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ADOPTION OF PIEZOELECTRIC TILES AS AN
ALTERNATIVE ENERGY SOURCES: A CASE
STUDY IN KLIA 1, SEPANG

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**ADOPTION OF PIEZOELECTRIC TILES AS AN ALTERNATIVE ENERGY
SOURCES: A CASE STUDY IN KLIA 1, SEPANG**


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A project report submitted in fulfillment of the requirement for the award of
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JUNE 2015

“I declared that thesis entitle Adoption of Piezoelectric Tiles as an Alternative Energy Sources: A Case Study in KLIA 1, Sepang is the result of my own research except as cited in the references”

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DEDICATION

I lovingly dedicate this dissertation to my beloved parent, Mr. Bohari and Mrs. Sara; my supportive Supervisor, Mr. Chew Boon Cheong; and my helpful friends who supported me along the way.

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ABSTRACT

Nowadays, the extensive fossil fuel exploitation has led to some unwanted atmospheric and environmental pollution to fulfill almost all human activities for energy consumption. Moreover, the recent fluctuations on the price of petroleum have affected worldwide economics which has forced an increased in the price of all goods. Piezoelectric is a mechanism to transfer ambient vibrations into electrical energy when subjected to mechanical stress. The objectives of this study are; (1) to examine the factors that will foster piezoelectric tiles adoption as an alternative energy sources for KLIA 1, Sepang, (2) to assess the strategies for KLIA 1, Sepang in adopting piezoelectric tiles in the airport, and (3) to propose innovative suggestions to improve or enhance piezoelectric tiles adoption in KLIA 1, Sepang, after some innovative suggestions will be made to overcome the negative factors for the ease of this technology adoption. Although KLIA 1, Sepang already fostering solar energy as alternative energy source, by adopting the piezoelectric tiles there is a variation of an alternative energy sources mix in KLIA 1, Sepang in order to enhance energy efficiency. In this study, the researcher will conduct the case study in qualitative research method, which included the semi-structured questionnaires technique to investigate the factors and strategies for the adoption of piezoelectric tiles as an alternative energy source at KLIA 1, Sepang. As a conclusion, by adopting piezoelectric tiles at KLIA 1, Sepang might raise economic growth in high technology industry to positioning Malaysia as one of the advanced country in Asean region.

Keyword: KLIA 1, adoption, piezoelectric tiles, alternative energy

ABSTRAK

Pada masa kini, eksploitasi bahan api fosil yang luas telah membawa kepada beberapa pencemaran atmosfera dan alam sekitar yang tidak diingini bagi memenuhi hampir semua aktiviti manusia untuk penggunaan tenaga. Lebih-lebih lagi, turun-naik harga petroleum telah menjejaskan ekonomi di seluruh dunia yang telah menyebabkan peningkatan harga semua barang-barang. Piezoelectric adalah satu mekanisme untuk memindahkan getaran ambien (persekitaran) kepada tenaga elektrik apabila berlakunya tekanan mekanikal. Objektif kajian ini ialah; (1) untuk mengkaji faktor-faktor yang akan menggalakkan penggunaan jubin piezoelectric sebagai sumber tenaga alternatif bagi KLIA 1, Sepang, (2) untuk menilai strategi-strategi bagi KLIA 1, Sepang mengguna pakai piezoelectric jubin di lapangan terbang, dan (3) untuk mencadangkan cadangan yang inovatif bagi memperbaiki atau meningkatkan penggunaan jubin piezoelectric di KLIA 1, Sepang, selepas beberapa cadangan yang inovatif akan dibuat untuk mengatasi faktor-faktor yang negatif bagi memudahkan penggunaan teknologi ini. Walaupun KLIA 1, Sepang telah memupuk tenaga suria sebagai sumber tenaga alternatif, dengan menggunakan jubin piezoelectric dapat mempelbagaikan sumber tenaga alternatif di KLIA 1, Sepang bagi meningkatkan kecekapan tenaga. Dalam kajian ini, penyelidik akan menjalankan kajian kes dengan menggunakan kaedah penyelidikan kualitatif, termasuk teknik soal-selidik semi berstruktur bagi menyiasat faktor-faktor dan strategi penggunaan jubin piezoelectric sebagai sumber tenaga alternatif di KLIA 1, Sepang. Kesimpulannya, dengan menggunakan jubin piezoelectric di KLIA 1, Sepang mungkin meningkatkan pertumbuhan ekonomi dalam industri teknologi tinggi untuk meletakkan Malaysia sebagai salah satu negara maju di rantau Asean.

