Prefabricated house in real estate business development in Jabodetabek

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Abstract. Within constructional technology prefabricated house is known as a house whose most of the components like walls, roofs, toilets, and structural cubes and columns are designated and produced in factory and assembled in site. Based on the experience in certain countries, prefabricated house has successfully entered commercial market. Prefabricated house shows a better infestation value than conventional houses. With prefabrication technology, building construction could be done faster and cost lower price, along with a good craftsmanship quality. Until now, Indonesia is still facing settlements issues and one of them is housing backlog whose amount revolves around 13 Million units. Prefabricated houses potentially solve the settlement issue in Indonesia in a much faster way. Yet the development of prefabricated house has not been accepted well in the market yet, both by the producers and the consumers. This writing talks about the result of the research about the causes of the lack of development in Indonesia when it comes to prefabricated houses though the method of comparison; comparing prefabricated house with conventional house when it comes to its 1) productivity rate, 2) consumers preference and 3) infestation performance. The data is collected through survey methods, interview and questionnaires. The result shows that even though the productivity rate when it comes to quality and time is high, prefabricated house shows low productivity when it comes to cost because it requires greater cost than it is in conventional houses. Other than that, the lack of business development when it comes to prefabricated houses is caused by the low preference of consumers toward the product - because of its inflexibility and monotonous appearance. The infestation of prefabricated house development shows a low NPV and IRR. With a more proper infestation approach such as mass constructions with effective numbers, good flexibility, and various appearances, prefabricated house could have a chance to be accepted in real estate commercial market in Indonesia especially in Jabodetabek.

Keywords: Property, Real Estate, Prefabricated House

1. Introduction

Prefabricated house is a house whose most of its elements (such as walls, roof, bathrooms, and structural elements) are designated and produced in factory and assembled in site [1]. Through the offsite prefabrication technology, the house construction tends to be faster and cheaper that it decreases the duration of construction and presses the cost. Based on Smith (2010) as a collective cost, the construction basic cost per unit whose system is modular might be more expensive compared to on-site built products. If so, this additional cost should be considered along with its shortened duration and quality increase [2].

In a lot of countries, business development of prefabricated houses show a really good infestation value, better than it is to conventional ones. Research by Sri Velemati found that savings resulted from the cost and items related to prefabricated house in America results and increase in NPV by 3,485 and IRR 1.56%. In Indonesia, preferences of prefabricated houses are still limited to several purposes such as worker mass settlements, temporary offices or houses for disaster casualties. The development of
prefabricated houses nowadays has not been accepted yet by real estate commercial market in Indonesia, both by the producers and consumers.

Indonesia is currently facing proper settlements issue especially for the middle to lower class people. Up until now, Indonesia is still shadowed by housing backlog issue whose number revolves around 13 million units. Prefabricated houses development in commercial market could have been one of the solutions addressing the settlement issue in Indonesia, yet the prefabricated house development has not yet been accepted in the market, both by the producers and the consumers.

Looking for the causes of the lack of business development of a product could be treasured through three things, which are (1) productivity rate of product construction, (2) Preference rank of the consumers toward the product, and (3) the level of product infestation profit. In the world of construction, productivity level is an output performance of a constructional activity related to three main indicators which are cost, quality and time (Ir. Iman Soeharto, 1999). Consumers preference is a behavior of consumer towards a choice of product formed by evaluations of variety of choices available. Consumer’s wants to purchase a product is basically influenced by a lot of factors that relate to each other that it creates certain pattern as long as the pattern of wants of consumers when it comes to purchasing a house, which are: (1) Knowledge : level of how well the consumers understand the product whether it is a thing or a service; (2) Liking : level of wants of the consumers toward the product available; (3) Preference : the choice of consumers toward a product compared other products available; and (4) Conviction/intention : the will to buy- how much the consumers are willing to purchase the products (Kotler dan Keller, 2009). Temporarily, the level of profit of property business could be known through the infestation simulation to know the value of NPV and IRR. NPV is a difference between spending and income after the discount using social opportunity cost of capital as discount factor, or in other words, a cash flow predicted in the future, while IRR is an indicator of efficiency level of an infestation. (Suratman, 2001)

