refurbishment projects.

The conflict or disputes between the contractor and superintending officer is the least significant factor that affecting time performance of refurbishment in Singapore as indicated from the result above. The result is comparable to the research done by Ali (2008) as the factor is least significant. It indicated that almost 5 percent of the respondents (superintending officers) rated their relationship with contractors as poor or very poor. The relationship between contractor and superintending officer becomes strained when contractors do not perform as well as the superintending officer required; or when they do not carry out the work according to the drawing specification given. The relationship between contractor and superintending becomes very tense and it affects the time performance of construction process when key participants are not working towards the same goal of performing progressively. Due to uncertainty and complexity of refurbishment projects, the contractor need more cooperation with superintending officer, as compared to new build projects, since the contractor may encounter challenges in finding materials, skill labor, structural work of existing building, all of which are needed by the superintending officer to make a faster decision and ensure that the work is progressive.

Occupancy in a refurbished building is one of the significant factors that affect time performance of refurbishment projects in Singapore. Occupancy in a refurbished building would disturb the progress of construction work. It is agreed by Dauod (1997) that simultaneous operations done by building users would disturb the overall flow of refurbishment projects. As stated in literature, it can hardly determine the sequence of work as the occupants and project team share the same building. This creates problems for contractors in accessing building with big equipment. Quah (1988) mentioned that refurbishment work in an occupied building should not hold up the normal usage of the buildings. All the above mentioned issues may affect the time performance of a project. By not having full possession of the site, it is very difficult for contractors to complete any work which could bring project delays. However, the experience and knowledge of the contractor is very important to minimize any inconvenience to the building occupants and to minimize the time disruption during construction process.

Lack of teamwork among different parties working on project is a significant factor that affects time performance of refurbishment projects in Singapore. This is indicated from result above. Teamwork is very important in a construction project as the lack of it can create many problems and affects the time performance of a project.

According to Othman (2006), there are many types of poor coordination between different parties involved in the projects. Examples include the lack of teamwork among the project team, lack of communication between the S.O and contractor, uncooperative attitude towards the contractor and the lack of communication between S.O. The coordination between contractor and S.O. directly affects the time performance of

refurbishment projects. The lacking coordination between the project team leads to poor time performance of a project.

In a project team, every team member has their own objectives. For a consultant, it is looking for a project that will increase his level of professional development. Contractors mainly focus on the profit generated by the project while the owner is extremely interested to know that the project functions properly and that it is free from any defects. Different objectives of the team members can lead to poor time performance for refurbishment. Ward et al. mentioned that it is important for a client and superintending officer to set clear objectives, have communication channels with other parties and avid conflicting guidance to different parties. Dainty et al. (2003) defined communication as explaining issues to others through written, oral and non-verbal ways, with knowledge transfer to others within the team as an effective way to achieve the project goal. The study conducted by Saram and Ahmed (2001) revealed the importance of coordination between contractors in Hong Kong and Singapore. They also concluded that the respondents identified strategic activities and potential delays as the most important activity to achieve construction coordination. Due to lack of interaction of S.O and his staff, they are unable to complete the project supervision. The S.O. usually focuses on office administration, budget management, and human resources management which leave him little time to manage the project. Chalabi and Camp (1984) found that communication is very important among project team members as it was the reason for delays in developing countries which slowed down projects. Walker (1995) did an investigation on the factors affecting the construction time in Australia of which the communication management for decision making between the construction and design team was one of the seven variables incorporated in his time performance model.

5.2.6 SKILLED LABOUR RELATED FACTORS

The result suggests that the shortage of qualified or skilled labor is the topmost significant factor that affects the time performance of refurbishment projects. This is evident as the significance of skilled labor shortage recorded the highest percentage among other factors in construction.

Table 5.6: Skilled labor related factors

Skilled labor related factors	Mean, (N=33)	Percentage : Significant and extremely significant
Shortage of qualified/skilled labors.	4.52	90.9

(Moselhi, Khan, 2010) noted that the impact of labor productivity on completing projects within their targeted time and cost, play an important role in the industry. (Missbauer and Hauber, 2006,Moselhi, Khan, 2009) described that the success or failure of a project is predicated on the labor productivity rate of a project. (Brisco, 1988, Christian and Hachey, 1995) said that labor productivity has declined over the past few decades. Labor plays an important role in completing projects within the contract period. The contractors believed that the shortage of qualified and skilled labor workers for refurbishment projects is important in Singapore. Refurbishment projects are more intense in terms of site operations compared to new build projects. Quah (1992) noted that refurbishment projects consist of small labor intensive operations scattered throughout an existing building, often with tenants in occupation. According to feedback from interviews with contractors, shortage of qualified labors in refurbishment projects is the problem faced by contractors due to the uncertainty and complexity of the refurbishment work.

From the research done by Rahmat(1996) in the United Kingdom, only 6% of refurbishment projects suffer from shortage of skilled labor. Skilled labor in refurbishment projects is important in Singapore, as Table 5.6 shows.

The construction industry demands labors in areas where a lack of manpower can delay the progress in the construction of a project. Lack of skilled labors was found to be significant in this survey. The construction industry in Singapore is heavily dependent on foreign labor in refurbishment projects. As stated in literature, Singapore is highly dependent on foreign labor, especially in the construction industry. In conclusion, lack of skilled labors could be contractors' utmost concern in Singapore due to high dependence on skilled labor and the complexity of the projects.

5.2.7 MATERIAL RELATED FACTORS

The result suggests that the shortage of construction material is the significant factor that affects the time performance of refurbishment projects. Shortage of construction materials also contributes to the probability of project delays in refurbishment projects.

Table 5.7: Material related factors

Material related factors	**Mean, (N=33)**	**Percentage : Significant and extremely significant**
Shortage of construction materials.	4.36	93.9

The complexity of refurbishment projects could also be derived from the project environment. Winch (1989) called it environmental complexity and uncertainty. The

impact of weather, availability of labor and materials are some of the sources of environmental uncertainties which have major impact on construction progress.

