

## VALUE-ADDED TECHNOLOGY SELECTION MODEL FOR SMALL AND MEDIUM REAL ESTATE DEVELOPERS IN THAILAND

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### ABSTRACT

According to the Twelfth National Economic and the Social Development Plan and the Office of Small and Medium Enterprises Promotion, the Thailand Government's policies place importance on national economic development by enhancing innovative capability to strengthen domestic enterprises, as well as trying to stimulate greater use of technology to drive the national economy. This study focuses on technology selection for value-adding in residential real estate projects of small and medium real estate developers, which are grouped to the energy technology, health technology, and assistive technology. This is a qualitative study using the Analytic Hierarchy Process (AHP) to study the weighted scores of various factors and to recommend technology selection guidelines for value-adding for small and medium real estate developers. The results of this study showed that the weighted score of the Ease of Use factor is the highest score for technology selection for small and medium real estate developers. Meanwhile, the Initial Investment factor and Return on Investment factor are ranked as the second and third highest scores, respectively. In contrast, Efficiency, Specialist, and Material are ranked as the three lowest factors. Consequently, the results of this study could be applied as a technology selection tool to evaluate and select suitable technology for small and medium real estate developers.

**Disciplinary:** Business Administration and Real Estate Development.

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## 1 INTRODUCTION

From the 12<sup>th</sup> National Economic and Social Development Plan, both state and private agencies

must adjust themselves to support and push Thailand's development forward. Meanwhile, the Office of Small and Medium Enterprises Promotion (OSMEP) wants to develop Thai small and medium enterprises to have greater potentiality and competency in international business to assist small and medium enterprises in having greater business roles. Important factors for national economic development are creating innovative capabilities and strengthening Thai enterprises as well as efforts for innovative use and development for the greater economic drive (SME, 2017). In addition to Generation Y consumer groups in Thailand presently accounting for 28 percent, they are the group of people who are agile in technologies, like to socialize, make decisions based on information, are selective, and have knowledge of finance. They also have a high purchasing ability. Under highly competitive conditions for the real estate business, especially high-rise residents (condominiums), which occupy 50 percent of Bangkok and its vicinity, entrepreneurs need to find suitable strategies both in design and innovation to meet the needs of Generation Y consumers, who have the main purchasing power.

Therefore, entrepreneurs attach importance to the selection of technology to be present as part of the development of real estate projects. However, the essential limitation of small and medium enterprises is a limited fund for project development, so it needs to consider the form of the technology that will be used systematically to respond to the needs of consumers and add more value to the projects effectively. Therefore, having focused on the analysis of factors and decision-making processes in choosing the technology used in residential real estate projects in Bangkok and its vicinity to create value for the residential real estate projects of small and medium real estate developers, the developers can apply this study results as guidelines when adapting themselves into a competitive market.

Currently, the construction sector is continuously growing, and it is an important strategic industry that drives a country's economy and society. The key to a good construction project is cost, time, and quality. One of the important factors is "construction cost", which drives the construction project to success or failure (Afzal et al., 2018). Good and accurate cost planning will lead to smooth project management during the construction period (Cho et al., 2010; Shi et al., 2014). Otherwise, if the cost management plan is mistaken, it may result in the project being at risk of construction cost overruns from the anticipated budget, which may lead to many problems. Therefore, construction cost overrun risk analysis is a method that helps to analyze the risk possibilities, which may occur with projects for decision making and reserve planning in case of exceeding the construction budget so the project can be completed (Memon et al., 2011; Sovacool et al., 2014).

## 2 LITERATURE REVIEW

In Thailand, real estate entrepreneurs are classified based on sales amount. The sales amount of small and medium enterprises are less than 100 million Baht per year and 100-500 million Baht per year, respectively (Bongsadadt, 2014). In 2017, large real estate development companies occupied 78 percent of the market share. This means small and medium real estate companies occupy 22 percent of the share, while the OSMEP has developed the Small and Medium Enterprises Promotion Plan No. 4 (2017-2021) to be guidelines for the development and promotion of small and medium enterprises to have greater potentiality and competence in international business (SME, 2017). This focuses on real estate groups being able to apply technologies and innovations to raise and increase product value in the future.

