

**POST OCCUPANCY EVALUATION OF GREEN BUILDING:
A CASE STUDY FOR JOHOR PORT AUTHORITY'S BUILDING**

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DEDICATION

“To my dearest parents, family members and my fellow friends,

Appreciate the support and encouragement given”

ACKNOWLEDGEMENT

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ABSTRACT

The development of green building has become a trend among the developers not only in the private sector but in the government sector as well. Green buildings are not only beneficial economically to the building owner but they also provide a conducive environment for the occupants and inflict less harm to environment. Up until September 2016, there are 715 registered green building projects in Malaysia. However, the success of green building in term of their performance is still in doubt and very much speculative. In fact, there have also been reports saying that green building fail to perform as they are intended too. Thus, there is the need to evaluate the performance of green building as it is crucial to determine whether or not they are performing as expected and what are the performance aspects that require improvement. To address this issue, Post Occupancy Evaluation (POE) on green building was conducted. Fifteen (15) performance criteria and thirty-five (35) parameters were identified from the literature and validated by green building facilitators and green building managers. Content Validity Survey was carried out resulting in the selection of eleven (11) performance criteria and twenty-six (26) performance parameters. 120 staffs of JPA were engaged as respondents in the questionnaire survey and the data was analysed descriptively via frequency calculation. The result identified which aspects of building performance are perceived as performing and not performing well by the occupants and require attention and improvement by the Engineering Department of JPA. The findings of this research can significantly benefit JPA and the design team of the Public Work Department. This study can also be an eye-opener for Public Work Department to carry out POE for other green building projects by the government.

ABSTRAK

Pembangunan bangunan hijau telah menjadi satu trend di kalangan pemaju bukan sahaja dalam sektor swasta tetapi dalam sektor kerajaan juga. Bangunan hijau bukan sahaja memberi manfaat dari segi ekonomi kepada pemilik bangunan itu tetapi mereka juga menyediakan persekitaran yang kondusif untuk penghuni dan kurang bahaya kepada alam sekitar. Sehingga September 2016, terdapat 715 projek bangunan hijau yang berdaftar di Malaysia. Walau bagaimanapun, kejayaan bangunan hijau dari segi prestasi mereka masih menjadi tanda tanya dan sangat spekulatif. Malah, terdapat juga laporan mengatakan bahawa bangunan hijau gagal menunjukkan prestasi seperti yang sepatutnya. Oleh yang demikian, terdapat keperluan untuk menilai prestasi bangunan hijau kerana ia adalah penting untuk menentukan sama ada atau tidak bangunan hijau berfungsi seperti yang diharapkan dan menentukan aspek prestasi yang perlu diperbaiki. Untuk menangani isu ini, Penilaian Pasca Menduduki (POE) di bangunan hijau telah dijalankan. Lima belas (15) kriteria prestasi dan tiga puluh enam (36) prestasi parameter telah dikenal pasti dari pembacaan dan disahkan oleh fasilitator bangunan hijau dan pengurus bangunan hijau. Satu Survey Kesahan Kandungan telah dijalankan seterusnya memilih sebelas (11) kriteria prestasi dan dua puluh enam (26) parameter prestasi. 120 kakitangan JPA telah terlibat sebagai responden dalam kajian soal selidik dan data dianalisis secara deskriptif melalui pengiraan kekerapan. Hasil kajian mengenalpasti aspek prestasi bangunan yang mana dilihat sebagai prestasi yang baik dan prestasi yang tidak baik seperti yang dinilai oleh penghuni bangunan serta memerlukan perhatian dan penambahbaikan oleh Unit Kejuruteraan JPA. Hasil kajian ini boleh dimanfaatkan kepada JPA dan pasukan reka bentuk daripada Jabatan Kerja Raya. Kajian ini juga boleh menjadi pembuka mata kepada Jabatan Kerja Raya untuk menjalankan POE untuk projek-projek bangunan hijau yang lain yang dibina oleh kerajaan.

