

TECHNOLOGY MARKET INTELLIGENCE
OF PREFABRICATED MODULAR HOMES
FOR CONSTRUCTION INDUSTRY IN MALAYSIA

WAN NORSYAHIRAH BINTI WAN OMAR

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

SUPERVISOR'S
APPROVAL

'I hereby declared that I have read this thesis and this research is sufficient in terms of scope and quality. This project is submitted to Universiti Teknikal Malaysia Melaka as a requirement for completion and reward of Bachelor Degree in Technology Management (Innovation Technology) with Honours (BTMI)'

Signature :

Name of Supervisor : Madam Mislina Binti Atan @ Mohd Salleh

Date :

Signature :

Name of Panel : Dr. Mohammed Hariri Bin Bakhri

Date :

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DECLARATION

"I hereby declare that this project paper is the result of my own and independent work except the summary and experts that have been specifically acknowledgement"

Signature :

Name : Wan NorSyahirah Binti Wan Omar

Date :

DEDICATION

This paper is dedicated to everyone who have contributed directly and indirectly for my Final Year Project especially my honorable supervisor, Madam Mislina Atan Binti Atan @ Mohd Salleh who has provide full support and guidance in the preparation of this project. The special greeting for my beloved parent, Wan Omar Bin Hassan & Wan Nor Hafiza Binti Wan Hassan and for my family who always encouragement me in everything.

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ABSTRACT

The traditional methods of construction have made the proper initiative to make a paradigm shift in the prefabrication construction in order to achieve a higher standard and able to adapt global business trend. The purpose of this research are to examine the acceptance factors, to investigate the perceive advantages and to figure out the awareness of Prefabricated Modular Homes technology among construction industry players in Malaysia. Prefabricated is defined as a construction system where components are manufactured at factories or off-site, transported, and then assembled into a structure with minimum work. The term was coined to shift from the typical paradigm of prefabricated systems. Prefabricated Modular Homes has been introduced as a method with better productivity, quality and safety. In a nutshell, however the terms used in construction industrialization are ill defined, often interchangeably with other term and their precise definitions depend heavily on user's experience and understanding, which vary from country to country. The lack of uniform definition and uncertainty in context and boundary contributed to the prejudices and misunderstanding. Thus, it is hoped that the outcomes highlighted in this paper will encourage positive debate and explore the outcomes to gain attention and perception from the construction industry. The semi-structured interview was conducted with architects from Sime Darby Property and developer from Oxford Thinkers Sdn Bhd that shared their in-depth experience and expertise about the prefab technology. Conversely, it also to highlight the important role of the government and researcher in educating the construction industry players and to transform the construction industry into a modern and efficient industry. Nevertheless, the manufacturing industries need to find new source to sustain their innovation strategies in implementing the Prefabricated Modular Homes by encouraging the society especially from construction industry players.

Keyword: Prefabricated Modular Homes, Construction Industry, Encourage, Perception.

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LIST OF ABBREVIATIONS

Ringgit Malaysia	=	RM
United States	=	US
Construction Industry Development Board	=	CIDB
United Kingdom	=	UK
Industrialized Building System	=	IBS
Gross Domestic Product	=	GDP
Modern Method of Construction	=	MMC
Offsite Manufacturing	=	OSM
Jabatan Kerja Raya	=	JKR
Malaysia Construction Industry	=	MCI
Unified Theory Acceptance and Use of Technology	=	UTAUT
Research and Development	=	R & D

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CHAPTER 1

INTRODUCTION

1.1 Introduction/Background of Study

Malaysia is certified as a middle-income country which later moving toward high income country by 2020. However, currently due to the currency fails of the price for Ringgit Malaysia (RM), government take advance incentives related to 2017 budget whereby to develop affordable and sustainable low and medium cost housing project (IEM, 2016). In recent year, the modular construction methodologies for dwellings has evolved tremendously in many developed countries such as United State, United Kingdom, Australia and many more, whereby a house built literally on the concept of LEGO's. Despite the challenges, modular construction is a less costly, faster and simpler means of construction with wide applications across many construction needs that is proven to improve productivity, economically and promotes sustainability of the construction industry (Musa M.F., Mohammad M.F., Yusof, M.R. and Mahbub R, 2015).