Shortage of construction materials was also found to be significant causes of delay in refurbishment projects. This problem appeared to be very common in developing country as noted in number of earlier studies (Chalabi and Camp, 1984; Ogunlana et al., 1996; Elinwa and Joshua, 2001; Frimpong et al, 2003, Othman, 2006). Shortage of material was ranked as one of the top ten causes by three groups of respondent in a research done by Othman (2006). Othman (2006) found that the shortage of material is mainly due to local manufacturers not being able to cope with increased demand in the construction industry. Othman (2006) also noted that the shortage of material can delay the construction activities.

The research done by Othman (2006) contradicts with the result of a research done by Rahmat (1997). The research was done by Rahmat (1997) shows that the availability of material is unlikely to affect a project's timeline, and is not a major concern in the majority of refurbishment projects. It could be concluded that the problems of availability of material tend to be related to economic conditions, rather than inherent in refurbishment projects. Its impact, which could be reduced, demonstrates the need for construction firms to involve in strategic planning of refurbishment projects. It is beneficial for both the contractors and their suppliers to maintain long-term relationships.

Slow delivery of material to site is second top most significant factor from the result shown in Table 5.7. Othman (2006) noted that government regulations were found to be the cause of procurement delay of imported materials in Nepal. This was manifested in the form of delays in sanctioning the release of foreign currency required for importing materials and equipment, delays in customs clearance, bureaucratic procedures and red tape (Manavazhi and Adhikari, 2002) This problem has been recognized by Frimpong et al., (2003) and Assaf et al. (1995). In Singapore, the procedure of getting import permits can also be considered lengthy. A few agencies are involved in issuing approval. They are Ministry of International Trade and Industry (MITI) and Ministry of Finance and Customs. Fluctuations in foreign exchange can also be a cause of delay in procurement of imported materials. Slow delivery of material to site can be the result of shortage of construction materials.

5.2.8 PROJECT OR SITE RELATED FACTORS

The result suggests that all the project or site related factors are significant factors that affect the time performance of refurbishment projects. The percentage of significant and extremely significant recorded the highest among contractor factors. Uncertainty and complexity of the project, difficulty to gain access to site and existing building and necessary variation or additional works were ranked as topmost significant factors.

Table 5.8: Project or Site related factors

Project or Site related factors	**Mean, (N=33)**	**Percentage : Significant and extremely significant**
Uncertainty and complexity of the project.	4.85	100.00
Difficulty to gain access to site and existing building.	4.55	100.00
Necessary variation or additional works.	4.85	100.00

The result in Table 5.8 shows that the complexity of a project contributes to the delay of refurbishment projects in Singapore. According to Daud, one of the factors contributing to the uncertainty is the design process. Hence, the identification of the uncertainty factors related to the design process of refurbishment projects is needed because it could affect the projects' performance (Rahmat, 1997; Hashim, 2004). According to Ali (2008), it would be possible to assist the designers involved in refurbishment projects become familiar with the degree of risk and uncertainty that need to be mitigated in the design process of the projects. The uncertainty of refurbishment projects is an outcome of the unavailability of design information. Aho et al. (1998) stated that the availability of information during the design process affect the time performance of the refurbishment project because the designer can make wise decision to avoid any mistake in design.

Ali (2008) pointed out that refurbishment differs from new-build projects because design in refurbishment need to be matched with existing building conditions so that it can be compatible in structural, mechanical, electrical and builders works. The main problem arising from existing building is unavailability of the information. Furthermore, limited information about services contributes to uncertainty in refurbishment projects. The requirement for services is becoming stricter due to the advancement of automation and information communication technology (ICT). This requirement makes it harder to complete refurbishment of existing buildings. Information about building services is very limited because majority of services such as electrical wiring and piping are fixed in walls or ceilings. Insufficient information of services often forces the designers to make their decision based on rules of thumb and personal preferences (Stauffer et al., 1987). This could lead to errors such as error in calculation that results in major design failure.

Based on the result shown, difficulty in gaining access to site and existing buildings has become one of the most significant to affect the time performance of refurbishment in Singapore. Ali (2008) stated that the uncertainty in the availability of access to the work area can result in refurbishment works being more difficult compared with new-build projects. The Chartered Institute of Building (1987) pointed out that the difficulty of access to refurbishment projects sites could increase the level of uncertainty in refurbishment projects which affect the time performance of construction projects.

The site of refurbishment projects is located inside the existing building. The designers need to consider the accessibility of site during design stage such as doors, windows, stairs and lift. Mitropoulos and Howell (2002) mentioned that the level of uncertainty related to the access to buildings need more time and cost as time is needed to do coordination.

Rahmat(1997) stated that majority of refurbishment projects have to be carried out in sensitive premises such as embassies and government offices. A contractor working in such premises needs to take extra precautions in relation to sensitive documents kept in the premise. The CIOB (1987) cited that the difficulty of access to refurbishment projects sites could increase the level of uncertainty of the refurbishment projects which lead to time delay in construction process.

Necessary variation or additional works was ranked by contractors as the significant factor that contributes to time performance of refurbishment projects in Singapore.

Necessary variations or additional works were common causes of delay in all refurbishment projects. Kumaraswamy and Chan (1998) found that variation orders in general was the most common and principal sources of time overruns as identified in their survey involving 111 projects in Hong Kong. From the research conducted by Okpala and Aniekwu (1998) and Elinwa and Joshua (2001), variations were identified as the most significant factor that is affecting time performance.

Variation orders come from the changes made during construction. Okoroh (1992) noted that insufficient information in specifications, design and changes made by designers during construction; make it difficult for contractors to define the exact scope of their work. Therefore, it would lead to extra cost and time. Rahmat (1997) pointed out from the research on the degree of changes in design during the construction stage of refurbishment projects that about half the refurbishment projects started the construction work with only 60% of design being completed. It showed that the necessary variation or additional works are needed during construction stage and it can affect the time performance of refurbishment projects.

5.2.9 UNPREDICTABLE WEATHER CONDITION

The result suggests that all the external factors are insignificant and does not affect the time performance of refurbishment projects. The percentage of significant and extremely significant recorded the lowest among the contractor factors.

Table 5.9: Unpredictable weather condition

External factors	Mean, (N=33)	Percentage : Significant and extremely significant
Unpredictable weather condition.	1.70	3.00

Unpredictable weather has long been the cause of delay in construction projects. Weather is one of the most difficult and unknown factors that influences construction projects. Inclement weather was found to be the one of the factors that affects time performance after having semi-structural interviews with contractors.

