

CHAPTER ONE

INTRODUCTION

1.1. Background of Study

According to International Energy Outlet 2019, world energy consumption is expected to increase from 2015 to 2040. In 2018, global energy consumption increased substantially, powered by sustained economic growth and rising demand in China, the world's largest user of energy since 2009. Chinese energy consumption reported its highest growth since 2012, driven mainly by an increasing fleet of vehicles, strong industrial demand and increased fuel consumption for transportation. In 2018, gross U.S. energy consumption hit a record high of 2.3 Gtoe, up 3.5 percent from 2017, partly driven by weather (hot summer, cold winter) conditions, Global Energy Statistical Yearbook 2019.

Energy use is expected to increase in developing countries such as Malaysia due to economic growth that will drain the limited energy supplies Wai CW, Mohammed AH, Ting LS (2011). The disparity between demand and supply would continuously increase as a result of the energy crisis. Due to the threat of energy shortage, sky rocket energy price, unhealthy energy supply and the problem of enormous waste, the world today is searching for energy solution and substitute. Globally, the world community will think and act collectively to solve this problem by creating a long-term plan to maximize the limited energy supply. The Malaysian government has stressed that energy efficiency is one of the key elements of its system for energy policy. Energy management is one proven method of improving energy efficiency. Energy management helps improve the quality of the environment and maximize profits by reducing the demand for oil. Rising the demand for energy helps reduce costs Loganthurai P, Parthasarathy S, Selvakumaran S, Rajasekaran V (2012).

So, a strategy is needed to measure and evaluate the building's energy management. This paper identifies recommended strategies to develop an energy management guideline based on the literature. Although Public Work Department (JKR) has provided the manual, the effectiveness of energy management practice needs to be evaluated to develop an effective strategy for implementing energy management in Putrajaya office building.

1.2. Conceptual Research

According to Zaini Wahab (2013), energy management is a comprehensive implementation of systematic planning, management and application to save energy and reduce costs. In addition, energy management is also one of the elements in improving efficiency in quality management, facilities and so on.

Buildings globally consume about 40 per cent of total electricity generated and generate around 30 per cent of carbon dioxide (CO₂) (JKR and CIDB, 2016). In this regard, this study was conducted to find out the effective energy management practices in two Putrajaya office buildings. The aim of this study is to provide strategic energy management practices to be implemented in the building. In addition, the objective of the study was to provide improvement in energy management practices performed there.

During the course of this study, the researcher has stated the research question to achieve the objectives. The research question that aligns with the objectives of the study is the extent to which effective energy management practices are practiced by the energy management in the two selected buildings of Putrajaya.

1.3. Problem Statement

Energy resource management has undergone significant changes in recent times as consumption has increased. According to the report of the International Energy Outlet 2019, world energy consumption is increasing from 2015 to 2040 and will lead to declining energy resources as the global community relies on increasing energy.

Buildings consumed up to 40% of the total global energy and, based on current trends, demand is expected to rise to at least 50% by 2030. Buildings use a minimum of 48% of Malaysia's energy. Commercial buildings such as office buildings and retailers consume up to GWH 38,645 while residential buildings consume GWH 24,709. Malaysia's electricity consumption rate is one of the highest among emerging countries, and increasing energy consumption is due to rapid economic growth, especially in residential and commercial sectors, which invest around half of the total electricity generated (Choong, Weng Wai, Yin Fong Chong, and Sheau Ting Low. 2012).

A study conducted by the Malaysia Green Technology Corporation (MGTC) suggests that the majority of office buildings in Malaysia exceeded the BEI between 200kWh /m²/year and 250kWh /m²/year. Diagram 1.1 below demonstrating inadequate energy use during the building activity phase. (A. C. S Aun 2009). There are certain internal and external factors contributing to energy-efficient challenges, but most of the building in Malaysia were operate without taking energy conversation into account.

While some researchers focus on practices and activities proposed and implemented in the public building to achieve sustainability, it is not sufficiently thorough because they focus on a wide range of sustainability issues, (Button, C. E, Feng, Y. P. Wu, Y., & Liu, C. B.2009). So that, this study was conducted to find out effective energy management practices in two office buildings of Putrajaya.

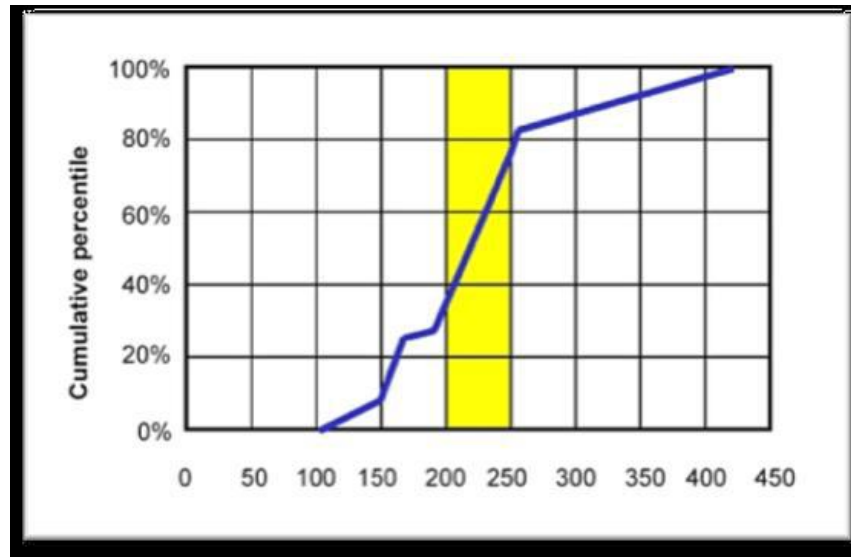


Diagram 1.1 Building energy efficiency index (kWh/ m2/ year)

1.4. Central research question

The main research question is how to achieve effective energy management practices in Putrajaya office buildings? This question helps us to formulate the aim of this study? Although there is a practice of energy management applied in those buildings, a strategic needs to be developed to enhance energy management efficiency.

1.5. Research Aim

An aim was created to meet the finding of the research that is to provide improvement strategies in effective energy management practices in office buildings at Putrajaya. .At the end of this research, an appropriate recommendation will be produced to implementing effective energy management practice according to the data collected.

1.6. Secondary Research Question

From the concerns raised, there are a number of issues that are fundamental to the overall implementation of this study. The purpose of this study is to obtain the following research questions:

- I. What is the energy management practices implemented in office building at Putrajaya?
- II. How to evaluate the efficiency of energy management practices used in office building at Putrajaya?
- III. What is the best way to increase energy management practices in office building at Putrajaya?

1.7. Research Objective

In order to achieve the aim of the study and to answer the research question, several specific objectives have been identified:

- I. To identify the energy management that practices in office building at Putrajaya.
- II. To analyze the effectiveness of energy management practiced in office building at Putrajaya.
- III. To recommend improvements to energy management practiced in office building at Putrajaya.

1.8. Research Scope

In order to compare energy efficiency practices among residents, three case study buildings were selected. The study was focused on two office buildings in Putrajaya. Office buildings were chosen as they represent well used buildings that have large numbers of permanent building users. To achieve this research objective, two case studies were selected to meet the research requirements and enable researchers to evaluate the effectiveness of energy management practices. Building characteristics play an important role in the study of energy management practices. Both case studies selected have similar building characteristics.

The table below describes the characteristics of the selected building.

Table 1.1: Description of the selected building

Description	Case study 1: Ministry of Communications and Multimedia Commission	Case study 2: Ministry of Rural Development
Gross Area/ m ²	108 719	97 650
Start operating	2011	2011
Number of Level	38	35
Developer	Putrajaya Holding	Putrajaya Holding

1.9. Research Significant

It is hoped that this study will achieve the aims and objectives of the research. Moreover, energy management practices improvement recommended will assist facilities management to identify strengths and weaknesses in their organizations to achieve energy efficiency performance. In addition, this study can also inform management and consumers about the importance of efficient energy management and establish a self-discipline to be more responsible in their day-to-day activities without wasting energy and exemplifying future generations in energy management.

The implementation of effective energy management practices offers the three-pronged ecological, financial, and social benefits of sustainable development (Nilashi et al., 2015). Many environmental benefits include: improving the quality of air and water; reducing waste; and protecting natural resources (CIDB, 2016). Certain potential economic benefits might include: decrease in operational and maintenance costs; enhancement of economic performance over the life cycle, etc. (Ahn, 2010). The perceived social gain often includes: the increase of efficiency of the inhabitants and the healthy living of the occupants.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

The source of energy is one of the main driving forces for a nation to grow. With a population of approximately 28 million, Malaysia is endowed with natural gas and petroleum supplies, and rising industrialization and living standards have significantly increased energy use. Due to the increasing demands of industrialization and urbanization, Malaysian energy consumption has risen dramatically over the past 20 years (US Energy Information Administration 2013).

Aspects of energy management should be given priority in every management and operation currently carried out in the building. Thus, energy consumption can be optimized at the optimum level and meet the needs of consumers. Energy management practices should have the right direction in achieving management goals. These include continuous identification and improvement, always up to date, finding ways to optimize energy use and make smart decisions. In addition, in achieving energy management goals, management needs to have strategic planning and the ability to implement it.

2.2. Theories

This chapter will explain the literature study that is related to the research conducted by the researcher and energy management in Malaysia.

2.2.1. Energy

Scientists have interpreted energy as the ability to do any work. In this sense, we can say that wind, sun, water and coal are potential sources of energy.

According to the fourth edition of the Language and Library Council, energy is defined as a force, power or force produced. The energy produced can be used by humans in general.

2.2.2 Energy management

Energy management is defined as a negotiation with a rational explanation of energy consumption directed towards minimum energy use in a systematic and planned manner. Energy management can also reduce operating hours, optimize jobs and control equipment operations. It can generally be said that energy management can utilize all sources of energy and control or reduce power costs

Energy management is the organized use of administration and technologies to enhance the energy efficiency of the company. Energy production, energy efficiency and renewable energy must be combined, constructive and implemented in order to be fully effective. (Carbon Trust, 2011)

2.2.3. Sustainable Energy Management in Malaysia

Sustainable energy management applies to the energy consumption control process to ensure efficient energy use. Sustainable energy production also

requires measures and procedures to do that, not just the implementation of goods (Bower et al., 2012; Shafie, Mahlia, Masjuki & Andriyana, 2011).

Sustainable energy management applies by nature to the organization's method of controlling energy consumption to achieve optimal use of the resources (Greentech Malaysia, 2012). A sustainable energy procurement method would cover all aspects of the organization's technological and non-technical energy consumption. A variety of policy guidelines have been developed in order to successfully implement sustainable energy management cycle, such as including all workers in the organisation, improving the expertise, designing the continuous improvement framework and also combining it with the standard working method.

2.2.4. Energy Management Based on Level

Building energy control can be split into management of the macro level and management of the micro level. At the macro level, it primarily relates to the development of policies and regulations, the application of energy efficiency requirements in the design and construction of energy-saving projects for analysis, assessment, supervision and acceptance (Rensburg et al., n.d.; Torre & Caparica, 2012; Xiao & Zhang, 2010). Micro point, primarily through the day-to-day operation and maintenance of buildings and consumers with energy-consuming activity, achieving effective management, as well as enhancing energy efficiency and converting energy savings to achieve energy savings. Another degree of energy management design is more practical and has more ability to save electricity.

2.2.4. Effective

A calculation of the degree to which, when applied in normal situations in the region, a particular action, method, program, or facility does what it is supposed to do for a specific population. It is a metric of performance from those health

services in the health field that leads to the aspect of a concern or enhancing an unsatisfactory condition. (Wojtczak 2002)

2.2.5. Practice

Something that is done, for example applied, performed or go through as a habit. To practice means to get used to doing something that becomes habit or responsibility. Mat Ali et al (2006). In this study the practice referred by the researcher is the daily culture of performing the operation and maintenance of the building in effective energy management practices.

2.2.6. Office building

According to Master Repurchase Agreement in 2014, office building means a building owned by the Obligor or for which the Obligor is a Ground Lessee, the primary usage of which is as an office building, including all land, amenities and improvements, with individual office space held principally for lease to commercial tenants and not principally for lease to recreational or residential tenants.

In this study the office building referred to by the researcher was 3 sample of high rise ministry building at Putrajaya that responsible for managing the affairs of the government.

2.2.7. Energy source

According to the World Energy Outlook (2017), today's energy demand is constantly increasing to meet the needs of the world's people. World energy sources can be classified into two types: renewable and non-renewable energy.

2.2.7.1. Renewable Energy Resources

According to Hazziq (2012), renewable energy is energy derived from natural resources such as sun, wind, rain, tides, and heat, renewable (naturally recharged). Example of renewable energy resource are:

- Solar energy
- Wind energy
- Hydro energy
- Tidal energy
- Geothermal energy
- Biomass energy

2.2.7.1. Non-renewable Energy Resources

According to the Energy Commission, non-renewable energy is a source of energy that cannot be replaced in a short period of time when it is depleted. Example of non-renewable energy are:

- Petroleum
- Natural gas,
- Coal and
- Nuclear energy.

