EXPLORING THE FACTORS LEAD TO COMMERCIAL BUILDING'S OPERATION AND MAINTENANCE PROBLEMS IN KLANG VALLEY

TAN YI WANG

A project report submitted in partial fulfilment of the requirements for the award of Master of Project Management

Lee Kong Chian Faculty of Engineering and Science
Universiti Tunku Abdul Rahman

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DECLARATION

I hereby declare that the dissertation is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UTAR or other institutions.

Signature : Tan Yi Wang

Name : TAN YI WANG

ID No: : 20UEM4336

Date : 15th November 2021

APPROVAL FOR SUBMISSION

This dissertation/thesis entitled "**EXPLORING THE FACTORS LEAD TO COMMERCIAL BUILDING'S OPERATION AND MAINTENANCE PROBLEMS IN KLANG VALLEY"** was prepared by TAN YI WANG and submitted as partial fulfillment of the requirements for the degree of Master of Project Management at Universiti Tunku Abdul Rahman.

Approved by:

(Puan Nur Aqlima Binti Ramli) Date: 15th November 2021
Supervisor
Department of Surveying
Faculty of Engineering and Science
Universiti Tunku Abdul Rahman

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ABSTRACT

EXPLORING THE FACTORS LEAD TO COMMERCIAL BUILDING'S OPERATION AND MAINTENANCE PROBLEMS IN KLANG VALLEY

This study aims to investigate the factors that lead to commercial building's operation and maintenance problems in Klang Valley; understand better from the distinct perception of the parties involved in the building maintenance field. Furthermore, it aims to raise the awareness of building maintenance practitioners towards the operation and maintenance (O&M) practices; and explores the underlying factors impacting team effectiveness to improve operation and maintenance performance. A literature review on the O&M problems and the factors leading to commercial building O&M problems in Klang Valley. A total number of hundred (100) questionnaires were collected from the experts and individuals involved in commercial building works, such as Maintenance Technician, Facilities Operation Executive/ Manager, Building Manager, Building Technician, and others. The data obtained were analyzed statistically with several tests and entered into a computerized system known as SPSS software for data interpretation. The result got reconstructed, abstracted, and tabulated for further explanations. From the O&M problems in commercial buildings, water leakage problems ranked first from the RII results. Based on the five (5) main factors found, all five factor's hypotheses are accepted and significantly impact commercial buildings' O&M problems in Klang Valley. This paper furnishes a better understanding of the importance of O&M on commercial buildings and provides insights and raises awareness concerning the importance of commercial buildings' O&M problems to a minimum level.

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CHAPTER 1:

INTRODUCTION

1.1 Background

Buildings are known as the country's valuable assets to give shelter and facilities to humans for business and leisure, and building maintenance is classified as the fundamental and necessary process to a building (Lateef, Khamidi, & Idrus, 2010). Maintenance has many different definitions, and majorly defined as the process, activities, procedures, and services to undertake to keep or preserve and care every facility such as building, infrastructure, and equipment to an acceptable standard (Allen, 1993; Zawawi, Kamaruzzaman, Ithnin, & Zulkarnain, 2011). Francis, Yik, Lee, & Ng (2001) asserted that building operation and maintenance management refers to an activity that requires intercommunication or a compound of technical, cultural, political & legal, and financial factors that affect the building's usage and value.

Building maintenance is known as a critical element that has brought in countless investigation studies in the buildings (Amani, Ali, Mohammed, Samat, 2012). Building maintenances can be planned and unplanned. According to Chanter & Swallow (2008), These maintenances are known as corrective or preventive maintenance. Planned maintenance or preventive maintenance refers to maintenance coordinated and taken with planning to a predestined plan or a fixed agenda; unplanned maintenance refers to ad-hoc maintenance conducted with no predetermined plan or after a disruption or any obvious shortcoming has befallen (Tran, Yang, Oh, & Tan, 2008).

This research paper sets out to identify commercial buildings' operation and maintenance problems in the Klang Valley construction industry. It begins with outlining the research methodology, followed by findings from the literature review, survey

questionnaires with professionals and individuals involved in Malaysia's commercial buildings' works, and lastly, conclusions for the research.

1.2 The Problem Statements

A commercial building must be maintained to a competent standard to assure its functioning and operating well. According to Olanrewaju and Kafayah (2008), an unwell-maintained building will influence the users' quality, productivity, and environment. Also, Seeley (1987) remarked that building operation and maintenance are essential with the principal intention to maintain a building in its fundamental element (Mong; Mohamed, & Mohd, 2019). The operation and maintenance (O&M) of buildings play an essential function in the constructions' overall design and building process (Shabha, 2003). Therefore, the maintenance costs comprise all capital spent on a building to retain to an adequate measure. Some circumstances affect this quick rising in the sustaining cost to the commercial buildings.

According to Zakaria & Hamzah (2007), the operation in building maintenance management in Malaysia is unsystematic; no precedence for maintenance and corrective acts results in over-budget expenditures. For instance, commercial buildings around Malaysia commonly face maintenance issues, including jointing leaking issues, faulty doorknobs, wall cracks, floor leakage stains, floor tiles cracks, faulty waterproofing system, dampness on walls, and others (Sulaiman, 2013; Sivanathan, et al., 2019)

According to Mong; Mohamed, & Mohd (2019), all buildings must be sustained in a livable and proper form (Sliteen, Boussabaine, & Catarina, 2011); a facility cannot function and achieve its most significant outcome without being well maintained and managed (Stoy & Kytzia, 2008). According to Lai & Yik (2008), O&M works of a commercial building are recognized as a service that the owner or the management organization must obligate or cater to its tenants. Moreover, the services of O&M are such as activities to retain the whole built environment and structure in a condition that meets the signified functions of the building's expected life cycles (Bardey, Riane, Artiba, & Eeckhoudt, 2005).

The O&M problems might negatively impact Malaysia's commercial buildings' maintenance. In this research, factors will be identified, valued, and judged based on their significant value and impact; factors could ease estimate the necessitated preservation cost, crucial for funds allocation in advance.

1.3 Research Aim

This research strives to investigate the factors that lead to commercial building's operation and maintenance problem in Klang Valley; understand better from the distinct perception of the parties involved in the building maintenance field. Furthermore, it aims to raise the awareness of building maintenance practitioners towards the operation and maintenance practices; and explores the underlying factors impacting team effectiveness to improve operation and maintenance performance.

1.4 Research Questions

The main research questions as the foundation of this study are as below:

1. What are the critical problems of operation and maintenance (O&M) of commercial buildings in Klang Valley?
2. Which of the critical factors leading to the O&M problems of commercial buildings in Klang Valley?
3. Which of the relationship between the problems and factors are significant?

1.5 Research Objectives

This research's main objectives are to conduct a field study of factors that impact the commercial buildings' maintenance in Klang Valley, Malaysia. The objectives are as follows:

1. To identify the critical problems of operation and maintenance of commercial buildings in Klang Valley.

2. To investigate the critical factors that lead to operation and maintenance problems of commercial buildings in Klang Valley.
3. To evaluate the significant relationship between the problems and factors.

1.6 Research Scope

The research will be based on commercial building effectiveness in the operation and maintenance. Information on building maintenance practices in Malaysia will be gathered; research papers from other countries related to building maintenance will be reviewed, studied, and used as a literature review.

In addition, a questionnaire will be distributed to experts and individuals involved in commercial building works, such as Maintenance Technician, Facilities Operation Executive/ Manager, Building Manager, Building Technician, and others. Different perceptions are collected from different people in the field of commercial building operation and maintenance. Therefore, it is crucial to obtain the data equally from experts and individuals in the commercial building maintenance industry; different individuals' perception would significantly impact effectiveness to improve building operation and maintenance performance.

1.7 Significance and Justification of Study

The significant maintenance of a building could play an essential role in sustaining the buildings over the past centuries. Shipley, Utz, & Parsons (2006) affirmed that replenishing or maintaining an existing building for reuse can render a ten to twelve per cent cost-saving instead of constructing a new building. The cost-saving could relate to reducing construction works needed, the vital savings obtainable in the operational energy expenses of a sustainable building.

According to Madew (2006), a study conducted exhibiting a sixty percent (60%) saving in water and energy use in a sustainable building and could lead to a reduction of fifty percent (50%) on the operational costs. Ali (2009) stated that the awareness of repair

and maintenance work in the Malaysian context has become more critical as the development plan allocation for replacement and preservation works rose from RM296 million (8th Malaysian Plan) to RM1,079 million the 9th Malaysian Plan.

Seeley (1987) asserted that building O&M is essential to maintaining a building meeting all sanctioned requirements and improving all facilities in every part of a building to an agreed standard. Moreover, the execution of building O&M enables the building to attain its purpose ultimately; various primary objectives to sustain buildings, as below:

- To retain the building's architectural and investment value.
- To keep the buildings and the associated services are in a secure state and required standard.
- To grant a solid form of the building in meeting all statutory requirements.
- To generate profit for the building and surrounding events.

1.8 Research Method

Figure 1.1: Research Methodology Diagram

The study will begin with reviewing past scholarly papers or articles and the past standard practices of commercial building maintenance. The literature review could enhance the trustworthiness of the research and provide a theoretical framework for the research.

Primary data is newly collected in this research study when using a quantitative method through a questionnaire (Forshaw, 2000). Primary data will be collected based on the research objectives. Hypotheses developed based on existing theory and to test against the literature findings from the data collection through questionnaires (Patterson & Spreng, 1997).

An interpretation of data will be conducted using data software (SPSS) after collecting all the primary data. Analysis and test will be executed to examine and compare the reliability and the relationships between the variables; data statistics will be analyzed and addressed further in the research with data tables and figures.

After the interpretation of the research results, recommendations and limitations of the study will be discussed; a conclusion will be formed in summarizing all vital message of the research study, which matching with the research's aim and objectives.

1.9 Chapter Organization

This research study comprises five chapters: the introduction, literature review, research methodology, results and discussion, conclusion, and recommendations.

1.9.1 Chapter 1: Introduction

This chapter is the opening chapter that presents a general view of the study conducted; it comprises the research background, problem statement, research aim, research objective, research scope, the research significance and justification, and chapter organization.

1.9.2 Chapter 2: Literature Review

This chapter will gather and analyze the literature reviews from the past related published research and scholarly papers, which could provide important information and variables on issues and factors that lead to commercial building’s operation and maintenance problem in Klang Valley.

1.9.3 Chapter 3: Research Methodology

It presents and explains the method and mechanism applied to conduct this research. In addition, this chapter includes research setting, data collection approach, sampling design, measurement scales, and data analysis.

1.9.4 Chapter 4: Results and Discussions

In this Chapter 4, the findings and data collected will be analyzed, evaluated; research results will be discussed in detail after the data collection process. Finally, the generated results are to be assessed to attain the research's aim and objectives.

1.9.5 Chapter 5: Conclusion and Recommendation

Finally, in Chapter 5, the conclusion will be formulated as the last chapter of the research study. It addresses and concludes the research's actual content and supported with recommendation and limitations for the future related research study.

1.10 Conclusion

This chapter describes the background and the difficulties faced in the commercial building maintenance industry; the research's goal is also known in this chapter. This research aims and objectives as a guideline that can help the research be conducted subsequently. This research provides information on operation and maintenance practices in the Klang Valley to the concerned parties, including the building maintenance practitioners. It is important to keep maintenance problems to a minimum in commercial buildings to make the commercial buildings in Malaysia better.

Next, the research scope and research justification are also clearly presented in this chapter which can help the readers understand deeper about the study. Furthermore, this chapter also covered the research method and chapter outline to show the proper procedure of the research.

CHAPTER 2:

LITERATURE REVIEW

2.1 Introduction

This chapter gathers and analyzes the existing theories and secondary data from past research studies and scholarly papers, which could better understand the factors that lead to commercial building's operation & maintenance (O&M) problems in Klang Valley.