Severe or adverse weather delays may be defined in the contract for construction. If it is not mentioned, actual weather delays are generally measured against the 10 years average for the specific time of year and the location of the project. If the number of actual delays days is not unusual for the area at that time of year, the contractor will not be entitled to a delay no matter how severe the weather is.

As mentioned in literature, the National Environment Agency stated that there is no distinct wet or dry season in Singapore. There is rain fall every month of the year. There are two rainfall peaks which are the northeast monsoon month of December and the inter-monsoon month of April. Singapore receives an average annual rainfall of 2342.2 mm a year. Rainfall in Singapore is unavoidable, according to a National Environment Agency report. From Othman's study on 2006, the finding indicated the importance of inclement weather to the time performance of irrigation and flood mitigation projects. Yogeswaran et al. (1998) analyzed 67 completed projects in Hong Kong and the extension of time occurred from inclement of weather. Therefore, rainfall cannot be

avoided in Singapore and it may affect the time performance of refurbishment projects. So there needs to be an alternative way to minimize the effect of rainfall to project time performance. When weather is the basis for requesting job delays, it is important that the job superintendent or project manager has been diligently indicating daily weather conditions properly on the daily time sheet or daily dairy. Weather conditions should be reported at the start of the workday, at noon and at mid-afternoon. If inclement weather delayed the start of work or forced an entire day's work to be put on hold, the report should contain an entry such as "No work day today due to extremely heavy rain from 6:30am to 10:30am. If any workers reported for work and awaited a decision on whether the day would be considered a "no work" day, that should also be noted in the report, identifying these workers by name. A call to the local weather bureau to determine the amount of rainfall during the period is also advisable.

As a conclusion, the unpredictability factor is the most significant factor to affect time performance of refurbishment projects in Singapore. It cannot be avoided as Singapore is in monsoon location, so an alternative way is required to minimize the effect of rainfall on a project in order for work to continue.

5.3 SIGNIFICANT FACTORS AFFECTING TIME PERFORMANCE OF REFURBISHMENT PROJECTS IN SINGAPORE

Initially 18 possible factors of affecting time performance of refurbishment projects were identified through extensive literature reviews and confirmed by semi-structured

interview among contractors directly involved in the refurbishment projects. Initially, these factors were grouped under nine categories.

In order to indicate the extent of the effect of each of the 18 factors affecting time performance, the respondents were asked to tick an appropriate rating on the scale of 1 to 5 against each identified factor. This reflected their opinion on the significance level of each factors.

As stipulated in the table 5.1, necessary variation or additional works was ranked by contractors as top one significant factor that contributes to time performance of refurbishment project in Singapore. Variation orders come from the changes made during refurbishment works. Okoroh (1992) noted that insufficient information in specifications; make it difficult for contractors to define the exact scope of their work. Therefore, it would lead to delay in refurbishment and it was the significant factor that affects the time performance of refurbishment in Singapore. The research conducted by Okpala and Aniekwu (1998) and Elinwa and Joshua (2001), variations were identified as the most significant factor as well that affecting time performance.

Uncertainty and complexity of the project is ranked as the top two among the factors that affecting time performance of refurbishment projects in Singapore. From the study of Rahmat on the year of 1997, the size of project could affect the level of complexity and uncertainty of the project. As the size increases, the complexity and uncertainty tend to increase. From the semi-structured interviews, the respondents have given the range of contract value for refurbishment projects that suitable to be taken for final questionnaire as the respondents agreed that $US 193,350.00 is the suitable contract value to determine the factors affecting the time performance index in Singapore due to its complexity and uncertainty of the projects varies with the contract value. The size of the project reflects the degree of complexity for a project.

Due to uncertainty and complexity of the refurbishment project, contractor has the difficulty of gaining information and changes made by architect, and the exact scope of work. It would cause delay in refurbishment projects due to uncertainty and complexity of the project as ranked by contractors as top two significant factors through final questionnaire.

Difficulty to gain access to site and existing building is ranked as the top three significant factors. Rahmat(1997) pointed out that the refurbishment works that carried out in sensitive premises such as embassies and government offices. Contractor need to take extra precautions to ensure the security of the documentation. The client may restrict the labor access from certain part of the building. Refurbishment progress is affected as it has many obstacles especially in shopping mall, contractors have to set the limit of available working time to work when is after business hour at night. The client and occupants may set the limit of working space available to work and to store material. In order to minimize the disruption, some refurbishment works have to be undertaken on fast track and it needs the good planning and management of contractor on accessibility to work on existing building without bringing disruption to the occupants. This factor is found significantly ranked by contractor in final questionnaire and it affects the time performance of refurbishment project in Singapore.

Skilled labor is ranked as top four among 18 factors as shown in table 5.10. Rahmat (1997) quoted that the difference between refurbishment and new build project is more obvious in the degree of intensity of site operations. Quah (1992) described the refurbishment projects consists of small labor intensive operations scattered around the

existing building. Otman (2006) found that the lack of skilled labor significantly affected the project performance and it becomes top ten causes for project delay. The construction industry is labor intensive and it does affect the progress of project directly. From the analysis done on previous chapter, Singapore construction indicates instability of labor supply and it is highly depending on foreign workers. As a conclusion, shortage of skilled labor is a significant factor that affecting time performance of refurbishment projects in Singapore.

Slow in decision making or frequent change in decision which affects the progress of work is ranked as topmost significant factor among 18 factors. From the result of semi-structured interview, slow decision making happens when it comes to variation or discrepancy on drawings, contract documents. Designers have to make decision on the design in order to run the progress smoothly. Besides that, Galbraith (1977), Simon and March (1958) and Cyert and March (1963) suggested that much of what goes on in organization is decision-making and information processing. A large number of people involved in decision-making reflect the limited authority and ability to process information. The larger the number of people involved in decision-making, the slower decision will be made. Slow decision making or frequent changes in decision making are caused by the designers' failure to commit to the design changes and wanting to take the responsibility of making wrong decision. It could bring to the result of project delay. Summary of the significant factors that affecting time performance of refurbishment projects in Singapore is shown as in table 5.10.

