COMPARATIVE STUDY BETWEEN CUSTOMER AND DEVELOPER ACCEPTANCE OF MODULAR CONSTRUCTION SYSTEM

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There are several advantages of a modular construction system that both developers and customers of housing estates can benefit from. However, such a system has not yet been as well adopted as it should be to suit Thailand’s housing industry. This research surveyed and analyzed opinions regarding the acceptance of a modular construction system from a questionnaire survey of 100 potential customers. The acquired data were analyzed using descriptive statistics and Chi-squared analysis. The results from the questionnaire survey were then compared with the real estate developers’ opinions from a former research study, and conclusions could be drawn. The results showed that the customers give precedence to three key factors, e.g., construction duration, on-time delivery and price of residence. In addition, customers who pay higher prices for their houses are more concerned about the developers having a good reputation. However, if the developers cannot control the construction cost and it becomes too high, such a situation will lead to a higher selling price compared to conventionally constructed houses. The process of modular construction is also faster than the required house delivery rate. These troubles seem to prevent developers from adopting a modular construction system into their projects. This research’s findings highlight the obstacles and limitations to developers, as well as providing information needed for seizing the advantages of such a system in countries with labor-intensive construction industries, like Thailand.

Keywords: Modular system, Construction system, Housing estate, Technology acceptance, Construction industry.

1 INTRODUCTION

Thailand is an important hub for modular construction systems with many manufacturers and exporters (Department of Business Development 2016). However, Thailand’s market itself is not very responsive to modular systems. It is more often used for temporary offices or smaller buildings such as house extensions and resorts, or temporary accommodation. From the researcher’s former study about the real estate developers’ opinions on the implementation of a modular system, the findings suggested that such a system is suitable for projects that require high construction speed. For example, some projects such as condominiums can benefit from expeditious construction because the buildings must be completed before the developers can obtain the Certificate of Building Construction, Modification or Relocation Form to be able to
transfer the ownership in the following step (Theerapatrathamrong, et al. 2017). However, that study did not cover the customers’ opinions, which is one key factor to the success of the business (Medlin 2004, Nallathiga et al., 2012).

From the mentioned reasons, the research’s objective was to study the factors that affect the acceptance of a modular construction system among the customers of housing estate projects, which take up the majority of Thailand’s construction industry, especially when the Covid-19 pandemic struck during the year 2020-2021 (Pornchokchai 2021). In 2021, the Real Estate Information Center estimated that there would be 53,693 new residential units added into the market, along with 171,283 units already announced for sale. The scope of this research aims to study the customers of housing estates in the Bangkok Metropolitan area (Thailand’s capital and its surrounding provinces, e.g., Nakhon Pathom, Pathum Thani, Nonthaburi, Samut Prakan and Samut Sakhon), which is the main area for housing estate development in Thailand. The results of this survey will be co-analyzed with those from a former study about factors related to the developers in the Bangkok Metropolitan area, to conclude the obstacles, opportunities and suggestions for the implementation of a modular construction system, to give advantages for both developers and customers of housing estates.

2 RELEVANT LITERATURE

2.1 Advantages of Modular Construction System

There are several pieces of literature citing the advantages of modular construction systems compared to other conventional construction methods. It can be summarized that modular construction systems are outstanding due to their various advantages (Rogan et al. 2000). Those good points include (1) less construction time, (2) better quality and safety, (3) less cost, (4) less effects on the environment, (5) lighter weight so it is easier for the extension of buildings and (6) fewer workmen required on site.

2.2 Acceptance of Modular Construction System by Developers in Thailand

Theerapatrathamrong et al. (2017) analyzed interviews with the executives of five companies about the implementation of a modular construction system in the housing estates industry. The interviewees were asked about their perceptions of the advantages and the limitations, as well as the reasons that supported and obstructed the use of a system in their projects. The researchers found that some of the interviewees agreed that this system is more suitable for big projects that require high construction speed, such as condominiums, because the construction must be completed before the developers can acquire the Certificate of Building Construction, Modification or Relocation Form to be able to transfer the ownership to the customers.