2.2 Built Environment Industry

The building life cycle relates to a building or service throughout its whole life in the built environment (Ngwepe & Aigbavboa, 2015). For instance, this includes its design, construction, operation, maintenance, and disposal concerning a building. Examining the entire building life cycle can assure that all aspects are adequately granted, not just the construction cost. According to Bardey, et al., (2005), the services of O&M are such as activities to retain the whole built environment and structure in a condition that meets the signified functions of the building's expected life cycles.

As shown in Figure 2.1, the building life cycle (BLC) consists of six (6) stages and begins with the initiation stage, where happens from reusing an existing building or constructing a new building; continues with the stage of production and construction (Watson, 2003). Stage of operation and maintenance (O&M) comes after the stage of construction by running, sustaining, refurbishing the parts and components of the building to prolong the building life before entering the last stage of the building life cycle-disposition.

Figure 2.1: Building Life Cycle (Watson, 2003)

2.3 Operation and Maintenance (O&M)

O&M refer to the preserving of the building public presentation and functionality per the design plan and the building owner's operational necessities. This process comprises direct access systems to the activities that sustain a building's profitability and reliability.

2.3.1 Definition of Operation

Operation is known as the activities like equipment scheduling and optimizing energy-efficient and comfort control strategies. The operation degree of buildings is the longest as some buildings have a life span of over fifty (50) years (Ngwepe & Aigbavboa, 2015). There is a necessity to continually maintain and refurbish to sustain and preserve the building's structural, aesthetic, and functional conditions (Chan, 2014). For instance, water and energy are required for users and equipment such as Heat-Ventilation-Air Conditioning (HVAC), electrical systems, and telecommunications networks. Commonly, the energy that is practiced is rendered from fossil-fuel-based sources most times.

2.3.2 Definition of Maintenance

Maintenance refers to the physical side of activities, process, and services obliged to keep or preserve the system running, including equipment, building, and infrastructure to ensure reliability and minimize the likelihood of unexpected breakdowns (Allen, 1993; Zawawi, Kamaruzzaman, Ithnin, & Zulkarnain, 2011). Maintenance can take place before the building is devastated. Enormous tons of solid waste are produced throughout sustaining and refurbishments; vast volumes of natural resources are repeatedly used for new materials, and whereby all the prior stages to maintenance are repeated, producing more enormous consequences on the environment (Ngwepe & Aigbavboa, 2015).

2.3.2.1 Planned Maintenance and Unplanned Maintenance

Planned maintenance is designed and conducted with forethought, control, and documents to a predetermined plan (Seeley, 1987). Preventative maintenance is known as the work that is planned and performed routinely to sustain the infrastructure and facilities in a good state; comprising piping repair, wall patch, and replacement of parts with a short lifespan; often practiced for building structures and site improvements, yet it is mainly executed for building services (Dillon, 2009). While in the formulation of the maintenance strategy, the probability of building asset breakdowns, disruptions to service delivery, and health and safety problems can be minimized. Next, statutory maintenance could be practiced in meeting obligations mandated in Acts, Regulations, and other statutory instruments; condition-based maintenance is based on a condition assessment or an inspection process, which could be practiced on buildings. Due to the building's physical condition, building structure, or site improvement, all the maintenance works are required under adequate requirements.

Unplanned maintenance refers to the maintenance carried out to no predetermined plan and is reactive; happens due to failures and the malfunctioning or breakdown of a building element and needs prompt inspection, and it often limits the rectification for the reasons or purposes of well-being, safety, or protection and could be a result of a substantial

hazard (Seeley, 1987). When the preventive measures take place adequately with a regular schedule, the risk of costly replacements on building elements can be minimized.

2.4 Studies on O&M in Built Environment

Table 2.1: Studies on O&M Built Environment

No.	Title	Research Area	Author
1	Determinants of Operational and Maintenance Costs of Condominiums	Condominiums	Perera, Chethana, Illankoon, & Pepera, 2016
2	Critical Factors that Lead to Green Building Operations and Maintenance Problems in Malaysia.	Green Building	Mohammad I, Zainol N, Abdullah S; Woon N, & Ramli N, 2014
3	Study on Maintenance Practices for School Buildings in Terengganu and Kedah, Malaysia.	School Buildings	Ropi and Akhavan Tabassi, 2014

Table 2.1 above shows fewer studies on the issues or factors conducted on commercial buildings; hence, the study was conducted.

2.5 Issues of O&M in Commercial Building

Defects and destruction to new buildings, commercial buildings, and infrastructure, primarily developed by the government, are frequently difficulties in building maintenance management, which is discomforting and too severe to be neglected. Low and Wee (2001) asserted that buildings and facilities that are not well maintained could lead to accidents and injuries, mainly due to faulty work implementation, inadequate management, poor maintenance culture and absence of work ethic from the personnel (Zawawi & Kamaruzzaman, 2009). According to Al-Zubaidi (1997), complex designs and services

have always been a significant concern confronting O&M personnel and require correspondingly great standards for maintenance personnel (Christer and Whitelaw, 1983). Shen (1997) stated that complexity is an extensive technical problem affecting building structure, finishes, aesthetics, and services. Furthermore, Sulaiman (2013) asserted that usual O&M issues in commercial buildings around Malaysia include jointing leaking issues, wall cracks, pipe leakage, floor leakage stains, floor tiles cracks, faulty waterproofing system, dampness on walls, and others. The buildings O&M play an essential function in meeting the signified functions of the building's expected life cycles or even prolonging the life span (Bardey, et al., 2005).

2.5.1 Paint Peeled

Paint peeling is a common defect that is critically seen on the building surface, primarily on the plastered walls, ceilings, and columns (Kasim, 2009). According to Othuman Mydin and Wang (2011), the elements were frequently exposed to sunlight, rain, wind, or dampness, rising in paint peeled. The excessive weathering decayed the facade of walls, and hence, the surface turned out chalky, flaked, and blistered. Issue of the wall blister will occur when applying a paint coat over a damp surface. Moreover, wall and ceiling paint will be peeled and mottled due to the presence of moisture (Figure 2-1). The maintenance personnel should take building walls and ceiling care periodically to avoid it from happening.

Figure 2.2: Paint Peeled and Faded on Walls

2.5.2 Water Leakage

Water leakage in buildings commonly happens from a water incursion, results from roof defects, waterproofing material failure, or poor external wall joint (Chong & Low, 2005). This defect affected the aesthetic value of the building and turned out a severe issue of the building structural strength deteriorated when buildings' materials became soaked for extended periods. Furthermore, Othuman Mydin and Wang (2011) asserted that excessive moisture in the air due to poor air ventilation systems in the buildings could also impact dampness. Penetrating dampness is the usual kind of dampness encountered in commercial buildings; dampness from the ceiling is commonly due to waterproof defects resulting in rainwater intrusion into the building (Figure 2-2).

Figure 2.3: Dampness on Ceiling & Slab

2.5.3 Dampness

Dampness in buildings typically occurs from the unintended water caused by the poor installation of air-conditioner pipes, pipes leakage, flashings, and others. Water leakage from the pipe penetrated the wall, resulting in terrible water stains, and excessive moisture increased the mold growth on the wall's surface beneath the long-term dampness (Soleimanzadeh & Mydin, 2013), as shown in Figure 2-3. Moreover, air-conditioner pipes should be covered wholly without exposing them to the external air; condensation occurs when moist air meets colder surfaces and causing dampness and mold growth. Competent and experienced O&M personnel is crucial for building maintenance, which would minimize the issue, as shown in Figure 2-3.

Figure 2.4: Dampness and Mold Growth on Walls

2.5.4 Cracks

Crack is a usual occurrence that split in concrete happens and results in the cut on the surface of the building; frequently visible on the building wall, floor, column, and beam (Figure 2-4 & 2-5). A crack can be known as a structural and non-structural crack (Bakri & Mydin, 2014), commonly be distinguished from its width. According to Lai (2019), a structural crack surfaces wider than 2 mm; otherwise, it is non-structural, usually in the screed or other finishes with cement render (Low & Wee, 2001). Structural crack is a threatening matter as the building's structural integrity might be impacted and causing building safety concerns, commonly due to false design, overloading, and shoddy construction method. Next, the non-structural cracks may be due to moisture content and repetitive thermal change, symbolizing the building ageing and having no significant force on the building's structural integrity; but the crack can turn wider and cause a severe effect on the building structure when there is water seepage to the concrete.

Figure 2.5: Cracks on Wall & Beam

Figure: 2.6: Cracks on Floors

2.5.5 Defective Tiles

Due to improper building O&M, various tiles defects may be visible on tile surfaces, including buckled, cracked, faded, rust stains on tiles, and others. Defective tiles can influence the visual appearance of floors and walls (Othuman Mydin & Wang, 2011). Tile defects arise from multiple reasons, such as improper installation techniques, vandalism, uneven floor, poor materials, and others. The cracked tiles defect shown in Figure 2-6 is mainly due to the heavy object dropped on tiles, inferior quality tiles, improper subfloor, and others. Furthermore, tiles can be buckled (tented up on the floor) when lacking expansion joint, moisture absorption by tiles, improper cleaning, and others more.

Figure 2.7: Tiles Crack

2.5.6 Roof Defects

The roof is an essential component in a building as it shields the interior from external weather, such as rain, sunlight, and wind (Low & Wee, 2001); every commercial building practicing various roof covering materials, such as concrete, zinc sheets, and others. Figure 2-7 Figure 2-7 shows signs of wear and tear at the roof fittings and flashing, which results in water leakage in the building. With the routinized inspection, the issues can be prevented and minimized by having fittings replaced before the defect turns awful.

Figure 2.8: Roof Flashing Defect

2.5.7 Lift and Escalator Problems

Lifts and escalators under maintenance are significant trouble for any buildings users and worse when trapped during the lift breakdown (Figure 2-8); defects include bearing breakdown, power failure, contamination of lubrication or oil, and others. A periodic inspection, operation and maintenance can prevent this from happening and performing safely and reliably (Laughman, 2012). Typical breakdown issues of lifts and escalators are due to the absence of routine maintenance, incompetent skills of maintenance personnel, insufficient maintenance budget, and others. Moreover, according to Aznan Bakar (2020), DBKL identified the factors contributing to the elevator damage mainly because of user-related issues and vandalism.

Figure 2.9: Lifts Breakdown

2.5.8 Waste

Outrageous waste is the typical operational issue in the commercial building; it happens when labor, materials, period of working, and equipment are not being operated effectively or efficiently. The incompetency of maintenance personnel or unskilled workers will be a waste for the buildings; they cannot operate the building systems and facilities efficiently, to keep track of all daily operations as per Standard of Procedure (SOP), to notice and report potential defects to prevent the malfunctions or breakdown from happening, and others (Zavadskas; Kaklauskas; and Bejder, 1998).

2.5.9 Performance Delay

All facilities in a building must be operated and monitored from time to time to ensure all systems and facilities are running as in proper form. According to the National Roofing Contractors Association and industry professionals (Staff, 2019), roof inspection should be carried out twice a year. In addition, routinized inspection should be applied for the building's lighting, electrical, and HVAC systems, to assure the highest functionality, security, and energy conservation. The incompetency of maintenance personnel or unskilled workers will impact the performance delay in the commercial building O&M (Zawawi, 2009). The personnel or workers unfamiliar with the SOP of the building O&M and did not perform the facilities inspection on schedule will lead to the performance delay in the commercial building O&M.

2.6 Summary of Issues

Table 2.2: Summary of Issues

No.	Issues	Authors
1	Paint Peeled	Kasim, 2009
2	Water Leakage	Chong & Low, 2005
3	Dampness	Soleimanzadeh & Mydin, 2013
4	Cracks	Lai, 2019; Bakri & Mydin, 2014
5	Defective Tiles	Othuman Mydin & Wang, 2011
6	Roof Defects	Low & Wee, 2001
7	Lift and Escalator Problems	Bakar, 2020
8	Waste	Zavadskas; Kaklauskas; and Bejder, 1998
9	Performance Delay	Zawawi, 2009

2.7 Factors Lead to O&M Problems in Commercial Building

In order to overcome the O&M issues and prolong the constructability principles and the building life span to consolidate O&M considerations, it is crucial to distinguish the significant factors that lead to O&M problems in commercial buildings (Lateef, 2009). Saghatforoush, Trigunarsyah, and Too (2012) classified the factors into five categories: managerial factors, technical factors, social and cultural factors, political and legal factors, environmental and biological factors.

