THE INTEGRATION OF MAINTENANCE REQUIREMENT INTO DEVELOPMENT PLAN OF WORK FOR GOVERNMENT BUILDING

by

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BS	British Standard
GDP	Gross Domestic Productc
IT	Information Technology
JPAK	Government Asset Management Committee
mySPATA	Immovable Asset Mmanagements System
NAFAM	National Asset and Facilities Management Convention
NAPIC	National Property Information Centre
PAM	Persatuan Akitek Malaysia
PWD	Public Work Department
RIBA	Royal Institute of British Architect
RICS	Royal institute of Chartered Surveyor
RII	Related Important Index
UiTM	Universiti Teknologi MARA

INTEGRASI KEPERLUAN PENYENGGARAAN DI DALAM PEMBANGUNAN RANCANGAN KERJA BAGI BANGUNAN KERAJAAN

ABSTRAK

Keberkesanan penyenggaraan bangunan amat mustahak bagi mengurangkan kesan kerosakan bangunan dan kos penyenggaraan. Penyenggaraan yang berkesan memberikan satu kelebihan kepada organisasi awam bagi mengurangkan kos penyenggaraan aset bangunan secara keseluruhannya; meningkatkan tahap keselamatan penghuni dan pengguna; memanjangkan jangka hayat bangunan; meningkatkan nilai perlaburan aset bangunan kerajaan. Sementara penyenggaraan berkesan diamalkan oleh pihak berkuasa secara global; namun di Malaysia ianya boleh dilihat berada pada tahap berbeza bagi penyenggaraan bangunan awam. Negara maju seperti United Kingdom, Amerika Syarikat, Jepun, dan juga Singapura mengamalkan penyenggaraan bangunannya yang lebih maju berbanding Malaysia yang sedang membangun. Kajian ini dibuat bertujuan untuk membina sebuah rancangan kerja penyenggaraan bangunan di peringkat rekabentuk berdasarkan kajian idea terbaik, teori terbaik yang diamalkan oleh negara maju yang lain. Tambahan daripada itu, bancian soalan yang terperinci telah diajukan kepada pemain utama di dalam industri pembinaan di Malaysia dan juga satu perbincangan berkumpulan telah dijalankan. kajian ini juga mengenalpasti informasi berkaitan yang diperolehi daripada bancian kerja-kerja lapangan. Kajian ini melibatkan seramai 312 orang peserta (38% daripada 820 orang yang dikenalpasti di peringkat awal kajian). Analisa kajian mendapati amalan kerja penyenggaraan bangunan di Malaysia masih bersifat ‘reactive’. Meskipun kerajaan Malaysia telah mula mengadaptasikan amalan penyenggaran

bersifat ‘proactive’ namun masih terdapat banyak salah anggap terhadap maksud sebenar konsep amalan penyenggaraan ‘proactive’ di kalangan pemain utama di dalam industri ini. Pernyataan ini selari dengan keputusan kajian yang menemukan senario penyenggaraan bangunan di Malaysia banyak dipengaruhi oleh salah tanggapan tentang konsep penyenggaraan ‘proactive’. Hal ini menyebabkan ramai pemain utama dengan mudah mengabaikan aspek penyenggaraan yang bersifat ‘proactive’ tanpa mereka sedari. Oleh yang demikian, kajian ini mengenalpasti beberapa pilihan yang boleh diadaptasikan bagi memastikan konsep sebenar penyenggaraan dipertimbangkan di peringkat rekabentuk bangunan. Selain itu juga, kajian ini menyumbang kepada pihak kerajaan di dalam aspek mengadaptasikan polisi penyengaraan yang bersifat ‘proactive’ di peringkat rekabentuk; memberikan kesedaran kepada pemain utama di dalam projek pembinaan; dan juga sebagai garispanduan kepada pemain utama di dalam mengadaptasikan rancangan kerja penyengaraan di peringkat rekabentuk.