2. Method
Looking for a cause of the lack in prefabricated house business development in Jabodetabek could be found through three steps such as (1) measuring productivity level of prefabricated house construction in Jabodetabek, (2) conducting a research on consumers preference toward prefabricated house in Jabodetabek, and (3) calculating the value of NPV and IRR through infestation simulation of prefabricated house development in Jabodetabek.

Measuring the productivity level of prefabricated house construction is done through assessments using table of productivity level calculation that covers three aspects (cost, quality and time) which consist of 11 indicators overall. Assessment is done by giving scores to each indicator following 1 (lowest scale) up to 5 (highest scale). The assessment of productivity level of prefabricated house construction is done towards three products of prefabricated houses that have been developed by some producers in Indonesia such as (1) Rumah Instan WIKA Beton, (2) Rumah Prefab BBI, dan(3) Rumah RISHA. The technical data of these three prefabricated houses is conducted through survey and direct interviews with the involved producers. As a comparison tool, the productivity level of conventional house construction is also measured. Both prefabricated and conventional houses are assumed to effectively have area of 36m$^2$.

Preference research is conducted by spreading questionnaire consisting of eight questions related to four aspects such as knowledge, liking, preference and conviction of consumers. The questions within the questionnaire are both confidential and open in a way that every question is provided several options of answers yet also provided with empty space for respondents in case they have additional answer, reason or information. The questionnaire is spread randomly using google.doc online. Around 42 respondents filled the questionnaires and gave them back. To complete or confirm the responses of these consumers, another interviews were also done to developers.

Measuring the profit level in business development infestation of prefabricated house in Jabodetabek is done through simulation of business infestation measurement of prefabricated house by finding its NPV and IRR. Within this simulation, primary data are used especially those that are
factual, conducted from direct field survey (such as volumes, unit price, etc) so a realistic result is expected.

3. Discussion

3.1. Aces increases the productivity of prefabricated house construction.

The result of assessment shows that generally the productivity level of prefabricated house development is higher than the conventional one. Prefabricated house shows the excellence in two criteria which is time and quality, but it is weak on cost aspect (see Table 1)