2.7.1 Managerial Factors

The managerial defect/problems comprise project management, resource management, economic and financial defects, and maintenance management problems (Saghatforoush, Trigunarsyah, & Heravitorbati, 2011). Many buildings and infrastructures are needed/required to refurbish to improve the effectiveness of maintenance management processes (Awang, Mohammed, Sani, Shukor, 2011).

2.7.1.1 Project Management Problems

It is commonly referred to unclear construction plans and specifications, poor relationship between designers and maintenance team, time limitation limit leading to lower design quality, and others. According to Arain, Low, and Assaf, (2006), a project quality can be affected due to inadequate construction documents, designs, and specifications, causing an interpretation problem. These problems will affect a building's quality after the building's completion and eventually leads to difficulties in maintaining the building.

According to Arditi and Nawakorawit (1999), poor communication between designers and facilities or maintenance managers could cause design-related maintenance problems. Moreover, the time limitation is another issue that could impact/limit designers in lowering work quality to cover all necessary design works (Arain, Low, and Assaf, 2006). In order to cover all the future maintenance considerations, designers should be allowed to have additional time to ensure that the materials, system, specifications, and technology are appropriately integrated (Lucuik, Trusty, Larsson, Charette, 2005).

2.7.1.2 Economical & Financial Problems

The past researchers, Moua and Russel (2001), have indicated that the buildings' maintenance is an inevitable cost burden for projects; and the actions are not taken out based on the present necessity. Therefore, the maintenance tasks could often lead to over budget concerns throughout the O&M process due to deferral of some maintenance works.

Moreover, researchers of El-Haram and Horner (2002) has indicated that the deferral of maintenance works are often due to insufficient budget allocation; and caused further consequences as results, such as excessive damage and defects, and others more (Narayan, 2003). Hence, all the buildings' maintenance and replacement works are required additional funds/ budget allocation (Azlan Shah, Syahrul Nizam, Raha, Au-Yong, 2010).

The budget for maintenance is commonly based on an additional percentage allocated from the previous year (Lateef, Khamidi, & Idrus, 2010). There are difficult to

assess maintenance quantity technically and challenging to execute the accurate cost of work maintenance, which may result in budget overruns and underestimates.

2.7.1.3 Resource Management Problems

These shortcomings are mainly relevant to human resources, equipment, and materials. This refers to the problems caused by human/ social factors such as poor workmanship, the inexperience of the workforce, work attitude towards maintenance work.

The high cost of building maintenance is relative to the low quality of materials used in the building facilities, elements, and others (Al-Hammad, Al-Mubaiyadh, Mahmoud, 1996). Ali, Kamaruzzaman, Sulaiman, Cheong Peng (2010) noted that the limited or unavailability of materials or resources such as tools, spare parts, equipment to perform or execute the maintenance works could also lead to building maintenance problems.

Furthermore, poor workmanship skills are the predominant cause of maintenance defects emerging on the projects or building works (Khalid, Marton, Steven, 2006). The employment of technicians with requisite skills and experience could improve the work's quality, minimize cost, and reduce unnecessary maintenance work. Thus, Al-Khudair (1988) and Al-Khatam (2003) concluded that building maintenance works require adequate tools and skillful manpower to perform tasks appropriately.

According to Shear (1983), a well-trained and educated workforce could easily and quickly form bonds with others and perceive the transmitted information or instruction. All the manpower (technicians) involved in the maintenance management team should be well-trained with technical skills in order to operate and monitor the facilities of building and infrastructure efficiently. Thus, technicians' competencies could ensure the work quality of maintenance management provided to Polytechnic (Zulkarnain, Zawawi, Rahman, & Mustafa, 2011).

2.7.1.4 Maintenance Management Problems

Maintenance management's primary purpose is to improve the maintenance planning, execution, utilizing the appropriate materials and tools, minimize the total life cycle cost, and reduce the need for building defects restoration/ repairment (Horner, El-Haram, Munns, 1997). Low maintenance management practices could often cause many issues, including poor building functionality, defective buildings, and others. (Azlan Shah, Syahrul Nizam, Raha, Au-Yong, 2010).

Besides, the Polytechnic building's management defects are majorly due to the inefficient system in the data record, improper work planning, failure of potential defect or weakness causes identification, and incorrect remedial work specification (Zul-Atfi Ismail, 2014). According to Razali, Halim, and Jusoff (2011), the defects report is haphazardly complete in paper-based form; the docket information such as daily news is not updated, and all the works are not fully implemented. Moreover, complex, and large amounts of data such as data analysis and complaints track/trace get managed with an unsystematic database. Hence, low maintenance planning is critical in assessing decision making for remedial works; building maintenance works will fail due to the absence of this management.

2.7.2 Technical Factors

As per the evidence of Saghatforoush, Trigunarsyah, & Too (2012), technical problems marked critical causes and costly reworks in the O&M state of a building; the issues are not related to a particular state and can befall throughout planning, design, construction, or maintenance state of a building. Thus, the problems are comprising building characteristic, construction related defects, design problems, and maintenance related defects.

2.7.2.1 Building Characteristic

According to Ahluwalia (2008), the building defects vary to the building's structure, location, and building user; the defect circumstances that affect the building state comprises

facility status, age or significant year of the building renovation, the form of building, and others. Next, Usman, Gambo, and Chen (2012) stated that the application of inferior materials and building parts is an essential component that impacts building maintenance primarily due to inferior materials have a shorter life span and durability than standard substances and elements. For instance, the fire at the Employees Provident Fund (EPF) building was reported due to the application of cladding substances that were inflammable polyfoam, which failed to meet designated specifications breached the Uniform Building By-Laws 1984 (Hartono, 2018). Moreover, ageing building is also viewed as a crucial factor influencing building maintenance. The present buildings are challenging to value as all properties from the construction date due to varying maintenance standards and frequency. Seeley (1987) stated that buildings built with the aim of a minimum of sixty (60) years, and many buildings had exceeded.

2.7.2.2 Construction Related Defects

The election of experienced and competent contractors is crucial in accomplishing a building project (Liska, 1988). The project works in the construction stage must be fulfilled by skilled contractors with the greatest quality and construction techniques to obtain a minimum level of maintenance throughout the building life cycle. Assaf (1996) and Adejimi (2005) acknowledged that inadequate and poor craftsman skills are due to vital factors of construction inspection defect and the inaccuracy of site measurements or dimensions. Thus, the negligence or carelessness of the contractors in work inspection and measurement taking off causes the quality delivery impact in accomplishing a building project.

2.7.2.3 Design Problems

Liska (1988) declared that a facility or building outline and design should be based on a distinguished function and low-cost maintenance concept; much cost can be avoided with the precise plan and design. Thus, the relevant personnel such as the building manager and maintenance team should be involved and consulted in the initial stages of the building

design. The public presentation of buildings relies greatly on design class and the act of construction decisions. Okuntade (2014) asserted that defects in the building functions arise from inadequacies in design and build, reflecting on the level of operation and maintenance (Adejimi, 2005; Usman, et al., 2012). Design and maintenance are two essential criteria in the building life cycle (Kiong and Akasah, 2012). A certified and effective building design could lead to high building aesthetic values with accessible operation and maintenance activities. The lack of consideration in maintenance study throughout the design stage of the building could lead to grievous problems in the building function, performance, and security of the system, result in total replacement of the system (Al-Khatam, 2003). Assaf (1996) and Adejimi (2005) affirmed that the building maintenance problems are due to poor design in structural, architectural, and others. Furthermore, Adejimi (2005) asserted that the building maintenance difficulties could be lowered by optimizing the design method to obtain a good outline in electing proper materials, skillful workmanship, plants and equipment, and others more.

2.7.2.4 Maintenance Related Defects

According to Hermawan (2013), building defects are due to poor design, faulty construction processes, improper material installation, and poor craftsman skills. Competent workers are necessary for maintenance work; they could improve the work's quality, reduce cost, and minimize work time (Al-Khudair, 1988). In addition, experienced and adequate maintenance personnel would understand the maintenance costs and their responsibility (Ahmed 2002). Adejimi (2005) affirmed that numerous buildings undergo severe maintenance difficulties due to the incompetent technician or personnel in maintaining the buildings; maintenance problems can be diminished by employing adequate and skillful personnel.

2.7.3 Social and Cultural Factors

For many years, social and cultural defects are critical issues for O&M people, involving the end-user such as the building tenants and occupants (Saghatforoush, et al., 2012). The

problems involved are such as user cultural practices, third-party vandalism, and user-related defects.

2.7.3.1 Cultural Practices

The notion of maintenance culture is the internal atmosphere between management and team in conducting maintenance efficiently through partaking thoughts, norms, and values for each member in an organization (Mark, Ogaji, & Probert, 2006). Maintenance culture refers to the thoughts and behavior that can be formed based on the individuals' efforts in sustaining and protecting a system, facilities, and structure (Suwaibatul, et al., 2011). The cultural practice of maintenance is an attitude lacking in private and public sectors users or occupants, and it is a widely identified problem that affects and thwarting buildings maintenance work (Adejimi, 2005; Usman et al., 2012). According to Suwaibatul (2010), the cultural practices, norms, and attitudes associated with maintenance effort should be embedded in every organization member.

2.7.3.2 Third-Party Vandalism

Vandalism is recognized as reckless acts that can harm and cause excessive damage to building facilities, property, and infrastructures (Ikpo, 2006). The poor awareness and understanding of users or the public towards the building facilities and property are the root causes of vandalism. The lack of consciousness and knowledge in building facilities leads to damages in the building facilities and higher maintenance issues and costs (Azlan Shah, et al., 2010).

2.7.3.3 User-Related Defects

This factor involves user attention, delays in defect reports, and property accessibility. According to El-Haram and Horner (2002), early response and reports on building defects or failure could reduce the maintenance cost and increase the efficiency in building operation and maintenance. However, building users frequently have little awareness of

keeping the buildings in good working order; difficulty in users' property accessibility is one of the significant circumstances affected on the building maintenance cost. For instance, some tenants' units or places are restricted and may not be accessible for maintenance due to privacy reasons (Azlan Shah et al., 2010). Hence, the maintenance team requires extra equipment or machinery like a scaffold or tower crane to access the external building to execute the maintenance works.

2.7.4 Political and Legal Factors

The circumstances involve political or governmental constraints or rules and contracting shortages (Saghatforoush, et al., 2012). It causes issues for O&M management of buildings, resulting in an incompetent and unproductive management process. The factors comprise political & government restrictions & standards and contractual defects.

2.7.4.1 Political & Government Restrictions & Standards

In Malaysia, the government introduced the right-to-buy policy to allow tenants to purchase the property they live in from the Local Authority or pay the rent (Mohammad, Zainol, Abdullah, Woon, and Ramli, 2014). El Haram and Horner (2005) indicated that maintenance difficulties might have befallen from the shared ownership policy due to the repairs or services activities for common building elements, such as elevator, walkway, roofs, that may be shared or apportioned among the local authority and private occupants. Hence, the building O&M will be impacted due to the legal constraints and standards inconsistencies.

2.7.4.2 Contractual Defects

Shen (1997) cited that maintenance budgets in most local authorities are significantly limited due to the missing contract specification and affected the maintenance activities cannot be performed according to the maintenance schedule; however, to carry out items based on the urgency. Hence, that could impact vast costs and excessive damage to the

building structure when the maintenance or replacement did not carry out within the required timeline.

Next, the owner has limited input and less control over the result when a construction project is titled, turnkey. According to Huse (2002), the engineers design and coordinates the construction, where the owner's perception towards the design and construction works process may be diminished in the project. Therefore, the owner with a lack of understanding of the processes may require more effort in the maintenance activities in the future.

2.7.5 Environmental & Biological Factors

Environmental and biological issues are external circumstances that cause various significant impacts throughout the O&M phase of buildings.