Table 5.10: Significant Factors That Affecting Time Performance

Rank	Factors Affecting Time Performance	Mean (n=33)	Percentage: Significant and extremely significant
1	Site-Necessary variation or additional works.	4.85	**100.0**
2	Site-Uncertainty and complexity of the project.	4.85	**100.0**
3	Site-Difficulty to gain access to site and existing building.	4.55	**100.0**
4	Skilled labour-Shortage of qualified/skilled labours.	4.52	**90.9**
5	Designers-Slow in decision making or frequent change in decision which affect the progress of work	4.42	**90.9**

5.4 CURRENT LEVEL OF TIME PERFORMANCE FOR REFURBISHMENT PROJECTS IN SINGAPORE

Time performance is important to all construction parties especially clients. It concerns the completion date and the sequence of work. As stated by Garsden (1995), construction time correlates with the actual cost because increasing time always results in additional cost to the whole project. In this study, time performance can be scoped by the owners' perception towards the actual time when compared with original planned time at the start of the project. If the actual construction time is less than the planned construction time, then the project is adjudged to be successful. Time performance index for each project can be defined as actual time of construction project with extension of time over the schedule time for construction project. For time performance index (TPI), a figure greater than 1.0 indicates that the time spent for the construction process of the refurbishment projects was exceeded. Time performance index for each project can be defined as the actual contract duration over original contract duration. The formula is used in the present study to calculate the time performance index as shown below:

$$\text{Time Performance Index} = \frac{\text{Actual Time}}{\text{Predicted Construction Time}}$$

The majority of refurbishment projects suffer from delays and escalating cost during the construction stage. This happens due to a high degree of uncertainty in defining the scope of work especially when handling a building that is badly damaged due to war or fire (Daoud, 1997). For the present study, the current level of time performance refurbishment projects is evaluated from the results of final questionnaire as Appendix C. Respondents were requested to indicate the project duration (Excluding extension of time and including extension of time, if any) for the particular project that they had chosen for the questionnaire. Time performance index equally to one indicates that the refurbishment project performed within the contract period. If the TPI is less than one, it brings the meaning that the project completed before the contract period. If the TPI is more than one, this indicates that the project took more than the estimated contract period to complete.

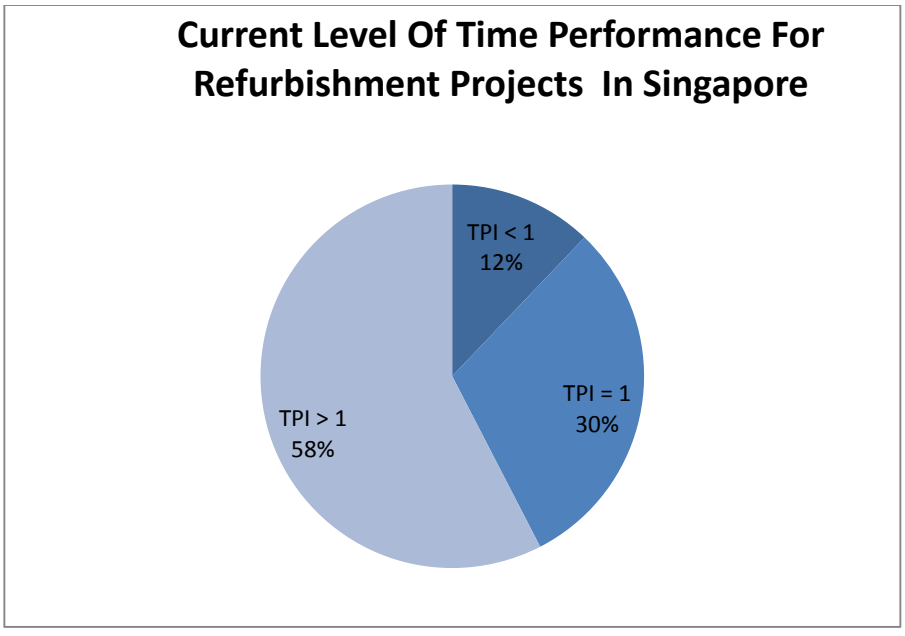

Figure 5.4: Current level of time performance for refurbishment projects in Singapore.

From the chart as shown above, it indicates the current level of time performance for refurbishment projects in Singapore. The result was taken from the final questionnaire for 33 refurbishment projects.

From the result as shown in the chart above, 58% of refurbishment projects took more than the scheduled time to complete. This shows that there are project delays in refurbishment in Singapore. 30% of refurbishment projects were completed within the contract period, indicating the low percentage for time performance of refurbishment scenario in Singapore. Only 12% of refurbishment projects are completed before the contract period from the result taken from the final questionnaire. The result above indicates the low productivity of refurbishment projects in Singapore. It is a result that needs to be emphasized as this is an issue that the government needs to be aware of and improve the overall performance of refurbishment projects in Singapore.

5.5 SUMMARY

Chapter 5 explains the final data collection for time performance of refurbishment projects by using different method of analyses such as graph, pie chart, and tabulation. It includes a mailed questionnaire survey involving contractors as respondents. The questionnaire survey consists of variables thought to have effects on project completion times. The questionnaire was prepared based on literature review and by interviewing experienced practitioners involved in refurbishment projects. In this section, 18 significant factors and its influence to the time performance of refurbishment projects in Singapore will be discussed.

In the following chapter, Chapter Six will discuss the research findings of correlation tests and multiple regressions. A prediction model for time performance of refurbishment is developed.

CHAPTER 6

DEVELOPING A PREDICTION MODEL FOR TIME PERFORMANCE OF REFURBISHMENT PROJECTS IN SINGAPORE

6.0 INTRODUCTION

The project variables that affect the time performance of refurbishment projects have been discussed in the previous chapters. The project variables are used to measure the time performance. Correlation test is used to describe the strength and direction of the linear relationship between two variables. Spearman's rank correlation coefficients were employed. The project variables are the independent variables whereas the time performance was the dependent variable.

The project variables are the factors that affecting the time performance of refurbishment projects in Singapore. They are used to measure the time performance of refurbishment projects.