Increasing product value might be done by increasing profits from reducing the cost to the organization of the administration, promoting an increase in the services, and developing better products (Jan van Ree, 2002; Kraft & Munk, 2011; Lindholm & Leväinen, 2006). Also, another way of adding value is seeing opportunities which others have not or cannot achieve, such as the change of form in real estate used to be more valuable together with an increase in consumers' satisfaction (de Chernatony et al., 2000; Roulac et al., 2006). The information presented supports the idea of adding value to products and services, which is an important tool for modern-day business competition, especially small and medium businesses. In the literature review section, technologies, alternatives in real estate businesses, decision-making processes and sequential analysis processes will be explained, and variables used in the study will be summarized.

## 2.1 ALTERNATIVE TECHNOLOGIES IN REAL ESTATE BUSINESS

The real estate business is one that integrates a range of knowledge by applying technological ideas, which leads to the development of systems related to the real estate businesses and causes real competitive advantages. From the information surveyed about technology and innovation presented on the websites of 22 residential real estate development companies in Bangkok, by focusing on concrete technologies that have been implemented and resulted in the creation of additional value for consumers and organizations, it is found that alternative technologies, which can be applied to real estate businesses, are divided into four areas: energy, health, convenience, and security (Charoensuk, 2017). The details are

**1) Energy Technology:** due to concerns about global warming and the increase in electricity bills, consumers have more interest in the technology considered as part of conservation, power use reduction, or even greater use of clean energy in daily life. Also, from the survey on real estate project developers in Thailand, it was found that technologies that entrepreneurs chose to present repeatedly in the first order included solar cell systems, energy-saving lamp systems, and connection systems for charging electric cars.

**2) Health Technology:** as well as the health care of generation Y consumers in Thailand and international people, which attaches importance to alternative health technologies, real estate developers, currently, have promoted technologies together when designing and selling projects. Common technologies added to projects comprise ventilation and heat transfer systems, shockproof floor system, automated external defibrillator, and air circulation machine.

**3) Assistive Technology:** lifestyles in the age where everyone can access information technology systems results in competition from many complementary products to create convenient alternatives.

From the survey, it is found that entrepreneurs have presented a variety of technologies, such as service robot system, voice command system via a control device, automatic deposit system, automatic parking system, virtual reality technology, and smart home system. **4) Safety Technology:** no matter how much technology will be developed in other areas, safety is the basis of human needs. Therefore, a residential place should be safer than in other places. Most entrepreneurs, therefore, choose to offer safety technology to promote consumer decisions. This group comprises digital door systems, animated communication systems, and burglar alarms.

From the list of technologies obtained from a survey of 22 leading real estate project developers

in Thailand, it indicates guidelines for the overall selection of technology to create additional value in project development in Bangkok and its vicinity. However, such aspects may be unable to be used as a guideline for small and medium project developers due to the limitations in the development of different potential projects, which affects the ability to choose different technologies as well. Factors affecting the use of technology in residential real estate businesses consist of what will be presented in the next section.

## 2.2 FACTORS AFFECTING USE OF TECHNOLOGY IN REAL ESTATE BUSINESS

The basis of technology in each area is created and developed with the knowledge and skills of each area for living and solving human problems. Therefore, the selection of technology in each business must determine the response, safety, and suitability of the area condition or environment in that area. The feasibility analysis of the project will include the process of study and analysis steps to determine the best alternative for investment. The feasibility study covers four areas: 1) marketing 2) physics 3) finance and 4) techniques (Davis, 1989; Watchravesringkan et al., 2010). This research focuses on a feasibility study of the use of technologies applied for residential real estate projects according to a study as shown in the following details.

**Marketing Factor:** In project development, important factors in the feasibility analysis of project development decisions, which affect technology use in residential real estate businesses, consist of four factors:

1. **Social Influence:** according to the fact that humans are social animals, decision making on big deals tends to be influenced by information from outside. The individual acknowledgment depends on how such a group of people is important for decision making or affects their beliefs, especially for making decisions to buy property, where purchasers tend to use social marks. Therefore, it has a great effect on decision making.
2. **Technology Reliance:** as modern technology is a product of quick changes; it results in a lack of confidence in usage from consumers. The information that consumers receive from marketing communication, therefore, is very important for decision making, especially when it is a new technology in real estate, which is often high in value compared to other types of products.
3. **Personal Perception:** personal factors inevitably are important for individual technology acceptance. However, this results from the basic knowledge, experience, and interests of individuals.
4. **Ease of Use:** as technologies are often new to the market, important conditions for choosing those technologies, therefore, are the individual's confidence whether the applied technology would help promote or facilitate the ease of use and hassle-free applications.

