

**ENERGY EFFICIENCY READINESS FRAMEWORK FOR  
OCCUPANTS OF GOVERNMENT BUILDINGS IN  
MELAKA**

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**ENERGY EFFICIENCY READINESS FRAMEWORK FOR  
OCCUPANTS OF GOVERNMENT BUILDINGS IN  
MELAKA**

by

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## LIST OF ABBREVIATIONS

AEMAS	ASEAN Energy Management Accreditation
ACEM	Association of Consulting Engineers Malaysia
AVE	Average Variance Extracted
BEI	Building Energy Index
BRE	Building Research Establishment
BREEAM	Building Research Establishment's Environmental Assessment Method
BSEEP	Building Sector Energy Efficiency Project
CA	Cronbach Alphas
CASBEE	Comprehensive Assessment System for Building Environmental Efficiency
CASBEE-EB	CASBEE for existing buildings
CASBEE-NC	CASBEE for new construction
CASBEE-PD	CASBEE for pre-design
CASBEE-RN	CASBEE for renovation
CEPAS	Comprehensive Environmental Performance Assessment Accreditation
CETREE	Centre for Education, Training and Research in Renewable Energy, Energy Efficiency and Green Technology
CO <sub>2</sub>	Carbon Dioxide

CR	Composite Reliability
DEM	Danish Energy Management
DV	Dependant Variable
DfE	Design for Environment
EnMS	Energy Management Systems
EPC	Energy Performance Contracting
EPBD	Energy Performance of Building Directive
ESCO	Energy Service Company
EPCert	Energy Performance Certificate
EPCs	Energy Performance Certificates
EU	European Union
GHG	Green House Gases
GEF	Global Environment Facility
GB Tool	Green Building Tool
GCAP	Green City Action Plan
GSCM	Green Supply Chain Management
HVAC	Heating Ventilation and Air Conditioning
IV	Independent Variable
IAQ	Indoor Air Quality
IBEC	Institute for Building Environment and Energy Conservation
IFMA	International Facility Management Association
ISO	International Organisation for Standardization
JKR	Jabatan Kerja Raya



LEED	Leadership in Energy and Environmental Design
MITC	Malacca International Trade Centre
MAESCO	Malaysia Energy Service Company
MCE	Malaysian Certificate of Education
MV	Mediating Variable
MeGTC	Melaka Green Technology Corporation
NABERS	National Australian Built Environment Rating System
NOIIE	National e-readiness, Organisational preparedness, Industrial relationships, Internal resistance and External influence
NGTP	National Green Technology Policy
nZEB	nearly Zero Energy Building
NEM	New Economic Model
NEP	New Economic Policy
OECD	Organisation for Economic Cooperation and Development
PMR	Penilaian Menengah Rendah
PAM	Pertubuhan Akitek Malaysia
pHJKR	Penarafan Hijau Jabatan Kerja Raya
PLS	Partial Least Squares
ROI	Return of Investment
SBS	Sick Building Syndrome
SPM	Sijil Pelajaran Malaysia
SRP	Sijil Rendah Pelajaran
STPM	Sijil Tinggi Pelajaran Malaysia

SSC	Smart Sustainable City
SAP	Standard Assessments Procedure
SE	Standard Error
SPSS	Statistical Package for Social Science
S-O-R	Stimulus-Organism-Response
SEM	Structural Equation Modelling
SBRS	Sustainable Building Rating Systems
SBAT	Sustainable Buildings Assessment Tool
SDG	Sustainable Development Goal
SPiRiT	Sustainable Project Rating Tool
TRI	Technology Readiness Index
TPB	Theory of Planned Behaviour
UK	United Kingdom
UNDP	United Nations Development Programme
USA	United State of America
USGBC	US Green Building Council
VIF	Variance Inflation Factor
WCED	World Commission on Environment and Development
WGBC	World Green Building Council

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# **RANGKA KERJA KESEDIAAN KECEKAPAN TENAGA UNTUK PENGHUNI BANGUNAN KERAJAAN DI MELAKA**

## **ABSTRAK**

Sektor tenaga adalah dipertanggungjawabkan terhadap segala pelepasan gas rumah hijau dan banyak program untuk menambahbaik kecekapan tenaga sejak tahun 1990. Sejak itu, kerajaan negeri Melaka melalui Perbadanan Teknologi Hijau Melaka (PTHM) dan Pusat Pendidikan Dan Latihan Tenaga Boleh Baharu, Kecekapan Tenaga Dan Teknologi Hijau (CETREE) pada tahun 2016 telah mewujudkan program kecekapan tenaga dan pelabelan bangunan (EPCert) dalam usaha untuk mempromosikan budaya cekap tenaga yang boleh mengawal kadar penggunaan tenaga dalam bangunan di Melaka. Kajian terdahulu telah menunjukkan kepentingan kesediaan organisasi dalam menentukan kejayaan inisiatif kecekapan tenaga dalam bangunan. Penilaian kesediaan organisasi dalam menjalankan projek/skim akan dapat membantu pihak berkepentingan dalam menentukan potensi yang efektif semasa menjalankan program. Maka, kajian ini adalah bertujuan untuk menyiasat tahap kesediaan organisasi dalam bangunan utama kerajaan negeri Melaka berpandukan kepada kesedaran terhadap alam sekitar dan penjimatan tenaga dalam kalangan penghuni bangunan. Kajian ini telah menggunakan kaedah tinjauan untuk aktiviti pengumpulan data. Responden utama dalam kajian ini adalah penghuni bangunan dan/atau pekerja di 8 buah bangunan utama kerajaan negeri Melaka. Sebanyak 53 peratus kadar maklumbalas borang soal selidik telah diterima bagi kajian ini.. Data kajian ini telah dianalisis menggunakan perisian *Structural Equation Modeling (SEM) - Partial Least Squares (PLS)*. Hasil kajian menunjukkan bahawa pelbagai bentuk promosi dan