However, literature reviews to date had shown that no such research has been carried out to test the factors affecting time performance of refurbishment in Singapore. However, it is beneficial for contractors to know the factors affecting time performance so that they can make improvements in performance.

In this chapter, the outcome of the correlation test is to fulfill the second objective of this study. The two objectives of this chapter are:

a. To examine the significant relationship between the project variables and time performance of refurbishment projects.

b. To discuss the implications of the findings.

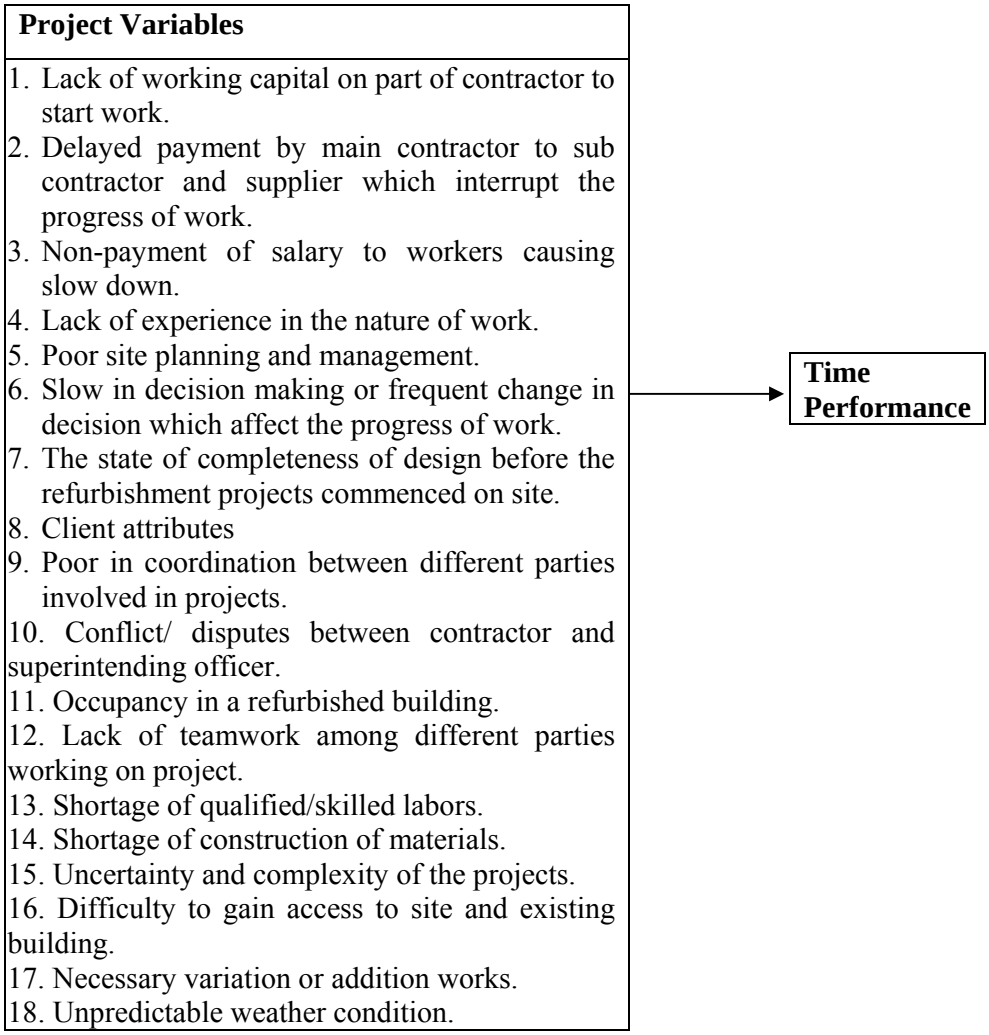

Figure 6.1: The Correlation Test Diagram between Project Variables and Time Performance.

The project variables were coded from not very significant (1) to extremely significant (5). The time performance variables were coded in ascending order from low to high, as shown in figure 6.2. The time performance does not vary with the project variables in the present study.

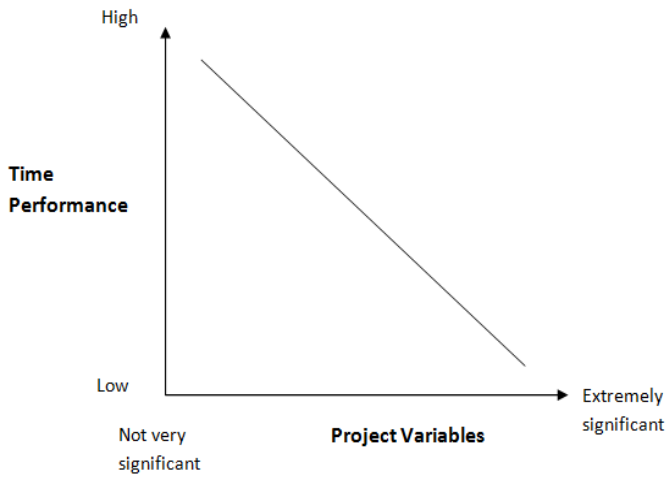

Figure 6.2: The Expected Results Diagram for Correlations Tests between Project Variables

6.1 CORRELATION ANALYSIS

Correlation is the outcome of the data analysis which is to describe the strength of correlation. The correlation coefficient is used to measure the significant relationship between the variables.

In order to measure the strength of relationship between the independent variables and TPI, correlation analysis is needed to be used. Eighteen independent variables are included into the correlation analysis to find out their relationship with time performance index. The concurrent effect of all the variables on TPI would be examined using multiple regression analysis. Spearman's correlation is used to analyze their correlation as shown in table 6.1. Data of ordinal type were analyzed using Spearman's correlation.

Analysis indicated on table 6.1 shows that three factors had significant correlation with TPI where p-values were less than α value of 0.05. Some factors were significantly correlated but correlations were not strong, while some factors were strongly correlated. The summary of the result of analyses is shown in Table 6.1.