| Table 1. Development of prefabrication and convention house productivity level result |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| Variabel                        | Rumah Instan - Wika Beton | BBI Prefab - PT Bakrie | Risha | Conventional House |
| Materials (m2)                  | Wall | Structure | Roof | Accessories | Fabrication | Assembly |
| Cost (Rp. m2)                   | 3,300,000,-/m2 | 3,000,000,-/m2 | 2,400,000,-/m2 | 2,700,000,-/m2 |
| Transportation                  | Average /m2 | Rp | 2,900,000,00 | Rp | 2,700,000,00 |
| Value                           | 3 | 3 | 5 | 4 |
| Materials                       | Wall | hollowcore Panel K-350 | Sandwich panel | Concrete | Hebel |
| Value                           | 5 | 5 | 5 | 1 |
| Structure                       | Concrete Precast K-350 | Galvanized metal | Concrete Precast K-225 | Concrete K-125 |
| Value                           | 5 | 1 | 3 | 2 |
| Roof                            | Galvanized Metal Frame + Concrete roof | Galvanized Metal Frame + Harflex Strap | Galvanized Metal Frame + Zincalume | Galvanized Metal Frame + Concrete Roof |
| Value                           | 3 | 2 | 3 | 3 |
| Design                          | Limited | Limited | Limited | Unlimited |
| Value                           | 1 | 1 | 1 | 2 |
| Flexibility                     | Module | Column & Beam 3m, Wall 0.6x2.2m | Column & Beam 3m, Wall 1x3m | Module 1,5m |
| Value                           | 1 | 4 | 4 | 5 |
| Portability                     | Structure Component | Material Component | Material Component | No |
| Value                           | 4 | 5 | 5 | 1 |
| Construction Technology         | Concrete System | Screw System | Knockdown with bolt | In situ |
| Value                           | 1 | 4 | 5 | 1 |
| Durability                      | Designed with SNI Earthquake of 2012, with Normal scale Earthquake risk up to zone 6 |
| Value                           | 5 | 3 | 5 | 1 |
| Workmanship                     | Fabrication | Fabrication | Fabrication | Mantal |
| Value                           | 5 | 5 | 5 | 1 |
| Time Schedule                   | Fabrication 4 weeks | Fabrication 4 weeks | Fabrication 4 weeks | Mantal |
| Value                           | 2 | 2 | 2 | 1 |
| Assembly 1 weeks |
| Value                           | 2 | 2 | 2 | 1 |
On the cost aspect, an average of prefab house production is more expensive 6.8% or Rp.200,000./m² than the conventional house. One the cause of the high cost of prefabricated house is quality of material that is better than the conventional one. For example, wall material for all prefabricated house is concrete. BBI- prefab is using sandwich panel, Wika concrete is using hollow core concrete panel with K-350 quality, and RISHA is using a standard concrete. Meanwhile, the wall conventional house is made by brick and plastered concrete. For building structure, WIKA concrete prefabricated house is using cast assembly method; meanwhile RISHA is using concrete with bolt connection system. From three prefabricated house types, RISHA house is cheaper and even than the conventional house. It does not mean this house with low quality material but because the fabricated method of this house is developed by government with non-profit goals. Big costs of this prefabricated house are caused by another cost on fabrication stage in workshop, transportation to development location and assemble cost on site.

Most of construction quality (workmanship) for prefabricated house is better than conventional house. It is because of its material and it’s produce in factory so it has an accurate, precise and neat product. The prefabricated house that is developed by house producer in Indonesia has a limitation on design, it is because the prefabricated house is focused on time efficiency and decreasing construction fee. Design aspect on three prefabricated house products have a monotone design. It affects on preference level on prefabricated house that is lower than the conventional one.

In durability aspect and workmanship for prefabricated house shows, that level of productivity is higher than the conventional house. Most of prefabricated house in Jabodetabek is planned for earthquake resistant design to zone 6. WIKA concrete instant house is designed based on earthquake SNI 2012, with 1000 years earthquake condition. Prefabricated house workmanship is more excellent than the conventional house because by this off-site fabricated produced a good product, more precise and less waste construction than on site construction system.

By the time aspect, prefab house development is faster than conventional prefab house in Jabodetabek, that it produce about 3-4weeks for assembling time in project location for type 36 house that is only needed 7 days, it is faster than conventional house that is need about 2 months. According to the producer of WIKA concrete prefab house and Bakrie, it only need about 7 days for 1 unit of house, because it is more easier to be done and several item job will be done in parallel, not sequential. Besides that if, the prefabricated house is in mass production so that time efficiency can be produce by fabrication in factory and construction on site can be done parallel.

Previous study in Gradute School of Clemson University by Lu Na in 2000 in USA reveals that the advantage of using the prefabricated component is to reduce the construction time and efficiency time, increasing building quality and quality of execution and labor productivity [3]. One thing that also found on prefabricated house in Jabodetabek is the higher productivity on time and quality than in conventional house. Kullman added that time efficiency on construction is about 50-70% if the construction is done in factory rather than on site [4].