pendekatan perlu ditekankan kepada penghuni bangunan tentang amalan kesedaran alam sekitar dan penjimatan tenaga bagi mewujudkan budaya organisasi yang sesuai dan, akhirnya menjadikan mereka dalam keadaan bersedia untuk melaksanakan akreditasi Sijil Prestasi Tenaga. Walau bagaimanapun, amalan kesedaran penjimatan tenaga menunjukkan korelasi negatif terhadap kesediaan organisasi untuk melaksanakan akreditasi Sijil Prestasi Tenaga. Hasil penemuan menunjukkan bahawa beberapa amalan kesedaran tenaga akan menyebabkan rasa kurang selesa dalam kalangan penghuni bangunan dan juga mampu merendahkan tahap produktiviti kerja mereka. Akhir sekali, hasil kajian menunjukkan bahawa, amalan kesedaran terhadap alam sekitar dan penjimatan tenaga ini dapat meningkatkan tahap kesediaan sesebuah organisasi iaitu boleh disegmentasikan sebagai ‘pelopor/peneraju’ yang terdapat di dalam peringkat persediaan organisasi, dan jika amalan ini diterapkan sebagai budaya sesebuah organisasi, ianya pasti memberikan hasil yang menakjubkan. Oleh itu, amalan kesedaran terhadap penjimatan tenaga dapat dipupuk dan perlu diterapkan dengan baik dalam budaya kerja di organisasi. Justeru, ia dapat membuktikan bahawa, alam sekitar dan penghuni bangunan dapat berinteraksi secara positif hasil daripada penerapan kesedaran alam sekitar dan penjimatan tenaga.

# **ENERGY EFFICIENCY READINESS FRAMEWORK FOR OCCUPANTS OF GOVERNMENT BUILDINGS IN MELAKA**

## **ABSTRACT**

Energy sectors are accountable for greenhouse gas emissions and many programmes to improve energy efficiency have been conducted since 1990. Ever since, the state of Melaka, through the Melaka Green Technology Corporation (MeGTC) and the Centre for Education, Training, and Research in Renewable Energy, Energy Efficiency, and Green Technology (CETREE) in 2016, has introduced energy efficiency and labelling programmes (EPCert) in an effort to promote an energy-efficient culture and ultimately control the total energy consumption of buildings in Melaka. Prior studies revealed that organisational readiness plays a crucial role in determining the success of energy efficiency initiatives in buildings. By assessing an organisation's preparedness to undertake such projects, stakeholders can gauge the potential effectiveness of implementing energy-saving measures. Thus, this study is an initial attempt to investigate the occupants' readiness in Melaka state government buildings towards environmental and energy-saving awareness practices among occupants. A survey method was employed for data collection. The respondents were building occupants and/or employees at eight major state government buildings in Melaka. A questionnaire was disseminated to the respondents, which generated a 53% response rate. A structural equation modelling-partial least squares approach was performed for the main data analysis. As the result of the study suggests, more promotion and education for building occupants are needed for environmental and energy-saving awareness practices that create a well-suited organisational culture for them,

eventually making them ready to implement the Energy Performance Certificate (EPCert) accreditation. However, the energy-saving awareness practices show a negative correlation with organisational readiness to implement the EPCert accreditation. This finding demonstrates that some energy awareness practices are less convenient for building occupants, and some may impair work productivity. Finally, the result indicates that environmental awareness and energy-saving awareness practices increase the organisational readiness level of 'explorers and pioneers' in readiness segmentation if embedded through organisational culture, and the result is considerably improved. Thus, energy-saving awareness practices can be nurtured and need to be well managed in their work culture. Moreover, it indicates that building occupants and the environment can benefit from the adoption of these environmental and energy-saving awareness practices.

# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 Overview**

An energy performance certificate can be the best instrument that can assist governments in reducing energy consumption in buildings. For the theoretical case, the energy efficiency of buildings and electrical appliances progresses over time. Nowadays, all buildings and equipment are fitted with energy-saving features. Therefore, the organisation in a building should be ready with the new method of work process that will be engaged in energy-saving procedures. This study investigates the extent of organisational readiness on the implementation of the Energy Performance Certificate (EPCert) accreditation. This study also explores the influence of environmental awareness and energy-saving awareness on organisational culture. This chapter discusses the background of the study and also addresses the problem of the study. In Chapter 1, the research questions and objectives are presented in order to achieve what this study seeks. The scope and significance of the research are then put forward. Lastly, the definition of key terms and structure of the thesis are described towards the end of the chapter.

### **1.2 Research Background**

Disputes on organisational readiness for a new method of work process have always been discussed for a long time. In a modern world where technologies move fast and forward, work procedures are changing rapidly and every organisation should adopt adequate managerial instruments to become more competitive (Passetti & Tenucci, 2016; Isik, 2016). Nowadays, the awareness of environmental issues among Malaysians has led to the construction of green buildings in the country (Ibrahim et al., 2014).