THE INTEGRATION OF MAINTENANCE REQUIREMENT INTO DEVELOPMENT PLAN OF WORK FOR GOVERNMENT BUILDING

ABSTRACT

Effective building maintenance management is vital in reducing the impact of building defects and costly building maintenance work. Such practice can provide significant contributions to the public sector in term of cost reduction; improved effectiveness and efficiency in maintainance works; increasing safety and well-being of the occupants and users; expanding the life of building stocks; and expanding the value of investment for government building assets. While building maintenance is widely practiced among various authorities globally; in Malaysia, however, some differences in level of commitment are experienced in public building maintenance management. In developed countries such as the United Kingdom, United States of America, Japan, and Singapore, building maintenance management are more advanced; whilst, by contrast, the maintenance practice in Malaysia is still emerging. The aims of this research are to integrate and develop a maintenance plan of work for public building through lessons learned from an extensive survey of research literatures on some of the best ideas, approaches, theories, advanced practices practices by the developed countries. In addition, an extensive questionnaire survey of key players and focus group discussions are also held involving the key players in Malaysia. The survey questionnaires involved 312 key players (38% out of 820 predetermined participants). The analysis showed that the current practice of building maintenance in public building in Malaysia is still in reactive approach. Despite the Malaysian government adoption of a proactive maintenance approach, unfortunately

there some are misunderstanding among the key players on proactive maintenance approach. This is evident in the research results that demonstrated the key players` lack of understanding of the proactive maintenance management approach. Many of the key players are either ignorant or have insufficient awareness of proactive maintenance approach. This study showed several options that can be adopted to ensure building maintenance is considered at the very beginning of the stage of building project especially at design stage. The contribution of this study is useful for the government to adopt a more proactive building maintenance policy at design stage; to give awareness on proactive building maintenance to the key players in their construction project; and as a guide to the key players to adopt maintenance plan of work at design stage.

CHAPTER 1

RESEARCH BACKGROUND

1.1 Introduction

In Malaysia, building maintenance is not considered as a factor of production but rather a burden.The trend show that the property owners or stakeholders are frequently intended to keep building maintenance expenditure to a minimum as possible. This clearly affected building performance, fast deterioration and harmful to building occupants safety. Therefore many researchers insisted that the building maintenance management should be broader in practices and not only focus after building completion stage (Shardy et al., 2011, Ramly et al., 2006, Hashim et al., 2012, Abdul-Rashid and Ahmad, 2011). Building maintenance should be concurrently emphasised and commenced at the initial stage of the building development process. The aim of building maintenance is to produce a building with maintenanable, reliable, durable, and economical to maintain. Therefore, the building should be constructed to reduce any probability of building defects by minimising the costs of the unnecessary maintenance work. Therefore, adherence to building maintenance requirements is a must in building development process.

To realise these objectives, the line of communication among the owners or stakeholders of the building, designers and property managers (after this, referred as key players) should be widely opened. It is beneficial to the key players to have efficient maintenance activities on their property investment. To achieve efficiency in maintenance activities, it is important to apply an effective maintenance strategy at the

very early stage of the building development process. This could furthermore maximise the aesthetic and economic value of the asset. Therefore, the building should be designed to be in a state of maintainable, durable and reliable for future use.

The fundamental problem in building maintenance in Malaysia is ineffective building maintenance procedures. In general, the implementation of current procedures in building maintaince is reactive in nature (Mohd Zulakhmar, 2006). Even former prime minister of Malaysia, Tun Abdullah Ahmad Badawi had notably highlighted that it is very common to see most of the government buildings were not regularly maintained, and he suggested that early detection and identification of defects and damages in building is of paramount importantance in building development process. He also stressed that the building maintenance guidelines need to be prepared for the future betterment.

Ignoring building maintenance at early stage will result in fast deterioration of the building physically, and as a consequence it will be costly to maintain. Furthermore, defective and deteriorated buildings can be harmful to the building occupants and their safety. Further, this condition also may cause losses of profit in term of property investment. Evidences from the previous researches proved that most of the building defects (physical deterioration) in Malaysia had originated regularly from ineffective design decision particularly in the context of requirement of future building maintenance in the building design (Yacob, 2005a, Ramly et al., 2006, Isa et al., 2012, Hassan et al., 2011b). Therefore, it is very vital to adopt building maintenance requirements in building development stage especially at design stage.