2.3. Research Conceptual Framework

The title of the research is effectiveness of energy management practices in office building at Putrajaya. There are 6 constructs formed in the framework of this study. The research framework is as below

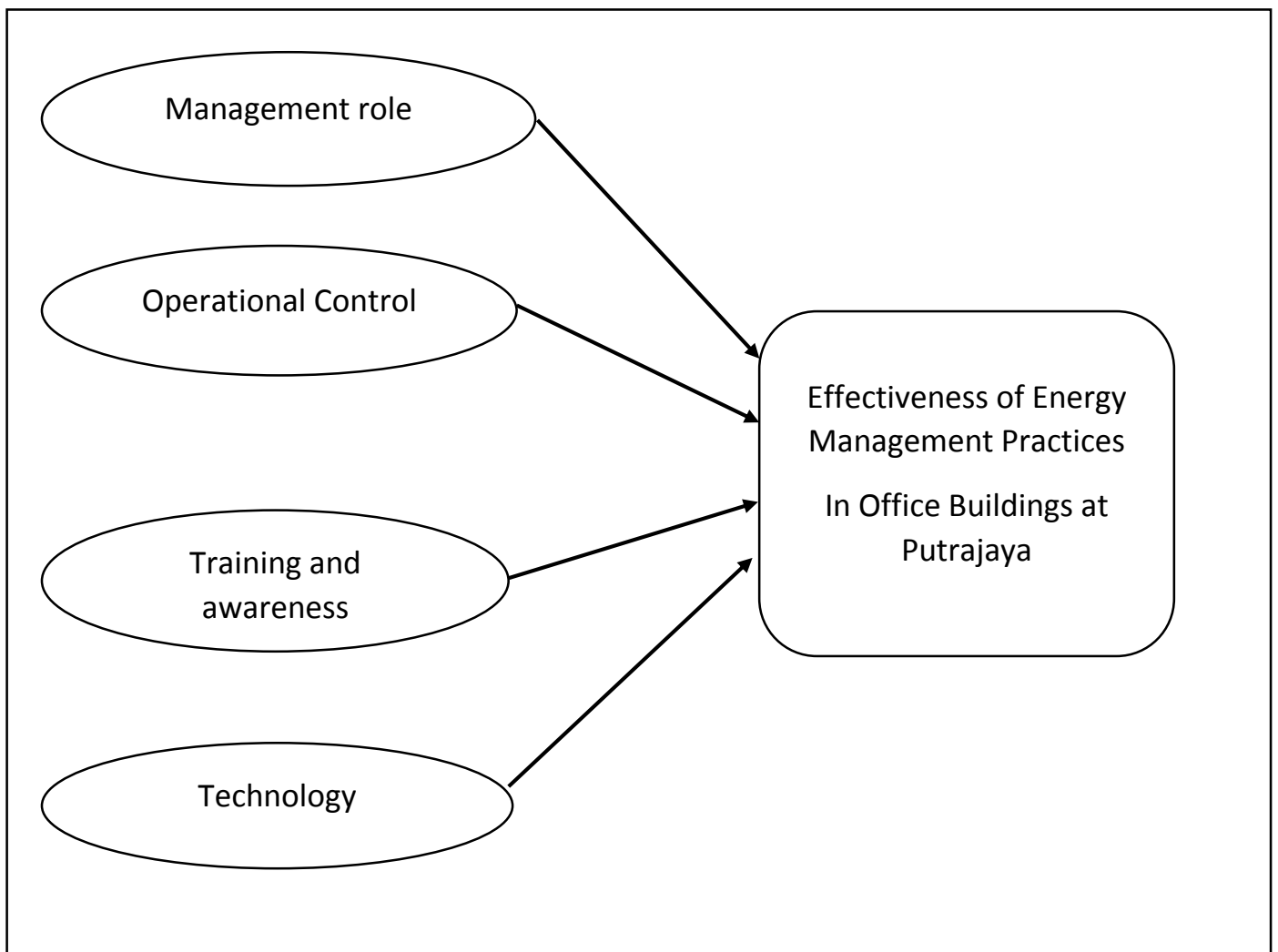


Diagram 2.1: Conceptual Framework

2.3.1. Management

The first construct is on management who practices effective energy management practices in office buildings. Energy management is a way of addressing obstacles to energy efficiency. Research has shown that energy-management businesses can save up to 40% of total energy consumption C. Caffal (1996). Hink (2000) prescribe that the operators ' control method should be more proactive than reactive. To pursue effective activities in energy management. Energy managers as operators need to manage energy management strategically.

Moreover, to attain forceful energy preservation objectives, it is increasingly important to create coordinates techniques that connect mission, hierarchical arrangements, and behavioural alter tactics to persuade and bolster better approaches of collaboration with the building environment (Moezzi and Janda, 2013). The effective action plan informs and directs the organization's energy consumers to direct their energy management and improvement activities and optimize them. In order to provide direction for decision-making, the process of setting energy performance goals is also very fundamental and will be needed during the tracking and measuring process (Gorp, 2000, 2004; Rensburg et al., n.d.; Wu, 2009).

In addition, Facilities managers are in the forefront of delivering sustainable management in practice (Elmualim et al., 2010). They can make a significant difference by applying sustainable management in many areas of their responsibility (British Institute of Facilities Management, 2013c).

2.3.2. Control

Operation control is a very important practice in managing energy in building. Hes (2005), Kato et al. (2010) and Bond (2011) stated that many buildings with four-star ratings do not operate at two-star level. This inconsistency is primarily due to the discrepancies in perceived and real trends of control use and management of building activities (Bordass et al., 2001; Kubba, 2010; Reiss, 2005). The GBI performance method says "update the building operating plan if appropriate to incorporate any adjustments to the occupancy schedule, equipment runtime schedule, construction set points and lighting rates." Energy Star, United States (Energy Star 2012) and EECA, New Zealand (EECA 2012) discussed this dimension in particular when it comes to managing energy use for lighting and heating, ventilation and air conditioning (HVAC). Carbon Trust, UK (Carbon Trust 2010) and LEED-EBOM (USGBC 2009) stated that all facilities, instrumentations, and systems provide comprehensive plans for best practice management. Scheduling is considered a poor building management strategy with only some of the plant and control systems. For more practices in operating control, Energy Star (2012) also specifies that the outdoor lighting plan should be adjusted according to the season throughout the year. Sensitivity and time-delay settings of occupancy or motion sensors should be adjusted to the needs of each human room

2.3.3. Training

Baloi (2003) found that the most critical energy management issues involve lack of environmental knowledge and training. Under the GBI program, management staff training should be offered on a wide range of sustainable building service subjects, including energy efficiency and design, operations and

maintenance of equipment and systems. (GBI 2011). New technologies such as computerized control systems for energy management (EMS) offer the ability to execute complex energy-efficient control strategies but are often underused due to poor preparation. Once workers grasp the EMS program operating theory, they may configure equipment management to compensate for a range of internal and external situations, (Tudi Haas1999). Moreover, contract and energy-related financing such as performance contracting, negotiation under utility deregulation, arrangement of service contracts, and equipment leasing should include training for management-level facility staff (Tudi Haasl 1999).

Increase the attitudes of occupants against energy usage, provide occupants with all the necessary information relevant to EE activities, implement efficient energy instruction and daily seminars for occupants, create appropriate methods for improving occupants ' behaviour, and provide opportunities for occupants with energy-oriented behaviour. Upon leaving the office, this technique allows occupants to shut off all electrical, illumination, and HVAC equipment.

2.3.4. Awareness

Management may play an important role by actively supporting sustainability management activities such as initiatives for energy savings, conferences, lectures or basic opportunities to conserve resources Tahir et.al (2016). Such activities must involve the participation of all levels of employees within the organization. Moreover, most property managers, building owners, and tenants typically do not grasp preservation or environmental efficiency well. Building owners or tenants often have little information about the impact of their actions on the use and pollution of carbon. Some owners of buildings also have the perception that investment in energy efficiency would not yield a return. Instead, some consumers treat the energy efficiency requirement as compliance and cost burden. (Marquez et al., 2012; Thomas, 2015; Achtnicht & Madlener,

2014; Caputo & Pasetti, 2015; Castleberry et al., 2016; Ernst & Young, 2015). Though fully aware of the energy-efficient system, certain building owners are not interested in improving the quality of their buildings unless the machinery is about to fail or there is a high level of vacancies that reduces their rental income. (Climate Policy Initiative, 2013; Marquez et al., 2012; Thomas, 2015; Weiss et al., 2012; Achtnicht & Madlener, 2014).

The production of appropriate educational materials is the number one priority for raising awareness among the employees of the department about the potential benefits of energy efficiency. Some of the forms the participants listed was creating blogs with information required, showcasing the successful projects, presenting latest research and information, and awareness training initiative supported by the government (Morshed Alama, Patrick X.W. Zoua,, Rodney A. Stewartb, 2018)

Introducing energy efficiency and energy conservation awareness programs to the organization can actually generate significant energy savings. Intensive awareness programs such as campaigns for energy savings or simple incentives for energy management will be conducted regularly as it would be an incentive to strengthen the culture of energy efficiency. The effectiveness of the projects, however, relies on the participation of all senior and middle management workers in both office buildings.

2.3.5. Technology

The indicators measured are patterns of energy operation, equipment use and maintenance performed to maintain energy management practices. The energy use of commercial buildings relies to a significant extent on how specific technologies are brought together as structures utilizing equipment such as fans, lamps, chillers, pumps and heaters, rather than relying on the efficiencies of the individual devices. (Hartley, 2013; Jiang & Rahimi-Eichi, 2009). Other than that,

Wayne 2005 also stated that equipment plays an important role in saving energy. Selecting energy-efficient tools is essential in order to improve energy efficiency and optimum use. Larsen et al. (2010) expressed that utilizing the six show chain of command, i.e. nearness and appliances, windows, strong squander, lighting frameworks and blinds, warming ventilation and air conditioning (HVAC), and hot/cold water will definitely diminish the effect of tenants on energy utilization.

The GBI method addresses the improvement of upgrades to insure the major energy-using structures of a building are restored, managed, and efficiently controlled in order to optimize efficiency. One of the core steps listed in Carbon Trust, Energy Trust, and EECA maintenance is that lighting diffusers and shades need to be cleaned or maintained on a regular schedule. Energy Management System (EMS) is checked regularly to ensure that they are operated in the most efficient and effective manner. (Armitage 2010; Bordass et al. 2001). The maintenance work includes the EMS periodically tests and calibrates all equipment (i.e., space and vent thermostats, humidistats, pressure sensors, and temperature sensors) and meters. Carbon Trust (2010) indicated that more than once a year should be achieved with these fine tuning control systems.

2.4. Summary

In this literature study, the researcher has described some basic knowledge of the research being carried out such as the details of the definition, the background of the study. At the beginning of this chapter, the researcher provided some basic knowledge of the topic of the study conducted on the basis of data collection regarding the effectiveness of energy management practices in Putrajaya office buildings. Literature review helps researchers identify the research gap that needs a solution. In addition, the literature review from the previous study helped to formulate a study of the framework to achieve the research objective.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction

The chapter explains the techniques used to conduct the study's modus operandi in more depth. Methodology is a method used in response to research questions to collect data more efficiently. This research method is a key element in the study and implementation of a structure that consists of data collection procedures and guidelines to complete the analysis for the whole study.

The methodology in the study should be properly designed and applied so that the data collection process is carried out without any constraints in conducting this study. In addition, the aspects discussed include study design, variable measurement, instrumentation, studies design, validity and data analysis. In this study, the researcher chose a mixed method to obtain the study data. The mixed method will refer to the methodology emerging in the systematic study involving qualitative and quantitative data through research. This method also helps the researcher in the process of analyzing and interpreting the results of the research.

Therefore, the methodology in the study should be designed and applied in a comprehensive and accurate manner so that the process before and during the study can be carried out without hindrances that may affect this study.

3.2. Philosophy and research approach

In study research, there are various philosophies and studies involved. The researcher chose the Saunders philosophy of the 2011 Research Onion which was used as a methodological approach in general. Onion research model that has 6 layers of philosophy, approach, methodology, strategy, time horizon, technique and procedure Lewis et al (2012). There are three approaches commonly used in studies that are deductive, inductive and abductive. Each approach adopted brings different terms and procedures Merrigan et al (2004).

3.2.1. Research philosophy

The philosophy of pragmatism research describes relevant concepts that support their actions Thornhill et al (2012). Pragmatism is used in data collection techniques and analysis procedures in research design to facilitate data collection and relevance.

Creswell (2012) states that hidden research is done to affect the study and is important for discovery in a research. Thus, there is some pragmatism that researchers have chosen to explain the techniques used.

In pragmatism there are three types of approaches that can be selected by Saunders (2011): -

- I. Deductive
- II. Inductive
- III. Abductive

Deductive

Research using quantitative approaches only. This approach is used to test the theory, where researchers can develop the anchor made and design a working strategy to test the theory that has been formulated.

Inductive

A researcher begins by collecting data that is important to his or her topic of interest in an inductive approach to science. Once a large amount of data has been compiled, the analyst will then take a breather from data collection and step back to get a glimpse of her data from a bird's eye. The researcher is looking for trends in the data at this point, focusing on creating a hypothesis that could describe such patterns. So, when researchers follow an inductive method, they begin with a set of observations and then shift from those particular experiences to a more general set of ideas on those experiences.

Abductive

Abductive approaches are made to study phenomena, to identify themes, to explain the theme of a phenomenon to produce a new theory. This approach is usually a combination of qualitative and quantitative.

Therefore, to achieve the aim of this study an abductive approach was chosen by the researcher to analyze the data in the study of effective energy management practices in the Putrajaya office buildings.

3.3. Research design

Study design is the structure used by a research to analyze data, according to Bryman (2008). Study design aims to turn research questions into projects involving objectives, hypotheses, study issues, methodology and sampling techniques, Robinson (2011). Meanwhile, Creswell (2009) pointed that plan is a study program or concept requiring contact with theory of science, research policy and research methodology. In addition, the design is used to determine the strategy and appropriateness of selecting a statistical test to analyze the study data. Based on Figure 3.3, the study design consists of five components that are based on Maxwell's theory of 2012. Through his study design which shows the relationship between the five components: goals, conceptual frameworks, study design, method and validity. The research question is considered a central point and in other words all of these components can answer all the research questions for the research that have been made. In addition, the components of this study are related to the conceptual framework and methods of study because the purpose of this study will be to develop a conceptual framework while at the same time it will determine the appropriate method of obtaining research information and answering questions.

Validity has a relationship between objectives, conceptual frameworks, methods and questions of research. Both elements must be checked either through authorization and formal expert interviews or through the use of a system software commonly used by most researchers to show the study's validity and reliability.