Table 6.1: The Correlation Matrix between Project Variables and Time Performance

Factors Affecting	**Time Performance**
Finance-Lack of working capital on part of contractor to start work	0.244
Finance-Delayed payment by main contractor to sub contractor to subcontractors and supplier which interrupt the progress of work	0.299
Finance-Non payment of salary to workers causing slow down	**0.391***
Contractor-Lack of experience in the nature of work.	0.169
Contractor-Poor site planning and management.	0.204
Designers-Slow in decision making or frequent change in decision which affect the progress of work.	0.185
Designers-The state of completeness of design before the refurbishment projects commenced on site.	0.091
Client attributes	0.098
Contractual-Poor in coordination between different parties involved in projects	0.274
Contractual- Conflict/disputes between contractor and superintending officer	**0.375***
Contractual-Occupancy in a refurbished building.	0.130
Contractual-Lack of teamwork among different parties working on project.	
Skilled labour-Shortage of qualified /skilled labours.	-0.140
Material-Shortage of construction materials.	-0.031
Site-Uncertainty and complexity of the project.	**0.352***
Site-Difficulty to gain access to site and existing building.	0.006
Site-Necessary variation or additional works.	0.212
External- Unpredictable weather condition.	0.272
****Correlation is significant at the 0.01 level (2 tailed). ***Correlation is significant at the 0.05 level (2-tailed).	

6.1.1 NON-PAYMENT OF SALARY TO WORKERS CAUSING SLOW DOWN

The result in Table 6.1 shows that the factor of non-payment of salary to workers causing slow down is significantly correlated with time performance of refurbishment projects in Singapore. From the final questionnaire, majority of contractors has ranked the factor of non-payment of salary to workers causing slowdown to be significant influence to time performance. Money is a problem encountered at various levels within the project implementation (Hashim et al., 2003). Non-payment to workers is the significant problem leading to time delay. The result of the questionnaire shows that the non-payment to workers in Singapore significantly affected the time performance of construction projects. The construction industry is labor intensive and manpower significantly affects its progress (Ahmad, 2006). The construction industry in Singapore is heavily dependent on imported foreign labor from Malaysian, China and Indian. They have the practice to send back money to their hometown every month. Non-payment to workers may cause the decrease in team spirit and uncertainty for them. It directly affects the efficiency of work progress on site. Poor labor productivity was found to be one of the most important factors influencing time delay of construction projects in Indonesia (Kaming et al., 1997).

6.1.2 CONFLICT OR DISPUTES BETWEEN CONTRACTOR AND SUPERINTENDING OFFICER

The result in Table 6.1 shows that one of the contractual factors, conflict or disputes between contractor and superintending officer, is significantly correlated with time performance. From the final questionnaire, majority of the contractors have ranked fair significance on this factor and the effect on time performance of refurbishment as

shown. Lack of coordination, teamwork and poor communication can result in more conflicts or disputes between S.O. and contractor which will then lead to poor time performance. This factor of lack of coordination, teamwork and poor communication is discussed as above. Gardiner and Simmons (1992) suggested the disputes can be resolved by having good communication between parties in the project.

Arditi and Gunaydin (1997) described that the problems arising from discrepancy between drawings and specifications. Design errors or discrepancies in contract drawings and specification result in serious problems such as disputes and project delay. Contractors are not aware of the discrepancy on the drawing and specification and result to loss big amount of money. Disputes arise when there is no one willing to bear the responsibility. Kumaraswamy (1997) emphasized that unhealthy conflict can make the situation worse and result in unresolved issue in court. Superintending Officer is responsible to up keep the good team spirit among the project teammates and also to take on the significant role of coordinating and communicating effectively among the team members with the purpose of increasing the chance of project success.

6.1.3 UNCERTAINTY AND COMPLEXITY OF THE PROJECT

The result shows that there is a significant correlation detected between uncertainty and complexity of the project and the time performance. From chapter four, this factor was discussed and its contribution to time delay in refurbishment projects in Singapore is ranked high among contractors. Identification of the uncertainty factors related to the design process of refurbishment projects is needed because it could affect the projects

performance (Rahmat, 1997; Hashim, 2004). Ali (2008) pointed out that refurbishment differs from newly-built projects because design in refurbishment has to matched with existing building conditions so that it can be compatible in structural, mechanical, electrical and builders works.

6.2 DISCUSSION ON REGRESSION MODEL OF REFURBISHMENT PROJECT

The output of analysis showing regression coefficient values using data from refurbishment projects is shown in table 6.2. This coefficient indicates the degree of association between the independent variable and dependent variable and their importance. Regression also provides magnitude and direction (positive and negative) to each independent variable.

Table 6.2: Coefficients (a) of Regression Analysis in Refurbishment Projects.

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Co linearity Statistics	
	β	Std. Error	Beta			Tolerance	VIF
(Constant)	.945	.320		1.174	.025		
Non-payment of salary to workers causing slow down	.076	.029	.412	2.607	.014	.948	1.054
Conflict/disputes between contractor and superintending officer.	.035	.031	.190	1.124	.027	.829	1.207
Uncertainty and complexity of the project.	.076	.070	.180	1.088	.028	.864	1.157

a Dependent Variable: Time Performance Index

From the table 6.2, the p-values of certain variables appeared to be less than 0.05, thus the null hypothesis is accepted and not all β values are equal to zero. From the regression model shown in Equation 6.1, non-payment of salary to workers causing slow down and uncertainty and complexity of the projects had the most significant effect on TPI where the coefficient for both of them are 0.76. As the model was developed based on constant, TPI of factors of nonpayment of salary causing slow down and uncertainty and complexity of the projects were higher by 0 .76 if other variables are fixed. This means that +1 day of delay on nonpayment of salary to workers would increase TPI by 0.76 if other variables are fixed. The construction industry is labor intensive and manpower significantly affects its progress (Ahmad, 2006). The construction industry in Singapore is heavily dependent on imported foreign labor from Malaysian, China and Indian. Non-payment to workers may cause the decrease in team spirit and uncertainty for them. It directly affects the efficiency of work progress on site.

Table 6.3: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.560(a)	.314	.243	.13331

a Predictors: (Constant), Uncertainty and complexity of the project., Nonpayment of salary to workers causing slow down and Conflict/disputes between contractor and superintending officer.

b Dependent Variable: Time Performance Index

The final regression can be written as follows:

TPI: 0.945+ 0.076Finance-NP + 0.035Contractual-CD + 0.076Site-UC (6.1)

Coefficient of multiple regression, R^2 =0.787

Based on R^2 value, 78.7% variations in TPI of refurbishment are explained by three independent variables selected by the regression analysis. The coefficient in front of the independent variable, β_i measures the changes in TPI for every 1 unit increase of that particular variable when all other independent variables in the model are held fixed. The value β_0 =0.945 represents the y-intercept of the line which indicates that without any three significant factors, uncertainty and complexity of the project will be presented.