In Malaysia, it is more common for research to focus on building maintenance performance such as efficiency of building maintenance system, components, and materials. Also, many of the research commonly concentrate on building maintenance implementation at operational stage or at technical level. However, the fundamental maintenance problem requiring a proactive maintenance procedure is still under-researched (Yacob, 2005a, Ramly et al., 2006, Abdul-Rashid and Ahmad, 2011). This research intends to fill the gap; it shall explore the advantages of building maintenance at the planning level especially at design stage. The focus of this study is to integrate the building maintenance requirements into maintenance plan of work at design stage for government building.

1.2 Background of Study

As an advanced developing country, Malaysia has witnessed rapid growth in the value of fixed assets in term of building stocks. The Department of Statistic Malaysia (2013), indicated that in the last five years Malaysia has shown a tremendous increment on its building stock assets. In line with that, building maintenance programme is also on the increase in term of demand. However, maintenance activities in Malaysia indicated a rather unhealthy scenario, whereby the procedures of the current maintenance are more reactive in nature. Several studies showed that many government agencies performed buiding maintance on ad-hoc basis (Lateef, 2009, Olanrewaju et al., 2011). The consequences are evident from the maintenance expenditure of the Malaysian national budget. The maintenance expenditure is increased almost every year. Further compounding the problem is that the current building maintenance policy in government sector is still on the reactive basis

(unplanned maintenance). For example, the budget determination for building maintenance is not based on the actual maintenance need; but rather, the government of Malaysia is carrying reactive building maintenance policy in maintenance budget determination (Mohd-Noor et al., 2011, Olanrewaju and Abdul-Aziz, 2015, Mohd Zulakhmar, 2006). The consequences, being that the Government of Malaysia is currently facing a high number of building defects, increase of unnecessary building maintenance works, high building maintenance costs. Further compounded by incompatible programs for building maintenance, underutilization of properties, and diminishing user satisfactions.

There are five issues in building management in government sector have been highlighted. These are lack of unit or department for property management within government ministries, lack of expertise, lack of proper strategies, lack of proper management procedures and lack of IT usage (Shardy et al., 2011). Among these problems, the lack of understanding of proper strategy for building maintenance during designing a building is selected to be studied in this research. This is because building maintenance in Malaysia have indicated inefficiencies and ineffectiveness due to poor consideration of maintenance requirement during designing process (design stage) or implementation process (operational stage). However, to-date in Malaysia, as far as the researcher is aware of, there is yet to be a detailed research on the maintenance aspect at design stage to address the maintenance issues.

Lateef (2009), concluded that despite the successive Malaysian government policies on construction sector, ineffectiveness and deficiency issues in managing building maintenance procedures prevailed (Lateef, 2009). Furthermore, this scenario paints a situation of substantial weaknesses where the fundamental issue is still

ineffectively tackled. There are people in contruction industry that may not fully understand and realise the significance of having effective building maintenance upon future building performance. Proactive building maintenance can greatly affect and influence the value of property investment. If the intention of the government is to maximise profit from the building construction investment, it should be a requirement to impose a proactive maintenance strategy at the early stage of building development. The government must prioritise a proactive maintenance policy for future building maintenance as one of the important factor at design stage.

Building maintenance is a combination of technical and admistrative actions to ensure the items and elements of a building are up to an acceptable standard to perform its required function at minimum cost (Seeley, 1987). To achieve efficiency in building maintenance, it must be considered and interactively implemented at the very early stage of building development process. The maintainability aspect of a building is mandatory to consider during the design stage to reduce defects in the future. In the scope of maintenance policy, the condition of a building is assumed as central to the notion of the building performance and it must be considered entirely in the building life cycle (Chanter and Swallow, 2008). Therefore, if buildings were designed accordingly to the future maintenance needs and requirements, then occurances of building defects can be minimized.

Building maintenance has great relation to building performance. For effective building maintenance, proactive policies and procedures should be applied to ensure optimization of building performance throughout its life span. Building performance is a derivation from good quality building products. Building

performance is also attributed to the building physical, economics and functional requirements. One of the major factors that effect building quality are the building design (Chew et al., 2004). In Malaysia, building defect is rather common in construction industry, especially in public building construction. Most of the rectification works due to poor maintenance consideration has costed the government a lot of money (Hassan et al., 2011a). Meanwhile in other country, for example, in Hong Kong, up to 40 percent of rectification works were related to the building design, 30 percent were due to building construction faults, and lastly 30 percent of the defects problems were due to mismanagement in building maintenance (Lam, 2000). All these evidence underscored the need to have a proactive maintenance policy especially at design stage.