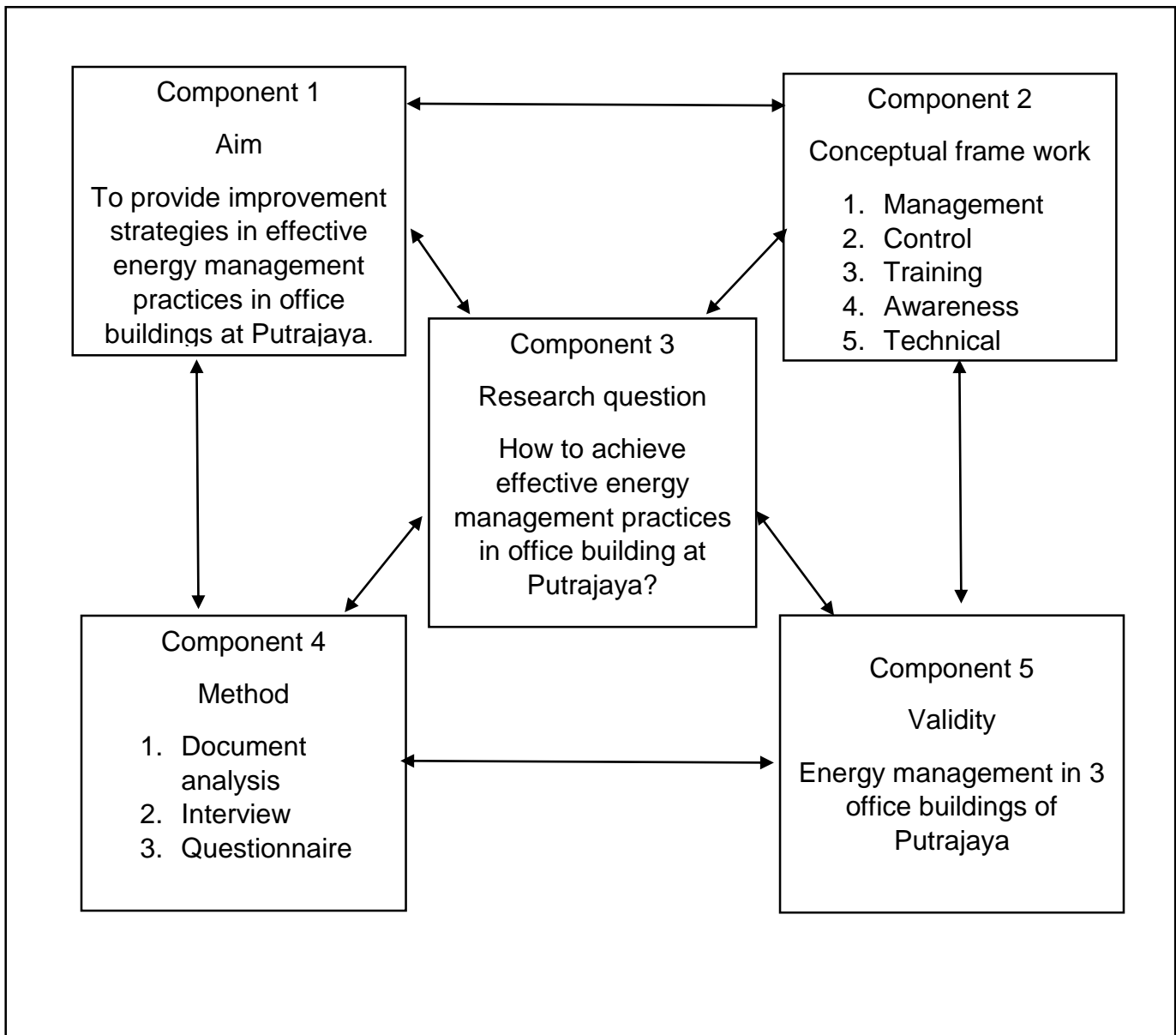


Diagram 3.1: Research Design

3.4. Methods of data collection

The data collection method used by the researcher is a mixed method. Work on hybrid approaches is a work methodology of philosophical assumptions and forensic techniques.

As a technique, in a single study or sequence of experiments, it includes methodological principles that govern the course of data collection and analysis and the combination of qualitative and quantitative results. The central premise is that the application of the use of quantitative and qualitative methods provides a better view of issues in study that either method alone. Creswell and Plano Clark (2007: 5) Therefore, to achieve the aim of this study, abductive emphasis will be used where this study is a combination of quantitative and qualitative approaches. Therefore, abductive emphasis is used to achieve the goals of this study. Abductive is a combination of quantitative and qualitative approaches.

3.5. Research instrument

In conducting the research, the research instrument needs to be defined first. There are several research instruments that can be used for the data collection process for the study:

3.5.1. Instrument one: Interview

Interviews are a two-way communication process for getting real information Chua (2006). Interview consists of the three types of structured interviews, semi-structured interviews and unstructured interviews. Structured

interviews are a form of questionnaire that is delivered orally. Throughout structured interviews, the interviewer is given a set of pre-determined questions. During the interview, the questions will not be modified and no follow-up questions will be asked for a clarification of the answer given. Unstructured interviews are usually described as purpose-driven interactions – capturing research study results. Such interviews have the least number of questions because they focus more on a standard yet underlying subject discussion.

Semi-structured interviews provide the interviewer with substantial leeway to evaluate the respondents as well as preserving the basic structure of the interview. Even though this is a directed dialogue between researchers and interviewees, the researchers are given tremendous versatility. Thus, the semi-structured interview method was used to achieve the goals in this study.

3.5.2. Instrument two: Questionnaire

Using questionnaires as a more practical and effective tool can help reduce the expense, time and energy of data collection Mohd Majid Konting (1998). Questionnaire is a form of instrument for obtaining facts about a current situation and practice. It is also used to study attitudes and opinions Deobold B. Van Dalen (1962). In the study, the researchers used questionnaires to obtain information from building users. Because the majority of building occupants are regular communities, data collection methods through questionnaires can help you get the right data.

3.6. Validity

The validity of this study is to test the extent to which the instruments used in the research include content relevant to the purpose of this research Miller (1994). Therefore,

the validity test is performed to see how far the instrument is being used to measure what should be measured.

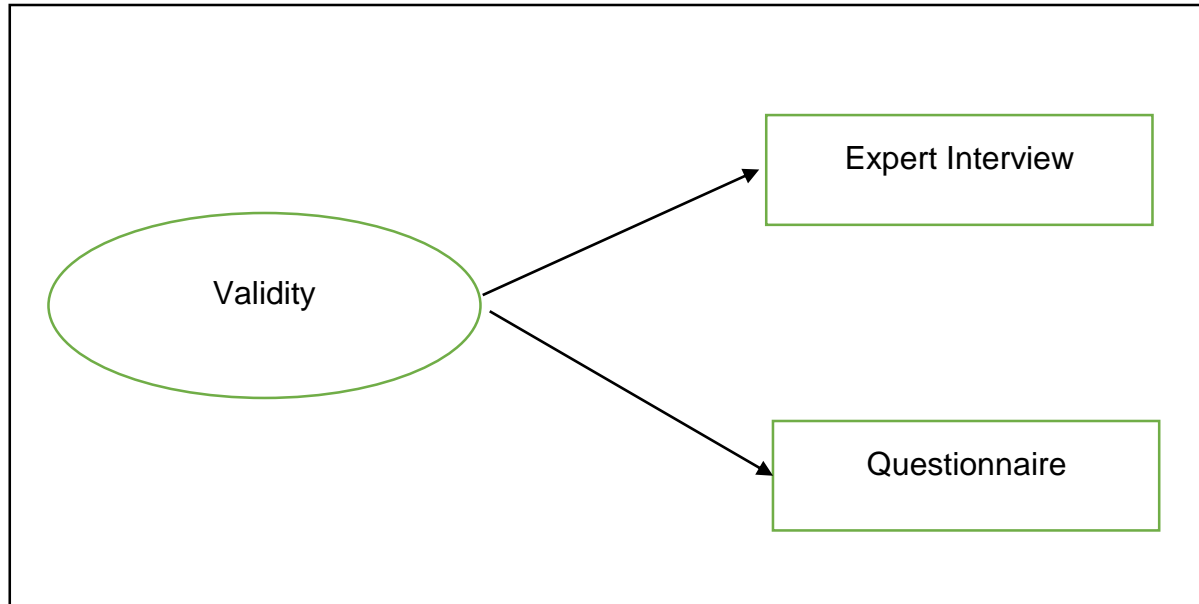


Diagram 3.2: Research validation techniques

The validation process in this study involves two steps to the validity of this study, the researcher divides the validity into two phases: the literature search phase and the data analysis.

3.6.1. Literature review search phase

Search comprehensive reviews of literature reviews for all the possible uses as a gauge. Further, in the construction of conceptual frameworks and indicators in the study. Therefore, the aspects of the verification process described in the questionnaire design as a pilot study as well as the main study and semi-structured

interviews. In search of literary highlights it is necessary to answer the objectives of this study.

3.6.2. Document analysis phase

Prior to the process of analyzing the workforce, the researcher conducted a series of interviews and questionnaires to ensure that the data obtained from management and building users were similar to the data obtained by the energy management of the two office buildings in this study.

3.7. Research sampling.

Sampling is the process of selecting a group of people, institutions, places, or phenomena from a large group or research. In this study, the researcher selected several samples to be grouped in semi-structured interviews. The sample in this study consisted of experts with experience in energy management. In addition, the researcher selected two samples that were directly involved in energy management The Energy Management Committee of the government office and the building occupants. The purpose of this sampling is to obtain more detailed and detailed information on energy management.

Furthermore, the use of sampling is intended to enable the researcher to determine the appropriate and specific respondents for the purpose of the study. There are also some researchers who use this sampling in the early stages and the beginning of their research solely for specific purposes such as testing the questionnaire or obtaining quick feedback. However, the findings from the study using this sample do not represent a specific population but at least provide a preliminary picture of the field of Syed Arabi Idid (1998); Wimmer & Dominick, 1997).

In addition, sampling is also related to the process of selecting subjects from a population to be the respondents of the study. Improper use of samples will reduce the

validity and reliability of the study. Proper sampling design facilitates data collection, minimizes measurement error and saves time and expenses Sabitha (2006). The design of the sample is determined based on the purpose of the study, the sample size required, the cost and time allotted by the study. Research using samples provides opportunities for research to get more detailed and accurate information about populations.

3.8. Summary

This chapter discusses the research methods and approaches used from the beginning of the study to the stage of data analysis to assist in obtaining data and information to obtain research results. In the first phase of the study, data collection began with reading the book, publishing articles, and referencing the previous study to understand the issues and issues to be addressed. Through the issues identified, researchers will formulate a number of research questions. Once the research question has been raised, a number of research objectives are formulated to make the study more focused. A conceptual framework was developed to briefly describe the overall concept of the study.

CHAPTER FOUR

DATA COLLECTION

4.1. Introduction

Data Collection is a mechanism through which the researcher collects the knowledge from all available sources to find solutions to the study question, test the hypothesis and analyze the findings. Furthermore, the responses to questions where the researcher asks how, where and where the data is to be obtained.

The choice of methods for gathering data depends on the research issue under analysis, the nature of the research and the knowledge collected about the component. . The strategies for gathering data may be narrowly divided into two categories:

- a. primary data collection method
- b. secondary data collection method

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4.2.1. Sampling design

According to Sabitha (2006), the sample design is calculated based on the research objective, the sample size needed, the expense and the time allotted. In general, sampling techniques can be divided into two types:

4.2.1.1. Probability sampling

Sampling of probability means that each item within the population has an equal chance of being included in the sample. One way to perform random sampling would be to build a sampling frame first and then use a random number generation computer program to collect a sample from the sampling frame (Zikmund, 2002). Probability or random sampling provides the greatest independence from bias, but may reflect the most time- and energy-consuming survey with a specified degree of sampling error (Brown, 1947). Probability

sampling methods include simple, stratified systematic, multistage, and cluster sampling methods

4.2.1.2. Non- probability sampling

Non-probability sampling is also connected with the nature of research paper studies and qualitative analysis. As for the above, research papers appear to rely on limited populations and are meant to examine a particular world event, not to draw statistical inferences in comparison to the larger population (Yin, 2003).

The basic random sample implies that the likelihood of inclusion in the survey is equivalent for each population scenario. Simple random sampling related drawbacks include (Ghauri and Gronhaug, 2005). Non-probability sampling methods include purposive, quota, convenience and snowball sampling methods.

Table 4.1: Probability Sampling

Probability Sampling Techniques	Explanation
Simple Random	Used to ensure that each unit or subject in the population has the same opportunity to be selected as the respondent of the study
Systematic	Every unit or subject in the population has the opportunity to be selected as the respondent
Cluster	For a population that involves a large area and a large number of subjects in the population

Randomly layered	Separate random selection for each subgroup in a population

Table 4.2: Non probability sampling

Non probability Sampling Techniques	Explanation
Dimensional	For small cases where there is only a small subset of subjects with special characteristics that the researcher is interested in
Quota	Sample group members are selected on the basis of specific criteria
Coincidentally	The researcher selects any subject that is found
Purposive	A group of subjects with specific characteristics were selected
Snowball	The study respondents were asked to suggest other subjects with characteristics that are suitable for the study
General variance	Individuals or groups of individuals are selected to represent the lowest and highest levels of a characteristic
Critical case	Specific cases involving strange, unusual or rare behaviour.

In this study the researcher selected the probability sampling as a sample. The researcher selects individuals from the pollutants that can represent the population. the probability sampling procedure is performed by randomly selecting the sample subject, where the subject in the sample has all the characteristics of the study population before

the probability sampling procedure is performed, the researcher needs to identify the population size and get a list of subjects in the population. . For this study, the population consist of building occupants from two different office building which are Malaysian Communications and Multimedia Commission and Ministry of Rural Development at Putrajaya.

4.2.2. Sample size

According to Abdul Ghafar (2003), population is a group of people with similar characteristics. The study population refers to the target group of the study activities. In a given study, the researcher was not able to use all available populations but only to use the sample to represent the sample being studied. Whereas according to Abbott (2002), the sample was a small number of individuals from the population included in the study. According to Krejcie and Morgan (1970), samples can represent population size. The use of samples from the population is intended to facilitate the work of researchers (Gafar 1998).

Table 4.3: Krejcie and Morgan

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

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970

Table 4.4: Total sample size required

No	Facilities Management Organization	Total Population	Total Sample Size Required	Sample Size
1	KKMM	50	88	44
2	KPLB	50		44
Total		100		88

4.3. Data Collection Instruments

Data collection instruments need to be determined before the study is conducted. There are several research instruments that can be used for the data collection process. A questionnaire survey and a semi-structured interview were used to collecting data.

4.3.1. Questionnaire

A questionnaire is the principal means of collecting key quantitative results. A questionnaire allows the collection of quantitative data in a standardized manner, so that the data is internally consistent and coherent for analysis. Questionnaires should always have a definite purpose related to the research goals, and it must be clear from the beginning how the findings will be used. (Roopa & Mani, 2012). Close ended questionnaire was used by the researcher to collect data from the respondent. The respondent will be provided a set of preset answers to pick their answer from. The collection of responses will contain any conceivable answer which does not conflict with the context of the responses. An example of a similar

survey query will be, "Please score how strongly you agree with the following statement or disagree with it: 'I feel comfortable about my work on the job.' Do you strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, or strongly disagree?" A Likert scale, used in the above example, is a widely used collection of answers for closed-ended questions.

4.3.1.1 Survey questions

Section A: Respondent demographic

This section was created to find out the socio-economic information of the respondents who will answer the questionnaire. Demographics include:

- Building information
- Gender
- Age
- Working experience in the building

Section B: Management role

ITEM	Statement
B1	I was exposed to policies, objectives and planning related to energy management
B2	Management conducts energy audits to monitor energy use in the workplace.