Environmental issues have turned into crises since the experience of global warming 30 years ago (Quirion et al., 2006). Global warming has driven the enactment of the United Nations Framework Convention on Climate Change in Rio de Janeiro, Brazil, in June 1992, followed by the Kyoto Protocol in Kyoto, Japan, in December 1997, which regulated the mandatory greenhouse gas (GHG) emissions from industrialised countries (IPCC, 2007; UNFCCC, 1998).

Moreover, the rapid growth of energy use worldwide has already raised concerns regarding over-supply problems, exhaustion of energy resources, and severe environmental impacts (e.g., ozone layer depletion, global warming, climate change, etc.) (Keane, 2012; Abu Bakar et al., 2015). The global contributions from buildings towards energy consumption, both residential and commercial, have steadily increased, reaching figures between 20% and 40% in developed countries (Saidur, 2009; Pérez-Lombard, Ortiz, González, & Maestre, 2009).

Thus, to achieve lower power usage, energy-efficient buildings that consume less energy and produce minimal emissions are being considered (Chaturvedi & Arch, 2008). Accordingly, the European Union approved the Energy Performance of Building Directive (EPBD) on December 16, 2002 to strengthen control the total energy consumption of buildings. In 2007, the EPBD adopted a regulation that forced building purchasers and tenants to provide energy performance certificates in the building sale or rental process. The United Kingdom also announced in December 2006 that it would realise its nearly zero-energy building target on all new homes in the country by 2016 (ECEEE, 2011; GFE, 2010; IRENA, 2012; Sunikka, 2005; ZCH, 2011).

In developed nations, numerous rating systems have been developed for fostering citizens to save energy consumption without compromising the activities and comfort in the building (Sukri, Yusri, Abdullah, Abdul, & Majid, 2012; Najihah, Bakar, Hassan, & Rahman, 2013; Sakina et al., 2013; Abu Bakar et al., 2015). The governments are moving towards executing policies on saving energy consumption because people keep consuming more energy every day (Keane, 2012) without realising the increasing energy demand and they need to build new plants to ensure energy supply is still sufficient for occupants (Brounen & Kok, 2011; Najihah, Bakar, Hassan, & Rahman, 2013).

However, in some theoretical illustration, the energy efficiency of buildings and electrical appliances improve over time, whereby they estimated that the annual delivered Building Energy Index (BEI) could decrease from 150 kWh/m<sup>2</sup> per year at present to 90 kWh/m<sup>2</sup> per year in 2070 (Swales, Allan, McGregor, & Turner, 2009; Naess et al., 2018). Therefore, building energy efficiency awareness could accelerate the projection of BEI at an early stage. It also seems to be parallel to the improvement of energy-saving appliances. Thus, it raises a question on how important is the readiness of occupants in the adoption of the EPCert accreditation.

### **1.3 Problem Statement & Research Questions**

A building is designated as a shelter for human to protect themselves from any kind of weather and danger, retain and keep their belongings, and also as a resting place. However, the activities in buildings, especially in commercial buildings, have been acknowledged as one of the major sectors that causes environmental degradation, consuming a large amount of energy, and yielding a large amount of gas emissions every

year (Aswad & Ibrahim, 2012). Therefore, more efforts are needed from different parties in the building industry to develop sustainable buildings in Malaysia.

According to the International Energy Agency (IEA)(2010), the building industry is the most cost-effective sector for reducing energy consumption, and energy efficiency awareness plays an important role in controlling energy usage, as well as reducing costs and maintaining a comfortable environment in buildings (Abu Bakar et al., 2015; Shaikh et al., 2016). In the view of fact, buildings expected consume up to 50% in 2030 which Malaysia is one of the top energy consumers in Asia (Aldhshan et al., 2021). Therefore, the responsibility of providing this energy efficiency awareness must be borne by all stakeholders, together with the government's party as the main player.

In addition, building industries nowadays are under increasing pressure from governments, building markets, regulators and community to implement energy-efficient buildings (Ma & Jørgensen, 2018; Miśkiewicz et al., 2021). Balancing economic and environmental performance to be green, money-saving and competitive is main issue. Some of the building occupants still have little common understanding of what this term means (Michelle, 2016; Vigna et al., 2018). Therefore, building automation and energy efficiency schemes are the familiar concept to be an approach to the building industry by governments or regulators (Arinda et al., 2018; Indrawati; et al., 2020; Ma, 2018; Miśkiewicz et al., 2021). The building occupants can make a significant contribution to environmental conservation and energy consumption by using energy-efficient products or embracing energy-efficient schemes in building (Kim et al., 2019; Kontadakis et al., 2017; Sakah et al., 2019; Swales et al., 2009).

The impact of a shift towards energy-efficient building as part of the green building initiatives that would be globally recognised (Ma & Jørgensen, 2018), being embedded in both the business and government context. Building industries and occupants worldwide are increasingly becoming aware of the strategic role that building owners and organisation leaders can play in both infrastructure energy efficiency and supporting a business's overall energy efficiency initiative. What we don't know is how ready the building occupants are to discharge such roles. Gaining a better understanding of energy efficiency and its impact is a key research priority, which can give rise to a multitude of research streams.