Kata Kunci: KLIA 1, adaptasi, jubin piezoelectric, tenaga alternatif

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LIST OF ABBREVIATIONS

ABBRV.	DETAIL
ACEM	Consulting Engineers Malaysia
CBA	Cost-benefit analysis
CG	Corporate Governance
CR	Corporate Responsibility
CSR	Corporate Social Responsibility
EE	Energy Efficiency
EPC	Energy Performance Contracting
ESP	Energy Savings Programme
GBI	Green Building Index
GLC	Government Link Company
GT	Green Technology
IPRs	Intellectual Property Rights
IT	Information Technology
ITA	Investment Tax Allowance
KeTTHA	Kementerian Tenaga, Teknologi Hijau dan Air
KLIA	Kuala Lumpur International Airport
Ltd.	Limited
MAHB	Malaysia Airports Holding Berhad
MEGTW	Ministry of Energy, Green Technology and Water
MOSTI	Ministry of Science, Technology and Innovation
MOSTI	Malaysia and Ministry of Science, Technology and Innovation
PAM	Pertubuhan Arkitek Malaysia
PBB	Passenger boarding bridge
PMO	Project Monitoring Office

PPP	Public Private Partnership
PQ	Power Quality
PS	Pioneer Status
R&D	Research and Development
R&D	Research and Development
RE	Renewable Energy
ROI	Return on investment
SEDA	Sustainable Energy Development Authority
SMEs	Small Medium Enterprises
SROI	Social Returns on Investment
TEMIF	Technical, Environmental, Institutional and Financial decision making model
TLC	Technology Life Cycle
TNB	Tenaga Nasional Berhad
WCM	World Class Maintenance

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CHAPTER 1

INTRODUCTION

1.1 Introduction

According to Sustainability Report of Malaysia Airport in year 2013, there are 79.5 million passengers in 2013 based on a report from Malaysia Airports Holding Berhad (MAHB). Meanwhile, high energy cost in Kuala Lumpur International Airport (KLIA) recorded at 193,548,483 kwh/year for months of January to August. Thus, as an international airport, KLIA must manage the cost of energy effectively and one of the way is by considering by using an alternatives energy sources.

Meanwhile, according to primary survey by Ministry of Science, Technology and Innovation (MOSTI), Research and Development (R&D) activities in alternative energy pioneer the green technology activities. Wind turbines and solar power are the most popular choices in renewable energy. However, the fast pace of technological changes nowadays have driven Malaysia to take a proactive step that is comparable to other developed countries. Therefore, technology adoption is important because it is the vehicle that allows most people to participate in a rapidly changing world where technology has become central to our lives.

Therefore, to differ from both main stream of alternative energy (solar and wind turbine), the researcher has chosen piezoelectric system in KLIA 1, Sepang as an alternative energy source which converts kinetic energy to electricity. According to Trimarchi (2008), piezoelectricity is an electrical energy produced from mechanical pressure (including motions such as walking). When pressure is applied to an object, a negative charge is produced on the expanded side and a positive charge on the compressed side. Once the pressure is relieved, electrical current flows across the material. It is expected that the human energy will contribute significantly in harvesting energy to produce electricity when they are passing on the piezoelectricity tiles.

1.2 Research Questions

In response to this much needed elaboration, this research introduces the notion of adopting piezoelectric tiles in KLIA 1, Sepang as an alternative method to harvest energy. Through piezoelectric adoption, KLIA 1, Sepang will benefit as a pioneer in Malaysia that implements piezoelectric tiles in energy harvesting.

If the adoption of piezoelectric tiles are successfully installed at KLIA 1, Sepang, there is a variation of an alternative energy sources mix in KLIA 1, Sepang besides solar energy in order to enhance energy efficiency. Moving forward, the next phase will be adopting it at other bull's eye location for example main shopping malls and train stations. The three questions to be answered in this research are as follows:

- i. What are the factors that will foster piezoelectric tiles adoption as an alternative energy sources for KLIA 1, Sepang?
- ii. How does KLIA 1, Sepang strategize the adoption of piezoelectric tiles in the airport?