B3	I comply with government laws, standards and policies related to energy and water consumption.
B4	I am satisfied with the management of the in-house energy operations team.

This section is used to obtain information from building occupants based on management role constructs. The findings of this section are analyzed using SPSS software and will be discussed to answer objectives one and two

Section C: Operational Control

ITEM	Statement
C1	Scheduling of operating hours such as ventilation fans, lifts, lighting systems and air conditioning systems is done by the management.
C2	Management makes a public announcement every day so that the occupants of the building turn off the computer and printer after working hours
C3	Control of operating time of lighting system and air conditioning system save energy consumption in the building.
C4	Setting the air conditioning temperature to 24 degrees Celsius can help towards energy saving.

This section is used to obtain information from building occupants based on operational control constructs. The findings of this section are analyzed using SPSS software and will be discussed to answer objectives one and two

Section D: Training and Awareness

ITEM	Statement
D1	I apply the energy management training given in the operation of daily work activities.
D2	Awareness notices of the importance of saving electricity and water are provided in the workplace
D3	The energy management training provided, helped me do energy saving.
D4	Energy saving awareness briefing helped me towards energy saving.

This section is used to obtain information from building occupants based on training and awareness constructs. The findings of this section are analyzed using SPSS software and will be discussed to answer objectives one and two.

Section E: Technology

ITEM	Statement
E1	Ventilation system control is controlled automatically using Building Control System (BCS)
E2	GDC air conditioning system (boiling water) is widely used in buildings.
E3	Using energy efficient equipment such as LED lights can save energy consumption.

E4	The installation of motion sensor lights in the toilet helps towards energy saving.
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This section is used to obtain information from building occupants based on technology constructs. The findings of this section are analyzed using SPSS software and will be discussed to answer objectives one and two

4.3.2. Interview

4.3.2.1. Semi structured interview

Interviews are performed mainly in qualitative studies, which arise when researchers ask broad, open-ended questions to one or more subjects which document their answers. Audiotapes are also used to facilitate more accurate transcriptions (Creswell, 2012). Semi structured interview was used by the researcher to collect data from the respondent. Semi-structured interviews are those in-depth interviews in which subjects have to address open-ended questions in advance and are thus commonly used in their study by practitioners. Semi-structured, in-depth interviews can be used widely as a method for interviewing a person or even a community at times. (Corbin J, Strauss A, 2018). Semi-structured interviews include the characteristics of both structured interviews and unstructured. In semi-structured interviews, the moderator presents a series of same questions for all interviewees to respond. Around the same time, supplementary questions could be posed during interviews to explain and/or extend any concerns further.

Interview question

Question 1: What energy management methods are practiced in your building?

Purpose: Researchers want to know the energy management methods practiced whether the methods used are efficient or otherwise. Energy management includes various aspects and methods that can be applied according to the criteria and requirements of building management.

Question 2: What is the pattern of energy operation in your building?

Purpose: This question is designed to find out more about the pattern of energy consumption from the energy management that conducts energy management practices here. The pattern of energy consumption depends on the energy management planning practiced. A declining pattern means that the method practiced affects the energy savings.

Question 3: What are the influencing factors in the energy management strategy in your building?

Purpose: Researchers want to know the factors that drive for energy management planning in the building. Factors in the form of guidelines, manuals and so on are studied to know the planning strategies used in both buildings.

Question 4: How the energy management methods practiced can ensure savings?

Purpose: researchers on the effectiveness of energy management through the methods used. Therefore, the researcher can analyze the applied practices to find out the best practices. In addition to knowing practices that need improvement in order to suggest more effective strategies

Question 5: What improvement suggestions can be made for effective energy management in your building?

Purpose: Researchers want to get suggestions from energy managers to make improvements to existing energy management strategies. Energy managers from both selected buildings have over 8 years of experience in energy management. Therefore the proposed improvements can ensure energy consumption to a minimum

4.4. Pilot test

This validity test needs to be done by the researcher to obtain the authenticity, accuracy and usability of the questionnaire that has been formed to achieve the objectives of the study. The purpose of this pilot test conducted is to measure the reliability of the statement in the questionnaire used. Table 4.4 shows the Cronbach's Alpha readings obtained with a total of 20 respondents.

Table 4.5: Cronbach's Alpha Value for pilot test

Section	Cronbach's Alpha Value	Item
B	0.755	4
C	0.793	4
D	0.745	4
E	0.827	4
F	0.855	4

Based on table 4.4, the researchers recorded the Cronbach's Alpha for reading of the questionnaire and validity tests were performed for sections B, C, D, E and F using the Likert scale. Data from the pilot test obtained will be analyzed and problematic items will be corrected. Referring to Sekaran 1992, Cronbach's Alpha values of 0.60 - 0.80 are

good and readings above 0.80 are excellent readings. Even readings less than 0.6 require improvement, unacceptable and invalid. Researchers have obtained a Cronbach's Alpha value of 0.70 and above for each section. . This proves that this questionnaire exceeds the stated level. Further can be used to obtain actual data for the research.

4.5. Summary

The researcher has described the data collection method used in this study. This chapter also provides an explanation of the instruments used by researchers in obtaining adequate data. Furthermore, the selection of the right research instrument plays a very important role in achieving the objectives of the study. Researchers have used questionnaires and semi-structured interviews to answer research questions.

CHAPTER FIVE

DATA ANALYSIS

5.0. Introduction

This chapter is the most important part of the research, where this chapter will describe the findings of the research as a result of the mixed method that has been used to collect data. This chapter will also give the results of the study from the data collection that has been done. The data collected is analyzed to answer the research questions as well as help achieve the objectives of the study built through the problem statements that have been identified. Both instruments that have been selected by the researcher help in achieving all three objectives. The analysis performed gives clear processing and will justify the objectives of the study. Every aspect related to energy management practices applied in the two selected office buildings will be described in this section.

To obtain data on energy management in office buildings, survey forms were distributed to building occupants the majority of whom are government officials working there and are permanent building occupants. A total of 50 questionnaires were distributed to each building, namely Ministry of Communications and Multimedia Malaysia (Malay: Kementerian Komunikasi dan Multimedia Malaysia) and Ministry of Rural Development Malaysia (Malay: Kementerian Pembangunan Luar Bandar) to collect data. Each of the 50 respondents selected represents each department in the building. The number and representative of respondents are selected according to the recommendations from the customer service division of each building responsible for managing the building. For the semi-structured interview method, energy managers from both buildings were selected to obtain data. Researchers have interviewed the two energy managers face to face to obtain data on energy management.

The results of the study analysis obtained will be shown in the form of tables and diagrams. The data obtained from questionnaire survey will be analyzed using

SPSS software (26.0). The analysis method used is in the form of percentage, mean and standard deviation obtained through SPSS software.

5.2. Respondent demography

Demographics of these respondents provide an explanation of the background of the individual who has answered the questionnaire. A total of 100 questionnaires were distributed to respondents from both ministry buildings to achieve the objectives of the research. Socioeconomic characteristics of respondents comprising of:

- Building information
- Gender
- Age
- Working experience in the building

Demographic information of each respondent that has been received through questionnaires is explained in the form of diagrams to facilitate understanding.

5.2.1. Analysis of respondents based on place of service.

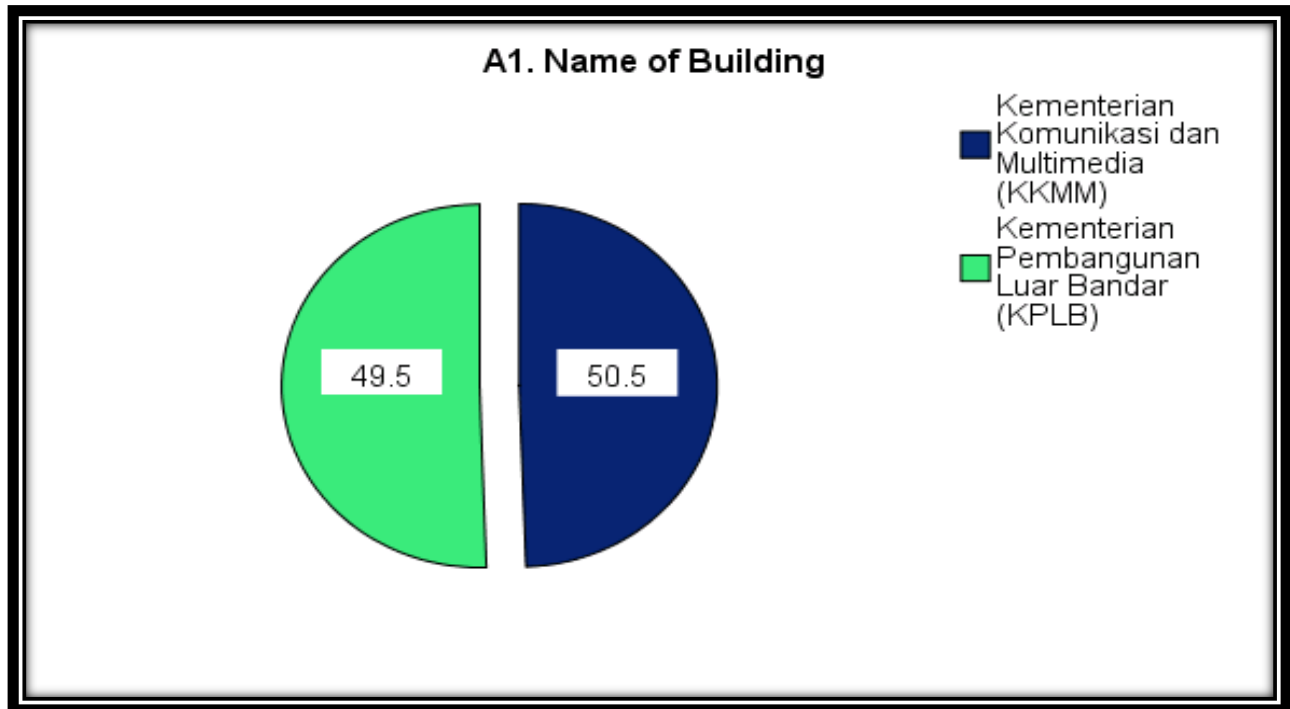


Diagram 5.1: Pie chart of name of building

The diagram 5.1 shows the distribution of the building of the selected respondents serving. These two ministry buildings are selected based on several criteria that have similarities in terms of gross area, building age, function, building structure and so on. Respondents from both buildings are permanent occupants of the building. They have significant experience and role in energy management in the building. They are very suitable respondents to study the practice of effective energy management.

5.2.2. Analysis of respondents based on gender

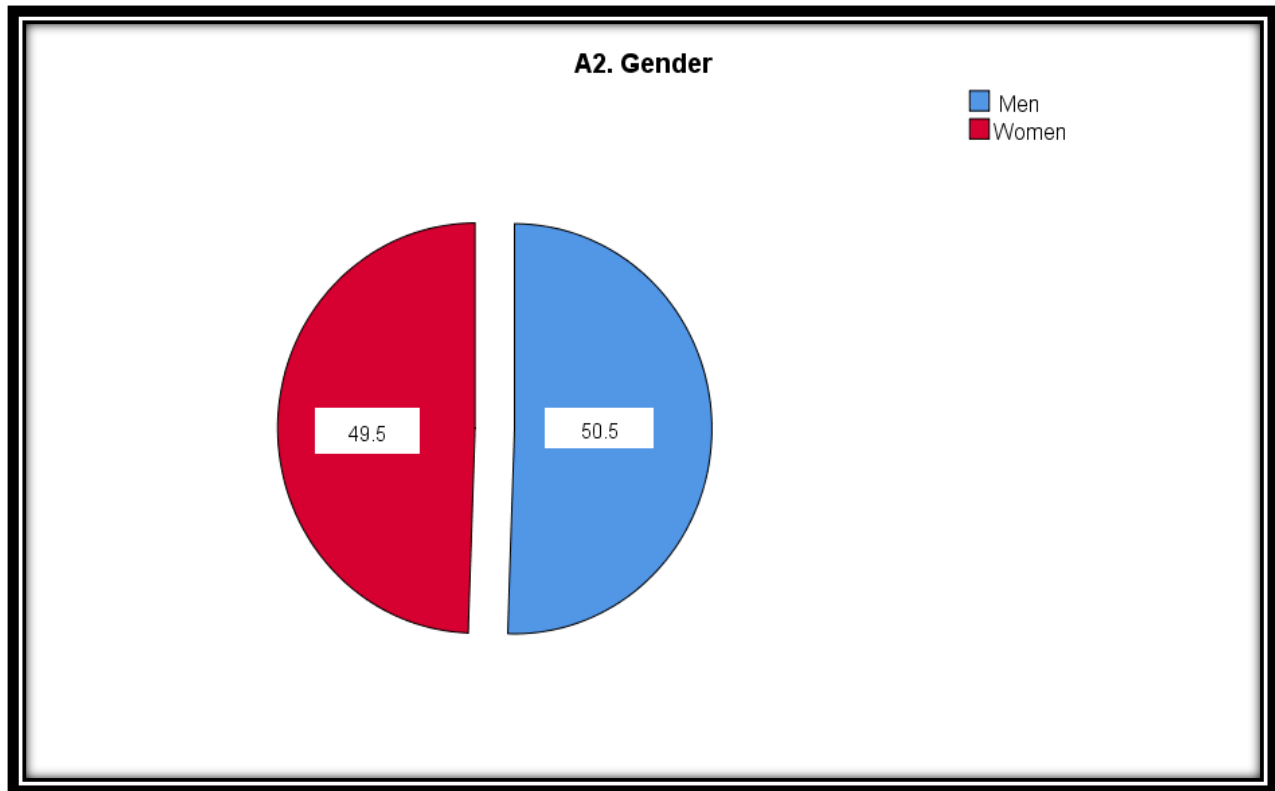


Diagram 5.2: Pie chart of respondent gender

The diagram 5.2 shows the number of respondents from both ministry buildings based on gender. According to data from the ministry, the majority of the occupants of the building are women. Therefore, the questionnaire distributed is balanced for both men and women. Percentage for the number of male respondents are 50.5% equivalent to 46 respondents. Thus, the number of female respondents is 49.5% equivalent to 45 people. Data show that the respondents for this study are balanced, directly facilitating the researcher to analyze the findings from both parties equally.