Prefabricated Modular Homes or more familiar with the term prefab technology is one of the type for modular construction that is classified as off-site prefabrication and modern method of construction and used in developed countries due to its benefits. Modular construction was developed since the 1940's, during the World War 2 as a solution for the soldier's accommodation and after World War 2 due to the increase in housing demand in the US. Modular construction is a construction method to construct a building using three-dimensional or modular

units, which are assembled and produced in a factory. An early example of prefabrication use can be found in Britain's Great Exhibition of 1851, featuring a building called the Crystal Palace. Designed in less than two weeks, the building used light and cheap materials like iron, wood and glass. The construction period lasted only a few months and consisted of assembling the prefabricated components. After the exhibition, the palace was taken apart, piece by piece, and moved to another location (Azman., et. al., 2012). However, recent innovations after World War II over the past few decades have allowed the prefab technology to make significant advances in developing processes and materials to build and deliver more sophisticated and complex facility types (Musa M.F., Mohammad M.F., Yusof, M.R. and Mahbub R, 2015). This project research are related to modular construction whereby it constantly seeking and explore the alternative for construction methods in order to overcome problems faced by construction industry. It primarily focus on the three main objectives which is to examine the acceptance factors, investigate the perceive advantages and to figure out the awareness factor in implementing Prefabricated Modular Homes technology for construction industry in Malaysia.

Technology Market Intelligence for Prefabricated Modular Homes is the new alternative for any construction industry. The technology market intelligence means it is widely used, widely misunderstood, or often mistaken for a mysterious art requiring high-level detective work (Veugelers., et. al., 2010). It is the information relevant to a company's markets, gathered and analyzed specifically for the purpose of accurate and confident decision-making in determining market opportunity, market penetration strategy and market development metrics (Majid., et. al., 2011). Market intelligence also concerned about what happened with the competition, which business intelligence ignores altogether. As it same goes to Prefabricated Modular Homes technology that some of the construction industry still not aware about the beneficial.

Software or technology options for companies are in need of a business intelligence system that can simply help share business intelligence among units (Katherine Arline, 2015). It also designed to help a company establish a foothold in a market, or increase its presence in a market. As such, market intelligence can be obtained by a market research and intelligence company, or by an internal department that typical areas covered would be routes to market analysis, market size

calculations, competitor analysis, substitute product or service analysis, and market growth predictions that information about the external market environment (Matthew H. and Julia C., 2016). Thus, Technology Market Intelligence is to provide decision makers with a more complete picture of ongoing corporate performance in a set of given market conditions.

The prefab technology have made recent strides to architects, contractors and developers in finding new applications for the technology beyond the single family house to towers whereby it can be constructed from modular units and prefabricated components (Muhamad Faiz M et. al., 2016). Apart from that, this technology also can be choose from many variety of home designs that can be selected according to desired productivity, style and requirements, and it will be built in twenty days, deliver and installed in 3 hours. Moreover, it is build with single storey to three storeys, with one to four bed whereby it is customizable to client's need (Oxford Thinker Sdn Bhd, 2017). Even though it is under the climate-controlled environment, the projects can be built with zero weather-related delays. In addition to that, the quality of the work to be done can be determined as it uses precision engineering in all the supplier ventures which by making sure that every corner is adequate in every aspect (IBS Roadmap, 2010).

In addition, prefab technology provides quality building, efficiency, sustainability, capability and speeds up in the schedule. The personnel work is in shifts whereas this is in order to enhance and maximize the output and productivity. Thus, producing quality homes can be built and complete within immediate periods. As the eco-surroundings are highly prioritized throughout the process, it can be ensure that the waste produced is at minimum by recycling the remnant and with huge quality work under a small quantity of time (Faludi., et. al., 2012). With less manpower consumption for the same end product and construction wastes kept to a minimum, modular construction translates to better sustainability for the environment.

Last but not least, nowadays, it is believe that Malaysia is ready to shift beyond conventional brick and mortar construction methods in order to promote innovation construction in Malaysian construction industry, the Malaysian government and Construction Industry Development Board (CIDB) introduced plans

and policies to encourage the implementation and highlighted the importance to sustainability for Malaysian construction industry (Mohammad M.F, 2013). At the same time, the construction process at this moment is become vital due to the issues such as cost overruns, labour shortage, low quality workmanship, low productivity, increasing in construction cost, poor quality workmanship and delay caused by adverse weather. Thus, I believe that this prefab technology of the dry construction method has a winning edge over the current work.