Lateef (2009) noted that building maintenance is not only about building condition but it also related to building performance. For example, serious defects in building physical aspects will effect building performance as a whole, for a defective building cannot perform its required function (Olanrewaju et al., 2011). Evidently defects in building could reduce the building performance. Thus, a building should be prevented from becoming defective and unable to perform its required functions.

Building performance and building defect are interrelated and most significance (Ramly et al., 2006, Hashim, 1994a, Chudley, 1981). Thus the combination of design faults and ineffective building maintenance procedure will bring unhealthy and catastrophic scenario, and these had been happening in Malaysia, especially the government building projects. For instance, there are many low cost public housings in Malaysia having problems with poor design, low quality materials,

poor construction, and poor maintenance practices. All these should not be allowed to occur to ensure sustainability of the public housing (Hashim et al., 2012). These evidently indicated that the fundamental issues in managing building are still prevalent and unresolved. Fortunately, most of the issues can be easily eliminated at the early stage of building development process (Chudley, 1981, Seeley, 1987, Hashim, 1994a, Ramly et al., 2006).

Most of the constraints related to building maintenance works are due to the effects of design decisions, methods and quality of building construction. Among these effects, Joseph (1999), concurred that building design has a great influence on future building maintenance (Josephson and Hammarlund, 1999). Building designers are often required to carefully consider the consequences of their design decision on future building operation and maintenance. Therefore, this research shall focus on design phase of building development process, given its major effects on the building future maintenance profiles. Many of the scholars agreed that the defects in building can be avoided by having a better understanding on the effect of building design over the future building maintenance; and the awareness among the key players is the main key to realise that philosophy into action (Hashim, 1994a).

1.3 Research Gap

Malaysian government policy pertaining to public buildings for provision of quality public services was underscored in early 1974 when specific regulations on building maintenance, public roads maintenance, and sewerage system maintenance were established under the Public Work Department (PWD) or Jabatan Kerja Raya. Later, in 1992, the government issued guidelines on total quality management where the strategy for quality improvement in public services guideline was introduced. Further, in 2007, the government introduced the guidelines for the management of movable assets and the first convention on national assets (NAFAM) was organised. During the convention, the Building and Common property (maintenance and management) Act 2007, Act 663 was introduced. In 2009, the government launched the Government Assets Management Policy and develop the immovable assets management system application (mySPATA). Also as a result of the NAFAM 2007, a special Government Asset Management Committee (JPAK) was established to develop management system for the government assets. This committee is responsible to establish the necessary standards and requirements in managing public properties. However, recent studies did indicate that the fundamental problem in maintenance management in public sector is still the ineffective reactive based or ad hoc maintenance procedures (Isa et al., 2012, Hassan et al., 2011b). The worst case scenario is that maintenance is carried out based on predetermined budget and not on actual costs of maintenance requirements. As the result, building failures and defects kept repeating due to the ineffectiveness of management. Despite the government being committed and recognising the needs for building maintenance, the fundamental problem is still untreated (Ahmad, 2006, Mohd Zulakhmar, 2006, Zawawi et al., 2011).

In Malaysia, many complaints of building defects seemed to occur a few years after occupancy stage. This situation became accepted as a normal process in contruction industry where constructors are required to rectify any defects on their own expenses within a certain period of time as in the contract of agreement. This perceived normality is accepted by many, for more than 82 percent of building defects were rooted from managerial errors. Such errors were not visible at the construction stage; and only appeared a few years after building construction were completed (Atkinson, 2002).

In the early stage of building development process, it is common for the building owner to allocate the budget and time that will be spent on the construction project. At this stage, the decision also will effect on allocation of future building maintenance works. Consideration of building maintenance at design stage will have a great influence and effects onto the regularity of maintenance works and future building performance. The main initiator of building maintenance at design stage is the owner or stakeholders of the building. The role of the owner in respect to building maintenance will vary, and normally depend on their interest in the use of the building (Arditi and Nawakorawit, 1999a). Sometimes the owner is a developer that involve in selling their end product, for them maintenance is not considered as a priority as long as they can sell the building. However for the government, the public service objective of contructing public buildings makes the requirement for building maintenance even more crucial. Evidently, proper consideration for building maintenance is needed to minimise overall cost of future building maintenance; and the right time to consider this objective is at design stage to reduce the amount of unnecessary future maintenance work (Seeley, 1987).