2.7.5.1 Environmental Effects

Environmental factors involved indoor and outdoor environmental diversity, such as external and internal climate, impacting building degradation (Duling, Cloete, and Horak, 2006). Designers or architects should understand and select building elements and substances that can stand the weather circumstances of the location. According to Al-Hammad, Assaf, and Al-Shihah (1997), building elements, structures, and substances will suffer early deterioration due to the hostile climate, weather circumstances, and the abrasive applications of the facility. For instance, the climate could impact the deterioration of building envelopes and coatings. Moreover, Ramanauskas and Stankevičius (2000) declared that the durability of buildings' external surfaces and coatings is limited by the attributes of frost resistance, moisture or damp resistance, and corrosion (chemical impact) resistance. Hence, the knowledge of weather conditions and material determination during the design stage is crucial for building construction, impacting vast building operation and maintenance costs.

2.7.5.2 Biological Effects

According to Liska (1988) and Streifel (2002) biological growth and other circumstances such as pest infestation could lead to costly damage to the building, endless repair, and building degradation. Excessive biological growth may severely impact the building structure (Eklund and Young, 2013). Al-Khudair (1988) affirmed that the designer or architect must be knowledgeable and aware of building site conditions such as soil quality or conditions; soil changes or shifts could lead to cracks in foundations or structural elements. Inferior materials such as unsuitable soil will lead to construction failure, result in high costs in future corrective maintenance activities.

2.8 Research Framework

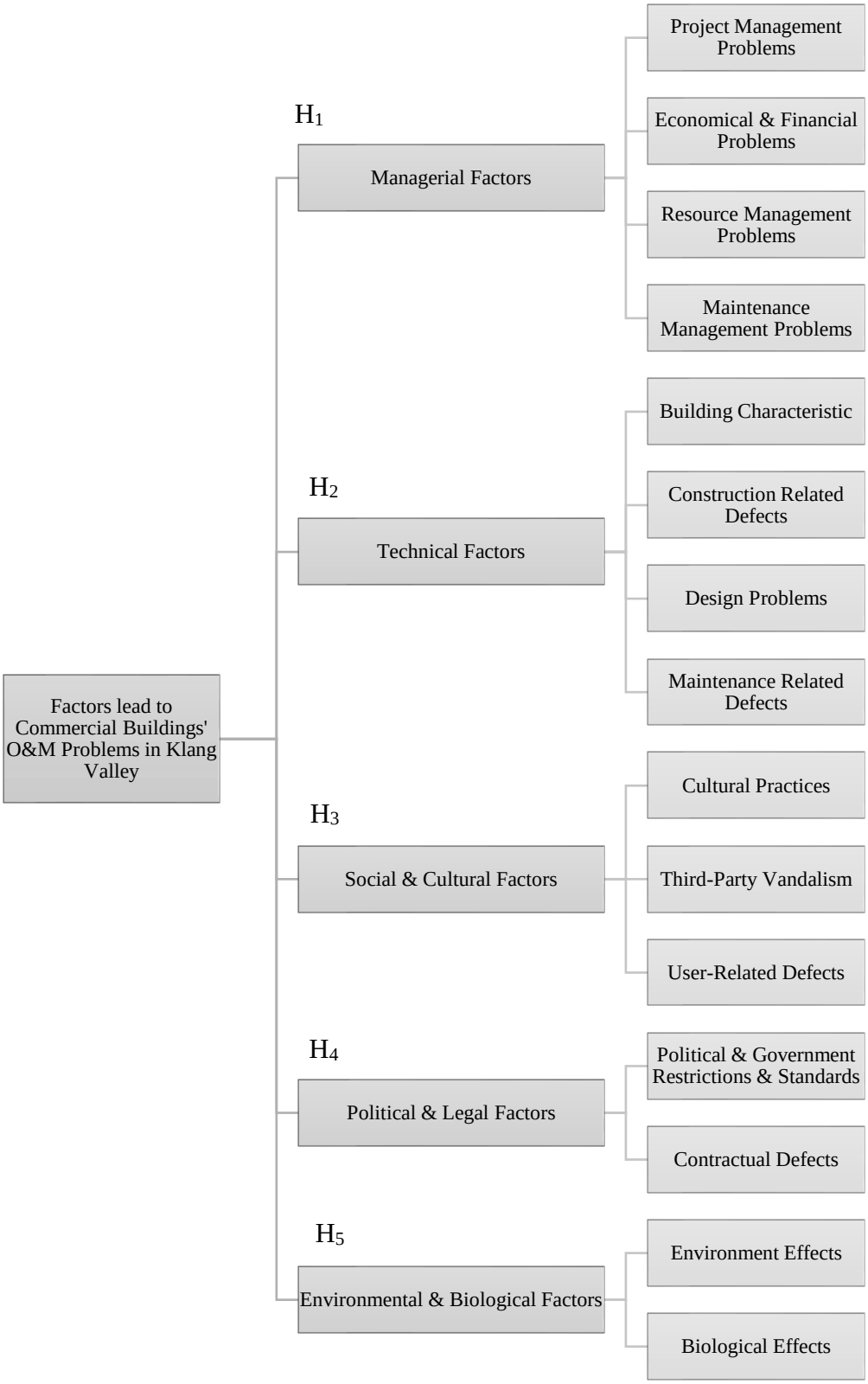

Figure 2.10: Proposed Theoretical Framework

Figure 2.1 demonstrates the proposed theoretical framework that works as the source for this research; to study the correlation between the variables. It comprises five independent variables (managerial factors, technical factors, social & cultural factors, political and legal factors, and environmental & biological factors); and one dependent variable (factors that lead to commercial building's O&M problem in Klang Valley). There are five hypotheses in the framework to examine the correlation within the variables under the discussion of hypothesis development.

2.9 Hypothesis Discussion

H_1: Managerial factors has a significant impact on commercial buildings' maintenance issues in Malaysia.

As the study supported by Arain, Low, and Assaf (2006), project management issues would positively influence buildings' maintenance. According to Moua and Russel (2001) and El-Haram and Horner (2002), buildings maintenance is an inevitable cost burden for projects, and deferral of O&M works is often due to insufficient budget allocation.

Research findings from Al-Khatam (2003) indicated that resource management problems have positively related and substantially influence buildings' maintenance issues. Next, Shear (1983) conceded that the incompetent workforce could lead to low maintenance quality to the building.

Horner, El-Haram, Munns (1997) reported that maintenance management has a strong relationship with buildings' maintenance and conceded that the maintenance management's primary purpose is to improve and minimize the needs for building defects. Therefore, it shows that the serious maintenance management problems and the relationship will be further examined.

H_2: Technical factors has a significant impact on commercial buildings' maintenance issues in Malaysia.

It is supported by Ahluwalia (2008), the building defects vary to the building's structure, location, and building user; the defect circumstances that affect the building state comprises facility status, age, or significant year of the building renovation, the form of building, and others. Next, Liska (1988) cited that the project works in the construction stage must be fulfilled by experienced and skilled contractors with the greatest quality and construction techniques to obtain a minimum level of maintenance throughout the building life cycle.

According to Okuntade (2014), defects in the building functions arise from inadequacies in design and build, reflecting on the level of operation and maintenance. The lack of consideration in maintenance study throughout the design stage of the building could lead to severe problems in the building function, performance, and security of the system, result in total replacement of the structure (Al-Khatam, 2003). Moreover, competent workers are necessary for maintenance work; they could improve the work's quality, reduce cost, and minimize work time (Al-Khudair, 1988). Experienced and adequate maintenance personnel would understand the maintenance costs and their responsibility, and the maintenance problems can be diminished (Ahmed 2002).

H_3: Social & cultural factors has a significant impact on commercial buildings' maintenance issues in Malaysia.

According to Suwaibatul (2010), the cultural practices, norms, and attitudes associated with maintenance effort should be embedded in every organization member due to the cultural practice of maintenance is an attitude lacking in private and public sectors users or occupants, and it is a widely identified problem that affects and thwarting buildings' maintenance work (Adejimi, 2005; Usman et al., 2012).

Ikpo (2006) indicated vandalism as reckless acts that can harm and cause excessive damage to building facilities, property, and infrastructures; the lack of consciousness and

knowledge in building facilities leads to damages in the building facilities and higher maintenance issues and costs (Azlan Shah et al., 2010). Furthermore, early response and reports on building defects or failure could reduce the maintenance cost and increase the efficiency in building O&M (El-Haram and Horner, 2002).

H_4: Political & legal factors has a significant impact on commercial buildings' maintenance issues in Malaysia.

It is supported by El Haram and Horner (2005), maintenance difficulties might have befallen from the shared ownership policy due to the repairs or services activities for common building elements, such as elevator, walkway, roofs, that may be shared or apportioned among the local authority and private occupants.

Furthermore, O&M budgets in most local authorities are significantly restricted due to the missing contract specification and impacted the maintenance activities cannot be conducted as per the maintenance schedule (Shen, 1997); however, to carry out items based on the condition seriousness.

H_5: Environment & biological factors has a significant impact on commercial buildings' maintenance issues in Malaysia.

Based on the above hypothesis, environmental & biological problems are assumed to directly influence commercial buildings' maintenance issues. Al-Hammad, Assaf, and Al-Shihah (1997) cited that building elements, structures, and substances will suffer early deterioration due to the hostile climate, weather circumstances, and the abrasive applications of the facility; the climate will impact the deterioration of building envelopes and coatings.

It is also supported by Liska (1988) and Streifel (2002), biological growth and other circumstances such as pest infestation could lead to excessive damage to the building,

endless repair, and building degradation. Hence, it shows that the severe impact and the relationship will be further investigated.

2.10 Summary of O&M Factors

Table 2.3: Summary of O&M Factors

No.	Factors	Authors
1	Managerial Factors • Project Management Problems • Economical & Financial Problems • Resource Management Problems • Maintenance Management Problems	Arain, Low, and Assaf (2006), Moua and Russel (2001), Al-Hammad, Al-Mubaiyadh, Mahmoud (1996), Horner, El-Haram, & Munns (1997).
2	Technical Factors • Building Characteristic • Construction Related Defects • Design Problems • Maintenance Related Defects	Ahluwalia (2008), Liska, 1988, Okuntade (2014), Hermawan (2013).
3	Social & Cultural Factors • Cultural Practices • Third-Party Vandalism • User-Related Defects	Mark, Ogaji, & Probert, (2006), Ikpo (2006), El-Haram and Horner (2002).
4	Political & Legal Factors • Political & Government Restrictions & Standards • Contractual Defects	El Haram and Horner (2005), Shen (1997).
5	Environmental & Biological Factors • Environmental Effects • Biological Effects	Ramanauskas and Stankevičius (2000), Al-Khudair (1988).

2.11 Conclusion

This chapter conveyed a literature review of the factors (managerial factors, technical factors, social & cultural factors, political and legal factors, environmental & biological factors) which could lead to commercial building's O&M problem in Klang Valley). Moreover, a theoretical framework was formed to investigate the correlation between each independent variable and dependent variable. The methodology adopted in the research will be examined in the following chapter.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

Research can comprehend the unknown, latent evidence and explanation for doubts within the topic area by adopting scientific investigation and methods on the assembled data (Kothari, 2004). A solid plan of research enables the researchers to accomplish the set objectives. This chapter discusses the method and mechanism used to conduct this research study. Furthermore, this chapter covers research setting, data collection approach, sampling design, measurement scales, and data analysis for the study factors that lead to commercial building's operation & maintenance (O&M) problems in Klang Valley.

3.2 Research Methodology

Research methodology refers to a systematic method that consists of a list of actions to obtain and establish novel and solid knowledge. According to Rajasekar, Philominathan and Chinnathambi (2013), it is the procedure used to define and foresee the events. In other words, it is known as the method applied to obtain data to form critical judgments. There are two main research methods: qualitative and quantitative approaches; each method type provides different procedures for research data collection. Based on the purpose of the research study, quantitative research and descriptive research have been selected to conduct this research.