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LIST OF ABBREVIATIONS

POE	-	Post Occupancy Evaluation
JPA	-	Johor Port Authority
PWD	-	Public Work Department
JKR	-	Jabatan Kerja Raya
PH JKR	-	Penarafan Hijau Jabatan Kerja Raya
GBI	-	Green Building Index
CVI	-	Content Validity Index

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In this modern living lifestyle, the comfortable, healthy working environment is essential for human beings. This is because most of the people spend their time working in the office building. The comfortable and healthy working environment will create more satisfying workplace for the building's user thus contributing to the higher productivity of workers (Altomonte & Schiavon, 2013; Nguyen & Gray, 2016; Paul & Taylor, 2008).

Green building can be considered as the popular choices for most peripheral countries as their working places (Zhao, He, Johnson, & Mou, 2015). According to (Zhao et al., 2015), the idea of the green building can be deliberated as a major transformation in the history of the construction industry. The goal in the marketing of residential and commercial space has been changed in order to achieve the

occupancy rate for the control of systematic construction to provide a healthy and comfortable space for activities and sustainability of space.

Nowadays, green building, as a commodity, is becoming the focus of global attention under the influence of the incentive based market economy (Zhao et al., 2015). Society has accepted sustainability as their substantial interest and it also gradually moved into the discipline of the built environment (Reed & Jailani, 2014). Moreover, the real estate sector increasingly put attention in green building and bring economic benefits to the building owner as the green building is able to save lifecycle costs and increase the competitive advantage (Nguyen & Gray, 2016).

As most of the country are running towards green construction that can support the global environment and providing a lot of benefits to the building users especially in terms of energy conscious, healthy building (Gou, Prasad, & Siu-Yu Lau, 2013), Malaysia is also part of the country that support this initiative. This is because green building can promote a lot of benefits not only to the building users but also protect the environment.

1.2 Background of the Study

In the recent years, the development of sustainability in office buildings and the acceptance of these buildings in the broader property market is increasing. Sustainable buildings are being said as the future for the property increasing. Thus, Malaysia is also part of the country that responds to this sustainable practice. Malaysia is currently heading towards Vision 2020. The vision calls for the Malaysia to achieve a self-sufficient industrialised nation by the year 2020, encompasses all aspects of life, from economic prosperity, social well being, educational world class, political stability as well as psychological balance. Malaysian former Prime Minister, Tun Dr Mahathir Mohammad had outlined nine strategic challenges that Malaysia must overcome to achieve Vision 2020 and one of the challenges (Challenge 6) is establishing a scientific and progressive society which is not only a consumer of

technology but also contribute to the scientific and technological civilization of the future. One of the criteria in this Challenge 6 is green building as it promotes environmental friendly and conserves the environment.

The National Energy Policy was formulated to achieve the following objectives for ensuring adequate, secure, quality and cost effective supply of energy; promoting efficient utilisation of energy and ensuring factors pertaining to of energy. Government of Malaysia also encouraged either public or private sector to develop green building project in order to promote sustainable development which have long term benefits. Malaysian Prime Minister, Dato' Sri Mohd Najib Tun Razak also agreed that green building will create a friendly and clean environment.

According to Green Building Index website, until September 2016, there were 715 registered projects and from that, 372 were being certified. For non-residential building, there were 370 registered project and 184 were being certified by the GBI. This is quite number of buildings had been recognised as green building. However, are all this building achieve the expectations of the users who are the primary occupiers in that building? The actual performance of the green building can be determined by carrying out the Post Occupancy Evaluation (POE). Nevertheless, this practice is still rare in Malaysia (Izran Sarrazin, 2011).

This research is focusing on the Post Occupancy Evaluation of the green building performances in the Malaysia. The case study focus on green building owned by Lembaga Pelabuhan Johor or the Johor Port Authority (JPA) located in Pasir Gudang, Johor.

1.3 Problem Statement

The Johor Port Authority (JPA) was established on the 1st of January 1975 under the Port Authorities Act 1963 in order to function as a regulatory body for the operations carried out in the Port of Tanjung Pelepas, Port of Pasir Gudang, Tanjung Belungkor Ferry Terminal and also responsible for managing the Changi Ferry Terminal in Singapore. On the early of January 2012, the Johor Port Authority (JPA) decided to construct their green building as their office headquarter in Pasir Gudang and Jabatan Kerja Raya (JKR) acted as the consultant for this project. The building was completed on November 2014 and the JPA started to take over the building on the early January 2015. The management of the JPA decided to construct green building in order to respond to the government's call that encouraging of sustainable development practice and also portrait JPA as part of the corporate responsibility strategies as response to sustainable issue like minimisation of harmful effects on the global warming (Isa, Rahman, Sipan, & Hwa, 2013). Besides that, the management of JPA also expect their green building will create comfortable living for the building occupant and also guarantees energy efficiency and environmental protection (Zhao et al., 2015).