However, many sustainable readiness frameworks prevalently focus on building systems (Vigna et al., 2018; Indrawati; et al., 2020); green building construction/design (Arinda et al., 2018; Fokaides et al., 2020), organisational characteristics (Miśkiewicz et al., 2021), and safety and security (Molla et al., 2008). The most popular standards for sustainable building rating system in Malaysia are Green Building Index (GBI), Building Sector Energy Efficiency Project (BSEEP), Melaka Green Seal, Energy Performance Certificate (EPCert), Green RE, Penarafan Hijau JKR (pHJKR) and CASBEE Iskandar Malaysia. This situation is contrary to the technology readiness theory which is always concerned with people's awareness and willingness on accepting new technology or system (Cherrafi et al., 2021; Holt et al., 2007; Wirahadikusumah & Ario, 2015). Therefore, the purpose of this study was to determine the effects of environmental awareness and energy-saving awareness on the organisational readiness for implementing EPCert. Therefore, the purpose of this study was to determine the effects of environmental awareness and energy-saving awareness on the organisational readiness for implementing EPCert. In academic terms, this study is relevant for expanding the discussions about the occupants' awareness

and acceptance of EPCert accreditation that reflect occupants' characteristics and segmentation of readiness.

Recently, readiness scholars suggest that the success or sustainability of energy-efficient buildings depends on the building occupant's awareness and knowledge to practice energy-efficient technologies in buildings (Risholt & Berker, 2013). Although awareness has been acknowledged as important, understanding this behaviour remains arguable (Zhang et al., 2018). Generally, the activities and awareness of environmental and energy-saving among building occupants display a strong correlation with energy consumption in buildings (Harputlugil & de Wilde, 2021). Occupants' awareness of energy efficiency or energy saving would affect building energy performance from their activities (Aldhshan et al., 2021).

Previous research has highlighted the barriers to readiness for change in sustainable development in the building industry. Aswad & Ibrahim (2012) explain that barriers are from several factors, which are organisational internal factors and organisational external factors. Further, the organisational internal factors have become the most important factors in driving an organisation to change (Ogunyemi & Johnston, 2012; Samari, 2015; Cherrafi et al., 2021). Within an organisational internal factor, organisational characteristics are becoming the main focus among researchers, which disregards the individual attributes in an organisation. Researchers have investigated organisational characteristics from various perspectives, ranging from culture, climate, and financial-related organisations (Cherrafi et al., 2021; Levovnik & Gerbec, 2018; Tavakoli, 2010).

As the lack of interest from the organisation in workers or building occupants is related to sustainable activity in buildings, it causes higher costs, and ultimately demands

more effort for an organisation to embrace energy-efficient activities in the building (Ali et al., 2020). In the same vein, Ohueri et al. (2018) and Zaid et al. (2017) identified that the lack of experience, encouragement, and a lack of technical knowledge have become the reasons why the building players are reluctant to implement or adopt the energy efficiency concept.

There are several gaps that have driven this research, including the deficiency of non-western perspectives in the organisational readiness literature. Although most theories have been developed in the awareness concept, this study argued for the need to investigate how well the theories apply to organisational readiness in other countries and cultures. For instance, cultural factors may limit the generalisation of the theory. The progress of organisational culture is very important. Research has shown that culture is a manifestation of human feelings and behaviours (Triandis & Hofstede, 1993); (Geert Hofstede, 2012).

Although several individuals' behaviour (Yue et al., 2013) and cultures (S. Yang et al., 2016) have been confirmed as factors influencing the energy-saving behaviour of the workplace, a solid understanding of the process underlying this relationship is clear. Energy-saving behaviour is developed from the energy-saving awareness of people in the long run, which means that energy-saving awareness will determine the energy consumption of buildings (Zhao et al., 2019). Energy-saving awareness comes from energy-saving knowledge and prolonged fostering by others, whereby it develops a direct impact on the occupants' intention to save energy (Wang et al., 2014).

A recent study shows that most building occupants are more interested in adopting new energy-efficiency technologies or programs (Żywiołek et al., 2021) if they have enough knowledge and are inspired by relevant parties (Yang et al., 2020). This lack of

understanding then posed further questions, such as if energy-saving awareness has a positive correlation with organisational culture? Can the same set of determinants be used to examine the indirect impacts of energy-saving awareness and organisational readiness with the appearance of organisational culture?

Organisational culture could be a plausible explanation for this relationship (Martins et al., 2002) and for assessing their readiness for implementing the EPCert accreditation (Martins & Terblanche, 2003). Organisational culture might lead to different organisational readiness (König, 2020; Yip et al., 2021), performance (Pinho et al., 2014) and capabilities (Alsmairat, 2022). In order to get an appropriate culture in an organisation is by getting a full commitment from organisational members (Bititci et al., 2006; Fadnavis et al., 2020). Several academic studies on human resource management practises suggest that commitment practises come from the willingness to act and awareness of organisational members (Miller et al., 2022; Si et al., 2022; Zsoka, 2007). In other words, desirable awareness among occupants will increase organisational readiness and effectiveness by creating a condition (decent culture in an organisation) whereby employees become highly motivated and involved in the organisational activities at achieving organisational goals (Chen et al., 2019; Rahman, 2016; Sau et al., 2016). Thus, the gap of knowledge between energy-saving awareness and environmental awareness factors towards organisational readiness will be the most important study aim and the impact of the presence of organisational culture would be examined as well.

Following this suggestion, this research examines energy-saving awareness and environmental awareness, which could be used by organisations as a strategy to cognitively reframe their unfavourable conduct or standard procedure that will reduce building energy

consumption, so that they can perform activities suitable for reducing building energy consumption.