On Mc Graw-Hill Construction’s Survey, the material efficiency and time efficiency give an impact for project’s budget efficiency [5]. 65% of the company who uses prefab/modularization method reported that they could lower project budget into 6% or more. This is not happened on prefabricated house product in Jabodetabek. The cost of prefabricated house production in Jabodetabek is still more expensive than the conventional house

3.2. Consumer’s preference study on prefabricated house in Jabodetabek

Four aspects such as knowledge, liking, preference and conviction did consumer’s preference study on prefabricated house, by the questionnaire random distribution that is done by google.com survey application. 43 respondents have already filled in the questionnaire. This study shows that the low result on consumer’s preference level on prefabricated house in Jabodetabek, especially with some aspects such as knowledge, preference and conviction, but it is quite high on liking factor.
• **Knowledge**

![Knowledge Pie Chart]

Do you know prefabricated house?

**Figure 1.** Result of consumer questionnaire on knowledge of prefabricated house.
A low level of recognition of prefabricated house in Jabodetabek, 47% respondents has already heard about prefab house but they are not really know it well, 38% has already known it and only 15% haven't known it at all. The society has not known well much about prefabricated house because the lack of information about prefabricated house in Indonesia.

• **Liking**

![Liking Pie Chart]

Are interested on prefabricated house?

**Figure 2.** Result of consumer questionnaire on liking of prefabricated house.
Even though the low result on level of recognition on prefabricated house in Jabodetabek, 70% of respondents are interested on prefab house concept, they're interested on a new prefab house concept. Respondent’s interest on prefabricated house is on concept of technology that is expected could give an time and cost efficiency.

• **Preference**

![Preference Pie Chart]

Do you want to live in a Prefabricated House?

**Figure 3.** Result of consumer questionnaire on preference of prefabricated house.
In addition, even though a high result on interest level on prefabricated house in Jabodetabek (70%), but we found a low result about their decision on choosing this prefabricated house. 55% of respondents said that they don’t want to live in a prefab house. Some of positive respondent’s reasons is about time and cost, which is the prefab house development could be done faster and cheaper than the conventional one. Meanwhile, some of negative reasons are about quality, such as monotone design, inflexible and about comfort ability.
Conviction

Figure 4. Result of consumer questionnaire on conviction of prefabricated house.
The level of willingness to buy a prefabricated house is low. 57% of respondents said that they choose conventional house even though it is 10% more expensive than prefabricated house. They are ready to pay even more expensive on design, flexibility and comfortability than prefabricated house.

The preference level on society of this prefab house is explaining on why this prefab house business hasn’t been improved well yet in Jabodetabek. By preference study could be found that the society still has a negative opinion about prefabricated house, such as monotone design, inflexible and a problem of comfort ability that still blurred on their mind. This negative opinion is on middle and high-income society.

On previous study by Robert Ferber and Hugh G. Wales (1951), “The Market for Prefabricated Housing” is concluded they have a low preference on prefabricated house in America, especially for an expensive prefabricated house. This phenomenon is found on preference study that is prefabricated house product now that shows a low society’s interest on this product. Meanwhile in recent situation the prefabricated house is popular in some countries, for example, Sekisui prefab house is in real estate market in Japan.

3.3 Prefabricated house business investment simulation for finding NPV and IRR value.
Based on researched data from prefabricated house’s producer in Jabodetabek, and actual data from the next survey, which is made a real estate development business simulation for two types products, which is prefab and conventional house. In this simulation, potential income and sum amount of need to be paid is counted, so that will be known the profit level and is compared with investment value of this two property products (prefab house vs. conventional house). In this simulation, there are 3-investment scenario, which is (1) 100 units development in 1 year, (2) 500 units development in 2 years, and (3) 1000 units development in 3 years, with large area is about 36m². A capital loan of 70%, an annual interest rate of 30% and an inflation of 7%. The project is located in Jabodetabek with land price of Rp.1.000.000,- / m². The cost of prefabricated houses development is more expensive at 6.8% compared to conventional homes. The cost of a prefabricated house development is assumed to be a 5% reduction price when it reaches 1000 units, resulting in the total investment cost incurred as follows: (see table 2)

| Investation        | 100 unit        | 500 unit           | 1000 unit          |
|--------------------|-----------------|--------------------|--------------------|
| Prefabricated House | Rp 27.183.196.800 | Rp 134.991.984.000 | Rp 264.532.968.000 |
| Conventional House  | Rp 26.463.196.800 | Rp 131.391.984.000 | Rp 262.552.968.000 |