5.2.3. Analysis of respondents based on age category

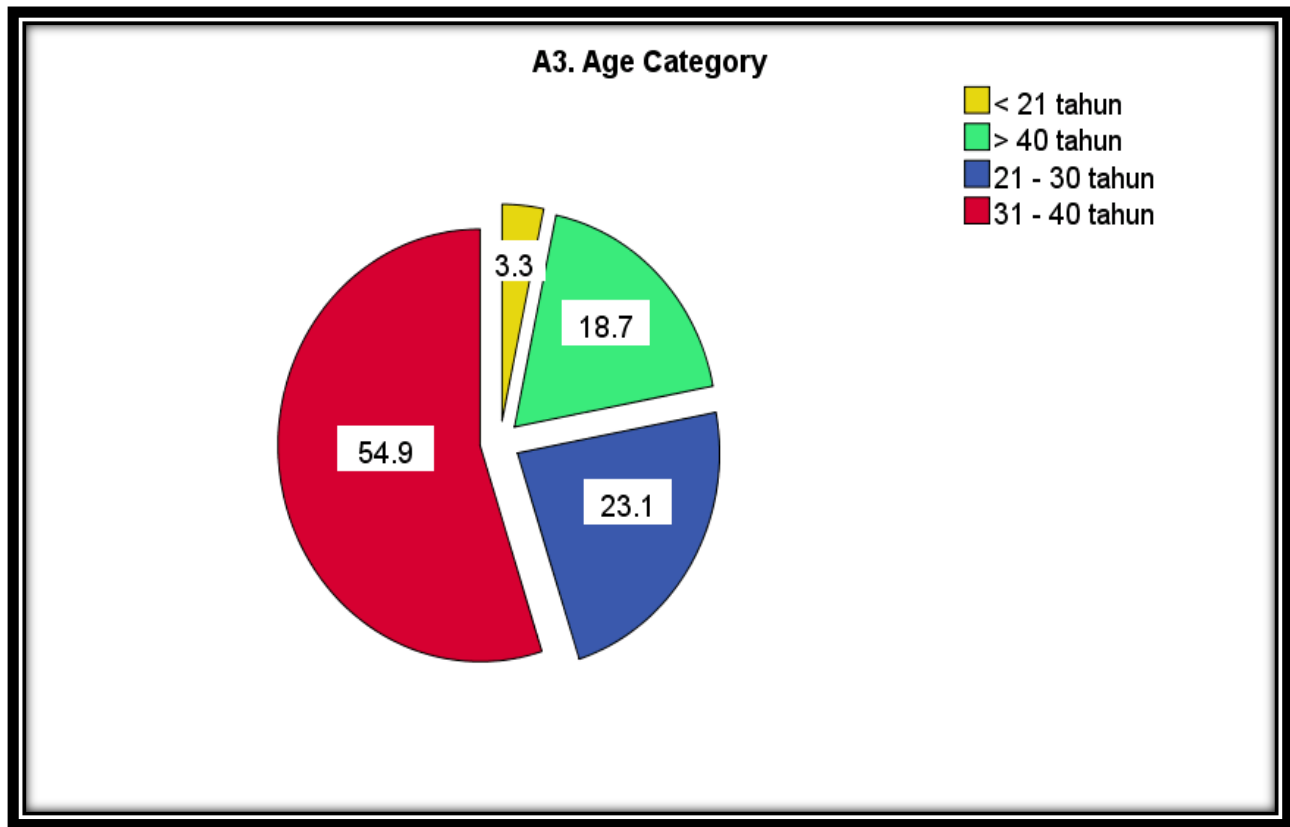


Diagram 5.3: Pie chart of respondent age category

The diagram 5.3 shows the analysis of the data according to the age category of the respondents. The age category of the respondents is between 18 to 40 and above according to the researcher's study. Respondents for the age category between 31 to 40 years which is 50.4% equivalent to 50 people is the majority age category who have answered the survey questionnaire. Next is 23.1% equivalent to 21 respondents consisting of age categories 31 to 40 years. The third range is 18.7% percent equivalent to 17 people aged 40 and above. The majority for this age category are in high positions as government officials in ministry

buildings. Last with 3.3 percent equivalent to 3 people is the age category for 21 years and below. Respondents for the age category 31 to 40 years old consist of government officials with high grades and parties who are leaders among them in various forms of management including energy management.

5.2.4. Analysis of respondents based on work experience in the building

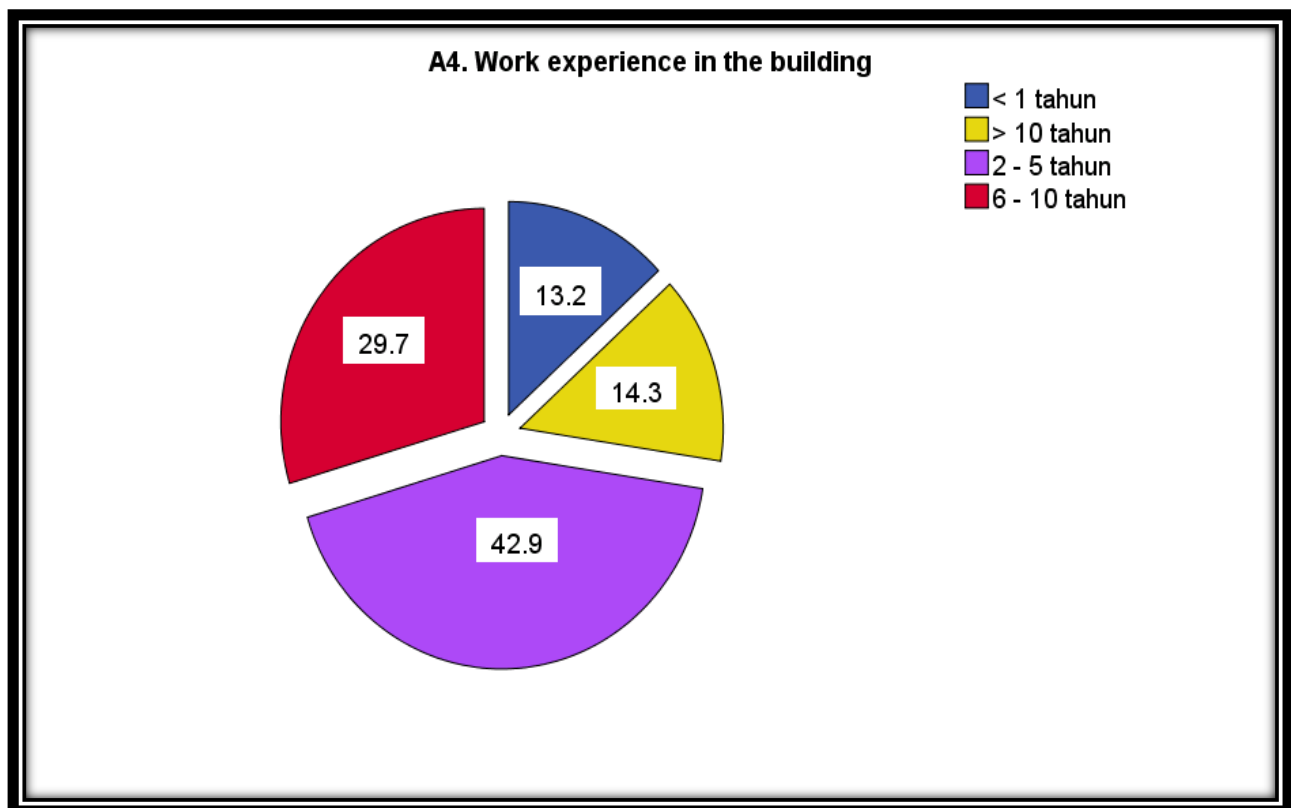


Diagram 5.4: Pie chart of respondent working experience

The diagram 5.4 shows the distribution of data according to the experience of respondents working in both ministry buildings. The researcher selects the permanent occupants of the building to answer the questionnaire because it plays an important role in analyzing the findings of the study. Therefore the experience of working in a building plays a very important role in measuring and the questions

and objectives of the study. The majority of respondents who answered this questionnaire had work experience between 2 to 5 years equivalent to 42.9%. Next 29.7% of respondents have work experience between 6 to 10 years. 14.3 & respondents have work experience for 10 years and above and the remaining 13.2 & respondents have less than one year work experience. Respondents who have 2 to 5 years of experience and above play a very important role because in studying effective energy management practices in both office buildings.

5.3. Research findings for the first objective

This section aims for the researcher to analyze the data to achieve the first objective of the study that is to identify the energy management that practices in office building at Putrajaya. The data obtained through the first instrument i.e. the data collection method which is questionnaire distributed to the occupants of the Ministry of Communications and Multimedia Malaysia and Ministry of Rural Development Malaysia is categorized as quantitative data. Data obtained from questionnaires were analyzed using SPSS software.

The process of validity of the content of the variable construction was performed to achieve the first objective in the study. Thus, a more comprehensive reading, evaluation and discussion process is made of the variables in the constructs previously discussed by the researcher. Other than that, researcher used mean analysis to answer the objective. Mean is defined as the sum in the distribution divided by the actual total score. By performing a mean analysis, the researcher can identify the average value generated from a set of data. Average analysis is used for statement in the questionnaire that influences the first objective which is to identify energy management practices in the Putrajaya office building.

5.3.1. Reliability analysis

Validity and reliability are two important concepts in affecting measurement and evaluation procedures (Johnson & Christensen, 2008). It is also an important element in determining the effectiveness of the data collection process. The pilot study involved the determination of the surface validity of the measuring instrument used before the test instrument used before the test measuring instrument to a group of selected study samples. Face validity is an estimate of whether a test seems to measure a criterion to be measured (Norain, 2010)

Reliability usually refers to the degree of consistency of an instrument or procedure to which it is measured. It also measures consistently and consistently (Khan, 2006). Reliability is explained by the correlation between the total score and the item score. If the data collected uses a Likert scale, then the method used to measure reliability is Cronbach Alpha. The value of this alpha coefficient exceeding 0.70, indicates that the item has high reliability and low error effect. (Gay.et. Al, 2009)

Table 5.1: Cronbach Alpha score

Cronbach Alpha score	Reability
0.90 – 1.00	Very good and effective with a high degree of consistency
0.70 – 0.80	Good and acceptable
0.60 – 0.70	Acceptable
<0.60	Items need to be repaired
>0.60	Items need to be dropped

With this study, the reliability of the research instrument was checked by analyzing the items in the questionnaire using SPSS program to obtain the

coefficient value of the coefficient showing the Cronbach Alpha value for each construct used in the study on effective energy management practices in Putrajaya office building

In general, this section will provide an explanation to identify energy management practices, applied in government office buildings in the Putrajaya area based on construct

Table 5.2: Mean score for management role construct

No.	Statement	Sample	Mean
B1	I was exposed to policies, objectives and planning related to energy management	91	4.37
B2	Management conducts energy audits to monitor energy use in the workplace.	91	4.22
B3	I comply with government laws, standards and policies related to energy and water consumption.	91	4.61
B4	I am satisfied with the management of the in-house energy operations team.	91	4.27
Mean average		91	4.37

Table 5.3: Mean score for operational control construct

No.	Statement	Sample	Mean
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C1	Scheduling of operating hours such as ventilation fans, lifts, lighting systems and air conditioning systems is done by the management.	91	4.49
C2	Management makes a public announcement every day so that the occupants of the building turn off the computer and printer after working hours	91	4.34
C3	Control of operating time of lighting system and air conditioning system save energy consumption in the building.	91	4.48
C4	Setting the air conditioning temperature to 24 degrees Celsius can help towards energy saving.	91	4.48
Mean average		91	4.44

Table 5.4: Mean score for training and awareness construct

No.	Statement	Sample	Mean
D1	I apply the energy management training given in the operation of daily work activities.	91	4.58
D2	Awareness notices of the importance of saving electricity and water are provided in the workplace	91	4.57
D3	The energy management training provided, helped me do energy saving.	91	4.46
D4	Energy saving awareness briefing helped me towards energy saving.	91	4.48
Mean average		91	4.52

Table 5.5: Mean score for training and awareness construct

No.	Statement	Sample	Mean
E1	Ventilation system control is controlled automatically using Building Control System (BCS)	91	4.62
E2	GDC air conditioning system (boiling water) is widely used in buildings.	91	4.62
E3	Using energy efficient equipment such as LED lights can save energy consumption.	91	4.55
E4	The installation of motion sensor lights in the toilet helps towards energy saving.	91	4.51
Mean average		91	4.57

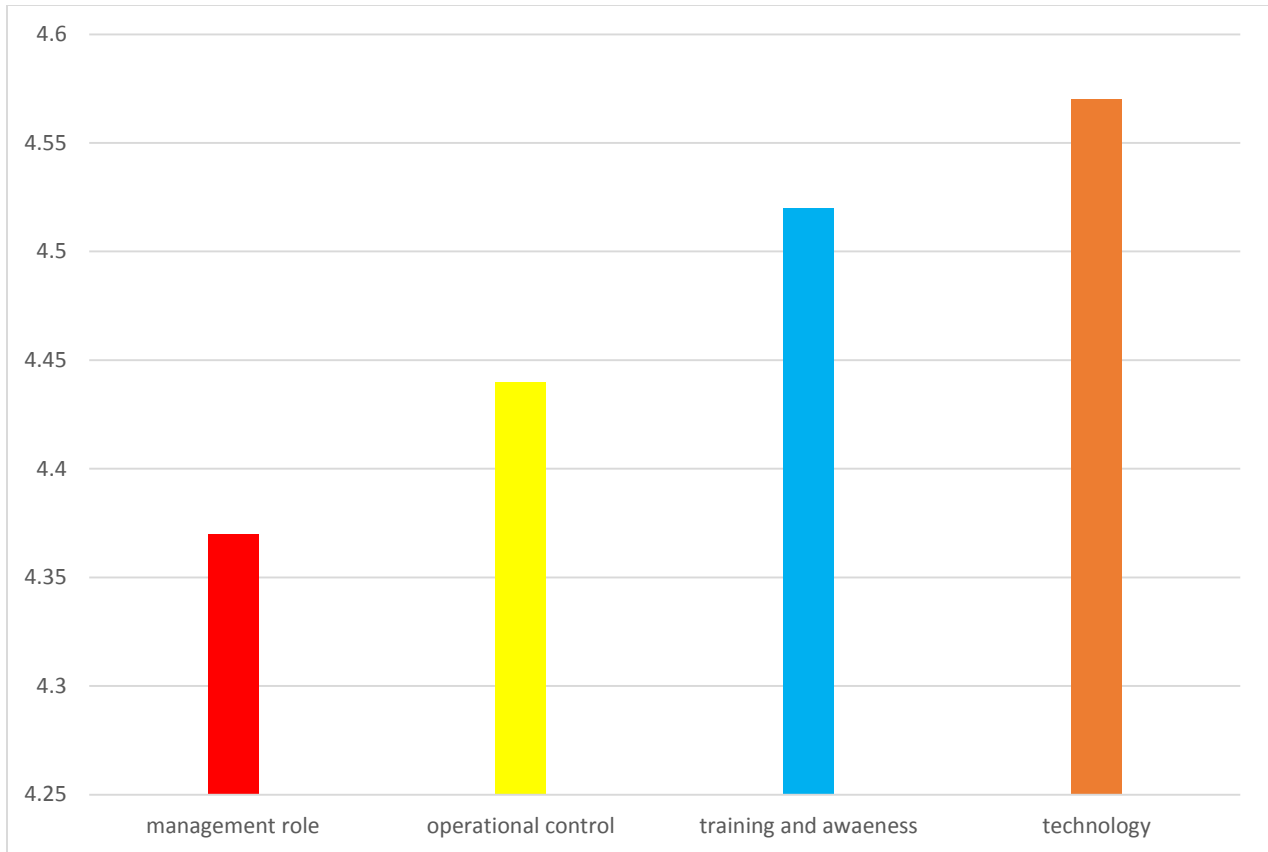


Diagram 5.5: Mean score chart for effectiveness of energy management practices based on construct.