According to the Green Building Index website, a green building focuses on increasing the efficiency of resource use – energy, water, and materials – while reducing building impact on human health and the environment during the building's lifecycle, through better siting, design, construction, operation, maintenance, and removal. Green buildings make efficient use of resources; have significant operational savings and increase workplace productivity. Green building is able to sustain and improve the quality of human life whilst maintaining the capacity of the ecosystem at local and global levels.

Green building should bring benefits to consumers, by means of gathering their individual feelings and then maximising their satisfaction and productivity (Altomonte & Schiavon, 2013; Zhao et al., 2015). Therefore, the green building is

showing the lot of benefits not only to the building users but also give positive feedback to the client.

However, starting from the JPA took over the building from on early January 2015 until now, according to the Head of Engineering Department of JPA, there is no formal building performance evaluation conducted by Jabatan Kerja Raya (JKR) or any other parties to measure their JPA's building performance. The building performance is important in order to know the exact performance of the building and to know whether the investment made by the JPA is worthy or not as the initial cost to construct the green building according to (Dwaikat & Ali, 2016; Isa et al., 2013) is higher compare to conventional building with the range from -0.40% to 21%. Moreover, many researchers also agreed that the overall cost for constructing the green building is higher compare to the conventional building (Aliagha, Hashim, Sanni, & Ali, 2013; Asdrubali et al., 2013; Dwaikat & Ali, 2016; Liu, Guo, & Hu, 2014; Yu, Sun, Ding, Wang, & Feng, 2015).

The JPA needs to identify the building performance whether it is fulfill their expectation or do not fulfil the JPA's expectation after JPA took over the building. As a owner, the JPA is hoping that their green building should performed well as intended because there is evidence indicates that green buildings can outperform non green buildings in many performance areas (Asdrubali et al., 2013; Dwaikat & Ali, 2016). This statement is supported by study conducted by (Dwaikat & Ali, 2016; Isa et al., 2013; Zhao et al., 2015); they indicated that green building cost less in energy cost with 20% to 35%. Moreover, according to Leaman whom had performed post occupancy evaluation in green and conventional building in the Australia as cited by (Altomonte & Schiavon, 2013) discovered that most green building outperformed conventional buildings in the aspect of occupant satisfaction. Thus, it is essential to understand the occupier's perceptions and expectations of sustainable building design and technology incorporated in the building since the social aspect is a major principle of sustainability (Jailani, Reed, James, Jailani, & Reed, 2015). The good performance evidence showed by the green building will attract another developer

either from private or government agencies to invest in the green building project as it creates a lot of benefit not only to the user, client but also sustain the environment.

As a consequence, their building that does not undergo building performance evaluation will lead to JPA the “question mark” regarding their building performance. The JPA will not know what their building performance at the current state is because there is no formal evaluation of the building performance. When there is no building performance evaluation conducted, the JPA also does not identify what are the problems and strengths of their building. For example, the air condition (thermal comfort) in the building at level 8 and 9 are too cold and this problem persists for a long time. Logically, that condition will affect human health; lead to flu, cough, etc. thus will increase the absenteeism of workers (Zhao et al., 2015).

When this problem persists, it will create discomfort situation and it will lead to unproductivity of the workers (Gou et al., 2013). Meanwhile, the engineering department team does not aware regarding the problematic air conditioning because there is no complaint from building user and there is also no building performance evaluation had been conducted. This is because also the occupants prefer to show “forgiveness” towards the situation without realising it will danger their health (Gou et al., 2013). Therefore, there is need to conduct formal building performance evaluation. Moreover, if the management of the building fails to evaluate their building performance, the similar problem will occur in the subsequent buildings (Izran Sarrazin, 2011). It will lead to waste of money spend by the government or private agencies. According to BRE website, poor building performance will impact on running costs, occupant well-being and business efficiency. Commissioning and measurement and verification are the best way to develop strategies for decreasing energy consumption (Kessler, 2010).