In order to reduce the overall maintenance cost, the initial cost is usually computed higher to offset more expensive maintenance. With a proper building design, these objectives can be achieved. Although the initial cost will be higher at the beginning (i.e. purchase of quality materials), it can save higher costs in the future. To adopt this formula into a solution, the line of communication among the key players such as the design, construction and maintenance teams are of paramount importance. Unfortunately, as David Arditi (1999) found out that almost 75 percent of his respondents agreed that often building maintenance consultant firms are not engaged during the design prosess, causing this maintenance problem to occur (Arditi and Nawakorawit, 1999a).

In the United Kingdom for instance, at the end of year 2000, almost £1 billion was estimated to be spent on rectifying defects in new buildings which it can be easily eliminated at the design stage (Wood, 2011). Meanwhile in Malaysia, many researchers insisted that faulty design and construction are the main factors that caused building defects and building failures (Ahzahar et al., 2011). This perception overlooked proactive maintenance factors that can be incorporated at design stage. This situation left a huge maintenance gap or loopholes in construction industry. Because of that, It caused building maintenance requirement are not considered very well at design stage. Let alone being currently well in practice for public buildings upkeep in Malaysia. If this situation is left untreated, it will lead to graver implications on many upcoming public construction projects.

To-date, in Malaysia, there is a dearth of studies on building maintenance issues especially on matters at the design stage (initial or planning level). Most

research focused on issues at the operational or implementational stage. These include technical matters such as defect recognitions, classifications, defects prevention, maintenance works i.e cleaning, inspecting, repairing and replacing building parts and its systems. Unfortunately the fundamental issues in managing building maintenance are still unresolved without effective solutions. Based on the literatures, the lack of maintenance prioritization at design stage is due to the lack of knowledge on proactive maintenance (Isa et al., 2012, Hassan et al., 2011b, Yacob, 2005a). Another factor is the low awareness among the key players on the effects of building design on future building maintenance. There are several factors that lead to lack of awareness of this fundamental issue. Part of them is lack of knowledge about building maintenance and its effect on property investment. Ignorance on the matter by the key players may also be contributed by their inability or reluctance to factor in that knowledge into practice as per their vested interests.

Thus, this research shall solely focus on building maintenance at design phase of the building development process given the gravity of the issues and major implications on future public building maintenance profiles.

1.4 Problem Statement

Malaysia's construction sector has been exhibited a tremendous growth (Khan et al., 2014). However, the declining global economic climate in 2009 affected Malaysia's domestic investment activities. Nevertheless, the impact experienced by Malaysia was small due to majority of the industry's sub-sector (94%) are influenced by domestic factors (Malaysia, 2007).

Considering of these evidences, there is urgency for the government to priotize effective maintainance of these building assets. These assets are considered as parts of economic engines for the growth of Malaysian economy. Maintenance of public buildings is a socio-economic necessity. According to National Property Information Centre (NAPIC), the construction of housing schemes alone in 2010 was estimated at 1,228,209 units of strata properties were provided, such as flats, service apartments and condominiums. Due to that, these properties should be proactively managed because these assets will start to deteriorate from the moment they were completed (Arditi and Nawakorawit, 1999a, Toland, 1991).

Pertaining to public buildings, the government has been facing challenges in maintaining these assets. The problem was highlighted by former Prime Minister, Tun Abdullah Ahmad Badawi during his speech at the NAFAM conference in Kuala Lumpur 2007 (Mohd-Noor et al., 2011, Mohd Zulakhmar, 2006). He noted that billions of ringgit had been spent for repairing defects in public buildings due to poor maintenance culture. He underscored that the defects in the buildings could be easily reduced through proper maintenance planning at early stage, when defects can be clearly predicted, spotted and rectified. This preemptive initiative is crucial to be adopted so that any defects in buildings can be rectified before turning into bigger problems and costlier to the government. Budget allocation defect rectification has been extensively high, with the government compelled to gradually increase the budget for maintenance (Abdul-Rashid and Ahmad, 2011).