1.2 Problem Statements

In this globalization world, the construction process create many issues due to increasing in construction cost, poor quality on site workmanship and delay caused by adverse weather. Thus, the technology of prefab technology is the answer to industry problem (Oxford Thinkers Sdn Bhd, 2017). With the announcement of the 8th Malaysia Plan, the country has embarked on the development of affordable and sustainable low and medium cost housing. However, the country faced uphill task to accomplish the target of 600,000-800,000 numbers of houses during those period because the conventional building system was practiced by the construction industry unable to cope with the huge demand (IEM 2015). Therefore, the industry must find an alternative solution such as this prefab technology which has immense inherent advantages in term of productivity, indoor quality, durability and cost.

Apart from that, the evolution of construction methods and materials are primarily caused by the increase in labour cost, scarcity of skilled labour due to labour shortage, low productivity rate due to substandard quality of workmanship, work delay due to poor weather and abundance of construction waste. The proportion of foreign to local workers also differs considerably through these stages because of different skills required to accomplish the task and whereas Malaysia, the number of legal foreign workers for the construction sector were 30.2 percent out of a total of 1.36 million in 2015 (The STARS, 2015). Therefore, yield number related to the demand and pushing labour cost to high levels record. However, fully prefabricated construction system requires high construction precision. Our labour forces still lack

of skilled workers. Many of foreign skilled workers had left the country for the better city thus the new batches of foreign workers do not possess the required skills. Therefore, by implementing this prefab technology will be significance in term of competitiveness advantage and has become a new trend in order to solve the housing problem and meet the demand for affordable homes especially in big cities with limited space for development area especially for construction industry.

Furthermore, with reference to the two pilot projects of modular construction along Jalan Pekeliling, Kuala Lumpur and Pulau Pinang back then in 1984, a performance comparison with the traditional construction has been carried in terms of cost, productivity and quality. It was discovered that the quality of building finishes was found better than the traditional construction method (W.A. Thanoon, et. al., 2003). These indicate that the performance of prefab technology is a competitive and ever since is more profound with the participation of private sector and public sector such as Housing Research Centre in Universiti Putra Malaysia that aimed at promoting and developing novel building system. Malaysia's produced system only account about 12% compared to other country. These indicate that there is a considerable room for improvement in the area of research and development in construction industry. Up to 65% of user respondents indicated that the use of prefabrication had a positive impact on project budgets, with 41% indicating that it reduced project budgets by 6% or more (McGraw-Hill Construction, 2011).

Last but not least, due to lack of incentive and promotion from government in the use of modular construction leads many architects, developers and contractors to still unaware of the basic element and advantages of prefab technology can achieve. The economic benefits of it are yet not well documented in Malaysia. Past experience indicated that modular construction is more expensive due to fierce competition from traditional construction system due to lack of knowledge (Veugelers, et. al., 2010). This project objectives associated to prefab technology is hoped to explore the solving problem statement stated which can ease the construction industry in a lot of recompense way. Additional to that, this project able to be a new solution for the developers and architects in Malaysia whereas it will give the alternative by cutting the cost and gives many beneficial for the construction industry. As well as, it will help identifying the factors that encourage the construction industry to utilize the prefab technology.

1.2.1 Research Objectives

The prefabricated housing innovations have the possible to reduce the environment impact of construction through improving efficiency and quality. It also has been used extensively in many developed countries to provide low cost housing. The objective of this research is mainly focused on topic related to the utilization of construction process which is Prefabricated Modular Homes technology. The main research objectives are as follows:

- i. To examine the acceptance factors of Prefabricated Modular Homes technology among developers and architects.
- ii. To investigate the perceive advantages obtained by construction industry by implementing the Prefabricated Modular Homes.
- iii. To figure out the awareness of Prefabricated Modular Homes among developers and architects players in construction industry.

1.3 Research Questions

Malaysia nowadays is holding a key role in achieving knowledge-based economy to stimulate innovation in the creative industries. Technology Market Intelligence of Prefabricated Modular Homes is one of the strategies need to implement at all construction industries in Malaysia. Construction industries needs to adopt new source of technology to help government in generate high income towards achieving 2020. Based on the reason above, the research question for the study area are as follows:

1. What are the acceptance factors of Prefabricated Modular Homes technology among developers and architects?
2. What are the perceive advantages obtained by construction industry by implementing the Prefabricated Modular Homes?
3. What are the awareness of Prefabricated Modular Homes among developers and architects players in construction industry?