Therefore, to prevent the mistake from being repeated, the evaluation of the green building performance needs to be proactively done. Feedback from the users of

the building is needed in order to identify the building performance. Hence, to identify the JPA's building performance, Post Occupancy Evaluation (POE) is needed. There are a few methods available to measure the building performance like Building Quality Assessment, Real Estate Norm and Architectural Feasibility. However, all these methods only focus on the physical condition of the building and focus on operation cost like utility bill only and involving the experts judgement (Woon, 2016). All these methods do not consider the social or human aspect. POE is the only method that involving the feedback from the users of the building, management and the designers. It reflects the comprehensive environmental performance and operation effect, feedback the design and provide improvement basis for developer (Yu et al., 2015).

In conducting POE, we need to determine performance criteria and performance parameter that need to be evaluated in the evaluation of office green building. According to Izran and Hakim (2007), Post Occupancy Evaluation (POE) is the formal evaluation of a building, measured with social science-based tools of interviews, surveys, focus groups, systematic observation, and behavioural mapping for achieving continuous performance improvement throughout the building's operational life.

POE evaluates how a facility meets organisational goals and user requirements after occupation of the building. Moreover, in conjunction with the one of the code of ethics implemented by JPA is harmony in every aspect. Thus, it shown that POE is needed for this building because it will encourage the JPA to operate in sustainable manners.

POE takes user satisfaction from the building users regarding performance of the green building as they are the primary users of the building who use and operate the building for the long term and they are the one to critics whether the sustainable building is considered a success or not. The users also have the chance to supply the design teams or facility managers with information about their expectations and what

they experienced with a green building. Implementing POE also increase accountability for facility managers, standardised best practices and the findings will assist the JPA or PWD for future project improvements (Tookaloo & Smith, 2015).

1.4 Research Questions

Here are the questions that must be answered:

- a) What are the performance criteria for Post- Occupancy Evaluation (POE) for green office building in Malaysia?
- b) What is the performance of green building in Malaysia?

1.5 Research Objectives

The study is carried out to achieve the following objectives:

- i. To identify the performance criteria and parameters for Post Occupancy Evaluation (POE) of green office building in Malaysia
- ii. To determine the performance of the Johor Port Authority's building through Post Occupancy Evaluation (POE).

1.6 Scope of Research

This study is focusing on the green building owned by the Johor Port Authority in Pasir Gudang, Johor. Respondent group is made up of the top

management staff and employers in that office building consisting of hundred and twenty (120) building users and the maintenance workers. This building is chosen as this building was first government building developed by PWD , thus it has to achieve the desired function and most import thing the government effort in enhancing the sustainable construction is successful. Therefore, the next development of the government green building will be developed better.

1.7 Significance of Study

The importance of this study is to be used by any facility managers, project managers, clients from government or private sectors, design team (Architects, Engineers, Interior Designers, Mechanical and Electrical Engineer and Green Building consultant) who are involved with green building projects. This study helps to for the future design team to avoid the same mistakes repeated.

1.8 Research Methodology

Figure 1.1 shows the methodology flow chart of this research. The first phase in the research methodology aim to identify the variable performance criteria and parameters for POE of green office building from the literature review. Then, the criteria and parameters are validated by the green building experts. The second phase is to achieve the second objective which is to determine the performance of JPA's green building. Detailed discussion on the research methodology is presented in Chapter 4.