3.2.1 Quantitative Research

Quantitative research was conducted in this research, known as the method that collects numerical data analyzed using mathematically based methods, which are statistics (Aliaga

and Gunderson, 2000). This quantitative research examines the correlation between independent and dependent variables in statistical forms based on extensive and representative samples (Hunter and Leahey 2008). The study results are reviewed and tabulated in figures, allowing researchers to understand which factors have the most significant impact on the commercial building's operation & maintenance (O&M) problems in Klang Valley.

3.3 Research Process

The research must be drafted well before research begins, known as a master plan that provides and establish the foundation base of research (Zikmund, Babin, Carr, and Griffin, 2012). In other words, the research design is the advanced plan of the methods to obtain the relevant data and examine the data systematically to accomplish the research objectives; research procedures can be conducted well when the research design is well developed (Rajasekar, Philominathan and Chinnathambi, 2013).

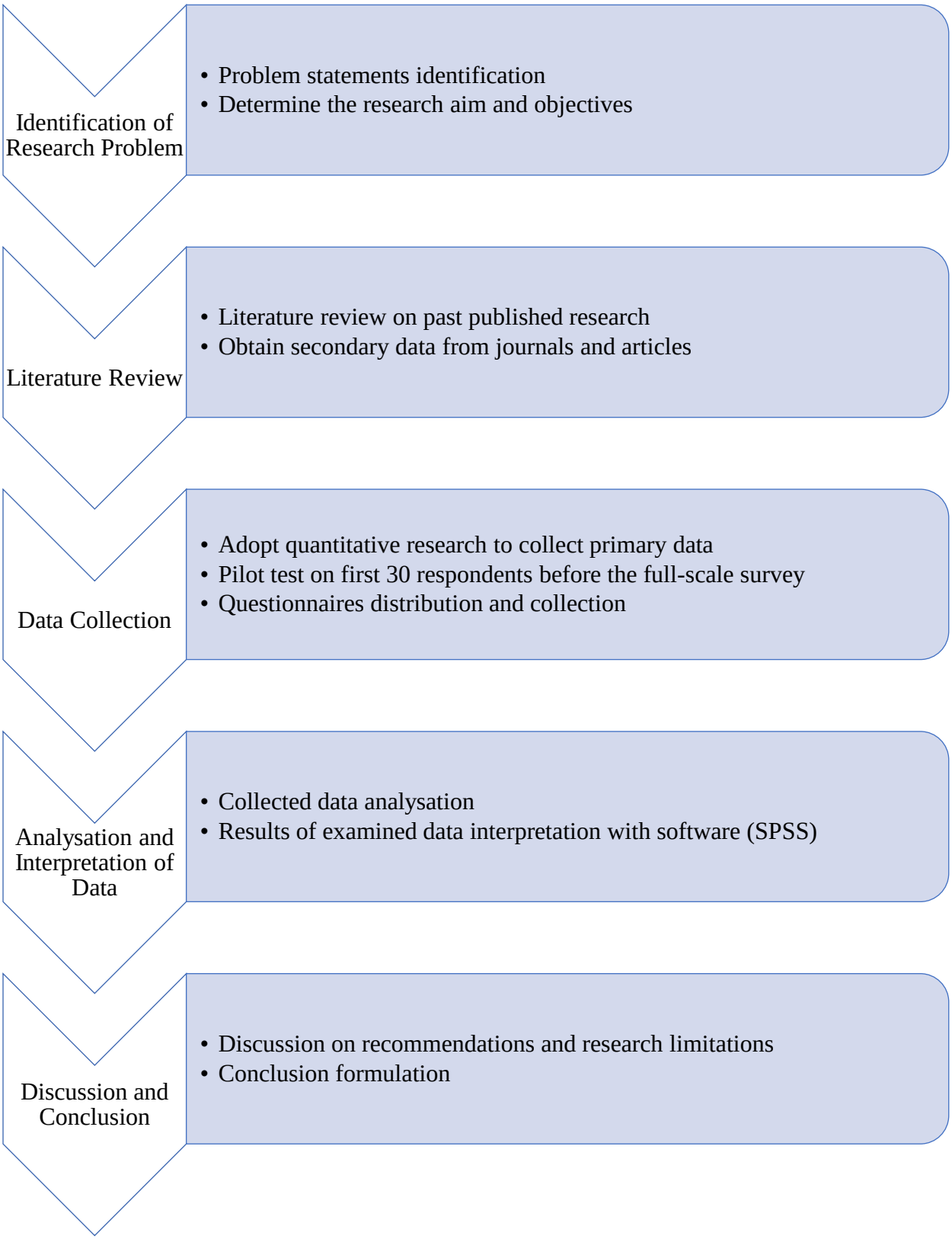

Figure 3.1: Research Design Diagram

3.4 Sampling Design

It is defined as a sample selection method from the population that enables the researcher to pick the suitable sample, the right time, and fit location for the research from a large group population (Kothari, 2004). The range of sampling is significant as it determines the trustworthiness and efficacy of the research study (Chua, 2016). The sampling design consists of several research study components, covering distinguishing the sample frame or target population, and sample size.

3.4.1 Target Population

The target population comprises specific population elements that researchers engage in and examine to get appropriate information for the study (Saunders, Lewis, and Thornhill, 2009). This research study aims to identify the factors that lead to commercial building's operation & maintenance (O&M) problems in Klang Valley. Therefore, the target respondents are professionals and individuals involved in Malaysia's commercial buildings' maintenance works, mainly because the information from the target respondents has higher relevance and accuracy. Also, the target respondents must be willing to share their experiences and provide relevant information to the researcher (Gibson and Whittington, 2010).

3.4.2 Sampling Technique

This research used a self-administered questionnaire. With the attached description and guidance on the questionnaire's cover page, respondents could fill up the questionnaire on their own quickly without any assistance. Also, this survey is online; thus, questionnaires were distributed/ sent to respective respondents and requested them fill it up and shorten the time and distance to reach all the respondents by running it on the internet.

The study was conducted by practicing a purposive sampling, which determined the research participants based on the responsibilities, position, and involvement in the

subject studied and judged that they could provide the specific information required for the research.

3.4.3 Sampling Location and Sampling Size

The questionnaire was conducted solely in the Klang Valley areas; the sample size was set before the data collection began, mainly due to the data's efficacy, reliability, and compatibility contributed to the research findings. Total responses of 200 questionnaires will be considered relatively good survey accuracy under most assumptions of a survey paper; 100 responses consider marginally acceptable accuracy (GreatBook, 2021). However, a total number of hundred (100) questionnaires were collected from the experts and individuals involved in commercial building works, such as Maintenance Technician, Facilities Operation Executive/ Manager, Building Manager, Building Technician, and others who understand better the factors that lead to the commercial building's operation & maintenance (O&M). The sampling location will mainly be through the internet due to the current pandemic of COVID-19; residents are restricted to stay home or work from home (FMCO/EMCO/NRP).

3.5 Data Collection Methods

There are two types of research data collected by the researchers for the study: primary and secondary data (Kothari, 2004). Primary data are the data newly obtained when practicing the quantitative method (Forshaw, 2000). The primary data collection's purpose for this research is to collect data associated with the research objectives' problem. Secondary data are the past relevant research's information and outcomes obtained and functioned through the analytical process by former research. Both primary and secondary data were gathered in the study to gain a broad wide prospect and recognition of the factors that lead to the commercial building's operation & maintenance (O&M) problems in Klang Valley.

3.5.1 Instrument Design

The primary data collection of this research is through a questionnaire survey, which could provide results numerically and statistically. A well-designed questionnaire is vital to get consideration from the respondents to gain concerns in responding to the survey. According to Kothari (2004), the quantitative method is standardly exercised by private and public sectors, individuals, and research mechanics while also extending to the use by governments. Nowadays, questionnaires are generally distributed and conducted online to the participants, especially during this pandemic of Covid-19. Furthermore, the phrasing and sentences applied in the questionnaire need to be precise and straightforward with easily understood English; and provide clear intention and instructions to the participants in responding to the questionnaire (Chua, 2013).

Next, the measurement scales in a research study refers to how variables are being measured. The characteristics possessed by a scale determine the scale level of measurement (Crossman, 2013). This study has several measurement scales: nominal scale (gender and race), ratio scale (work experience), and ordinal scale. The ordinal scale provided in the questionnaire is 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, and 5=Strongly Agree, to measure the extent of the factors that impact the commercial buildings' O&M issues in Klang Valley. By using this kind of scale, the information generated tends to be more accurate and reliable.

3.5.2 Pilot Test

Pilot rest refers to small-scale preliminary studies to examine the practicability of the ready questionnaire before conducting in-depth research (Chua, 2016). It is a crucial component to a good research design as it takes thirty (30) sets of questionnaires as a sample to ensure that no misunderstandings from the respondents on the question would arise. Moreover, the pilot test serves to enhance the research tool before the full-scale study is conducted. The pilot test was essential for the study to avoid getting incorrect and insignificant data from the respondents; the questionnaire will be required to revise when there is any scarcity or inadequacy of the survey questions.

3.6 Data Analysis Method

After the process of data collection, all the collected data will be interpreted for results formation. The importance of data analysis is to ensure the data collected from the respondents has been interpreted accurately through data editing, coding, grouping, and tabulation (Kothari, 2004). Data of this research study will be analyzed and entered into a computerized system known as SPSS software for data interpretation. SPSS is among the most widely used programs for statistical analysis in social science. On top of that, SPSS is a Windows-based program to perform data entry and analysis and create tables and graphs. The result will be reconstructed, abstracted, and tabulated for further explanations.

3.6.1 Descriptive Research

It refers to data gathering in the circumstances without changing its environment; and is exercised in this research. Commonly, it is defined as the data collected from individuals or associations to clarify puzzles concerning the study (Trochim, 2006). According to Kendra (2013), a cross-sectional study is a descriptive study that comprises a sample of elements from multiple segments of a population with various variables of interest but sharing characteristics such as socioeconomic status, educational background, or ethnicity.

3.6.2 Cronbach's Alpha

It is regularly applied for each set of measures to examine a multi-item scale's reliability. The purpose of implementing it is to validate the unreliable measure lessens correlation between research measures to confirm its reliability. Thus, the data that we collected has been tested by Cronbach's Alpha for the internal consistency of the data.

It allows us to estimate a composite's reliability when we know the composite score variance and the covariance among all its components (Price, 2000). On top of that, the Cronbach's Alpha is expected to be 0.7 or higher, indicating extensive evidence of reliability (Tomei, 2011).

3.6.3 Relative Important Index (RII)

RII is a method to measure and weigh the relative importance for each indicator (independent variables) and ranked respectively; obtained by summarizing the weight per independent variables. Where calculating with an Excel sheet, the formula is as below:

$$RII = \Sigma W / (N * A).$$

W = weighting as assigned on Likert's scale by each respondent in a range from 1 to 5, where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree.

A = Highest weight (It is 5 in this study)

N =Total number in the sample size (100 respondents in this study)

3.6.4 Multiple Regression Analysis

Multiple regression analysis refers to a statistical procedure that identifies the relationship between two or more independent variables (IV) to determine the relationship's patterns. And the independent variables (IV) in this research are managerial factors, technical factors, social and cultural factors, political and legal factors, environmental and biological factors, whereas the dependent variables (DV) are commercial buildings' operation and maintenance issues in Klang Valley.

According to Beggs (2003), ANOVA refers to an analysis of the variation present in a study. In this analysis, the F-value and p-value is used to examine whether the overall model is significant or not significant.

3.7 Conclusion

This chapter presented and summarized the research methodologies practiced in this study. A quantitative research method was exercised in the research, and a total of 211 questionnaire surveys were distributed to the respondents who are professionals and individuals involved in Malaysia's commercial buildings' works. In the subsequent chapter,

researchers will perform statistical analysis, the discussion, and interpretation of the hypotheses results.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter will examine and interpret the data collected from the questionnaire survey with software (SPSS). Several tests were applied to analyze the data collected, including Cronbach's Alpha reliability test, mean ranking, and RII. The results are analyzed and examined in this chapter after all the tests conducted, and it means to fulfil the aim and objectives stated in Chapter 1.

