

UNIVERSITI TEKNOLOGI MARA

**RELATIONSHIP
BETWEEN REFURBISHMENT
PROJECT COMPLEXITY
AND ENERGY EFFICIENCY
DESIGN PERFORMANCE THROUGH
THE MEDIATING DESIGN TEAM
ATTRIBUTES**

SITI NOR AZNIZA BINTI AHMAD SEKAK

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of the requirements for the degree of
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CONFIRMATION BY PANEL OF EXAMINERS

I certify that a panel of examiners has met on 19th April 2017 to conduct the final examination of Siti Nor Azniza Binti Ahmad Sekak on her Doctor of Philosophy thesis entitled “Relationship between Refurbishment Project Complexity and Energy Efficiency Design Performance through the Mediating Design Team Attributes” in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examiners recommends that the student be awarded the relevant degree. The panel of Examiners was as follows:

Ting Kien Hwa, PhD
Professor
Faculty of Architecture, Planning and Surveying
Universiti Teknologi MARA
(Chairman)

Zulhabri Ismail, PhD
Associate Professor
Faculty of Architecture, Planning and Surveying
Universiti Teknologi MARA
(Internal Examiner)

Azlan Shah Ali, PhD
Professor
Faculty of Built Environment
Universiti Malaya
(External Examiner)

Low Sui Pheng, PhD
Professor
National University of Singapore
(External Examiner)

**PROF. SR. DR. HAJI ABDUL HADI
HAJI NAWAWI**
Dean
Institute of Graduates Studies
Universiti Teknologi MARA
Date: 6th July 2017

ABSTRACT

There is a rising concern about energy consumption in buildings and its possible adverse impacts on the environment. This situation has made the existing building owners and designers to integrate Energy Efficiency (EE) design features into their refurbishment projects. However, the complexities of the refurbishment projects and design team attributes have been argued to be the main factors that determine the EE design performance in the refurbishment projects. Therefore, the main aim of this research is to produce a framework of energy efficient design for refurbishment projects. The research objectives are (1) to identify the extent to which energy efficiency design performance measure incorporated in refurbishment projects, (2) to determine the complexity of refurbishment projects (3) to determine the design team attributes of refurbishment projects (4) to establish the extent to which design team attributes mediate the effects of project complexity on the energy efficiency design performance of refurbishment projects. The respondents for this research are Architects, Electrical Engineers, and Mechanical Engineers. The data collection started with a pilot research on twenty-three (23) respondents and followed by online final questionnaire survey that involved 510 respondents. The response rate of the online final questionnaire survey was 29.8 percent. Exploratory Factor Analysis (EFA) was conducted to validate and refine the data collected. The Statistical Package for Social Science (SPSS) and Relative Importance Index (RII) analysis was used in the data analysis for both descriptive and inferential statistics. The overall relationships of the conceptual framework were analysed by using structural equation modeling (SEM) based on the PLS approach. The research found that refurbishment projects are generally moderately complex. The top three factors that caused the complexity are, 'matching of new material with the existing materials', 'the availability of energy efficient material databases' and 'integrating energy efficiency technology into the existing building'. The quality of the design team attributes and the energy efficiency design performance are also at moderate level. The findings also found that the design team attributes mediate the effect of refurbishment projects complexity on energy efficiency design performance. The research recommends the design team attributes, especially those related to Managerial Attributes should be improved in order to increase EE design performance of refurbishment projects.

TABLE OF CONTENTS

	Page
CONFIRMATION BY PANEL OF EXAMINERS	iii
AUTHOR'S DECLARATION	iv
ABSTRACT	v
ACKNOWLEDGEMENT	vi
TABLES OF CONTENTS	vii
LIST OF TABLES	xiii
LIST OF FIGURES	xvi
LIST OF SYMBOLS	xviii
LIST OF ABBREVIATIONS	xix
CHAPTER ONE: INTRODUCTION	
1.1 Introduction	1
1.2 Research Background	1
1.3 Problem Statement	4
1.4 Rationale for improving the Energy efficiency design performance of refurbishment projects	7
1.5 Conceptual Framework	16
1.6 Aim and Objectives of the Research	17
1.7 Research Questions	18
1.8 Scope of the research	18
1.9 limitation of the research	19
1.10 Significance of the Research	19
1.11 Research Methodology	21
1.12 The Structure of The Thesis	22
1.13 Issues, Aim and Objectives	25
1.14 Summary	26

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

This chapter presents the overall introduction of the chapters. The background of the research that includes the relevance and significance of the research is provided. The problem statements that define the aim and objectives are discussed. Subsequently, the scope, limitation and research methods of the research are also explained. This chapter also describes the flow of the research to assist the readers understand the whole structure of the research. This chapter concludes with summary of information that is provided.

1.2 RESEARCH BACKGROUND

The construction industry has been identified as a user of substantial amount of materials and energy resources that has an enormous impact on environment. The Star online (2009) reported that during the International Green Buildings Conference in Singapore (October 2009), A United Nations Environment Programme (UNEP) found that in order to achieve carbon dioxide-reduction targets, the building sector has to be taken into consideration in the plan. Moreover, most environmentalists have agreed that globally, the construction industry is one of the most important sectors that need to participate in energy efficiency (EE) development.

The rising awareness of sustainable construction's potential to positively impact environmental issues is pushing green building to the forefront. Thus, more local governments are providing permitting and financial incentives for sustainable development or adopting green building standards and regulations (Robichaud & Anantatmula, 2011). The EE improvement of building is one of the main decisions for saving primary energy and reducing greenhouse gas emissions (Schimschar, Blok, Boermans, & Hermelink, 2011). The EE plays an important aspect over the building life cycle and energy efficient refurbishment in buildings has an enormous potential for energy saving towards the reduction of greenhouse gas emissions (Asadi, da Silva,