Therefore, in an attempt to bridge the gap in the literature, this research investigated the association between awareness factors and organisational readiness, and whether organisational culture mediates the relationship. Meanwhile, this study is related to the organisational change theory. Most of the thoughts are focused around the theory of readiness, awareness factors related to energy savings and environment, and also organisational culture that contributes to the readiness in developing the EPCert accreditation. It is vital to develop a framework that exactly fits the local scenario because previously developed frameworks are from other countries' experience. Hence, this research explores the following questions:

1. What is the effect of environmental awareness and energy-saving awareness on organisational culture?
2. What is the direct effect of organisational culture on organisational readiness?
3. Does organisational culture mediate the relationship between environmental awareness and organisational readiness?
4. Does organisational culture mediate the relationship between energy-saving awareness and organisational readiness?
5. What is the current state of readiness among building occupants in Melaka state government buildings to implement the EPCert accreditation?

#### **1.4 Research Aims**

This study sets out to investigate the energy efficiency readiness of government buildings' occupants in Melaka. Hence, this aim was achieved by:



1. extend the existing understanding of the effect of environmental awareness and energy-saving awareness on organisational culture. A comprehensive understanding of environmental awareness and energy-saving awareness on organisational culture is important to direct the course of this study and other studies that are interested in the awareness and readiness topic;
2. extend the understanding of the direct effect of organisational culture on organisational readiness. The understanding of this organisational culture is important to encourage organisational readiness within implementing EPCert;
3. examine the effect of the mediating role of organisational culture in the relationship between environmental awareness and organisational readiness. Understanding the effect of organisational culture towards relationship between environmental awareness and organisational readiness is important as these factors are important to facilitate an organisational readiness;
4. examine the effect of the mediating role of organisational culture in the relationship between energy-saving awareness and organisational readiness. Understanding the effect of organisational culture towards the relationship between energy saving awareness and organisational readiness is important as these factors are important to facilitate an organisational readiness; and
5. assess the state of readiness to implement the EPCert accreditation among building occupants. This assessment is important as organisational readiness has been identified as an important factor that measures the members' perception of readiness and continuous intention.

## **1.5 Research Objectives**

Based on the above research questions, this research is designed to achieve the following specific objectives:

1. To investigate the effect of environmental awareness and energy-saving awareness on organisational culture;
2. To ascertain any relationship between organisational culture and organisational readiness;
3. To examine the mediating role of organisational culture in the relationship between environmental awareness and organisational readiness;
4. To examine the mediating role of organisational culture in the relationship between energy-saving awareness and organisational readiness; and
5. To assess the state of readiness to implement the EPCert accreditation among building occupants in Melaka state government buildings.

## **1.6 Scope of the Study**

The scopes of the research are as follows:

- a. The scope of the study is identifying the effect of environmental awareness and energy-saving awareness on organisational readiness in Melaka state.
- b. This study concentrates on organisational culture and readiness in order to increase the positive effect of environmental awareness and energy-saving awareness in government buildings.
- c. With the aim to limit the scope of this study, the research respondents are occupants in government state buildings encompassing in the EPCert accreditation.

- d. Data were collected through questionnaires distributed among building occupants encompassing in the EPCert accreditation.
- e. The data collection for this study was conducted in eight state buildings in Melaka.

### **1.7 Significance of the Study**

This research contributes to the growing body of knowledge in the organisational readiness theory, specifically on awareness and organisational readiness in the context of the EPCert accreditation implementation in Melaka. First, this research extends the work of Keyton J. (2005) on finding the possible condition of awareness in the context of readiness. Although organisational culture is a consistent predictor in organisational change efforts (Aswad & Ibrahim, 2012), little is known about the environment and energy-saving awareness of organisational culture (Yue et al., 2013; Wirahadikusumah & Ario, 2015; Nurul Sakina Mokhtar Azizi & Huemann, 2015).

According to energy-saving behaviour, guiding consumption behaviour towards a sustainable direction plays an effective role in controlling excessive industrial production because consumption behaviour affects production and transportation behaviours. Moreover, the extent to which occupants save energy may depend on factors that act as barriers or opportunities for energy conservation, such as income and work procedure, that may influence purchase decisions and the ability to pay energy bills. Similarly, the decision to reduce energy use is a conscious decision and entails conscious efforts to realise energy savings, indicating that relevant psychological factors would influence energy-saving behaviours (Yang et al., 2016). Therefore, the investigation on energy-saving awareness and environmental awareness levels is vital to conclude the energy limitation. This study aims

to tailor different types of buildings in Melaka, which can become a benchmark in Malaysia for any certification attachment.

As this study is related to the theory of awareness, most of the discussions focused on the theory of readiness, energy-saving awareness and environmental awareness, and organisational change that contribute to the building occupants of Melaka state government's readiness for implementing the EPCert accreditation. Further, this study attempts to investigate the influence of environmental awareness and energy-saving awareness on organisational culture, and also to ascertain any relationship between organisational culture on organisational readiness, energy-saving awareness, and environmental awareness. As mentioned by Aswad & Ibrahim, (2012) 'the organisational member's attitudes play a major role in the success of organisational change efforts, and cooperation and commitment from the organisational members derived from positive attitudes among them will finally result in the success of any organisational change initiative.' Meanwhile, it is logical to assume that awareness and consciousness may stimulate the willingness and create actual practices (organisational culture) (Wirahadikusumah & Ario, 2015). Motivated by their work, this research proposes environmental awareness and energy-saving awareness as possible antecedents of organisational culture. Generally, awareness is believed to influence an organisational culture component, in which the EPCert accreditation is viewed as the change element that could develop the indicator of building occupants towards implementing the EPCert accreditation.