4.2 Questionnaire Design

The questionnaire is designed to acquire the perceptions of the professionals and individuals involved in Malaysia's commercial buildings' maintenance works, and the purpose of the questionnaire was to weigh the critical problems of Operations and Maintenance (O&M) and the factors that lead to O&M problems of commercial buildings in Klang Valley.

The questionnaire comprised three sections: Section A, respondent's personal information including age, education level, work experience, and position; Section B, Operations and Maintenance (O&M) Problems; and Section C, factors lead to commercial buildings O&M in Malaysia. The question in Section B and Section C is designed with a Likert scale (1 = strongly disagree to 5 = strongly agree) to weigh the factors of each element.

4.3 Pilot Test

Table 4.1: Cronbach's coefficient α values for pilot test

Category of Variables	Number of Items	Cronbach's Alpha
Operations & Maintenance (O&M) problems	7	0.834
Factors lead to commercial building O&M problems in Malaysia	15	0.918

A total of 30 sets of the questionnaire were purposely distributed and collected to conduct a pilot test; to assure reliability and usability on the questionnaire; the pilot test was carried through the Cronbach's Alpha Reliability Test, shown in Table 4.1. The research can be resumed and distributed to more respondents when the results are greater than 0.70, considered reliable/ acceptable.

Table 4.1 explains that the alpha value of the reliability test for the variables of O&M problems is 0.834; factors that lead to commercial building's O&M problems in Malaysia is 0.829; both are greater than 0.70, which implies that the internal consistency among the data is good. Therefore, the pilot test has shown a reliable result and is feasible in the following main study.

4.4 Response Rate

Table 4.2: Response Rate

Distribution Method	Samples Distributed	Samples Collected	Response Rate
Pilot Study			
E-survey	35	30	85.7%
Main Study			
E-survey	176	70	39.8%
Overall	211	100	47.4%

As table 4.2 indicates, a total of 211 questionnaires were distributed through E-survey to the industry experts and individuals within the Klang Valley area who involved in commercial building works, such as Maintenance Technician, Facilities Operation Executive/ Manager, Building Manager, Building Technician, and others who understand better the factors that lead to the commercial building's operation & maintenance (O&M). The questionnaires were carried out between August 2021 and October 2021; distributed through the internet due to the current pandemic of COVID-19; residents are restricted to stay home or work from home (FMCO/EMCO/NRP).

The responses/results of the thirty (30) samples gathered for the pilot study were feasible and were included in the primary study sample; continued with seventy (70) responses were collected out of the total hundred seventy-six (176) questionnaires distributed for the main study; therefore, a total of hundred (100) responses were successfully obtained for this study, contributing to an overall response rate of 47.4%.

4.5 Respondent's Demographic Profile

Part A of this research survey inquiry the respondent's demographic aspects, including gender, age, race, education level, position, and years of experience, which are examined and analyzed in this section to understand better the respondents' perceptions are feasibly practicable in the following analysis.

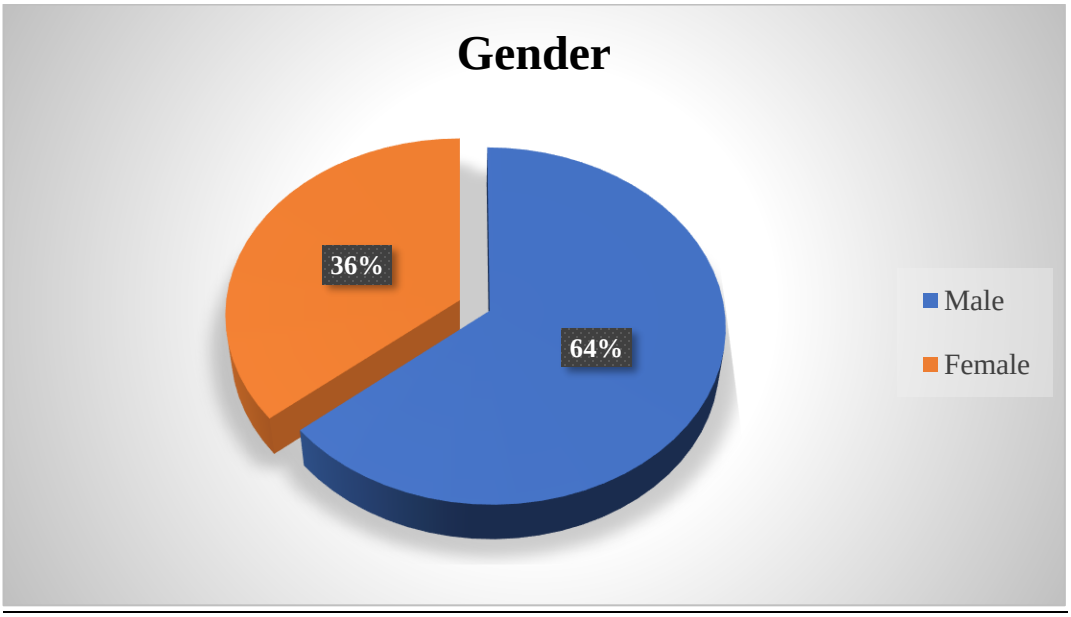

Figure 4.1: Gender of Respondents

Table 4.3: Gender of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	36	36.0	36.0	36.0
	Male	64	64.0	64.0	100.0
	Total	100	100.0	100.0	

Figure 4.1 and Table 4.1 show the gender of the respondents of this research study. Out of 100 respondents, 36% are female, while male respondents comprise 64%.

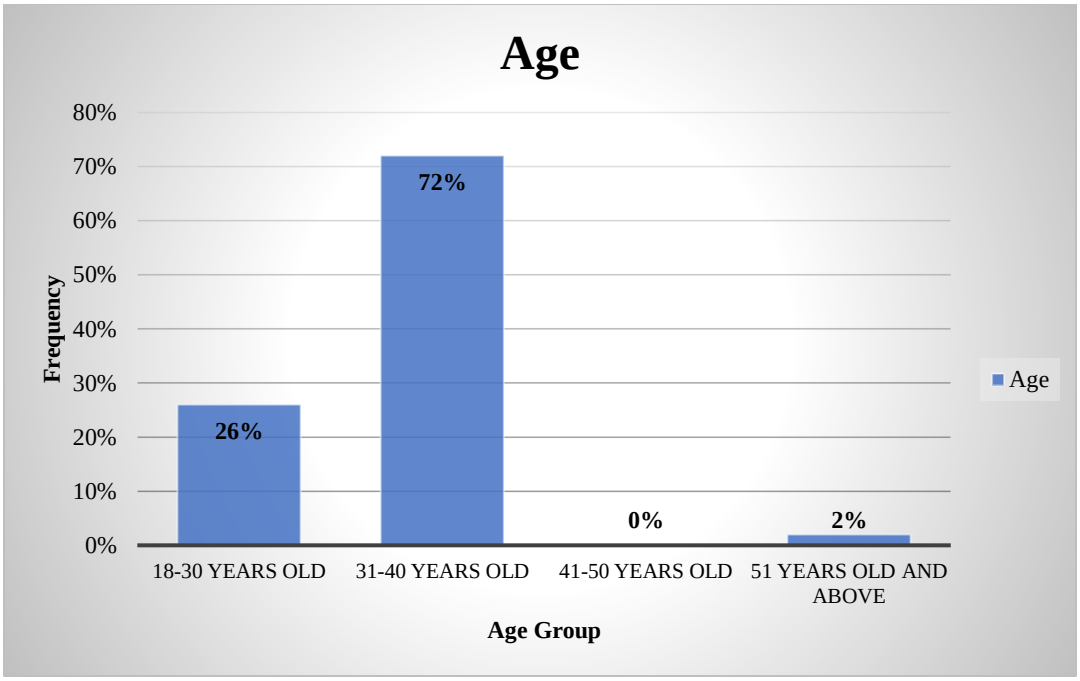

Figure 4.2: Age Group of Respondents

Table 4.4: Age Group of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18 -30 years old	26	26.0	26.0	26.0
	31 -40 years old	72	72.0	72.0	98.0
	51 years old and above	2	2.0	2.0	100.0
	Total	100	100.0	100.0	

As shown in Figure 4.2 and Table 4.2, the respondent's age group is classified into four groups, and the age group that carries the highest percentage is from 18-30 years old, which is 26%, followed by 72% for 31-40 years old and 2% for 51 years old and above.

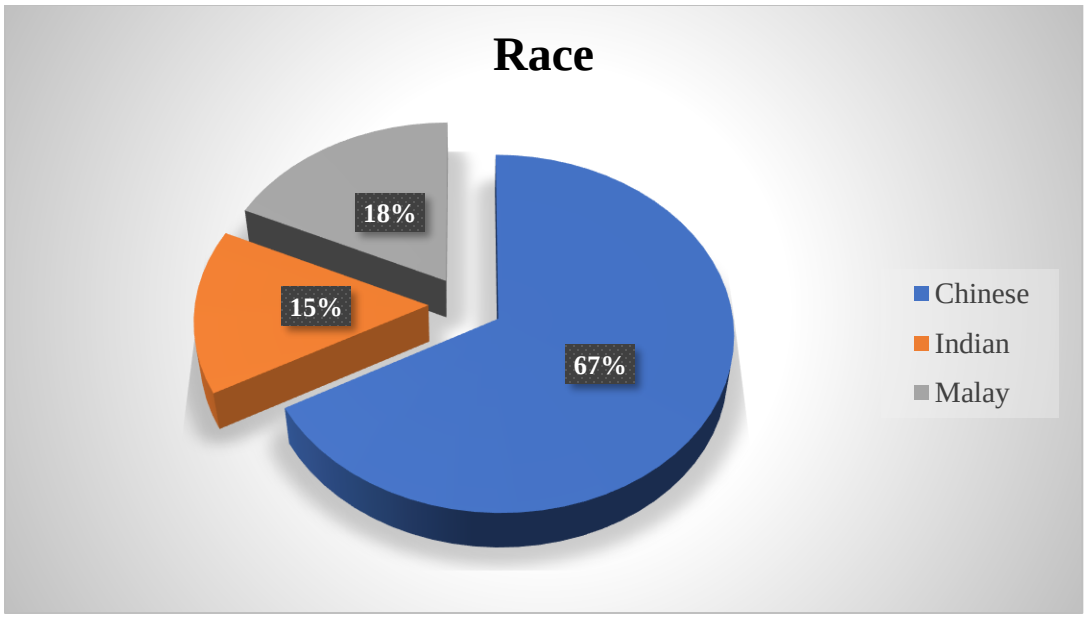

Figure 4.3: Race of Respondents

Table 4.5: Race of Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Chinese	67	67.0	67.0	67.0
	Indian	15	15.0	15.0	82.0
	Malay	18	18.0	18.0	100.0
	Total	100	100.0	100.0	

From Figure 4.3 and Table 4.3, most respondents' race is Chinese, consisting of 67%. Next, 18% of Malay respondents and 15% of Indian respondents.