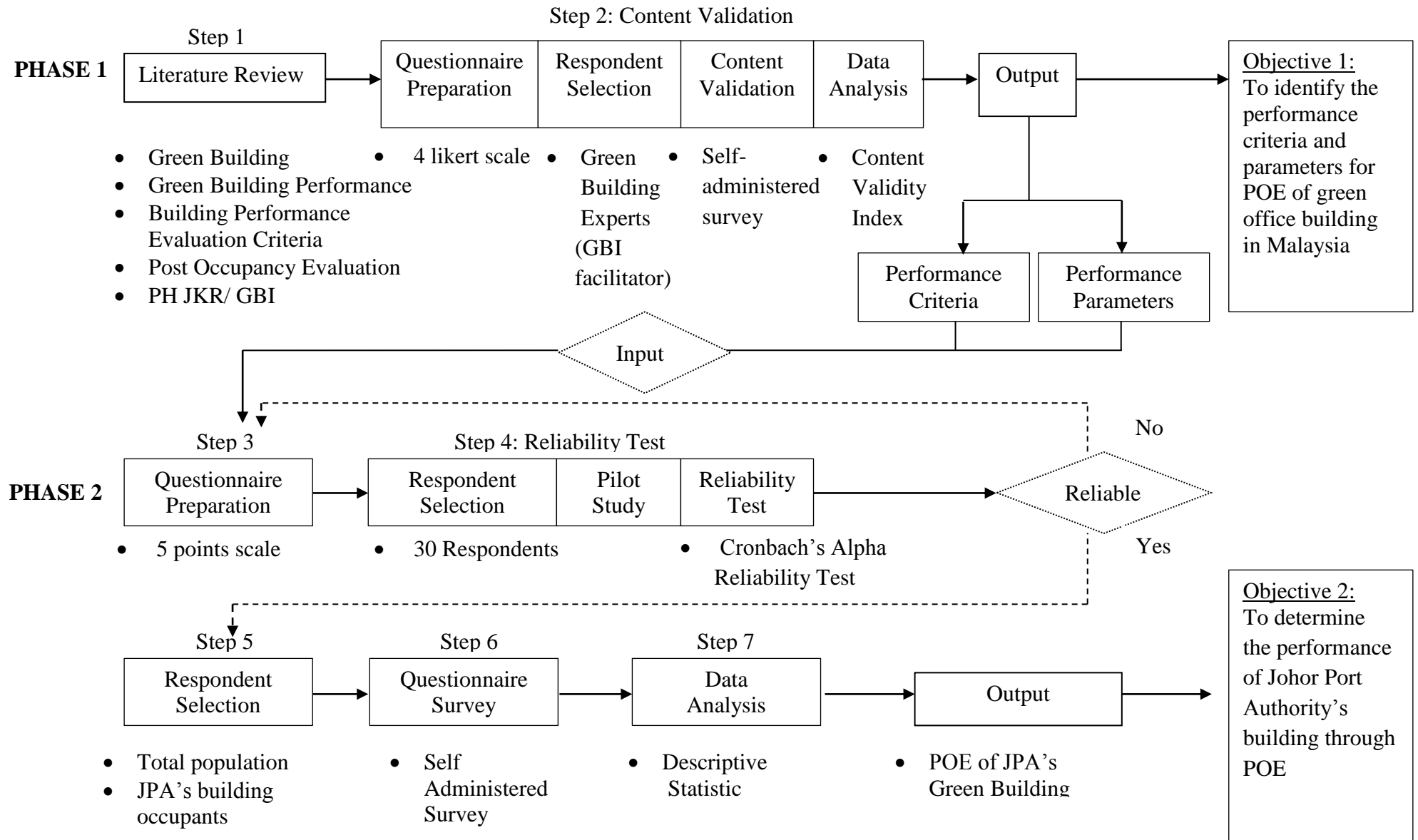


Figure 1.1: Research Methodology Diagram

1.9 Organisation of Chapters

Chapter 1 (Introduction) : This chapter consists of background of the study, problem statement, research question, objectives of the research, scope of the research, the significance of the research and a brief on the methodology of the research.

Chapter 2 (Green Building): Chapter 2 is about the literature review on the topic relevant to the studies. It will include about the Johor Port Authority, Green Building and Penarafan Hijau JKR.

Chapter 3 (Building Performance Criteria and Parameter): Chapter 3 explains about the building performance and the building performance evaluation, building performance evaluation criteria and Post Occupancy Evaluation.

Chapter 4 (Research Methodology): Chapter 4 describes on the research methodology used to conduct the research.

Chapter 5 (Data Analysis): Chapter 5 presented the research finding based on the objectives. The data were analysed and showed in this chapter. All the findings will be gathered and evaluated.

Chapter 6 (Discussion and Findings): Chapter 6 discusses the findings of the research findings based on the objectives. The data were analysed and showed in this chapter. All the findings will be gathered and evaluated.

Chapter 7 (Conclusion and Recommendation): Chapter 7 will be the summarisation of the whole study done. The findings summary was displayed and future research recommendations on the relevant field are discussed.

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