- iii. What are the innovative suggestions in order to improve or enhance piezoelectric tiles adoption in KLIA 1, Sepang?

1.3 Research Objectives

The objective of this research is to investigate the factors that foster piezoelectric tiles adoption as an alternative energy source in KLIA 1, Sepang. This is due to it is a strategic location as the main gateways for global travellers passing through to airports. Besides, the research also assesses the strategies for KLIA 1, Sepang to adopt piezoelectric tiles in the airport to create positive and lasting impressions to all visitors. Then, there is quite a few of innovative suggestions to improve or enhance piezoelectric tiles adoption in KLIA 1, Sepang. The objectives of the study are stated as below:

- i. To examine the factors that will foster piezoelectric tiles adoption as an alternative energy sources for KLIA 1, Sepang.
- ii. To assess the strategies for KLIA 1, Sepang in adopting piezoelectric tiles in the airport.
- iii. To propose innovative suggestions to improve or enhance piezoelectric tiles adoption in KLIA 1, Sepang.

1.4 Scope

The scope of this study to adopt to piezoelectric tile as an alternative energy source for KLIA 1, Sepang. Thus, this research aims to identify the factors that foster piezoelectric tiles adoption as an alternative energy source for KLIA 1, Sepang; the strategies for KLIA 1, Sepang to adopt to piezoelectric tiles in the airport; and the

innovative suggestion to improve or enhance piezoelectric tiles adoption in KLIA 1, Sepang.

Respondents are mainly divided into two groups. First category consists of the management associates and they are managers and executives. For this category, eight respondents are selected. Management associates are those who set up the organization policies and manage the organization while second category consists of technical associates, which is engineers and six respondents are targeted. Technical associates support technical part and maintenance purposes of the organization. Both categories plays an important role to answer the interview questions.

There are several limitations occurring in the research study. First, this research is to adopt piezoelectric tiles as an alternative energy sources for KLIA 1, Sepang. Thus, the location of survey was at KLIA 1, Sepang only. Second, the researcher will assume all respondents are answering honestly. Third, this study only focuses on KLIA 1 officers.

1.5 Importance of the Study

The study will benefit KLIA 1, Sepang and indirectly to Malaysia economic growth. It is important to reduce dependency on conventional electric consumption by adopting piezoelectric tiles as an alternative energy source at KLIA 1, Sepang. Meanwhile, the purpose the researcher has chosen KLIA 1, Sepang airport for adopting piezoelectric tiles because KLIA 1 is a main gateway entrance for international visitors entering Malaysia. Indirectly, it may commercialize Malaysia comparable with developed countries that has adopted piezoelectric tiles.

Besides, this research also provides a deeper study on key factors and strategies that foster piezoelectric tiles adoption as an alternative energy source for KLIA 1, Sepang. Most importantly, this research also propose innovative suggestions to improve or enhance piezoelectric tiles adoption in KLIA 1, Sepang for their future planning purpose.

1.6 Summary

As known, Malaysia is still a developing country and new in regards to technology adoption. Thus, to align Malaysia with developed countries, the researcher has chosen a main gateway the KLIA 1, Sepang to adopt a piezoelectric tile as an alternative energy source.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discussed about the definition of technology adoption. TEMIF is a decision making model by Chew (2012) which assesses factors need to be considered in a technology adoption in Malaysian will be explain in this chapter. While, several related strategies from prior scholar literature writing are elaborated in detail to provide clear understanding in terms of strategies of the technology adoption in alternative energy sources. By the end of this chapter, the researcher will be able to conclude a theoretical framework.

2.2 Technology Adoption

According to Enos and Park (2007), adoption is the entire sequence of decisions made within the developing country determining how, when, where, and with what consequences an imported technology is to be employed. Meanwhile, Hall and Khan (2002) state technology adoption is the choice to acquire and use a new invention or innovation which usually an absorbing state, in the sense that we rarely observe a new technology being abandoned in favour of an old one. Based on both statements, the researcher have concluded that technology adoption can be defined as