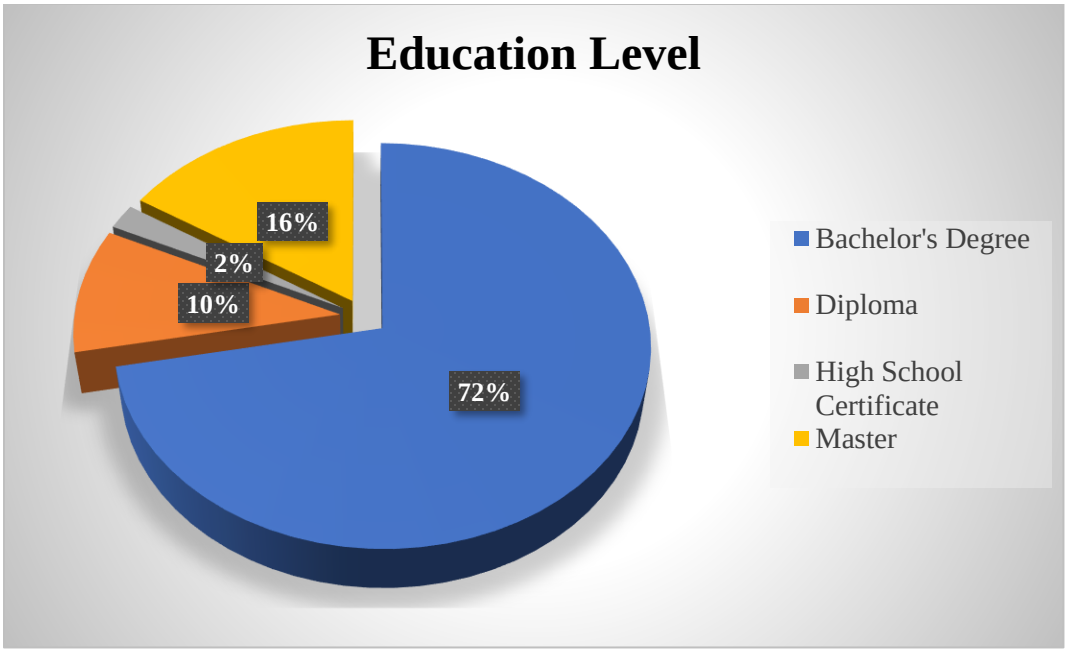

Figure 4.4: Education Level

Table 4.6: Education Level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bachelor's Degree	72	72.0	72.0	72.0
	Diploma	10	10.0	10.0	82.0
	High School Certificate	2	2.0	2.0	84.0
	Master	16	16.0	16.0	100.0
	Total	100	100.0	100.0	

From Figure 4.5 and Table 4.5, most respondents (72%) are degree holders at their highest education level. 10% of the total respondents are diploma holders, 2% of the high school certificate, and 16% are Master holders.

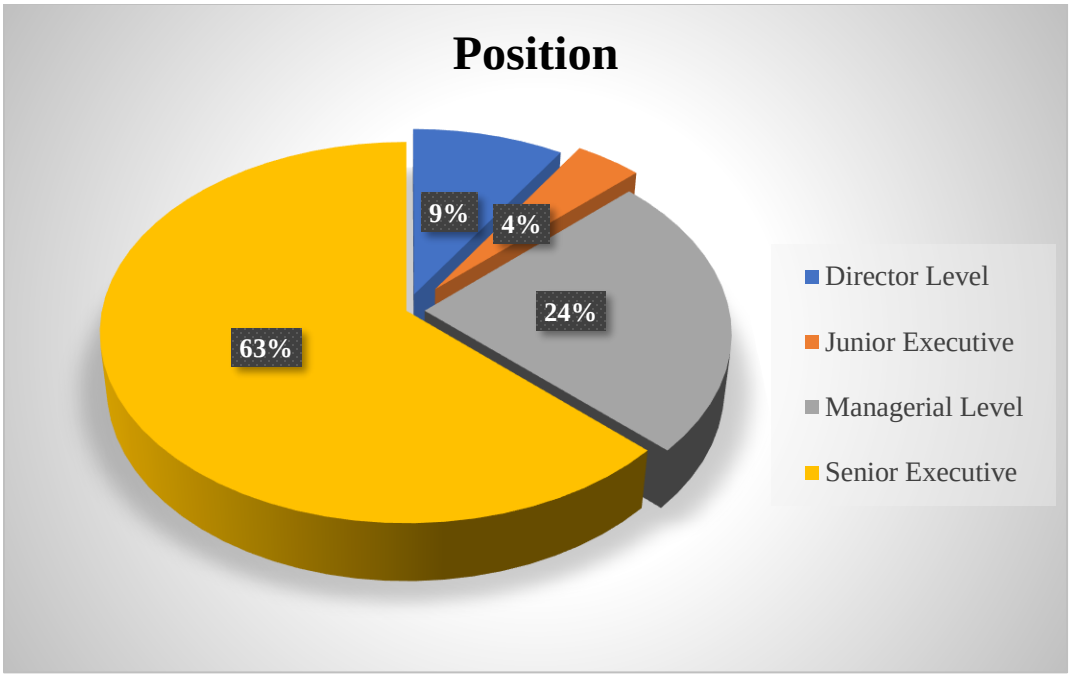

Figure 4.5: Position

Table 4.7: Position

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Director Level	9	9.0	9.0	9.0
	Junior Executive	4	4.0	4.0	13.0
	Managerial Level	24	24.0	24.0	37.0
	Senior Executive	63	63.0	63.0	100.0
	Total	100	100.0	100.0	

As shown in Figure 4.6 and Table 4.6, most of the respondents in this research study are in the senior executive position, 63%; followed by 24% for managerial level, 9% for director level, and the least respondent percentage with 4% for the junior executive.

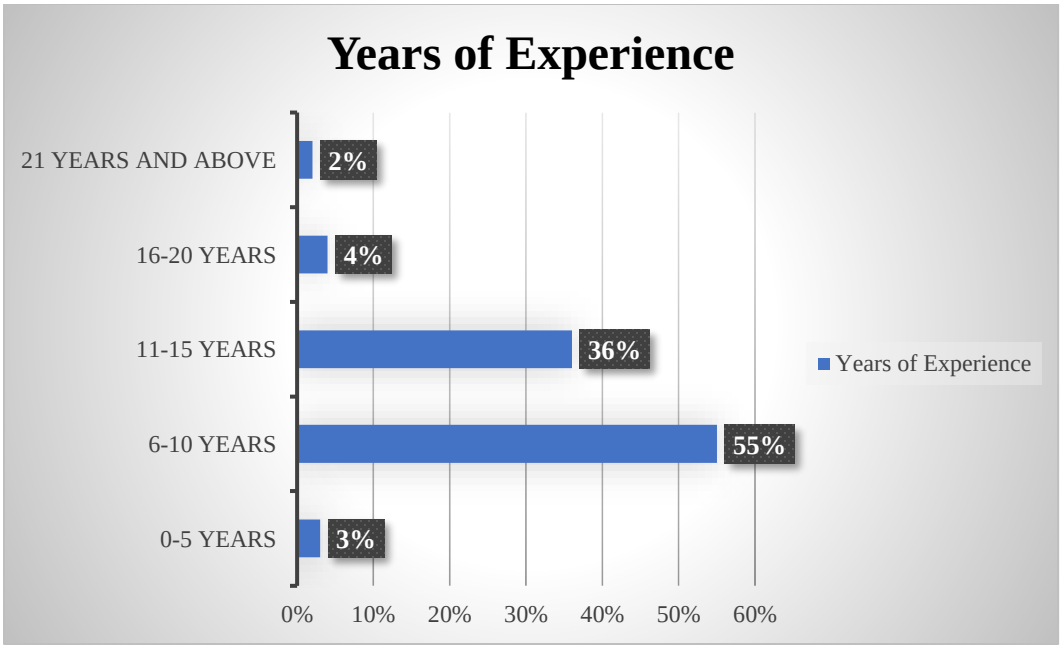

Figure 4.6: Years of Experience

Table 4.8: Years of Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0- 5 years	3	3.0	3.0	3.0
	11- 15 years	36	36.0	36.0	39.0
	16- 20 years	4	4.0	4.0	43.0
	21 years and above	2	2.0	2.0	45.0
	6- 10 years	55	55.0	55.0	100.0
	Total	100	100.0	100.0	

Based on Figure 4.7 and Table 4.7, respondents with 6–10 years of work experience have the highest percentage in this study, 55%, and followed by 36% for 11–15 years of work experience, 4% for 16–20 years, 3% for 0-5 years, and lastly, 2% for 21 years and above.

4.6 Cronbach's Alpha Reliability Test

Table 4.9: Reliability Analysis – O&M Problems

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
0.845	0.854	7

The alpha value of the reliability test from Table 4.9 demonstrates that the variable of O&M problems is 0.845 with a total hundred (100) respondents (out of 7 questions in the survey), which is greater than 0.70; implies that the internal consistency among the data is good.

Table 4.10: Reliability Analysis – Factors Lead to O&M Problems

No.	Variables/Constructs	Cronbach's Alpha	No. of Items
1	Managerial Factors (MF)	0.841	4
2	Technical Factors (TF)	0.886	4
3	Social & Cultural Factors (SCF)	0.823	3
4	Political & Legal Factors (PLF)	0.848	2
5	Environmental & Biological Factors (EBF)	0.919	2

As seen in Table 4.10, five (5) factors lead to O&M problems of commercial buildings in Klang Valley and the Cronbach's Alpha for the dimension of managerial factors is 0.841, which is measured by four (4) items. The alpha coefficient for technical factors is 0.886, which is measured by four (4) items. For social & cultural factors, three (3) items were applied to measure it, and the Cronbach's Alpha is 0.823. In addition, two

(2) items were adopted to measure political & legal factors, and the alpha coefficient is 0.848. Finally, the last variable, environmental & biological factors, is measured by two (2) items, and the alpha coefficient is 0.919.

In short, the internal reliability for the variables of managerial factors, technical factors, social & cultural factors, and political & legal factors is considered good, as Cronbach's Alpha values are above 0.8; the variables of environmental & biological factors imply the internal consistency among the data is excellent as the alpha value above 0.9.

4.7 Relative Important Index (RII)

Table 4.11 below presented the O&M problems in commercial buildings were weighted as assigned on Likert's scale by each respondent in a range from 1 to 5, where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

Table 4.11: Relative Important Index (RII) – O&M Problems

No	O&M Problems in Commercial Building	Frequency of "5" responses	Frequency of "4" responses	Frequency of "3" responses	Frequency of "2" responses	Frequency of "1" responses	Total respondents (N)	Weighted total	RII	Rank
1	Paint Peeled	43	47	10	0	0	100	433	**0.866**	**7**
2	Water Leakage	87	13	0	0	0	100	487	**0.974**	**1**
3	Dampness	63	37	0	0	0	100	463	**0.926**	**4**
4	Cracks	70	30	0	0	0	100	470	**0.940**	**2**
5	Defective Tiles	57	33	10	0	0	100	447	**0.894**	**5**
6	Roof Defects	56	27	17	0	0	100	439	**0.878**	**6**
7	Lift and Elevator Problems	73	21	4	2	0	100	465	**0.930**	**3**

Based on the hundred (100) respondents' perceptions of the O&M problems in commercial buildings, water leakage problems have the highest weight (487) or RII of 0.974 and ranked first compared to the other six (6) O&M problems; cracks issues weighted second with RII of 0.940; lift and elevator problems weighted thirdly with RII of 0.930. Dampness issues ranked fourth with RII of 0.926; defective tiles at fifth with RII of 0.894; roof defects at sixth with RII of 0.878 and lastly, paint peeled with RII of 0.866.

4.8 Multiple Regression Analysis

Table 4.12: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.815[a]	.663	.646	.38831

a. Predictors: (Constant), Managerial Factors, Technical Factors, Social & Cultural Factors, Political & Legal Factors, Environmental & Biological Factors

b. Dependent Variable: O&M Problems in Commercial Buildings

Table 4.12 above shows that the R-square value is 0.663. It symbolizes that about 66.3% of the dependent variable (O&M Problems in Commercial Buildings) can be explained by the variances in all the independent variables (Managerial Factors, Technical Factors, Social & Cultural Factors, Political & Legal Factors, Environmental & Biological Factors).

Table: 4.13: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	27.936	5	5.587	37.055	.000[b]
	Residual	14.174	94	.151		
	Total	42.110	99			

a. Dependent Variable: O&M Problems in Commercial Buildings

b. Predictors: (Constant), Managerial Factors, Technical Factors, Social & Cultural Factors, Political & Legal Factors, Environmental & Biological Factors

As shown in Table 4.13, the F-value is 37.055, and the p-value is 0.000. It concluded that the model was considered reasonable to predict that the independent variables (Managerial Factors, Technical Factors, Social & Cultural Factors, Political & Legal Factors, Environmental & Biological Factors) have a notable effect on the dependent variable (O&M Problems in Commercial Buildings).