Also highlighted in the NAFAM conference, were three major issues of concern, such as current Malaysia's maintenance culture, absence of proper and

systematic maintenance procedures, and lack of understanding of the maintenance concept (Mohd Zulakhmar, 2006, Mohd-Noor et al., 2011). It is these three issues that primarily motivate the researcher`s interest of this study. Henceforth, this study will focus on investigating issues impinging proactive maintenance management during the design stage or administration level rather than after building completion or technical level (implementation level). This is given the major effects and influence of building design on future building performance and building maintenance (Arditi and Nawakorawit, 1999a, Arditi and Nawakorawit, 1999b). Nowadays, Malaysia has been experiencing increasing demands for building maintenance. Recently, the government has been supportive of a systematic and proactive approach. The government has been spending billions of ringgit for some unnecessary rectification works every year. All these are due to excessive costs of maintenance and replacement of components for existing building stocks. Ironically, such defects or damages are happening to new buildings of age less than 3 years. Occasionally some public buildings are left to deteriorate into a state from which it is difficult to recover and very costly to maintain.

Based on previous research, defects in public buildings occurred mostly due to unreliable design and unsuitability for public use. The main cause of the problem is that both building maintenance and building design are often treated as two different activities and not connected to each other. This is due to the lack of understanding on building maintenance requirements; and lack of communication among the key players before construction activities commenced. Low awareness of future building maintenance and impact on building performance among the key players is also the case (Arditi and Nawakorawit, 1999a, Arditi and Nawakorawit, 1999b). David Arditi, in his research found that an average frequency of communication in the design stage

between designers and property managers was very low (Arditi and Nawakorawit, 1999b). Further, this weakness in Malaysia is also due to perceived lack of explicit linkages between maintenance needs and building performance (Lateef, 2009). It was due to the grave implication of these issues, that prompted the former Prime Minister of Malaysia, Tun Abdullah Ahmad Badawi to highlight that Malaysia had lost billions of ringgit due to poor building maintenance management approach to the public buildings.

The fact that there is no building free from maintenance however it does not mean that aphatically maintenance expenditure can be reduced. The easiest way to not spend the money is to stop doing maintenance but in the end we have to pay higher price for long term results. Despite the government efforts to improve maintenance management into more proactive procedures to optimise value on buildings investment; inadvertently, its huge bureaucracy still practiced a reactive or ad-hoc maintenance approach. This is still being the case, simply for the lack of official codification of proactive maintenance requirements in the design stage of building development.

The quest for viable proactive early stage building maintenance practice may be compounded by lack of research on clarifying the issues (Chohan et al., 2010). The issues have been underresearched and below the radar of built environment research interests. As mentioned previously, therefore building maintenance requirements are rarely considered critically at design stage by the key players (Olanrewaju and Abdul-Aziz, 2015, Shah Ali et al., 2008, Yacob, 2005a). This gap should be handled with adequate knowledge and awareness on building design and its implication upon future

building maintenance. For example the using of building information modeling (BIM) yet still need the experience person to handle the case. Mutual recognitions from the clients or stakeholders (government) on building maintenance are needed to have effective building maintenance as property investment. In Malaysia, most of the designers do not have access to records on long term performance of their own design. This situation occurred because the problem of building maintenance is always left to the people who manage the constructed facility or property managers to handle. Maintenance issues are rarely discussed among the key players at the design stage. This weakness will keep the mistake continuously repeated (Arditi and Nawakorawit, 1999a, Arditi and Nawakorawit, 1999b, Olanrewaju et al., 2011). Hence, it is crucial for the owner or stakeholder to initiate proactive building maintenance as one of the critical factors that need to be considered in their construction project. In addition, there is a need to provide a maintenance plan of work at design stage in order to infuse building maintenance requirement. In order to achieve that, RIBA plan of work can be used to insert maintenance factor to be considered and enforce to the key players for the future betterment.

Thus, summatively, the purpose of this study is to improve building maintenance practice by integrating proactive building maintenance requirements at design stage in order to reduce the probability of building defects occurred and to provide recommendations on a maintenance plan of works at the design stage for government building.