**Physical Factor:** One of the important factors in the feasibility analysis of real estate project development is the physical suitability analysis of the project. The modern technology that will be brought to add the value of the project should be considered, as it is necessary to determine the suitability of physical factors, which must be consistent. Therefore, four physical factors need consideration.

1. **Usefulness:** the technology that will be applied will not only meet the expectations of the technology developers but also technology with utilities according to the needs of the consumers, so more value that can be added to the project.

2. Efficiency: the technologies that can meet the needs of consumers very well, are accurate, relevant, and can be used together.
3. Durability: an important factor that needs to be considered when choosing technology is durability, which can be indicated from the lifetime and strength of that technology, from the installation process to delivery to the consumers and consumers' use.
4. Maintenance: the ability to maintain and service the process for consumers as well as the complexity of technology management and readiness of producers in the services is an important element in the decision making when choosing the technology for consumers.

**Financial Factor:** the decision-making process that is an important part of project development is the financial feasibility analysis, which is a consideration to determine the conclusion of finance in investments, returns, return rates, and project value measurements using the following indicators.

1. Initial Investment: it is a consideration of the investment cost at the beginning of the project before the project can produce and enter the normal operating period.
2. Project Cash Flow: the importance of estimating the income and outgoings with regards to the flow of money to maintain the status of the project processes normally.
3. Return on Investment: the investment return analysis is generally based on three methods: the consideration from the investment period, current value, and investment return rates. It is used as the basis for effective investment decisions.

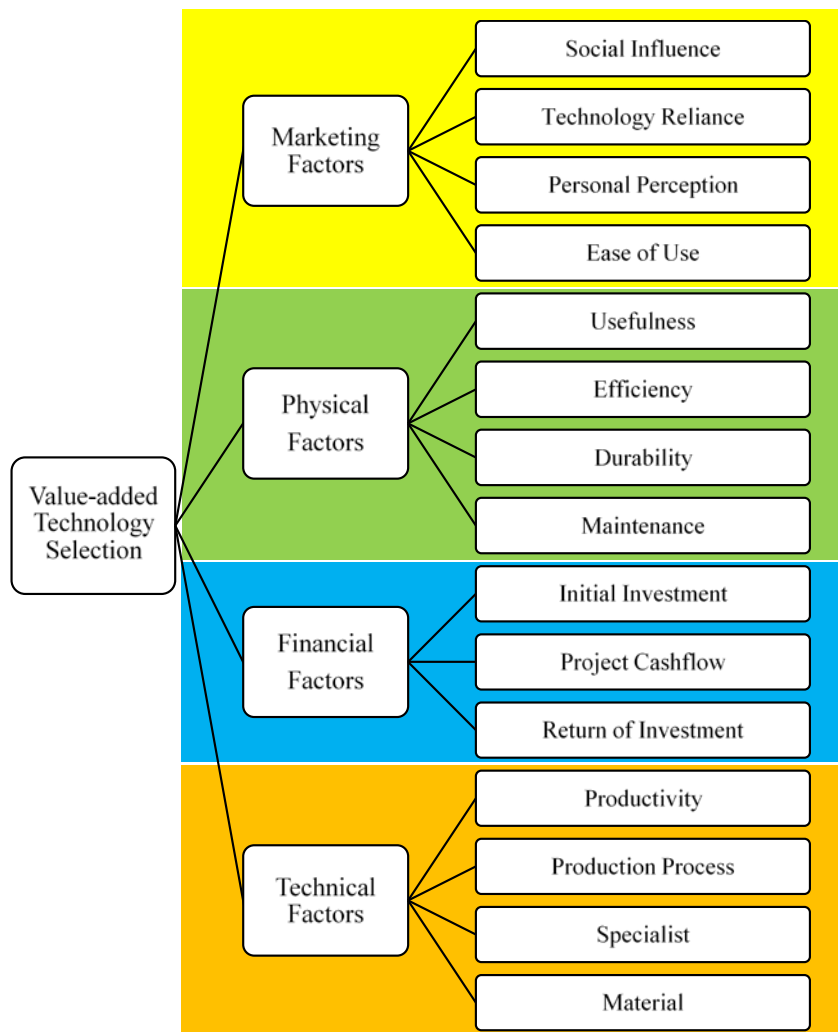
**Technical Factor:** For the main objective of analyzing the technical factors in the feasibility study process for choosing technology to create additional value in the projects, the study, in general, will gather information related to the production of raw materials, production control, production planning and the importance of the machinery and equipment used in production, which can be explained as follows.