Referring to figure 5.1, the technology construct got the highest average mean score of 4.57. There are four statements in this construct to identify the energy management practices used in the two buildings. It means that the technology factor is very influential in the energy management practices applied in both office buildings. Referring to literature review, technology nowadays plays a very important role. Energy management needs an effective view as demand is increasing every day. Therefore, practices such as the use of building control systems, the use of energy efficient equipment, the use of gas district cooling systems and motion sensors are used in such buildings.

Training and awareness constructs got the second highest mean score of 4.52. The majority of respondents agreed that training and awareness factors influence the effectiveness of energy management practices in both buildings. A total of four statements have been prepared in this construct to obtain identification from the respondents. All of these items can help in identifying the management practices used. The data received shows statements related to the practice in terms of training provided to building users, conducting awareness campaigns, applying the training provided and the preparation of awareness notices are activities practiced by energy management in both buildings.

Further energy management practices based on operational control constructs got a mean score of 4.44. Respondents agreed that operational control was performed in both buildings. A total of four statements have been prepared in this construct to identify practices performed based on operational control factors. According to the literature review, practices based on operational control can be done comprehensively in a building. Practice in terms of these constructs can lead to effective energy management. Scheduling is a key element influencing practices in the form of operational control.

The last construct is the management role with a mean score of 4.37. Although the average mean score for the statement based on the construct is low compared to other constructs, it is still at a high level based on the data collected from the respondents as the majority of respondents agree. Four statements to identify energy management practices have been provided in this contract. All statements got a mean score above 4.20 for this section. This clearly shows that researchers can identify energy management practices that influence management roles.

Through the findings of the analysis of the questionnaires that have been distributed, researchers have interviewed using the method of semi-structured interviews with energy managers from both office buildings that have been selected to obtain the validity of factors influencing the effectiveness of energy management practices. As a result of the face-to-face interview process, they agreed that these factors with the items discussed are important in determining the effectiveness of energy management practices.

5.4. Research findings for the second objective.

This section aims for the researcher to analyze the data to achieve the second objective of the research that is to analyze the effectiveness of energy management practiced in office building at Putrajaya. The data obtained through the first instrument of data collection method which is questionnaire distributed to the occupants of the Ministry of Communications and Multimedia Malaysia and Ministry of Rural Development Malaysia is categorized as quantitative data. Data obtained from questionnaires were analyzed using SPSS software.

Through the method used, the researcher analyzes the data received to answer the second objective and describes the findings obtained. Researcher has analyzed each item in the construct using mean scores to obtain the effectiveness of energy management practices. By performing a mean analysis, the researcher can identify the average value generated from a set of data. Likert scale used in this questionnaire is scale 1 to 5. Scale 1 - strongly disagree, scale 2 - disagree, scale 3 - moderate, scale 4 - agree and scale 5 - strongly agree. With this, the researcher can see which level of construct is the highest and lowest based on each item that has been prepared according to the construct. This second objective is also further strengthened by the results of a semi-structured interview with two respondents from each building that has been selected

5.4.1. Management role

Management role is one of the measurements of energy management practices to analyze the effectiveness of existing energy management practices in the office building. Data analysis of management role construct has four items in total. Below shows the comparison score.

Table 5.6: Mean score of management role items

Items	B1	B2	B3	B4
Mean score	4.37	4.22	4.61	4.27

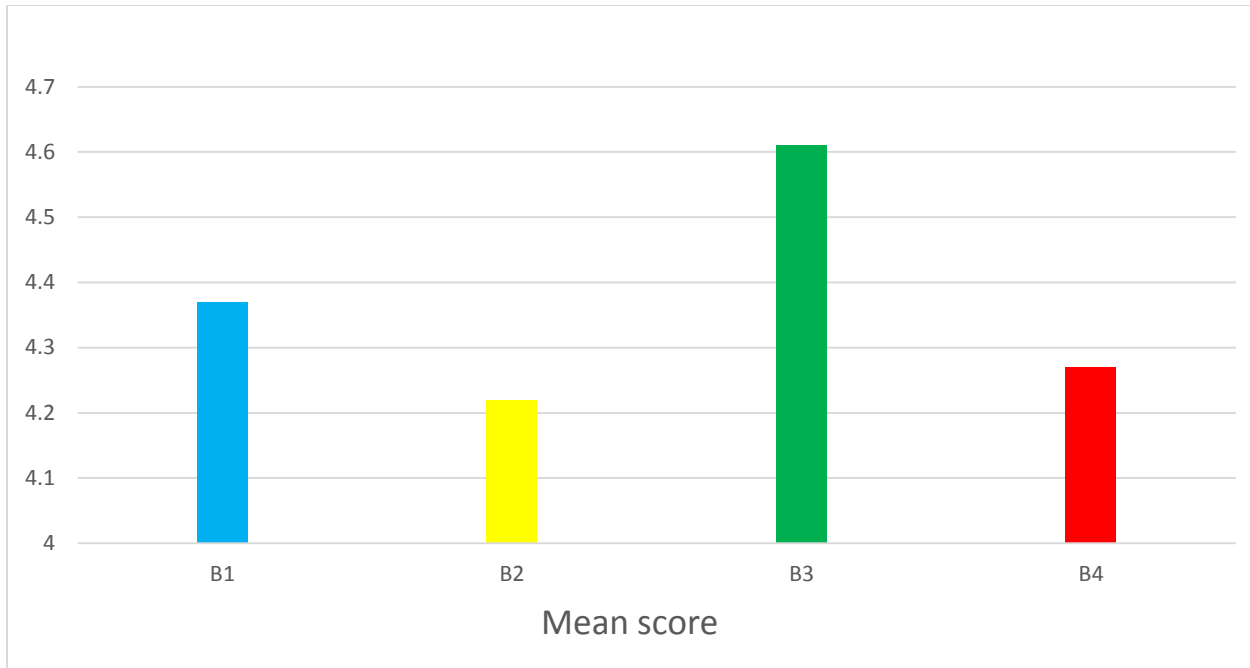


Diagram 5.6: Min chart for effectiveness of energy management practices based on management role construct

Refer to the table and diagram, first energy management practices is based on management roles. The four primary role of management are planning, organizing, leading, and controlling. First statement on the exposure of building occupants to the policies and objectives of the energy management statement in producing efficient energy management obtained a mean score of 4.37. The scale shows that 38.5% of the respondents strongly agree, 58.2% of the respondents agree and 2.2% moderate. None of the respondents gave a scale of 1 and 2. This means that the management is responsible to their role by exposing building occupants with energy management policies and objectives to be complied with and practiced. Their role are well executed as a facility management team. While the respondents also agreed that the management carried out their responsibilities. In addition, the mean score for management to conduct energy audits to monitor energy use in the workplace is 4.22. In terms of the data received, 38.5% of respondents strongly agreed with this statement, 49.5 respondents agreed, 7.7 moderate while 4.4 respondents disagreed. This means that the

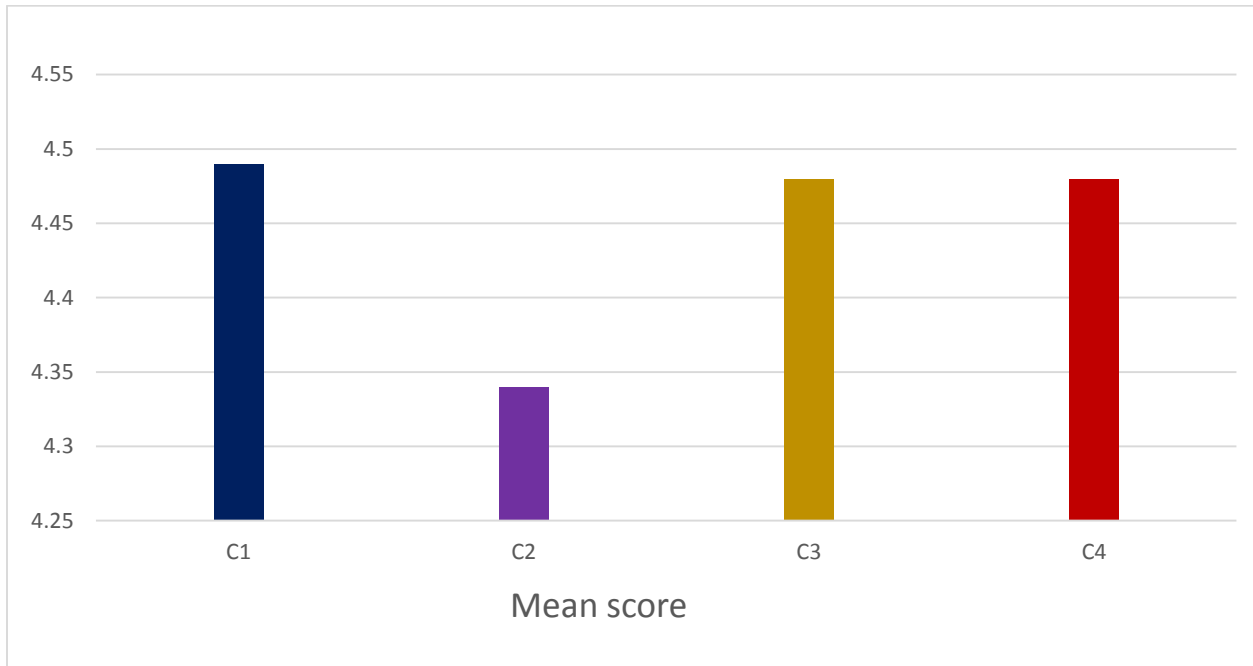
majority of respondents agreed with this statement. Researchers can conclude that conducting energy audit practices has a significant impact on energy management, especially office buildings as in the research that requires a continuous supply of energy resources. Third statements related to compliance with laws, standards and government policies related to energy and water consumption obtained the highest mean score of 4.61. The majority of respondents have agreed to the statements stated in this section. The scale shows 61.1% of respondents strongly agree and 38.9 respondents agree. No respondent disagreed with this statement. This means that as a responsible occupant of the building, they comply with all regulations related to energy management. When a person adheres to the rules, the effectiveness of the practice increases and avoids any problems. Building occupants are sensitive to this compliance practice. Through this practice, it benefits all occupants of the building and the environment. The next statement relates to the management of the in-house energy operations team. This statement relates to the satisfaction of the occupants of the building towards their management. This statement got a mean score of 4.27. Although this statement got the lowest mean score, 38.5% of respondents strongly agreed, 49.5% of respondents agreed and 7.7 moderate while 4.4 respondents disagreed. The energy operations team is the party responsible for maintaining a good energy management pattern. Each government official from each level of the two buildings is a representative of the energy operations team. They are responsible for channeling information from the management to each occupant of the building at their respective levels. This data shows the respondents. They play an important role in enhancing the effectiveness of energy management practices.

5.4.2. Operational control

Operational control is one of the measurements of energy management practices to analyze the effectiveness of existing energy management practices in the office building. Data analysis of operational role construct has four items in total. Below shows the comparison score.

Table 5.7: Mean score of operational control items

Items	C1	C2	C3	C4
Mean score	4.49	4.34	4.48	4.48

**Diagram 5.7: Mean chart for effectiveness of energy management practices based on operational control construct**

Next findings of the research for energy management practices are based on operational control. Operational controls are performed to ensure that day-to-day actions are consistent with established plans and objectives. Scheduling of ventilation fan operations in parking lots and toilets are operational controls performed in both office buildings. This statement got a mean score of 4.49. based on the scale, 50.5% of respondents strongly agree, 48.4 respondents agree and 1.1 moderate. Therefore, the majority of respondents strongly agree with the management incentive of operating a fan at a given time. Building occupants also have a clear understanding of the control system performed by management. The next operational control is to make daily public announcements so that building