Apart from that, the advantage of fewer laborers is another factor for the acceptance of the system not yet considered. Although many interviewees were confident in their employees’ capability in the current construction system, as well as their potential to learn and improve new skills, some were still worried about the unpopularity and knowledge of the modular system being too few and too new for Thailand’s real estate development industry. They feared that it would be complicated to find enough true experts who can really work for them and systematize or coach others in the company.
3 METHODOLOGY

This research was quantitative research, which was done by acquiring information from the customers of housing estates in the Bangkok Metropolitan area using 100 questionnaires, which were tested of their reliability and content validity by finding the Cronbach’s Alpha Coefficient of the Index of Item-Objective Congruence (IOC) of the questions (Cronbach 1951, Rovinelli and Hambleton 1977). The respondents were asked about (1) their basic personal data, such as gender, education, occupation and income, (2) their residence, such as type, price range and location and (3) their acceptance of the factors collected from the literature review, evaluated by a Likert Scale. The outcome of the research was then analyzed using descriptive statistics, and the interpretation of the average results was according to Best (1977), and Chi-squared analysis (Pearson 1900). The acquired main factors influencing the acceptance of the customers were then compared with a study that focused on the developers’ opinions upon the same subject from Theerapatrathamrong et al. (2017).

After retrieving the factors affecting the acceptance of the modular construction system from both concerned parties, the researcher used these factors to consider the obstacles and opportunities to implement a modular construction system, as well as suggestions and further information for those who are involved.

4 RESULTS

4.1 Opinions of Customers of Housing Estates

The questionnaires used in the research had a Cronbach’s Alpha Coefficient of 0.643 and the Index of Item-Objective Congruence (IOC) of the questions were more than 0.5, which are acceptable (Tochaiwat, 2021; Panthai, 1996). From the questionnaire survey, the authors can conclude as follows:

4.1.1 General information of respondents

The majority of the respondents were female (56.00%), who had a bachelor’s degree (60.00%), worked for private companies (55.00%), earned not more than $1,345 before tax per month (52%) and most were 30-39 years of age (59.00%). The ratio of the respondents who were interested in buying from different types and price ranges of housing estates is shown in Figure 1.

Figure 1 indicates that the majority of the respondents were most interested in buying detached houses (68.00%), with the price range from $59,779 - $149,446 (66.00%) and situated in the Bangkok area (64.00%). It should be noted that the currency used in this research is converted from Thai Baht to US Dollar, with reference to the currency exchange rate of the Bank of Thailand (2021) on October 18, 2021, which was 1 US Dollar = 33.457 Baht.

4.1.2 Factors affecting acceptance of housing estates built using modular system

The respondents in Figure 1 prioritized each factor that affects the acceptance of housing estates built using the modular system, as summarized in Table 1.

Table 1, which provides information affecting housing estates built using a modular system, according to potential customers, suggests that the three most important factors are the construction and delivery duration, the strength and stability of the house and the price. There are also five other important factors that customers take into consideration, including the developer’s reputation and experience, the eco-friendliness of the project, the variety of house plans and the
ability to adapt or extend the house afterwards. A factor that is considered only moderately important, is the developer’s registered capital.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Mean</th>
<th>S.D.</th>
<th>Level of importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Strength and stability of the house</td>
<td>4.84</td>
<td>0.42</td>
<td>Most important</td>
</tr>
<tr>
<td>2. Price of the house</td>
<td>4.47</td>
<td>0.66</td>
<td>Most important</td>
</tr>
<tr>
<td>3. Construction and delivery duration</td>
<td>4.24</td>
<td>0.82</td>
<td>Most important</td>
</tr>
<tr>
<td>4. Developer’s reputation</td>
<td>4.12</td>
<td>0.74</td>
<td>Important</td>
</tr>
<tr>
<td>5. Ability to adapt or extend the house</td>
<td>4.08</td>
<td>0.88</td>
<td>Important</td>
</tr>
<tr>
<td>Afterwards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Developer’s experiences</td>
<td>4.00</td>
<td>0.80</td>
<td>Important</td>
</tr>
<tr>
<td>7. Eco-friendliness of the construction process</td>
<td>3.97</td>
<td>0.97</td>
<td>Important</td>
</tr>
<tr>
<td>8. Variety of house plans</td>
<td>3.70</td>
<td>0.96</td>
<td>Important</td>
</tr>
<tr>
<td>9. Developer’s registered capital</td>
<td>3.19</td>
<td>0.92</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

4.1.3 Influence of different types and prices of housing estates that affect acceptance of projects built using modular system

From the analysis of the relationship between different types and prices of housing estates, comparing with the factors affecting the acceptance of housing estates that are built using a modular system by Chi-squared analysis, the results are shown in Table 2.