While looking at the current progress of energy-efficient buildings or energy awareness campaigns in Malaysia, the readiness of occupants on energy performance certificates needs to be examined. This study tries to set into effect a study that looks into

the factors that could initiate building owners to improve their energy consumption by enhancing environmental awareness and energy-saving awareness among building occupants. This study also believes in the importance of examining organisational culture in the relationship between awareness factors and organisational readiness. This framework is definitely formed for the local setting because the EPCert accreditation is only applied in Melaka state.

## **1.8 Methodology**

The methodology covers the details of the research design framework, instruments and tools, measurements, data collection, and data analysis. A quantitative research method was engaged in this study, in which the main research instrument used in this study is a structured questionnaire. Structured questionnaires were used as this type of questionnaire is the most popular and appropriate instrument for this study; furthermore, it is easy to conduct analysis using statistical analysis software. In this study, organisational readiness is jointly determined by environmental and energy-saving awareness. Respondent in the organisation in this study is defined as building occupants. Thus, the unit of analysis in this study is building occupants in Melaka state government buildings which directly involved with EPCert accreditation.

This study offers insights with respect to methodological contributions. Indeed, this study is a pioneer for running the quantitative data analysis using SPSS and PLS-SEM approach for the purpose of field study involving awareness and readiness in organisations. The advantage of using PLS-SEM is this approach can analyse and assess the formative items in the model (will be addressed in Chapter 3). For the purpose of the study, awareness

practices consist of two different dimensions (environmental awareness and energy-saving awareness) that are not correlated and have their own effect on organisational culture.

## **1.9 Definition of Key Terms**

In order to avoid any potential misperception in the interpretation of the thoughts engaged in this study, the definitions of terminologies used in this study are presented below. These definitions are used as guidelines in discussing the findings of the tested hypotheses.

**EPCert Accreditation** - The Energy Performance Certification (EPCert accreditation) is a tool to rate and label individual buildings, whether they are office, commercial, or public, concerning on how efficient (or inefficient) relative to the energy consumption required to provide users with acceptable degrees of comfort and functionality. The EPCert accreditation will emphasise the operational rating calculation method due to the low costs involved and the massiveness of existing and historical buildings in Melaka.

**Environmental Awareness** - This refers to the consciousness of people that may stimulate willingness and create actual practices. It has five components, namely ecological knowledge, environmental values, environmental attitudes, willingness to act, and actual behaviour.

**Energy-Saving Awareness** - This refers to people's consciousness of energy saving, which consists of three elements, namely interests, attitudes, and the need for information on energy and environmental issues.

**Organisational Culture** - This is a factor that contributes to the degree to which creativity and innovative behaviour are found among employees in an organisation.

**Organisational Readiness** - This is a multi-level, multi-faceted construct. As an organisation-level construct, readiness for change refers to organisational members' shared resolve to implement a change (change commitment) and shared belief in their collective capability to do so (change efficacy). The dimension of organisational readiness can be separated into four main dimensions: optimism, innovativeness, discomfort, and insecurity.

### **1.10 Thesis Organisation**

The subsequent chapters of the study are organised as below:

**Chapter 1:** This chapter starts with presenting background on the significance of awareness, behaviour, culture, and readiness of organisations in contributing to sustainable development through the EPCert accreditation implementation. At that point, the problem statement is presented, starting with the gap of the previous studies. Consequently, the gap is suggested in the study questions. Then, the objectives of the research are identified, and finally, the research significance is presented.

**Chapter 2:** This chapter provides an overview of the concepts of the EPCert accreditation and organisational culture that may affect organisational readiness in accepting new changes. This is followed by the description of the concepts used in the study. Practices and frameworks related to readiness and energy efficiency's model and theory are also presented. Based on the hypothesis of the research, a theoretical framework is developed. Related constructs in the study are specified and discussed in detail, as well as their hypothesised relationships.

**Chapter 3:** The methodological design is displayed and discussed in this chapter. It consists of measuring method's discussion, major instruments such as the design of the questionnaire, unit analysis, sample selection, data collection, observational study, pilot assessment, and testing, as well as the method used in the analysis of the data. The instrument (i.e., questionnaire) is discussed in detail with regard to previous literature.

**Chapter 4:** The achieved results are presented in Chapter 4. The survey carried out in this study focused on the occupants of Melaka state government buildings. The building occupants in this study are used as the basis for analysing the data of the research. The response rate and respondents' profile, and also the initial analysis are discussed in the early part of Chapter 4. The measurement model is assessed in the second part of this chapter by examining its validity and consistency. To sum up, the closing part of Chapter 4 emphasises the assessment and evaluation of the structural model and the result of the hypothesis.

**Chapter 5:** Chapter 5, consisting of two main parts, presents the findings and outcome of the analysis. The summary of the results achieved in Chapter 4 forms the first part of this chapter. For the second part, the discussion is directed on the results attained from the previous literature, and reasonable explanations concerted with pragmatic discussion are given accordingly.

**Chapter 6:** This chapter covers the discussion, implications, and conclusions by summarising the findings, discussing the implications, describing the limitations of the research, and offering suggestions for future research.



## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Overview

This chapter discusses the literature review in the contextual areas surrounding energy performance certificate and sustainable development, awareness theory, organisational culture, and organisational readiness. First, this chapter discusses the sustainable development concept that is underpinned by many scholars as a key concept of modern development. The chapter also discusses the history of sustainable development and energy performance certificate.

A significant study in the field of Energy Performance Certificate (EPCert) accreditation is also reviewed together with the history and recent progress in the global and Malaysia perspectives. The roles of building owners and occupants in Melaka state government buildings are presented at the end of the chapter. Thus, the current chapter will be the root of the development of the conceptual model in this study. Then, the basis of the developed model with related hypotheses is generated and the links between the variables are explained. Lastly, the summary is presented to wrap up the chapter.

#### 2.2 Sustainable Development, Energy Efficiency and Certificate

The subjects of global warming and climate change have extensively attracted much international attention in the last few years. According to IEA, (2019), buildings will signify the largest percentage of energy consumption in the economy, accounting for over 25% of the total final energy consumption and are equally responsible for approximately one-third of global carbon dioxide (CO<sub>2</sub>) emissions in the near future. The idea of

sustainable development was initially established by the World Commission on Environment and Development (WCED) in 1987, as stated in the Brundtland Commission 'Our Common Future' report. The basic thought of sustainable development is to maintain the three pillars of the modern city development model: environmental, economic, and social components (IEA, 2019). This sustainable development concept is a very dynamic process, as the communities anticipate and accommodate all generations necessities. The objective of all these processes is to achieve balance and reproduce decent local economic, social, and ecological systems.

Jing et al., (2017) also highlighted that the world is expecting a population increase to 10.5 billion people by 2050, in addition to the growing trend of urban development and comfort level improvement, where people work inside buildings for a longer time; thus, this situation leads to high demand in energy use in buildings, which further exceeds the energy consumption in transportation and industrial sectors (Li & Shui, 2015). Nevertheless, a developing country requires a different approach throughout establishing a sustainable built environment (Shen et al., 2015). In Malaysia, the country's journey on sustainable development started in the 1970s when the New Economic Policy (NEP) was introduced in 1970 to eradicate poverty and restructure societal imbalance. Then, in 2009, Malaysia formulated the New Economic Model (NEM), which further cemented Malaysia's commitment to pursue sustainable development based on three pillars, namely high income, inclusivity, and sustainability, which mirror the three elements of the Sustainable Development Goals, namely social, economy, and environment (United Nation, 2017). Table 2.1 exhibits the sustainable development concepts applied in several national strategic policies.

**Table 2.1** Road to Vision 2020 and Sustainable Development in Malaysia

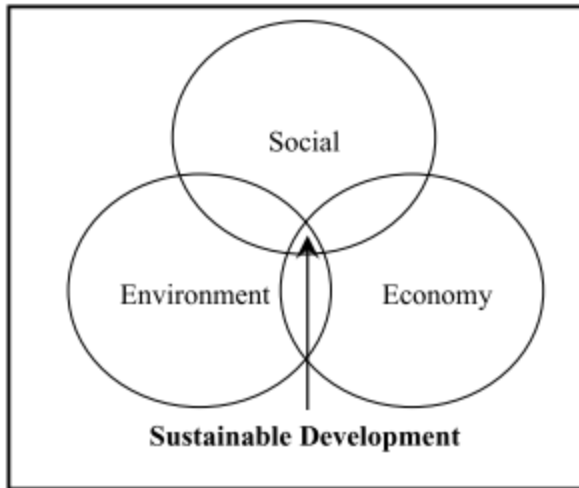
<b>Year</b>	<b>Malaysia Plan</b>	<b>Main Focus</b>
<b>1971-1990</b>	Second, Third, Fourth and Fifth Malaysian Plan	To improve Malaysia's socio-economy especially in poverty alleviation and the restructuring of society
<b>1991-2000</b>	Sixth and Seventh Malaysian Plan	To provide balanced and equitable developments in Malaysia
<b>2001-2010</b>	Eighth and Ninth Malaysian Plan	Striving to build a resilient and competitive nation to withstand domestic and global challenges
<b>2011-2020</b>	Tenth, Eleventh and Twelfth Malaysian Plan	Achieving sustainable development through sound economic, social and environmental principles and integrated practices

*Road to Vision 2020 and Sustainable Development in Malaysia*

*Source: Joseph and Taplin (2012)*

Generally, the sustainable development idea was established in 1987 in the Brundtland Commission 'Our Common Future' report by the WCED. Lee, (2006) stated that sustainable development is the most widely used and accepted definition between the practitioners and academics.

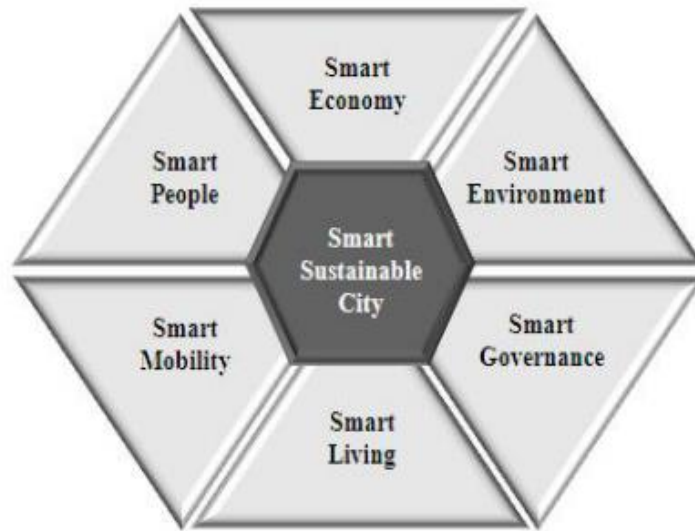
The WCED (1987) report expressed sustainable development as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs". The definition has turned into a prime definition that has been accepted by numerous publications to establish ideas, claims, and support related to findings on the subject of sustainable development (Jalil, 2010).