Table 2. Investment cost for development of cluster 100, 500, 1000 units (source: personal data)
In the operational cash flow, the income is fully obtained from the sale of housing unit with the selling price of Rp.300,000,000, - / unit with the assumption of purchase with DP 30%, as if the house is completed and then the customer pay another 60% and the last repayment is 10%. Meanwhile the other costs, in general operational expenditure on this project is assumed from the cost of administration, marketing, security, maintenance etc.

3.3.1  **NPV (Net Present Value)**

Dalam rentang waktu tersebut perkiraan okupansi penjualan diasumsikan 100% terjual, didapatkan besaran NPV sebagai berikut

![Figure 5. NPV comparison between prefabricated house and conventional house (source: personal data)](image)

Pada setiap skenario, NPV rumah prefabrikasi lebih rendah dibandingkan dengan NPV rumah konvensional, ini disebabkan oleh development cost dari rumah prefabrikasi yang lebih tinggi. Namun demikian karena NPV Rumah prefabrikasi menunjukkan nilai yang positif maka dapat disimpulkan bahwa investasi rumah prefabrikasi layak untuk dikembangkan.

In each scenario, prefabricated house’s NPV is lower than conventional house’s NPV, it’s because higher prefabricated house’s development cost. However, a positive NPV value of prefabricated house is concluded feasibility of prefabricated house investment.

3.3.2  **IRR (Internal Rate Return)**

From the calculation data obtained comparison of IRR prefabriksi home with conventional house as follows
Although prefabricated house NPVs have smaller values than conventional houses but based on the cash flow simulation results, prefabricated house IRRs have a higher compared to conventional house, this is because prefabricated houses have better productivity levels compared to conventional house in terms of working time, So that its operating cash flow turns faster.

From the results of a study conducted by Sri Velemati [6] in America, the savings is generated by costs and related items resulted in an increase in NPV values of 3.485 and IRR of 1.56%. In combination, all savings can yield 5-10% of the total project cost. Meanwhile, in the simulation of prefabricated house investment in Jabodetabek did not show an increase in NPV value of prefabricated houses compared to conventional homes because it did not result in savings from total cost of projects, savings can occur if production is done very massive. However, in the simulation the increase in IRR on prefabricated home investment still occurs because the processing time is shorter so that the cash flow of the operational flow becomes faster.

4. Discussion

Productivity level of prefabricated house construction in Jabodetabek is considered higher than it is in conventional houses, especially within two factors that are quality and time. From the cost side, the cost of prefabricated house production is 6.8% higher than it is in conventional one because of its material quality that is better than it is in conventional house. When it comes to material quality, durability and workmanship prefabricated house has a higher productivity level compared to conventional houses but worse than it when it comes to flexibility. And when it comes to time, the construction of prefabricated house is faster than the construction of conventional houses.

Preference research found out that preference level of the consumers toward prefabricated house in Jabodetabek is still low. This also explains the lack of development in prefabricated house business in Jabodetabek. Some of the reasons why the preference is low are limited design, low flexibility and production cost that is far more expensive.

Based on the cash flow simulation of prefabricated house business development, it is concluded that prefabricated house has lower NPV with a difference of Rp 1,510,666,135,- while the average of IRR from prefabricated house is higher than it is of conventional house by 2%.

The business of prefabricated house in Jabodetabek has better potentials to be one of the real estate business in Indonesia because of its construction that is far faster than the other and this can

Figure 6. IRR comparison of prefabricated house and conventional house
(source: personal data)
cause the business cycle faster as well, along with proper approach toward better flexibility of the product, variety of appearances, and mass production. Prefabricated house has a big potential to be one of the solutions addressing the settlements problem in Indonesia both as commercial housing products or as subsidized house products by governments.

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