The results of the Chi-squared analysis showed that overall, the customers who were interested in different types and prices of housing estates in Bangkok and its vicinity have no significant difference of opinion about the factors that affect the acceptance of the projects built using a modular system. The only factor that relates to the price of the housing estate is the developer’s good reputation. All in all, if the projects are in the higher price range, the customers tend to be more concerned about the company’s fame.

5 FINDINGS

When the authors considered the outcome of the data analysis of this research and that of Theerapattrathamrong et al. (2017), which is a study about the opinions of real estate developers in Thailand, it can be concluded as follows:

1) When making a decision to accept a housing project built using a modular system, the customers give the most priority to “the construction and delivery duration”, “price” and “strength and stability of the houses”, while the developers agree that the implementation of a
modular construction system will promote better quality, strength as well as stability of the residence, as mentioned in Theerapatrathamrong et al (2017). However, Thai developers still assess that such a system does not necessarily help reduce the project prices (since it requires even higher construction cost). This point differs from the study of Rogan et al. (2000), which, on the contrary, cites that applying the modular construction system will help cut the construction cost. That is probably because of the low wage paid to laborers in Thailand ($9.89 per day), compared to that in the UK ($92.423 per day), which is the country of origin of the mentioned research (Ministry of Labour 2020, VoiceTV 2021).

Table 2. Relation between different types, locations and prices of housing estates comparing with factors affecting acceptance of housing estates built using a modular system.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Types</th>
<th>Location</th>
<th>Price range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Strength and stability of the house</td>
<td>8.48</td>
<td>0.08</td>
<td>1.29 0.52</td>
</tr>
<tr>
<td>2. Price of the house</td>
<td>1.73</td>
<td>0.94</td>
<td>5.82 0.12</td>
</tr>
<tr>
<td>3. Construction and delivery duration</td>
<td>9.72</td>
<td>0.29</td>
<td>3.04 0.55</td>
</tr>
<tr>
<td>4. Developer’s reputation</td>
<td>3.80</td>
<td>0.43</td>
<td>1.72 0.42</td>
</tr>
<tr>
<td>5. Ability to adapt or extend the house Afterwards</td>
<td>9.74</td>
<td>0.14</td>
<td>0.78 0.85</td>
</tr>
<tr>
<td>6. Developer’s experiences</td>
<td>11.03</td>
<td>0.09</td>
<td>3.23 0.36</td>
</tr>
<tr>
<td>7. Eco-friendliness of the construction process</td>
<td>3.96</td>
<td>0.86</td>
<td>4.25 0.37</td>
</tr>
<tr>
<td>8. Variety of house plans</td>
<td>6.89</td>
<td>0.55</td>
<td>1.93 0.75</td>
</tr>
<tr>
<td>9. Developer’s registered capital</td>
<td>9.76</td>
<td>0.28</td>
<td>2.64 0.62</td>
</tr>
</tbody>
</table>

Note: * Factors were correlated at the 0.05 level of significance.

2) For the matter of the construction duration, as most housing estates in Thailand simultaneously do the construction work at the same time as proceeding with sales, and the customers are more concerned about the on-time delivery as stated in the contract than fast construction. Moreover, the developers point out that the fast construction of the modular system is actually not necessary, since the housing estate business needs to focus more on the balance between the construction and the sale rates (Tochaiwat 2020).

6 CONCLUSION

The factors leading to the acceptance of a modular construction system between housing estate developers and customers are partially different. The customers who reside in the housing estates are concerned about three factors, which are the construction duration, the strength and the price. These concerns correlate with only one of the developers’ opinions on the matter of the strength. On the other hand, the developers consider that such prompt construction is not necessary for the business as it may lead to the risk of the construction rate outpacing the sales. For the pricing aspect, the developers are concerned about the rising construction cost, which will consequently result in the prices being too high. As Thai laborers receive a low-wage compared to those in the US or Europe, the modular construction system is not yet as popular as it should be in Thailand.

For those who seek to continue further study on this matter, the results of this research can definitely be used as a reference. The researchers recommend further research on topics that will benefit the adoption of a modular construction system, such as an analysis of the minimum construction rate suitable for the adoption of a modular construction system in housing estate development projects or other types of construction.
References


Pearson, K. (1900). X. On the criterion that a given system of deviations from the probable in the case of a correlated system of variables is such that it can be reasonably supposed to have arisen from random sampling. The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science, 50(302): 157–175.