1. Productivity: it is an analysis of the technological products on how they maintain continuity. As the sale of real estate projects is a continuous activity, if there is an offer, but with an inability to deliver as stated, it will become high risk.
2. Production Process: it is an analysis of the complexity of the production and the potential for capacity expansion, which are important steps in determining the possibility of choosing technologies for managing long-term scarcity risks.
3. Specialist: due to most products that incorporate new technologies relying on knowledge from research, the main limitation that needs consideration in choosing technology is the analysis of the potential of the personnel involved in the development and production of those technologies.
4. Material: as the raw materials are a factor that affects the overall production, it is necessary to consider the continuity from the raw materials used in production as well as difficulties with procurement and the risk of a shortage of such materials.

The information above presents the factors that affect the use of technology, from the literature review, for creating a value-added technology selection model for small and medium real estate developers in Thailand, which can be presented as a hierarchical structure as shown in Figure 1. It is



found that such selection is under the basis of multiple-criteria decision-making (MCDM). The structure of the factors is in the form of a hierarchy, which causes more complexity in the decision-making process. Therefore, the selection of the Analytic Hierarchy Process (AHP) as the main tool in creating the selection model this time is appropriate, as shown in the next section.



**Figure 1:** Value-added technology selection hierarchical model for small and medium real estate developers in Thailand.

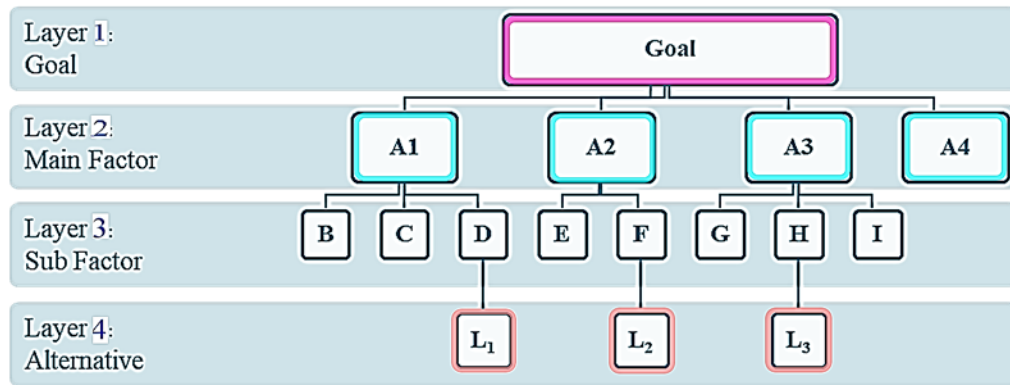
### 2.3 ANALYTIC HIERARCHY PROCESS (AHP)

MCDM is a method for problem-solving that is commonly used to analyze alternatives with complex decision-making factors. It is suitable for the selection by applying factors for sorting to allow users to choose the most suitable solution for problem-solving, which can clearly manage the problem structure, and there are analytical methods that are applicable to many types of data (Saravisutra, 2016).

However, when considering the structure of factors, which need consideration, if it is in the form of a multi-hierarchical structure, one process in the problem analysis for MCDM, which is acceptable in work, is AHP. AHP is widely used and accepted internationally. It is a process that brings subjective thinking and feelings to compare the weight using numbers as a representation of the process, to be seen clearly (Saaty, 1990). The process comprises three main steps as follows.

- 1) Hierarchical Decision Model:** the hierarchical analysis process has a structure that mimics human thinking and decision-making processes. Therefore, a hierarchy chart of the thinking

process for human decision-making has been created, see Figure 2.



**Figure 2:** Hierarchical Decision Model; A1, A2, A3, and A4 present the items in Layer 2: Main Factor; B to I present the items in Layer 3: Sub Factor; L<sub>1</sub>, L<sub>2</sub>, and L<sub>3</sub> present the items in Layer 4: Alternative.

- 2) **Decision Comparison Process:** the comparison of the criteria is a pairwise comparison approach to determine the importance weight between the criteria using numbers, and, then, to calculate the total weighting score of each alternative (Lootsma, 1999; Tam & Tummala, 2001). Determining the weight values when comparing each pair of criteria in the range of 1-9, which 1 defers to the equal importance between two factors, 3 is the moderate importance, 5 is strong importance, 7 presents one factor is favored very strongly over another, and 9 is evidence favoring one factor over another is of the highest possible order of affirmation. The principles and conditions of pairwise comparison are references for data collection in this research. In addition to the results of the comparison according to the direct purposes of the process, the results can be used to create a decision model for complex decision-making.
  