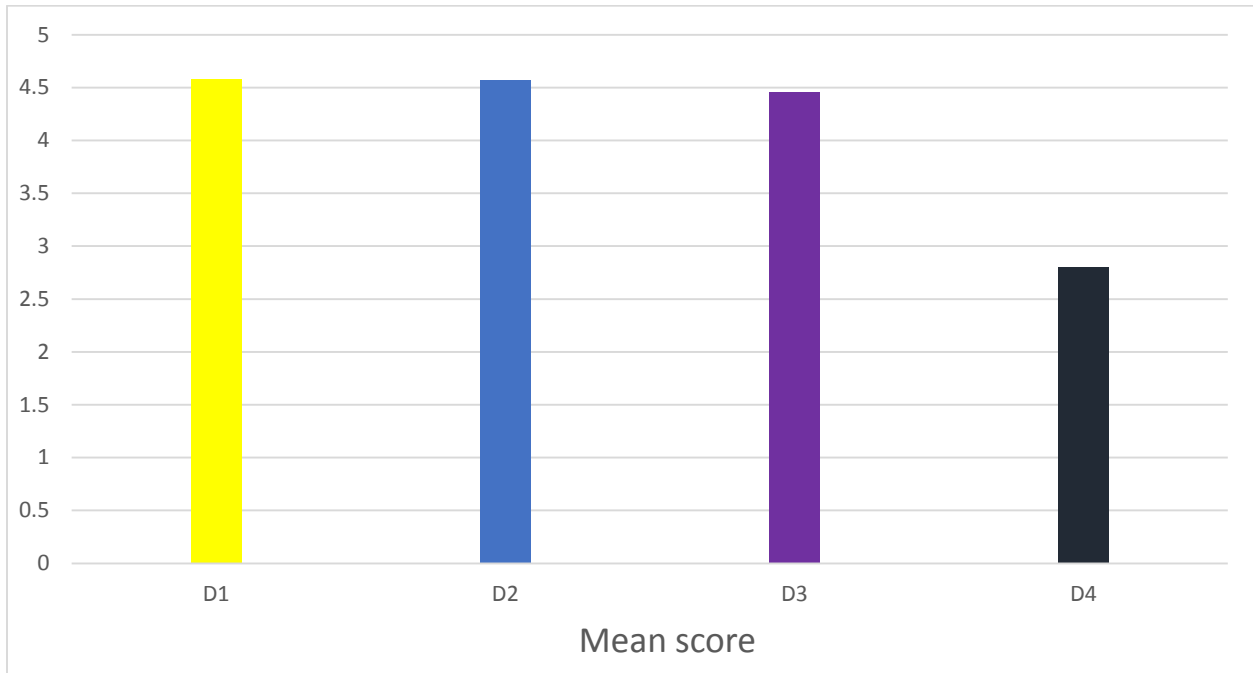
occupants turn off computers and printers after work hours. This statement got a mean score of 4.34. According to the findings of the study, 47.3% of respondents strongly agree with this practice, and 39.6% agree while 13.2% moderate. The percentage of respondents who gave the scale strongly agree is the highest. This explains that, the occupants of the building agree with the operating control practices. Making public announcements will always warn the occupants of the building to shut down the electrical appliances if they are used up. This practice will be a culture to the occupants of the building to be practiced without announcement. Third is operating time control of the lighting system and the air conditioning system. This statement got a mean score of 4.48 and respondents gave a response with a scale of 52.7% majority strongly agree, 44% agree and 2.2% moderate while 1.1% disagree. The analysis of the findings shows that the respondents agree that this control of operating time is an effective practice. These two government office buildings operate from 8.00 am to 6.00 pm in general. This also shows the level of understanding of the occupants of the building on the energy management of the building. The next statement got the same mean score, 4.48. Where, 56% strongly agree, 39.6% agree and 1.1% moderate while 3.3% disagree. The majority of building occupants agree that setting the air conditioning temperature at 24 degrees Celsius helps towards saving electricity. This setting will maintain a continuous and not excessive supply of ventilation. In addition, this determination is also based on international standards for organization that must be complied with by all parties and use minimal electricity.

5.4.3. Training and awareness

It is the third measurements of energy management practices to analyze the effectiveness of existing energy management practices in the office building. Data analysis of training and awareness construct has four items in total. Below shows the comparison score.

Table 5.8: Mean score of training and awareness items

Items	D1	D2	D3	D4
Mean score	4.58	4.57	4.46	4.48

**Diagram 5.8: Mean chart for effectiveness of energy management practices based on training and awareness construct**

In addition, the practice of energy management based on training and awareness construct are analyzed. A mean score of 4.58 is given on the applying the energy management training given in the operation of daily work activities statement. 59.3% of respondents strongly agree, 39.6% of respondents agree and 1.1% moderate. None of the respondents based on the scale disagree. This shows that the occupants of the building apply the training provided by the management to their daily activities throughout their work in the building. A mean score of 4.57 is given to the awareness notices of the importance of saving electricity and water are provided in the workplace statement. The scale shows 60.4% of respondents strongly agree, 36.3 respondents agree and 3.3 moderate. With this, it can be said

that the management provides awareness notices for all building occupants to practice it and increase knowledge on the importance of using electricity and water prudently. Statement related to management training given to the occupants of the building encouraged to make savings get a mean score of 4.46. Respondents gave a scale of 48.4% as strongly agree, 49.5% as agreed and 2.2% moderate. No scale of disagreement was obtained from the respondents for this statement. This practice is said to be effective when the majority of respondents who have answered the questionnaire agree. This means that the management provides adequate training to the occupants of the building and the occupants of the building carry out their duties properly. Training given in terms of how to use electronic equipment and how to use prudently is found to be effective on energy management by building occupants. The second statement in this construct relates to the effectiveness of energy-saving awareness briefings. Analysis of this statement shows a mean score of 4.48. This practice was found to be effective as it got a majority scale of 51.6 & strongly agreed, 45.1% and 3.3 & moderate. This shows that the occupants of the building received an awareness briefing provided by the management.

5.4.4. Technology

Technology last measurements of energy management practices to analyze the effectiveness of existing energy management practices in the office building. Data analysis of management role construct has four items in total. Below shows the comparison score.

Table 5.9: Mean score of technology items

Items	E1	E2	E3	E4
Mean score	4.62	4.62	4.55	4.51

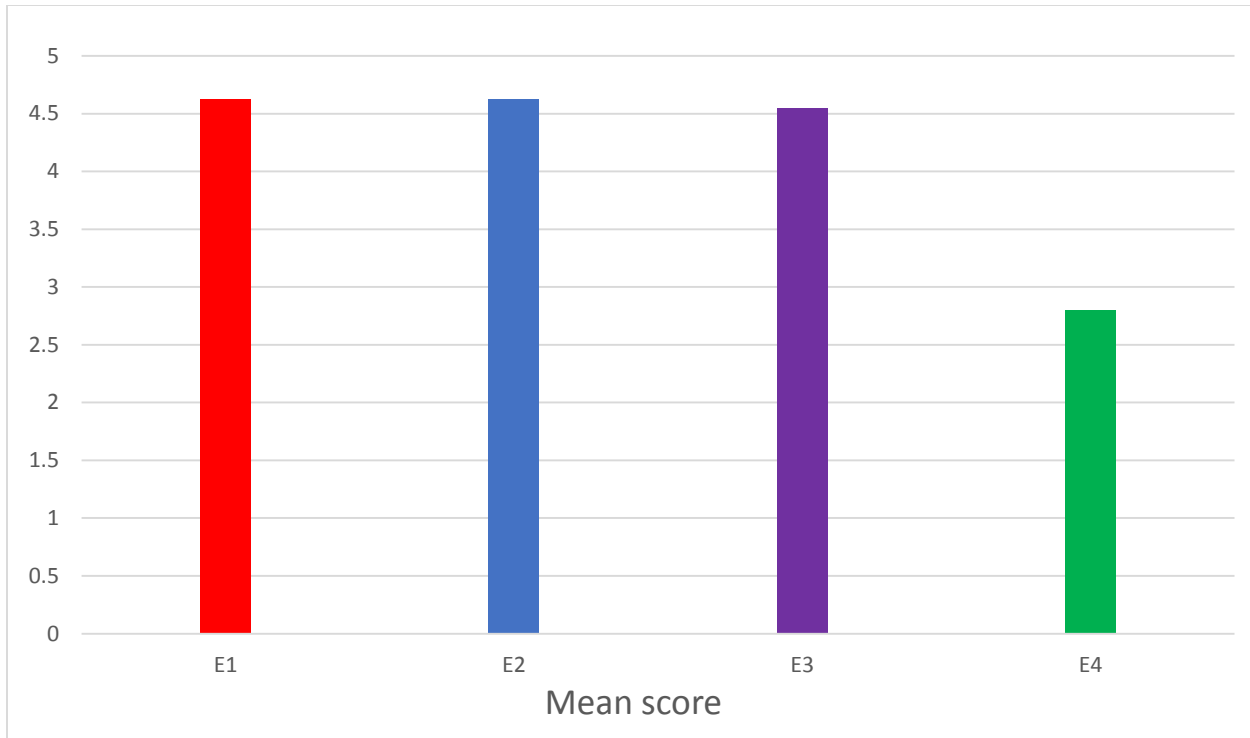


Diagram 5.7: Min chart for effectiveness of energy management practices based on technology construct

Lastly, is an analysis of the effectiveness of energy management practices in terms of technologies, first statement which are the control of the ventilation system automatically and the use of district cooling gas type air conditioning system gets the highest mean score of 4.62. According to the distribution from the questionnaire, 62.6% of the respondents strongly agreed, 36.3% of the respondents agreed and 1.1% moderately for the seventh statement. . While, for the eighth statement, 64.8 & respondents strongly agreed, 31.9 respondents agreed and 3.3 moderated. None of the respondents gave a scale of 2 and 1 which is to disagree. Thus it can be concluded that technology-based and systematic energy management practices play a very important role in energy management in both office buildings. Putrajaya is a planned city, gas district cooling is an air conditioning system used throughout the office buildings. In addition automatic control for this ventilation system is widely practiced. Statement related to the use

of energy efficient equipment prompts electricity savings to get a mean score of 4.55. The scale shows 57.1% of respondents strongly agree, 41.8% of respondents agree and 1.1% moderate. Researchers can make the impression that the occupants of the building have an understanding of energy efficient equipment and help save electricity consumption if used. Energy efficient equipment will provide the same function as other equipment but save in terms of energy consumption such as LED lights. The installation of motion sensor lights in the toilet helps towards energy saving. The statement related to the installation of sensor lights in the toilet got a mean score of 4.51 with 58.2% of respondents strongly agree, 31.9% agree, 3.3% moderate, 5.5% disagree and 1.1% strongly disagree. Although there is a scale of disagreement in this statement, the majority of respondents agree. The toilet is a space used only if necessary. Therefore, the installation of toilet lights using a sensor system saves electricity consumption.

5.5. Research findings for the third objective.

This section aims for the researcher to analyze the data to achieve the third objective of the research that is to recommend improvements to energy management practiced in Ministry of Communications and Multimedia Malaysia and Ministry of Rural Development Malaysia. The researcher conducted a semi-structured interview from two respondents from both buildings to get suggestions for improvement.

5.5.1 Research findings based on the second instrument: Semi structured Interview

5.5.1.1. Respondent profile

Table 5.10: Respondent Demographic

Company	Name	Position	Building
Ambang Wira Sdn Bhd	Mohd Yuslan Bin Mohd Yacob	Energy Manager	Ministry of Communications and Multimedia
Ambang Wira Sdn Bhd	Mohd Hafiz Bin Taib	Energy Manager	Ministry of Rural Development

One respondent from each building was selected to conduct a semi-structured interview. Both respondents are energy managers in their respective buildings from the same facility management company. Both have extensive experience in energy management

5.5.1.2. Respondent 1: Mohd Yuslan Bin Mohd Yacob

Objective 1: To identify the energy management that practices in office building at Putrajaya.

Energy management in the building is implemented according to the manual of the energy management system that has been provided by the ministry management services division through the Public Works Department (JKR). The manual contains guidelines for creating and implementing energy management

systems for government buildings. The energy management practices performed in this building include the following aspects

- Energy management operations team(POPT)

Management and operating team representatives are responsible for preparing and delivering all energy management plans to building occupants. In addition, they also play a role in monitoring the planning that has been done as well as conducting energy audits and more.

- Competence, Training and Awareness

The energy resource management division has the role of implementing energy management system courses, measurement procedures and energy saving performance to the energy management operations team as well as conducting awareness briefings to the building residents.

- Communication and documentation

The energy management committee has the role of conducting energy management system meetings, discussing performance monitoring of austerity measures, and preparing monthly energy management reports. In addition, provide energy management system manuals and operating procedure manuals.

- Operational control

Planning and practice through operational control is widely done compared to other practices. For example scheduling of operating hours such as ventilation fan in the parking lot, lift system on holiday, setting the room temperature to 24 °C, lighting system and air conditioning system.

- Technology

Technology is a management aspect performed with practices such as the use of energy efficient equipment such as LED lights and the use of energy efficient chillers. In addition the use of BCS technology for systematic planning and automatic system control. Therefore, the ventilation system using GDC is an aspect of technology used in all Putrajaya office buildings.

Objective 2: To analyze the effectiveness of energy management practiced in office building at Putrajaya.

He says that every form of practice adopted affects the reduction of energy consumption. Even practice in terms of operational control plays a very important role in controlling energy consumption especially electricity and GDC. The percentage of savings through this aspect is at the top of the ladder compared to other aspects. A lot of planning and strategy is more focused on this part to achieve the lowest BEI according to the data collected each month. According to other constructs such as management roles, training and awareness as well as documents are carried out according to regular procedures and there are no different changes or plans.

Objective 3: To recommend improvements to energy management practiced in office buildings at Putrajaya

In terms of planning, budget plays a very important role in making improvements to existing management. For example to strengthen practice based on technological aspects, a high budget is required to apply planning under technological aspects. For example solar heating can save electricity consumption for lighting systems. Subsequently installing monthly energy measurement meters at each level helps the operator to monitor and evaluate the quantity of use by the occupants of the building at each level.

Therefore, the operating team that was previously represented by the occupants from each level needs to be redistributed to be representative according to the department and organization. Each level in the ministry building consists of many different departments and organizations. Therefore only one representative is very difficult to convey information to all other occupants of the same level. So that, choosing a representative from each department / organization will give a high commitment and management planning can be conveyed to all occupants of the building easily. Moreover, the response from the occupants to any improvement can be obtained quickly.

The occupants of the building need to give a high commitment to any planning done by the management. For example attending awareness briefing, applying the training provided efficiently and in accordance with the standard operating procedures (SOP) provided. This compliance is expected to make a significant difference to the measurements of BEI taken each month.

5.5.1.3. Respondent 2: Mohd Hafiz Bin Taib

Objective 1: To identify the energy management that practices in office building at Putrajaya.

According to Mr. Hafiz, the KPLB building also uses the energy management system manual provided by the Public Works Department (JKR). He says that this manual contains all aspects of energy management. A more focused method of energy management is the practice of cost-free activities. The implementation and operation of energy management includes aspects:

- Energy management operations team(POPT)

This team is the top management representative is the executor of the energy implementation action plan (PIPT). Their job is to implement the activities planned under PIPT and provide monthly implementation report to the Energy manager. Other than that, POPT activities can be categorized into three (3) divisions namely office operations, facilities operation and maintenance and project implementation.

- Competence, Training and Awareness

Training in the form of energy measurement system courses and course of measurement of performance savings and verification of performance to the energy management committee. Thus, awareness programs in the form of

presentations, workshops, meetings articles, pamphlets, competitions and internal training to all building occupants.

- Communication and documentation

The energy management committee has the role of conducting energy management system meetings, discussing performance monitoring of austerity measures, and preparing monthly energy management reports. In addition, provide energy management system manuals and operating procedure manuals.

- Operational control

As in the MCMC building, management practices in the form of operational control practices give an advantage to saving electricity in the building. For example the operational control of office equipment, office and public lighting, air conditioning, water pumps and ventilation systems provide high savings on the use of electricity resources.