1.5 Research Objective

The research objectives for this study are:

i. To identify the building maintenance scenario in Malaysia public sector.

ii. To determine the critical issues faced by the key players regarding to the building maintenance aspects at design stage for public building.

iii. To determine the actions that can be adopted in order to improve building maintenance prioritization at design stage in public building.

iv. To develop and integrate building maintenance requirement into maintenance's plan of work at design stage for the government building.

1.6 Research Question

Several research questions were designed and developed in order to guide the implementation of the research. The research questions are as follows:

i. What are the scenarios of current building maintenance in public sector?

ii. Why the key players were having difficulties regarding to the building maintenance?

iii. What are the actions that can be adopted in order to improve building maintenance prioritization at design stage?

iv. When and where the proactive maintenance procedures should be considered in building development process?

v. How to promote the proactive maintenance at design stage in public building construction project?

1.7 Research Scope

The scope of research is limited to building maintenance and design stage issues in the context of public building construction in Malaysia. The key players who are involved in this study are the stakeholders: the government of Malaysia, architects, engineers, and maintenance experts. The discussion of the study is concentrated on the current scenario of public building maintenance, issues of building maintenance the government sector, actions to be taken to incorporate aspects of building maintenance at design stage, and development of maintenance plan of work at design stage. This study attempts to enable proactive maintenance components to be attached at design stage to support a production of maintainable, reliable, and durable building design. The variables in the literatures will be highlighted and to be tested using quantitative method of analysis. Further, the tested variables will be interpreted and formulated into a maintenance plan of work at design stage.

1.8 Research Methodology

This study has been conducted in a proper method. The stages of this study could be simplified as follows:

1.8.1 Conceptualization

The conceptual framework of this research is based on the aim and objectives of this research to integrate building maintenance requirement into a maintenance plan of work at design stage for the government building. This conceptualization is further developed into a methodology for data collection and analyses involving a comprehensive literature review and respondents` surveys and consultations on existing maintenance issues and related maintenance management problems.

1.8.2 Literature Review

The literature review is to gather the data on the issues or variables of this research. The review involved relevant journals, paperwork, thesis, articles and books related to research purpose. The data extracted form these literature reviews are used to develop the conceptual framework for this study, as well as providing the basis for the methodology and research instruments and analysis.

1.8.3 Questionnaire Survey and Focus Group

A questionnaire survey form is employed as a research instrument to gather quantitative data from the respondents. This questionnaires survey form is distributed among the respondents through postal and face to face and telephone modes. The items in the questionnaire are designed to collect data on prevalent scenario of the building maintenance management in Malaysia, critical issues faced by the key players concerning building maintenance aspects at design stage, actions that can be adopted

to improve building maintenance prioritization at design stage, and to develop the preliminary maintenance management plan of work at design stage for public buildings.

Meanwhile, the focus group discussion is to gather data of respondents` opinions on specific issues related to the findings from the survey. The focus groups discussions are aimed to verify and validate the results of the data analysis. Participants are a number of architects, engineer, maintenance practitioners, and local authority officers related to issues in the research area. As suggested by Krueger, the focus group members are normally selected given their professional familiarity with fellow participants. This professional relationship may provide advantages for them to mutually understand their respective or collective building maintenance practices. The members of group are encouraged to challenge each other on contradictions between what they were professing to believe and how they practice in the field (Krueger and Casey, 2014, Krueger, 1993).

1.8.4 Data Analysis

Quantitative and qualitative data analyses are conducted in this descriptive research to test and verify the variables found in literatures and focus group discussions. This mixed method allows the researcher to answer and understand the current situations of the building maintenance management practice at design stage.

Furthermore, the method of analysis fit this research on investigating a current and prevalent practice. The purpose is not to find a new theory, rather, to test the

variables that had been found in the review of previous studies. The data is analysed and concluded by using SPSS analysis. The relevant collected data are used to formulate recommendations to develop a maintenance plan of work at design stage that can be adopted by the industry. Finally the research findings will be discussed in focus group discussion in order to explore and to validate the research findings.

1.9 Chapter Arrangement

Generally, this thesis is structured according to the seven chapters as follows:

Chapter 1: Research Background

This chapter deals with introduction to the research, problem statement, objectives, research questions, significance of research, contribution to body knowledge, and the research methodology.

Chapter 2: Building Maintenance

The chapter is a comprehensive review the theoretical framework of building maintenance. The chapter discusses the issues of building maintenance within the context of the research accordingly to the the literatures. The aim is explain in details the concept of building maintenance and its relationship with building design, defects and performance.