1.4 Scope, Limitation and Key Assumption of the Study

1.4.1 Scope

The scope is primarily targeted the construction industry especially architects and developers as they are the most suitable and expert respondents for this Prefabricated Modular Homes technology theory and understanding compared with other field. Other than that, there are 5 respondents which have an adequate knowledge as part for the primary data collection and they are more experience in answering this research topic where he/she can provide most justifiable answer. Architects generally understand and educate clients on the benefits of prefabrication and modularization whereas architect has the greatest influence during the design phase in determining if prefab technology construction will be used in the project. Almost 15% of users report that saving time and improving quality was their primary motivation for doing model-driven prefabrication that is particularly important reasons for architects (McGraw-Hill Construction, 2011).

Meanwhile as for developers themselves, they consider as supplier in prefab technology implementation processes on the projects. Developer demand is the primary driver for architects to include prefabrication/modular construction into the project design. Some of the developers firm today shift their construction process by using prefab technology of modular elements for the building and the view they used as a way to differentiate themselves from their competition. Up to 17% of users indicated that saving money was the primary reasons of doing prefab technology whereas it is the important reasons for developers (McGraw-Hill Construction, 2011). Plus, this is also to adopt for competitive reasons in which prefab technology has become an integral part of their businesses.

1.4.2 Limitation

The limitation is always a barrier in implementing the research. For this research topic, there is only two main limitation that raised with the scope mentioned whereby the respondents is merely focused and limited to the architects and developers from both Sime Darby Property and Oxford Thinker Sdn respectively only. Thus, it certainly will create barriers when the respondents are not collaborate well. Apart from that, the second limitation is that most of the architects as refers to previous case study is that they prefer to use labour traditional construction system because it is far easier to lay off workers during slack period. Thus, the owners, architects and developers may lack of scientific information about the economic benefits of prefab technology can bring to the marketplace. This construction industry is so fragmented, diverse and involves many parties. These causes the industry players still unaware of the basic element of the modular construction especially the prefab technology system can achieve. Additionally, this prefab technology is still new for some of construction industry and they might lack of awareness and knowledge about it. Among all players, the primary reason they are not using prefabricated on some or all of their projects is that the architects did not design it into their project (McGraw-Hill Construction, 2011).

1.4.3 Key Assumption

The result acquired from this research could be used by helping the construction industry manage to overcome problems faced with the traditional construction methodology. It will eventually help exploring for the estimating labour input, control costs, cycle time and project scheduling as this prefabricated construction is faster than traditional construction. Additionally, they could be used to also determine the most appropriate construction system for executing a construction project at the conceptual stage. It therefore has the highest potential for productivity improvement and reduction in foreign workers.

In the end of this research, it is hoped that the acceptance, perceive advantages and awareness of the prefab technology will increase and gaining positive debates among industry players in Malaysia. The prefab technology construction is processes that have been used by generations of construction professionals. Over the past century, these processes have developed a stigma of cheapness and poor quality. However, through modern technology, that image has changed. Now, it is a key component of the drive to improve construction industry productivity (McGraw-Hill Construction, 2011).

1.5 Importance of the Study

The experience in some of the developing countries likewise Japan, Australia, UK and US indicate that there are a potential for the modular construction to progress as the evidenced of their growing of the market share (W.A. Thanoon, et. al., 2003). Indeed, the successful of prefab technology in those countries is prompted by concern of the home buyers that certainly about long term energy saving, indoor air quality, and other health and comfort related issues, and commitment of houses developers toward greater technological advancement and innovation. Clearly, if Malaysia wishes to imitate the successfulness of those countries, a long term comprehensive policy towards the industrialization of building and construction sector should be pursued.

Moreover, labour usage represents one of the critical elements in Malaysia construction industry due to severe shortage of local workers as they are skilled one. The industry relies heavily on the foreign workers from Indonesia, Bangladesh, Thailand and Vietnam which can precipitate economic and social problems. The government normally takes them as they can be paid as a low rate. Due to the labour productivity, structural cost, crew size, cycle time and workers daily salary could help project planners especially architect and developer to estimate labour input, control cost and project scheduling. Besides, they could be used by policy makers to determine the most appropriate structural building system for executing a construction project in the future.