- Technology

The Building Control System (BCS) in this building plays an important role for energy management. The BCS system helps to exercise operational control over all operating systems in this building. In addition the installation of sensors in the parking lot to detect co2 gas helps to control the operating time of the ventilation fan. Other than that, application of Led bulb, motion sensor, sub-meter installation on electric plug and using of electronic ballast help to reduce electricity use.

Objective 2: To analyze the effectiveness of energy management practiced in office building at Putrajaya.

En. Hafiz thinks that the manual provided helps a lot in energy management in the building. All practices are done according to the planning done. Each planning is done by analyzing the value of the BEI earned each month. Practices in terms of operational control have a lot of planning and are constantly being improved to increase savings potential compared to other practices. Furthermore,

cost-free activities involving the preparation of schedules and campaigns via email are actively carried out to achieve the BEI according to the targets recommended by the ministry.

Objective 3: To recommend improvements to energy management practiced in office buildings at Putrajaya.

To improve energy management efficiency, Mr. Hafiz thinks that conducting awareness campaigns more efficiently. Previously, awareness campaigns were conducted using mediums such as awareness notices, brochures and via email. As this building plays a role in managing the affairs of government ministries, the occupants of the building who are mostly government employees are difficult to gather for awareness briefings. Therefore this medium is still not effective enough to give awareness to the occupants of the building. He proposed to implement earth day. Where on that day all the occupants of the building engage to raise awareness. Through the implementation of earth day, the management is able to execute plans regarding energy management.

In addition, the ministry needs to select representatives for each level to conduct regular monitoring of the practice that has been executed. Each department can also do planning such as selecting one person on a daily basis in turn to check the use of electronic equipment, to ensure the lights are turned off in unused areas and responsible for advising others to do so.

Based on the interviews that have been conducted, the findings of the study for objectives 1 and 2 have similarities with the findings using the questionnaire instrument. Similarities in terms of management practices performed effectiveness of practices performed. Findings for objective 3 using questionnaire instruments are more to the responsibility of management. While the findings for the third objective of using interview instruments include the management and occupants of the building.

5.6. Summary

As a whole, the results of the study obtained using questionnaire instruments and semi-structured interview instruments have been analyzed in this chapter to achieve the three previously stated objectives. SPSS software helps validate the data that has been collected by the researcher. While the interviews have strengthened and provided more detailed data to achieve the objectives of the study. Data taken in the two buildings help researchers to analyze effective energy management practices.

CHAPTER SIX

CONCLUSION

6.1. Introduction

This chapter presents a summary of the research aims and objectives, followed by recapitulation of findings and discussion of results based on the empirical examinations of the theatrical framework of the study. Conclusions will be focused on the study as a whole by including conclusions and implications that can be translated from this research. In addition, strategic improvements in energy management practices will be recommended to Ministry of Communications and Multimedia Malaysia (Malay:Kementerian Komunikasi dan Multimedia Malaysia) and Ministry of Rural Development Malaysia (Malay: Kementerian Pembangunan Luar Bandar) management to practice effective energy management practices through this study.

Moreover, this chapter is the last chapter of this study. All the findings of the study will be formulated to achieve the objectives that have been formed previously. The findings that have been collected as a result of mix method using questionnaire instruments and semi-structured interviews were used to analyze and discuss the objectives of the study. Therefore, this chapter will briefly and thoroughly explain the findings of the 3 research questions, research implications, research limitations and further suggestions for the improvement of effective energy management practices in both office buildings.

6.2. Summary of findings for research questions

This study aims to find out the extent of effective energy management practices performed in Putrajaya office buildings. In addition, researchers have also reviewed the

energy management methods practiced to ensure the extent to which effective energy management practices are practiced.

6.2.1 Research question 1

What is the energy management practices implemented in office buildings at Putrajaya?

Based on the analysis that has been done by the researcher from the literature highlights, questionnaire instruments and interviews, several methods have been identified in the effective energy management practices in the two office buildings. Further allowing research question 1 to be answered. Through the data collection and discussion that has been done in chapter 5, the objectives that answer the first question can be achieved. Energy management methods practiced in both buildings based on government manuals provided by the Public Works Department (JKR). Key aspects that include energy management practices are management, operational control, documentation, reporting, training and awareness and existing system planning. Among them are planning, managing and monitoring energy consumption through energy operation groups, performing control on the systems available in the building automatically and schedule. Additionally, provide monthly reports to analyze energy consumption levels, conduct online awareness campaigns, providing evaluation and measurement training. Using energy efficient equipment and so on.

6.2.2. Research question 2

How to evaluate the efficiency of energy management practices used in office buildings at Putrajaya?

Based on the second objective, an analysis of the study was made to analyze the effectiveness of the applied energy management practices. To achieve the second research question, the data received through questionnaires and interviews were analyzed to find out the effective energy management practices. As a result of the analysis in chapter 5, effective energy management practices have been identified. Operational control is a very effective method of saving on energy consumption. This practice in the form of operational control provides a large percentage of savings according to the energy managers from both buildings. Various alternatives are performed on systems such as air conditioning, ventilation fans, lighting systems and elevators which are high electricity users. Although, other practices also help make savings. In addition to the advantages of the technology-based BCS system in each building contributes to the operational control performed.

6.2.3 Research question 3

What is the best way to increase energy management practices in office buildings at Putrajaya?

To achieve the third research question, the findings discussed in chapter 5 are in the form of improvements in effective energy management practices in the Putrajaya office building. The method used by the researcher to achieve the third objective is through questionnaires and semi-structured interviews. This semi-structured interview was conducted with two parties, namely the facility management energy manager for the government office building to find out more about the effective energy management practices that can be practiced in the building. Energy manager is the party responsible for carrying out all the planning that has been done in accordance with the cooperation of the ministry management and guided by the energy management system manual.

6.3. Research implications

Referring to the conceptual framework that has been built at the beginning of the study based on the literature review of previous studies, the study shows that the findings obtained can contribute a lot in various aspects. Based on the empirical evidence that has been discussed. Findings from the results of the analysis and discussions conducted have resulted in some suggestions for improvement that can be used as a reference, guidelines, considered and applied by the energy management in the office building. In addition, this study can also be used as a guide to energy management to improve energy management practices to improve effective energy management practices in office buildings. Thus being able to avoid wasting energy, becoming a 5 star energy rating building and becomes an example to other office buildings. In addition, the contribution to the contextual aspects, this study also provides contributions and implications for the following:

- Contributions to theory and model construction. Findings from the results of data analysis in this study can make a significant contribution to the efforts to strengthen the theory and highlight the literature of the study in terms of effective energy management practices practiced in the office building.
- Contribution to the formation of instruments for measuring effective energy management practices used in the Putrajaya office building .In terms methodology, this study has contributed from the aspect the formation of instruments to measure energy management methods practiced in the Putrajaya office building.

6.4. Research limitation

The conclusion of this study takes into account some of the limitations of the study that exist. The limitations faced by researchers in conducting this study are in terms of

limiting the scope of the study from selecting three office buildings to two office buildings. This was due to the Covid-19 outbreak which caused the state government to issue a movement control order. Therefore the researcher had to choose an office building that has energy management from the same company to facilitate obtaining information at that time.

The second limitation faced by the researcher is the difficulty in obtaining feedback from respondents to obtain data through questionnaires that have been distributed in the form of google form. Therefore, this study took time to obtain information for analysis. This study also conducted a semi-structured interview session with the energy management from both buildings to obtain information. Both interview respondents had time constraints and were busy with responsibilities as a manager especially during the movement control order. Dates had to be shifted to get an appointment for an interview.

6.5. Suggested improvement strategy

Through the findings of this study, researchers have identified the driving factors in effective energy management practices in Putrajaya office buildings. Therefore, the researcher provides strategies for improvement in effective management practices in the office building such as:

6.5.1. Training and awareness

- Energy Efficiency and Energy Conservation Awareness Programs

The intensive awareness programs such as energy savings campaign or simple energy management incentives shall be conducted regularly as it would be an encouragement to strengthen energy efficiency culture. However the success of the programs depends on the involvement of every staff top and middle management in both office buildings. Therefore, the ministry's management can introduce a day dedicated to running energy-related programs. Programs like

these provide very deep awareness compared to online awareness programs. Every occupant of the building will have the opportunity to get involved in the program. At the same time provide an opportunity for building users to share their ideas to improve energy management practices. This will directly change the culture of building users to practice savings. At last will enhance to strengthen the training and awareness construct based practice.

6.5.2. Management role

- Formation of special committees

Energy management in this building as a whole involves the energy management from the building facilities management and the ministry. Only one representative is selected from each level to deliver any planning to other building users. The formation of special committees among building users will enable third parties to be involved in any energy management. In addition, the formation of a special committee according to each department in the building helps towards savings such as conducting daily monitoring to control operations, increase the effectiveness of each planning done, increase the effectiveness of energy management methods practiced and allowing responsibilities to be borne together. So management should play their role effectively to add value on energy management strategies.

6.5.3. Technology

- Budget allocation for energy management.

No special provision is provided for practicing effective energy management. So that, the budget allocation by the ministry (client) is required to make improvements to existing management practices. Appropriate budget allocation will enable the energy management team to practice use of green

technology. For example, installation of double-glazed glass with low thermal emissivity layer will optimize usage of daylight and reduce heat gain in the building's thermal envelope. Motion detectors and daylight sensors can avoid occurrence of energy wastage and to optimize usage of daylight. Motion sensor lights are only installed in a few places. With budget allocation, the sensor can be installed in places where it is needed to reduce the use of electricity. In addition, it will also help management to increase the use of energy efficient equipment.

6.6. Recommendations and scope of further study

This study only focuses on the energy management practices practiced. After this study is made and analyzed, the energy management conducted is in line with the National Energy Policy but energy management practices need to be reviewed to achieve a BEI star rating according to the ministry's target. In addition, the weaknesses found in this study can be used as a guide in studying the same thing in the future. Energy consumption should be monitored continuously to avoid wastage of energy.

Besides that, energy waste can also increase high energy costs. As such, effective energy management practices should be given due emphasis to avoid wastage. There are several research factors that can be developed by the next researcher in further improving the conceptual framework model in the study that has been produced by the researcher.

In conclusion, good research results should be extended in the future to increase the effectiveness of energy management practices in office buildings. The implementation of the best energy management is the responsibility of all parties for an organization to maintain sustainability

6.7. Summary

Overall, this study was successfully implemented because all the questions constructed by the researcher were answered perfectly. The findings of the study are based on the current situation of this study and can be utilized to the energy management of the Putrajaya office building. This study also proves that effective energy management practices can help an organization in avoiding waste. Nowadays, effective energy management is very important because population growth and high demand cause excessive use of energy resources. Energy management theory is still new in this country which requires a lot of research and attention, therefore the results of this study can contribute to the development of the field of energy management. In addition, the energy management in the office building in Putrajaya can practice the results of discussions and suggestions that have been produced by researchers in practicing effective energy management.

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APPENDIX

Questionnaire

SECTION A : RESPONDENT DEMOGRAPHIC

This section was created to find out the socio-economic information of the respondents

A1) Building name :

• KKMM	
• KPLB	

A2) Gender:

• Male	
• Female	

A3) Age Category :

< 21 year	
21- 30 year	
31 – 40 year	
>41 year	

A4) Working experience

< 1 year	
2 – 5 year	
6 – 10 year	
>10 year	

SCALE:

1	2	3	4	5
STRONGLY DISAGREE	DISAGREE	MODERATE	AGREE	STRONGLY AGREE

SECTION B: MANAGEMENT ROLE

ITEM	QUESTION	SCAL E				
		1	2	3	4	5
B1	I was exposed to policies, objectives and planning related to energy management					
B2	Management conducts energy audits to monitor energy use in the workplace.					
B3	I comply with government laws, standards and policies related to energy and water consumption.					
B4	I am satisfied with the management of the in-house energy operations team.					

SECTION C: OPERATIONAL CONTROL

ITEM	QUESTION	SCAL E				
		1	2	3	4	5
C1	Scheduling of operating hours such as ventilation fans, lifts, lighting systems and air conditioning systems is done by the management.					
C2	Management makes a public announcement every day so that the occupants of the building turn off the computer and printer after working hours					
C3	Control of operating time of lighting system and air conditioning system save energy consumption in the building.					
C4	Setting the air conditioning temperature to 24 degrees Celsius can help towards energy saving.					

SECTION D: TRAINING AND AWARENESS

ITEM	QUESTION	SCAL E				
		1	2	3	4	5
D1	I apply the energy management training given in the operation of daily work activities.					
D2	Awareness notices of the importance of saving electricity and water are provided in the workplace					
D3	The energy management training provided, helped me do energy saving.					
D4	Energy saving awareness briefing helped me towards energy saving.					

SECTION E: TECHNOLOGY

ITEM	QUESTION	SCAL E				
		1	2	3	4	5
E1	Ventilation system control is controlled automatically using Building Control System (BCS)					
E2	GDC air conditioning system (boiling water) is widely used in buildings.					
E3	Using energy efficient equipment such as LED lights can save energy consumption.					
E4	The installation of motion sensor lights in the toilet helps towards energy saving.					

SEMI STRUCTURED INTERVIEW



OBJECTIVE:

The purpose of this interview is to obtain feedback in identifying the objectives of the research as follows:

1. To identify the energy management that practices in office building at Putrajaya.
 2. To analyze the effectiveness of energy management practiced in office building at Putrajaya.
 3. To recommend improvements to energy management practiced in office buildings at Putrajaya.
-

Research Topic: Effectiveness of Energy Management Practices in Office Buildings at Putrajaya.

This interview is a tool used for the research topic stated above. The aim of this research is to develop an effective strategy for implementing energy management in office buildings at Putrajaya.



SOALAN TEMU BUAL SEPARA STRUKTUR

1. What energy management methods are practiced in your building?
Apakah kaedah pengurusan tenaga yang diamalkan dibangunan anda?
2. What is the pattern of energy operation in your building?
Bagaimanakah corak pengoperasian tenaga di bangunan anda?
3. What are the influencing factors in the energy management strategy in your building?
Apakah faktor – faktor yang mempengaruhi dalam strategik pengurusan tenaga di bangunan anda?
4. How the energy management methods practiced can affect savings?
Bagaimanakah kaedah pengurusan tenaga yang diamalkan dapat memberi kesan kepada penjimatan?
5. What improvement suggestions can be made for effective energy management in your building?
Apakah cadangan penambahbaikan yang boleh dilakukan untuk pengurusan tenaga yang efektif di bangunan anda?