Non-payment of salary to workers causing slow down and conflict/disputes between contractor and superintending officer completed relatively faster than original contract duration. The model was based on 33 sets of questionnaire from contractor. Based on equation 6.1, TPI of refurbishment is affected due to uncertainty and complexity of the project, non-payment of salary to workers causing slow down and conflict or disputes between contractor and superintending officer. These factors caused an increase in TPI value by 0.076, 0.035 and 0.076 respectively. As p-value of the factors is less than α value of 0.05, thus null hypothesis is rejected. This leads to the conclusion that the model is statistically useful at 95% confidence interval. The value R^2 =0.787 implies that the factors shown in equation 6.1 explained 78.7% of the total sample variations of TPI. The output of multiple regression analysis using SPSS is provided in Appendix E.

Mendenhall and Sincich (2003) reminded that the F-test is usually regarded as a test the model must pass in order to merit further consideration. All models shown in Equation

5.1 satisfy the requirement. Furthermore, they had R^2 values higher than 0.7, which according to Lind et al.(2003), have high predictive powers.

6.2.1 THE VALIDITY OF REGRESSION MODELS

The validity of many of the inferences associated with a regression analysis depends on the error term, €. In testing hypotheses about a set of regression coefficients and if any assumptions had been violated, Hair et al. (1998) and Mendenhall and Sincich (2003) recommended three assumptions to be made and checked.

Assumptions made on error team, £ are:

i. £ is normally distributed with a mean of "0",
ii. The variance denoted is constant, and
iii. All pairs of error terms are uncorrelated (independent)

Hair et al. (1998) described that the principal variance as the residual which is the difference between the observed and predicted values for the dependent variable. Plotting the residual versus the independent or predicted variables is a basic method of identifying assumption violations for the overall relationship. The normality of residuals also needs to be checked to see if they were normally distributed.

Figure 6.3 and figure 6.4 do not exhibit any particular trend where there were no dramatic increases or decreases of the plots. The residuals look randomly distributed between +3 and -3. This confirmed that the residuals are normally distributed with mean of "0". All these diagnoses indicated no conspicuous deviation from the underlying assumptions of a linear model, leading to the conclusion that the models were reliable and realistic.

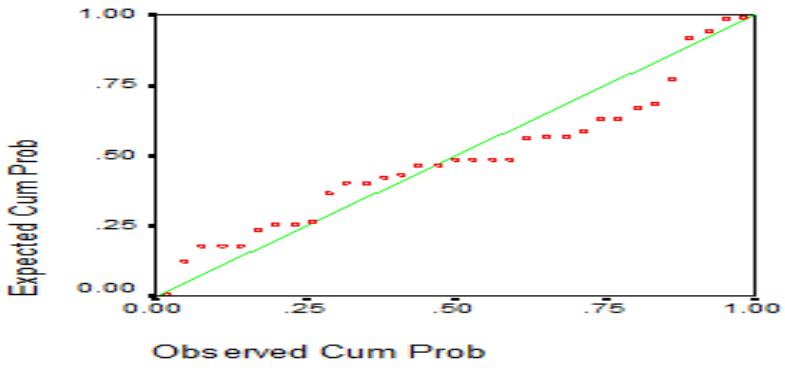

Figure 6.3: Regression Standardized Residual

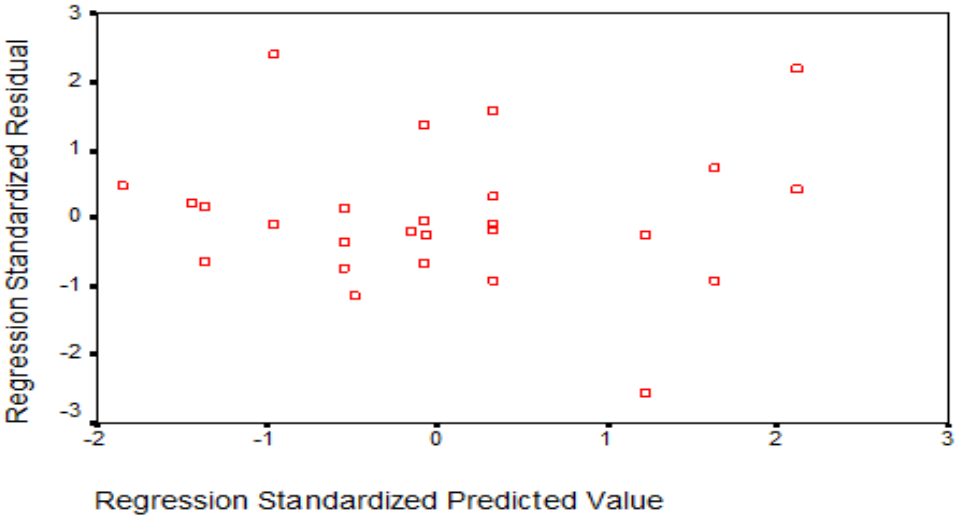

Figure 6.4: Dependent variable-Time Performance Index

6.3 SUMMARY

Chapter 6 explained the research finding of correlation tests which was conducted upon completion of the descriptive analyses. By using statistical package for the social sciences (SPSS), all the data has been analyzed through reliability scale test, correlation analysis and regression. The prediction model for time performance of refurbishment projects in Singapore as below:

TPI: 0.945+ 0.076Finance-NP + 0.035Contractual-CD + 0.076Site-UC

In the following chapter, Chapter Seven will discuss the conclusion of each chapter and conclusion for each objective to be achieved in this study and recommendations for future research will be reviewed.

CHAPTER 7

CONCLUSION AND RECOMMENDATION

7.0 INTRODUCTION

This study is about the factors affecting time performance of refurbishment projects in Singapore. It focuses on the time performance of refurbishment projects.