Chapter 3: Building Maintenance Management in Malaysia

The chapter consist of an in-depth review on the current scenario of building maintenance management in Malaysia. This chapter discusses review inputs related to

research objectives such as the maintenance scenario, maintenance issues, and actions for maintenance prioritization at the design stage.

Chapter 4: Conceptual Framework of Maintenance Plan of Work

As a continuity for chapter 3, this chapter has discusses the conceptual framework to construct the maintenance plan of work, as the fourth objective of this study. The discussion on this conceptual framework includes the prevalent scenario of the building maintenance management in Malaysia, issues faced by the key players regarding building maintenance at design stage, improvement of building design, and actions maintenance prioritization at design stage in public buildings.

Chapter 5: Research Methodology

This chapter discusses the method used to investigate the research issues to achieve the research aim and objectives. The elaboration is aimed to clarify the research methodology for this research. The discussion covers the structure of the research process, research design, research instruments, population samples, surveying process, data collection and analysis.

Chapter 6: Data Analysis

This chapter discusses the research data obtained form mixed methodology (quantitative analysis and qualitative analysis). The analyses are structured on data obtained from the survey questionnaire and focus group discussions covering the maintenance scenario in Malaysia public sector; critical issues faced by the key players regarding building maintenance at design stage; actions to improve building

maintenance requirements at design stage; and maintenance management plan of work at design stage.

Chapter 7: Findings and Discussion

This chapter discuss and conclude the research findings as per the research objectives and issues unders study. The elaboration is topicalised as per the order of the research objectives stated in the preceding information on chapters` content. An additional section to this chapter is a framework for maintenance plan of work and suggestions for future research.

Chapter 8: Conclusion

This chapter contain a conclusion for the research. The conclusion was gathered base on the finding in the previous chapter. Also the recommendation of the author about the researchs contribution and future recommendation for the up coming research were given.

CHAPTER 2

BUILDING MAINTENANCE

2.1 Introduction

This chapter reviews the theoretical aspects of building maintenance covering its concepts, definitions; objectives; principles and importance. These also include the relationship between building maintenance and building design, defects and performance. The discussion shall highlight the issues of building maintenance in the context of this research, as per the findings in the reviewed literatures.

2.2 Building Maintenance Concept

Building construction industry is a long term investment venture. For instance, the construction of a hotel building can be classified as a long term investment. This investment involves high budget and need to be efficiently managed for on time completion and optimum profit. Fundamentally, building maintenance is essential for optimum level of performance. Maintenance of a building is designed for maintainable, durable and cost effective building conditions to fulfil both internal and external corporate and regulatory requirements. Building maintenance involves activities that contribute to the fulfilment of internal requirement such as ensuring the productivity of the building and external stakeholders' requirements to fulfil local authority requirements. These activities should be considered as a business process that creates value and not something that is an unnecessary (Soderholm et al., 2007).

However, the case worsened when building maintenance management is carried out based on a predetermined budget that does not factor in actual maintenance requirements or maintenance needs. This may be due to the current maintenance policy not being comprehensively understood. Furthermore, the current building maintenance policy does not comprehensively prescribe maintenance at design stage in building development processes. Evidently, the government maintenance policy seemed to be applied only at implementation level. Recently, the government through asset management policy has introduced a few proactive maintenance policies for new construction projects, particularly for building maintenance management at design stage. For example, for a new building construction projects, the design should be considered for future maintainability. The building design should be accessible for the purpose of future building maintenance works (Malaysia, 2009a). However, this policy is not effectively implemented due to lack of specific standard, guideline or technical framework at design stage for building maintenance to be collaborated.

Generally, building maintenance is treated as poor relation to building design in construction industry (Chanter and Swallow, 2008). In supporting this statement, Ivor Seeley stated that building maintenance has likely been regarded as the "Cinderella Activities" where it is only concerned from the day the builder leaves the site (Seeley, 1987). Traditionally, many building owners regard maintenance as an unnecessary commitment and very costly to perform. Building maintenance seems to be unpopular task. Majority of the people in building construction industry do not realize the benefits of effective building maintenance of their building properties. This negative phenomenon seems to affect some professions in building construction