**Figure 2.1** The Three Pillars of Sustainable Development

A right balance between the three pillars of social, economy, and environment is the main target for every country in order to achieve perfect development (Jalil, 2010; Ibrahim et al., 2012). As displayed in Figure 2.1, the three overlapped circles usually represent the three pillars of the sustainable development concept (Giddings, Hopwood, and O'Brien, 2002). An equal size of circles in a symmetrical interconnection shows that every pillar needs to be dealt with equally in the sustainable development perspective.

This idea is supported by Al-Nasrawi et al., (2016), who asserted that the development of Smart Sustainable City (SSC) must undergo six dimensions: smart economy, smart environment, smart governance, smart living, smart mobility, and smart people (Figure 2.2), which is extended from the three pillars theory of sustainable development. Thus, the dynamic process of sustainable development will make the communities anticipate and accommodate the future generations' needs (Jalil, 2010) in the aspects that reproduce and balance the national systems (local economic, social, and ecological).



**Figure 2.2** Dimensions of a Smart Sustainable City

Generally, the main concern is developing countries always struggle with many problems related to environmental issues than those of developed ones (Najihah et al., 2013). Abu Bakar et al., (2015) contended that developing countries play bigger differences and face more serious problems with smaller resources to deal with the issue. In addition, the International Facility Management Association (IFMA) (2020) emphasised that urbanisation is putting pressure on our cities, buildings, infrastructure, and workspaces by 2050, and 66% of the world population will be urban. Besides, energy resources are also limited by 2050 (Agency, 2010), as the world will need more than 45% of energy. Furthermore, it is clear that built environment is responsible for 40% of carbon emissions (Koo & Hong, 2015 & Naess et al., 2018).

The large energy consumption in commercial buildings has attracted many agencies and governments to introduce a new policy that aims to reduce the rate of energy consumption and simultaneously enhance economic development (Shaari et al., 2013). At

the same time, energy-efficiency products and appliances improve over time (Naess et al., 2018) and technology creates a new way of life (IFMA, 2020). However, the guidelines that focus on different elements in buildings related to energy savings, resource efficiency, and environmental protection have not been widely used in Malaysia (Shaari et al., 2013).

In consequences, the European Union (EU) member states are the first agency that works seriously to improve energy efficiency and the potential of renewable energy in all sectors to tackle environmental concerns (Poel et al., 2007). Therefore, technology and guidelines for energy efficiency are expected to play the main character in meeting the EU target in accordance with the Kyoto Protocol commitments to reduce CO<sub>2</sub> emissions (Bagheri et al., 2013). In addition, it is widely accepted that human shelters are the best place to stimulate sustainable development and obviously, there is the context for the majority of human activity (Ibrahim et al., 2013).

The EU established the Energy Performance of Building Directive (EPBD) on December 16, 2002 for strengthening control the total energy consumption of buildings (Koo et al., 2014) in order to manage energy consumption in European countries (Sakina et al., 2013). Then, in 2007, the EPBD implemented a regulation that urged building purchasers or tenants to disclose energy performance certificates in the building's sale or rental process (Koo et al., 2014).

### **2.2.1 Sustainable Building**

The sustainable development concept addresses that the building sector is a well-admitted sector that has important purposes and roles. Hence, the building sector generates significant effects on the sustainable development pillars: economy, social, and environment. In general, the building sector is one of the main activities that catalysed the

economic development through the buildings and infrastructures' provision. For this reason, communities are able to live and work in an utmost conducive environment (Hargroves & Smith, 2016). However, the building sector development prevalently displays significant impacts towards environments, such as flash floods, destruction of vegetation, sedimentation and soil erosion, and pollution (Hamid & Kamar, 2012). Hashim, (2012) asserted that the building sector has a prospect in terms of executing the sustainable building practice. Therefore, sustainable building practices have a huge potential in affecting human life and encouraging communities to live in a sustainable approach through limited resource consumption. It also adds to the social capital development and reinforcing the local economy. Therefore, it illustrates that the construction industry and sustainable buildings have a direct and indirect link between them.

Furthermore, it can also be presumed that the building sector has a major role in conveying the objectives of sustainable buildings. Although the building sector is acknowledged as one of the national wealth contributors, it has always been insisted to consider the social and environmental factors during the development. This is because the building sector has been commonly identified as an industry that causes negative impacts, particularly on the social and environmental factors. Hence, the sustainable building concept was initiated with the purpose of favouring the sustainable development plan. It is believed that the building sector can play a major role and contribute a positive influence towards economic profitability, social needs, and environmental protection by adapting this concept (Lee & Burnett, 2006; Aswad & Ibrahim, 2012).

Historically, in 2002, eight nations formed the World Green Building Council (WGBC), a union of national councils whose mission is to accelerate the revolution of the