7.1 CONCLUSION OF THE STUDY

This chapter summarizes the main conclusions and re-states the main objectives of this study. In addition, recommendations are made to direct the research efforts into other potential areas of refurbishment management requiring examination.

7.1.1 OBJECTIVE 1: TO STUDY ON THE CURRENT CONDITION OF TIME PERFORMANCE OF REFURBISHMENT PROJECTS IN SINGAPORE.

Time performance is important to all construction parties, especially clients. It related the completion date and the sequence of work. Time performance index for each project can be defined by the schedule time for construction project over actual time of construction project with extension of time. Time performance index (TPI) with a figure greater than 1.0, indicates that the time spent for the construction process of the refurbishment projects was exceeded.

The current level of time performance for refurbishment projects in Singapore is evaluated and the result shows that more than half of the projects involved exceeded the time completion time. A small percentage of projects completed earlier than the completion time. This should bring the awareness to the government to do some improvement on the overall performance of refurbishment projects in Singapore.

7.1.2 OBJECTIVE 2: TO IDENTIFY THE FACTORS THAT AFFECTING TIME PERFORMANCE DURING THE CONSTRUCTION STAGE OF REFURBISHMENT PROJECTS IN SINGAPORE.

The identification of factors that contributes to time performance was made through an extensive review of literature. The verification of the factors and project characteristic was made through semi structured interview. The identified factors were validated during the final questionnaire. Eighteen factors were identified as dominant in construction process of refurbishment projects. They are:

i. Finance-Lack of working capital on part of contractor to start work
ii. Finance-Delayed payment by main contractor to sub contractor and supplier which interrupt the progress of work
iii. Finance-Nonpayment of salary to workers causing slow down
iv. Contractor-Lack of experience in the nature of work
v. Contractor-Poor site planning and management
vi. Designers-Slow in decision making or frequent change in decision which affect the progress of work
vii. Designers-The state of completeness of design before the refurbishment projects commenced on site

viii. Client attributes

ix. Contractual-Poor in coordination between different parties involved in projects

x. Contractual- Conflict/disputes between contractor and superintending officer

xi. Contractual-Occupancy in a refurbished building

xii. Contractual-Lack of teamwork among different parties working on project.

xiii. Skilled labor-Shortage of qualified /skilled labors

xiv. Material-Shortage of construction materials

xv. Site-Uncertainty and complexity of the project.

xvi. Site-Difficulty to gain access to site and existing building.

xvii. Site-Necessary variation or additional works

xviii. External- Unpredictable weather condition

Initially 18 possible factors of affecting time performance of refurbishment projects were identified through extensive literature reviews and confirmed by semi-structured interview among contractors directly involved in the refurbishment projects. Top five most significant factors through final questionnaire which ranked by contractors are discussed in the previous chapter as followed.

a) Site-Necessary variation or additional works.
b) Site-Uncertainty and complexity of the project.
c) Site-Difficulty to gain access to site and existing building.
d) Skilled labor-Shortage of qualified/skilled labors.
e) Designers-Slow in decision making or frequent change in decision which affect the progress of work.

7.1.3 OBJECTIVE 3: TO ESTABLISH A PREDICTION MODEL ON TIME PERFORMANCE BASED ON IDENTIFIED FACTORS

The research finding of correlation tests which was conducted upon completion of the descriptive analyses. By using statistical package for the social sciences (SPSS), all the data has been analyzed through reliability scale test, correlation analysis and regression.

From the data analysis, three variables were found to be significantly correlated with time performance variable. They are non-payment of salary to workers causing slow down; conflict and disputes between contractor and superintending officer; and uncertainty and complexity of the project. From the correlation analysis result, a prediction model was developed using multiple regression analysis. The result indicated that to control the time performance of refurbishment projects in Singapore, three variables need to be given more attention through the equation of *Time Performance= 0.945+ 0.076Finance-NP + 0.035Contractual-CD + 0.076Site-UC.*

In contrast, the time performance variables were coded in ascending order from low to high. Based on the finding, the time performance does not vary with project variables in the present study. The less significant of a variable, the higher time performance is achieved. The establishment of relationship between time performance and sets of significant factors are proven.

These contributions provide an innovative and useful approach to defining the time performance measurement in the refurbishment projects, which can be of great use for both research community and industrial practitioners. Based on the discussion of this research, academic researchers community and industrial practitioners can clearly

define the research contents, easily choose proper framework and techniques for further studies and come out with a more comprehensive performance measurement methods.

7.2 MAIN CONCLUSION OF THE STUDY

The study began with an analysis of the literature. The majority of studies in the area of construction management emphasize on the new build project management rather than refurbishment project management.

The refurbishment construction process is one of the most challenging tasks faced by the contractors. Refurbishment project is restricted by the existing condition of the building which makes the task more complex.

From the literature, a theoretical framework was constructed for the study. Due to lack of literature of refurbishment in Singapore, a semi-structured was carried out with 20 experienced practitioners in order to verify the variables. A preliminary questionnaire survey was conducted based on the theoretical framework. In the survey, 33 contractors responded to the questionnaire.

The three stages of the data collection process, which consisted of literature review, semi structured interview, final questionnaire survey. The study moved on to analyze the time performance of refurbishment projects by using 18 variables.

7.3 RECOMMENDATIONS FOR FUTURE RESEARCH

There are many ways of inquiry that can flow from this work. It would be good if the further study using the same research methods by gaining data.

1. An in-depth study is needed to identify the factors that significantly affected the time performance of refurbishment projects. The identification of important variables could be used for the development of a prediction model.

2. This study should be carried out in other countries. A comparative study is required to further confirm the research findings and the theoretical framework.

3. Similar research should be carried out using different profession as respondents such as consultant team and client. The results obtained could be compared with the present study.

4. While this study focuses on construction time, same method can be applied to examine the factors that affect the cost and quality of the refurbishment projects. It would be good to find out the effect on the construction time can also affect the cost as well as the quality of refurbishment projects.

5. A similar study should be carried out with smaller size of refurbishment projects i.e. less than $US 78,660.00. The main aim of this study would be to study

whether the smaller refurbishment projects has the same factors affecting time performance of refurbishment.

6. A study of refurbishment projects using different types of procurement system such as construction management and project management.