Table: 4.14: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.146	.319		9.853	.000
	Managerial Factors (H_1)	-.266	.077	-.290	-3.448	.001
	Technical Factors (H_2)	.211	.096	.199	2.189	.031
	Social & Cultural Factors (H_3)	-.882	.142	-.835	-6.200	.000
	Political & Legal Factors (H_4)	1.000	.080	1.332	12.577	.000
	Environmental & Biological Factors (H_5)	.232	.043	.405	5.402	.000

a. Dependent Variable: O&M Problems in Commercial Buildings

As referred to in Table 4.14, the p-value of managerial factors is 0.001, which is below the significant level of 0.05. Accordingly, the hypothesis (H_1) is accepted; managerial factors significantly impact commercial buildings' O&M problems in Klang Valley. Next, the p-value of technical problems is 0.031, which is below the significant level of 0.05; the hypothesis (H_2) is accepted.

Furthermore, the p-values of the other three hypotheses (H_3, H_4, H_5) are lower than the significant level of 0.05, at 0.000, meaning that the hypotheses are all accepted. All five factors of O&M problems significantly impact commercial buildings' O&M problems in Klang Valley.

4.9 Conclusion

The results were generated based on the data gathered from hundred (100) industry experts and individuals within the Klang Valley area who were involved in commercial building works. The overall response rate in this research was 47.4%. The data reliability of the O&M problems and the factors that lead to the commercial building's O&M problems were tested through reliability analysis. The result in the reliability test proved that the data collected in the study were reliable. Furthermore, RII was used to weigh the O&M problems, and the issue of water leakage ranked first compared to the other six (6) O&M problems from the outcomes. Multiple regression analysis examined the relationship between independent and dependent variables; results have shown that the hypotheses (H_1, H_2, H_3, H_4, H_5) are all accepted. The next chapter will furnish further discussion on the significant findings and outcomes.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter concludes the study's findings based on the aim and objectives established early in Chapter 1. In conjunction with recommendations for future studies improvement, the study's limitations are discussed in this chapter to enhance the studies comprehensiveness towards the factors that lead to commercial buildings' operation and maintenance problems in Klang Valley.

5.2 Research Conclusion

From the research studies, all the variables (Managerial Factors, Technical Factors, Social & Cultural Factors, Political & Legal Factors, Environmental & Biological Factors) positively correlate with commercial buildings' operation and maintenance (O&M) problems. This study provides a better understanding of the factors that significantly impact O&M problems in Malaysia's commercial buildings. The study's outcome could better guide commercial buildings' management team to understand the importance of O&M to commercial buildings.

Chapter 1 stated the three main objectives to be accomplished in completing this study. The objectives are as below:

1. To identify the critical problems of operation and maintenance of commercial buildings in Klang Valley.
2. To investigate the critical factors that lead to operation and maintenance problems of commercial buildings in Klang Valley.
3. To evaluate the significant relationship between the problems and factors.

5.2.1 Objective I: To identify the critical problems of operation and maintenance of commercial buildings in Klang Valley.

In order to accomplish the study's first objective, respondents were asked to answer the questions mentioned in Section B of the questionnaire prepared; by ranking the problems of O&M in commercial buildings that have identified earlier in the literature review; the overall ranking for the seven (7) issues are: (1) Water leakage, (2) Cracks, (3) Lift and elevator problems, (4) Dampness, (5) Defective tiles, (6) Roof defects, and (7) Paint peeled. Water leakage problems ranked first from the RII results, although the RII for the other issues is all very close, implying that the respondents perceive all the seven issues are significant and water leakage issue is carrying severe impact to commercial buildings.

5.2.2 Objective II: To investigate the critical factors that lead to operation and maintenance problems of commercial buildings in Klang Valley.

The literature review findings revealed five (5) main factors that significantly impact O&M problems in Malaysia's commercial buildings, including managerial factors, technical factors, social & cultural factors, political & legal factors, and environmental & biological factors. Based on the factors found, the respondents were asked to rank the factors through a Likert scale by weighing each element under Section C of the questionnaire. As the result of Chapter 4 shows, the Cronbach's alpha values for all the five (5) factors are above 0.80, which is considered good, and the alpha value of environmental & biological factors is above 0.90, implying the internal consistency among the data is excellent.

5.2.3 Objective III: To evaluate the significant relationship between the problems and factors.

The third objective for this research has been achieved through the multiple regression analysis by assessing the respondent's data from the questionnaire to evaluate the significant relationship between the problems and factors. Multiple regression analysis

disclosed the relationship of 66.3% of the dependent variable (O&M Problems in Commercial Buildings) could be explained by the variances in all the independent variables (Managerial Factors, Technical Factors, Social & Cultural Factors, Political & Legal Factors, Environmental & Biological Factors). Moreover, the p-values of all the variables are below the significant level of 0.05, implying the hypotheses are all accepted; all five factors of O&M problems significantly impact commercial buildings' O&M problems in Klang Valley.

5.3 Research Implication

The study is essential as it furnishes a better understanding of the importance of O&M on commercial buildings. The findings pinpoint the significant problems and factors contributing to commercial buildings' O&M problems in Klang Valley; provide valuable information to the building management personnel, owner, consultant, as well as society to prevent and minimize the commercial buildings' O&M problems.

The research is helpful as it raises awareness concerning the importance of commercial buildings' O&M problems to a minimum level. Building's O&M can be planned performed routinely to sustain the infrastructure and facilities in a good state. When the preventive measures take place adequately with a regular schedule, the risk of costly replacements on building elements can be minimized.

5.4 Limitation of Research

Some of the limitations exist in this research project, although it has been planned and carried carefully. The survey was conducted via the Internet, and questionnaires were distributed through email and other network platforms to all respondents. However, some were unwilling to participate or longer reply to the questionnaire, impeding the research progress.

Furthermore, the availability of time is insufficient in conducting questionnaires for the research to examine the validity of the data within the time frame given. Insufficient time also limits this study from carrying out complete and comprehensive research. Next, part of the respondents could not participate in the questionnaire since the questionnaires were prepared in the English version; they did not fully understand the questions asked in the questionnaires due to some language barriers and different levels of comprehension for every individual.

5.5 Recommendation

Some recommendations can be proposed to improve the completeness for future studies related to the factors that lead to commercial buildings' operation and maintenance problems in Malaysia. Future researchers could also expand this research by distributing the questionnaire to the respondents from other states of Malaysia who are involved in the commercial building's O&M, especially from Sabah & Sarawak located in East Malaysia. By increasing the sample location to more states of Malaysia, the time frame and the sample size should be increased to have a longer time frame to obtain more data from the entire population of Malaysia.

The distribution of the questionnaire through the face-to-face method is highly recommended; discussion, explanation, and eye contact are allowed between researcher and respondents to minimize the likelihood of respondents unwillingly participating in the questionnaire. Furthermore, different languages can be prepared and provided in the questionnaire for those less educated individuals by ensuring the questionnaire is understandable without language barriers.

5.6 Summary

This chapter concludes the study of every chapter; research limitations are being identified, recommendations for future research have been proposed. Future researchers could improve the future research quality with the given recommendation.

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APPENDICES

APPENDIX A: Questionnaire

FACTORS LEAD TO COMMERCIAL BUILDINGS' OPERATION AND MAINTENANCE (O&M) PROBLEMS IN KLANG VALLEY

Dear Sir/Madam,

Sincere greetings and best regards to you.

I am a postgraduate student from Lee Kong Chian Faculty of Engineering and Science of Universiti Tunku Abdul Rahman. Thank you for accepting my invitation. I appreciate your participation in my online survey. This survey is for understanding the factors that lead to commercial's building operation and maintenance issues in Klang Valley. It will only take 10 minutes to complete.

You can be assured that any information you provide in this survey will be entirely anonymous and confidential. It will be used solely for academic purposes. For further inquiries or clarification, please get in touch with me at yiwangzac@gmail.com.

Thank you for your time in this survey study.

Sincerely,

Tan Yi Wang
Postgraduate Student
Lee Kong Chian Faculty of Engineering & Science
Universiti Tunku Abdul (UTAR)

SECTION A: Demographic Information

Please tick (✓) or fill in the blank for each of the questions below. Each question can only choose **ONE** answer.

1. Gender:
   - Male
   - Female

2. Age:
   - 18 years old - 30 years old
   - 31 years old - 40 years old
   - 41 years old - 50 years old
   - 51 years old and above

3. Race:
   - Malay
   - Chinese
   - Indian
   - Others: _____ (please specify)

4. Education Level:
   - High School Certificate
   - Diploma
   - Bachelor's degree
   - Master
   - PhD (Doctorate)
   - Others: _____ (please specify)

5. Position:
   - Junior Executive
   - Senior Executive
   - Managerial Level
   - Director Level

6. Years of experience:
   - 0 – 5 years
   - 6 – 10 years
   - 11 – 15 years
   - 16 – 20 years
   - 21 years and above

SECTION B: Operations & Maintenance (O&M) Problems

Please tick (✓) in the appropriate column.

Strongly Disagree (SD)	Disagree (D)	Neutral (N)	Agree (A)	Strongly Agree (SA)
1	2	3	4	5

No.	O&M Problems	SD	D	N	A	SA
1.	Paint Peeled 	1	2	3	4	5
2.	Water Leakage 	1	2	3	4	5
3.	Dampness 	1	2	3	4	5

4.	Cracks 	1	2	3	4	5
5.	Defective Tiles 	1	2	3	4	5
6.	Roof Defects 	1	2	3	4	5
7.	Lift and Escalator Problems 	1	2	3	4	5

SECTION C: Factors Lead to Commercial Buildings O&M in Malaysia

Please tick (✓) in the appropriate column.

Strongly Disagree (SD)	Disagree (D)	Neutral (N)	Agree (A)	Strongly Agree (SA)
1	2	3	4	5

No.	Factors Lead to Commercial Buildings O&M in Malaysia	SD	D	N	A	SA
MANAGERIAL FACTORS						
1.	Project Management Problems The unclear construction plan for maintenance will cause an impact on future building O&M problems.	1	2	3	4	5
2.	Economical & Financial Problems The underestimation of the client towards the budget for maintenance works; insufficient funds/ budget allocation for facility/ maintenance works.	1	2	3	4	5
3.	Resource Management Problems The incompetent or inexperienced O&M personnel and poor workmanship skills will carry high risk and severe impact on the building O&M.	1	2	3	4	5
4.	Maintenance Management Problems Unsystematic database for maintenance works; the use of outdated or wrong maintenance policy.	1	2	3	4	5

TECHNICAL FACTORS						
1.	Building Characteristic Ageing buildings and the condition of the building structure will be difficult for building O&M.	1	2	3	4	5
2.	Construction Related Defects The unqualified and carelessness of the contractors in construction work inspection will carry a severe impact on the future building O&M.	1	2	3	4	5
3.	Design Problems The lack of consideration in maintenance study throughout the design stage of the building will affect the future building O&M.	1	2	3	4	5
4.	Maintenance Related Defects The skill of maintenance personnel is crucial; and will affect the building O&M.	1	2	3	4	5
SOCIAL & CULTURAL FACTORS						
1.	Cultural Practices The cultural practice of maintenance is an attitude lacking in private and public sectors users.	1	2	3	4	5
2.	Third-Party Vandalism The reckless acts of users and the poor awareness of users towards the building facilities and property will severely impact the building O&M.	1	2	3	4	5

3.	User Related Defects The way users exercise building facilities and the delay of the failure reporting will severely impact the building O&M.	1	2	3	4	5
POLITICAL & LEGAL FACTORS						
1.	Political & Government Restrictions & Standards Government policy on a right-to-buy property may neglect the future building O&M consideration.	1	2	3	4	5
2.	Contractual Defects With a Turnkey contract, the owner carries less power in construction specification decisions, where contractors may overlook future building O&M considerations.	1	2	3	4	5
ENVIRONMENTAL & BIOLOGICAL EFFECTS						
1.	Environmental Effects The external and internal climate will impact building degradation and lead to costly building O&M.	1	2	3	4	5
2.	Biological Effects The inferior materials such as unsuitable soil will lead to construction failure; the biological growth and other circumstances such as pest infestation will lead to costly damage to buildings O&M.	1	2	3	4	5

Thank you for your valuable time and participation in this questionnaire.

All responses will be kept private and confidential.