- 3) **Weighting Process:** in general, the data collection process with the pairwise comparison technique will derive the numerical value from the opinion of the expert diagnosis. The next process is to use the data to calculate the pairwise comparison matrix according to the double factor of each hierarchy of factors. This step remembers the sum of the values in the matrix equal to one by starting from adjusting from vertical to one, then calculating the sum of each row in the horizontal and dividing by the total sum of the horizontal sums. For the result obtained, it must be used to test the Consistency Ratio (CR), which is an examination of the importance of the comparison results of the criteria in the decision making whether the reason is consistent. The examination can be conducted by determining the index of the consistency of the reason. The CR value must be less than or equal to 0.10, and then it is acceptable (Saaty, 1990). Then, the data will be put into order from the evaluation of the weighting process for each factor. The maximum weight values indicate the factors that are most important to decision-making.

### 3 METHOD

The data in this research was collected via the Delphi technique by interviewing experts and analyzing the data to study the selection of technology that will add value to residential real estate projects. Then, the research applies the analysis structure and results to create a questionnaire for middle and small entrepreneurs. The research procedures are shown as follows.

### 3.1 DATA COLLECTION

The pairwise process is based on collecting opinions on complex issues using comparisons to eliminate prejudices and confusion from the information providers. Furthermore, it is expected that the information obtained would be consistent. Therefore, the information providers must be the people who are credible and that have knowledge in the area. Five experts who have experience in residential real estate project management were chosen for this study. All of them are senior executives for the organization or executive authorities, or are part of the strategy-planning department for the organization, and have relevant experience as follows.

- 1) Data providers are those who have more than five years of experience in the ongoing business development of residential real estate projects in Bangkok or more than three projects.
- 2) Data providers are those who have experience in marketing public relations in terms of technology and innovation for at least three years or one project with sales of more than 70 percent.

Data collection methods from all five experts were by requesting an interview and letting each person express their opinions comparing the relationship of each variable pair (with examples and explanations of the questionnaire as shown in Figure 3). However, the results of each expert's opinion may not be completely consistent. The important process is to find the middle value of the opinions, consider using the average value, together with the mode value of the data. However, to analyze the results, it is necessary to consider the Consistency Ratio (CR), which must be less than 0.10 to be considered acceptable (Saaty, 1990).

Factor	Intensity of Importance														Factor			
	More							Equal	Less									
A	9	8	7	6	5	4	3	2	(1)	2	3	4	5	6	7	8	9	B
A	9	8	(7)	6	5	4	3	2	1	2	3	4	5	6	7	8	9	C
B	9	8	7	6	5	4	3	2	1	2	(3)	4	5	6	7	8	9	C

**Explanation**  
**Example 1:** The pairwise comparison between factor A and B, which present "Two factors contribute equally to the objective"  
**Example 2:** The pairwise comparison between factor A and C, which present "Factor A is strongly important relative to factor C"  
**Example 3:** The pairwise comparison between factor B and C, which present "Factor C is slightly important relative to factor B"

Figure 3: Questionnaire example and explanation.

### 3.2 DATA ANALYSIS

Regarding the interviews with the five experts, the analysis of weight values from the hierarchical analysis process can apply tools to assist in analyzing the results with various programs. In this research, Microsoft Excel® was used to assist in the processing of the data and for checking data consistency. To check for errors in providing data from wrong decisions or the inconsistency of data being decided on each pair, such as consistency values must not exceed 0.1 to be considered acceptable according to the principles of hierarchical analysis, and then calculate the weight value of each factor. The score will be calculated by weighing with the main factors to prioritize the factors and create a further value-added technology selection model for small and medium real estate developers in Thailand.



## 4 RESULT

From the results of the data analysis from the above steps, it can be summarized as the factor results that influence technology selection to increase the value in the project development. Both the main and sub-factors that influence the technology selection to create more value for middle and small real estate developers are shown in Table 1.

**Table 1:** Evaluation results of the importance of the factors.

Main Factor	[A] Main Factor Weight	Sub Factor	[B] Sub Factor Weight 2,3,4,5	[C] Weight Score = [A] x [B]	Ranking
Marketing	0.472	Social Influence	0.183	0.087	6
		Technology Reliance	0.252	0.119	4
		Personal Perception	0.222	0.105	5
		Ease of Use	0.343	0.162	1
Physical	0.114	Usefulness	0.380	0.043	9
		Efficiency	0.167	0.019	13
		Durability	0.210	0.024	12
		Maintenance	0.244	0.028	11
Financial	0.309	Initial Investment	0.426	0.131	2
		Project Cash Flow	0.164	0.051	8
		Return of Investment	0.410	0.127	3
Technical	0.105	Productivity	0.497	0.052	7
		Production Process	0.401	0.042	10
		Specialist	0.089	0.009	14
		Material	0.013	0.001	15

Note: <sup>1</sup>CR of main factor = 0.06; <sup>2</sup>CR of marketing factor = 0.07; <sup>3</sup>CR of physical factor = 0.04; <sup>4</sup>CR of financial factor = 0.04; <sup>5</sup>CR of technical factor = 0.04.

From Table 1, the Consistency Ratio (CR) of each set in the hierarchy of all the factors is within the acceptable value (<0.10). When considering the hierarchy of the main factor value in column A, it is found that the most important factor is the Marketing factor with a significant weighting value of 0.472, while the less important factor towards the selection decision-making is the Technical factor with a significant weighting value of 0.105, which is close to the Physical factor at 0.114. It indicates the trend of technology selection by entrepreneurs that they emphasize the conditions of investment possibilities (Marketing and Financial) more than the other factors, which is consistent with most studies that reflect the investor comments. Although they focus on new technologies, they still think of the possibility of doing business as an important factor, especially SME businesses, which still have business instability more than large businesses (Brustbauer, 2016; SME, 2017), while concerns about physical and technical limitations in Thailand are less important because the basic physical and technological production in Thailand is high due to the promotion of innovation incubators in a systematic manner over a period. (Wonglimpiyarat, 2016). This might be the reason for the obvious significant reduction in this concern.

Besides, when considering the weighting value in every factor of every layer shown in column [C] (Table 1), it is found that the most important factor is Ease of Use. The second important factor is Initial Investment. The third is Return on Investment. The last three factors are Physical Efficiency, Technical Specialist, and Material, respectively. These findings confirm with the study of technology selection by Thangamani (2012), in which Key Performance Achievability and Commercial Risk are the most influential factors for the best technology selection. Moreover, the Ease of Use issue reflects frankly that the increased technologies for value-adding should provide convenience. Also, the

ease-of-use meets the needs of generation Y customers who look for convenience in living life (Mahmood et al., 2013; Ozturk et al., 2016; Watchravesringkan et al., 2010), while the degrees of importance of Initial Investment and Return on Investment are in the same way as the form of consideration for general business investment possibilities (Kuntonbutr, 2017; Tongyingsiri, 1999). However, the least important parts are Specialist and Material, which are in the scope of the same reason for the lack of concern about the factors of production and technology development in Thailand due to the appropriate support capacity (Wonglimpiyarat, 2016). However, the issue needing consideration is the Efficiency of new technologies, which is also at the bottom of the list (Suttiwongpan et al., 2019). In this section, when considering the terms of the entrepreneurs who have to offer products through advertising public relations and when there is a risk of exaggerating claims, they will be punished by the Office of the Consumer Protection Board, which is a Thai legal agency who investigate exaggerated claims, especially about the efficiency of new technologies, which may be difficult to prove if it is true or not. This makes the entrepreneurs (not only in the real estate business) aware of such issues (Kingsakul, 2015). However, this might need further proof.

## 5 CONCLUSION

From this study of the value-added technology selection model for small and medium real estate developers in Thailand, by undertaking interviews with experts to analyze the degree of the importance of the factors according to the Analytic Hierarchical Process (AHP) with a pairwise comparison to determine the importance level of the factors, and the results found that the Marketing factor is the most important for running a business, following by Financial, Physical and Technical factors, respectively. Moreover, the results of the study show that the technology of the facility is most important in the selection of technology for increasing the value by adding additional technologies over the common standard to facilitate the common areas and within the residential area, such as smart home technology, digital door technology, and solar cell technology for small and medium residential real estate developers. It is a way of doing business to create an advantage that is needed to respond to the changes and needs of consumers in a technological age, like the present. However, this study was only related to the expert opinion from the developer's point of view. The results should be used along with the results of a marketing study from targeted customers.

## 6 AVAILABILITY OF DATA AND MATERIAL

Data can be made available by contacting the corresponding author.

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