Categorization of Product Innovations in the Residential Condominium Projects

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Abstract

Product innovation in residential projects is a key component that real estate developers use as a key selling point today. However, product innovation is used in a variety of project elements. An analysis to categorize product innovations based on the degree of influence in the purchasing decisions of project residents can help them understand and choose innovations in order to effectively add value to their projects. This research aimed to study the key categories of the innovative products in residential condominiums of residents in Bangkok, Thailand, from surveying 300 condominium buyers and performing Exploratory Factor Analysis by Principal Component Analysis method, rotating perpendicular component axis by Varimax method. The results showed that the set of variables were analyzed in 5 groups which in order of the influence of the group of innovation elements affecting the decision to buy condominiums from greatest to least is as follows: (1) Digital innovation and intelligent systems, (2) Health and safety innovation, (3) Energy innovation, (4) Construction innovation, and (5) Automotive application innovation, which can explain the cumulative variance of 74.22%. The results of the research showed the degrees of influence on the purchasing decisions of various product innovations, which can provide competitive advantages for property developers.

Keywords: Product Innovation, Condominium, Factor Analysis, Innovation Type

1.Introduction

Thailand housing market in 2020 was be affected by the COVID-19 epidemic. As a result, the overall housing market has slowed down. Housing demand and changing consumer behavior require housing developers to adjust. Throughout the year 2020, 103911 units of condominium building permits were issued, a decrease of 24.8% compared to 2019. The Bangkok Metropolitan Region Permits were issued, representing 43.5% of the total, while the number of condominium ownership transfers in 2020 amounted to 122338 units, a decrease of 5.5% from the previous year, or 57.15% of the total number nationwide. This shows that the demand for condominiums in the economic center is still high, despite some slowdown from the epidemic situation (Real Estate Information Center, 2020).

The condominiums were popular and became a choice for several people, especially who need a residence connected to business districts and workplace. This is the reason why real estate developers expedite condominium development to meet additional demands midst of fierce competition. The development of condominiums in high-potential lands are scarce and expensive, affecting to the costs, selling prices, and demands of customers accordingly. Real estate developers have to adjust their strategies in order to build their competitive advantages. Concepts or theories are considered and adapted to create key selling points for projects, in addition to the basic requirements for location. One of the most-adopted strategies is bringing innovation to satisfy residents and add value to projects. Innovation creates added value, which will be assessed based on consumer satisfaction (KPMG Real Estate Advisory, 2020). However, to create or change a new technology, it's not just considering the technical aspects of the change. It is also important to consider other relevant issues such as marketing factors to consider the suitability and timing of technology development. Financial factors also need to be analyzed to clearly determine the feasibility of such a development, how appropriate and cost-effective it is (Hall, 1994). In order to gain a competitive advantage, developers should have innovative organization cultures and ability to be innovative (Dorf & Byer, 2008). Therefore, developers shall not only be business owners or management but also innovators. (Smith, 2006). There are two main concerns in determining product innovation: (1) technological opportunity, which refers to scientific and technological knowledge, tools and product development processes and (2) market demand, which refers to the demand and readiness to purchase. Product innovation that is consistent and responsive to the said concerns will have both economically and socially benefits including good turnovers and the residents' living satisfaction. (Capon et al, 1992; Ettlit & Reza, 1992; Gopalakrishnan & Damanpour, 1997). Examples of innovations include smart homes, which combine living with computers and information technology to meet the needs of residents, which aims to promote the quality of life more convenience .The form of use must be easy to understand and suitable for people of all genders and ages for maximum benefit (Hong-jun Ou, Chien-Jen Hung, 2019). Another important innovation that supports living is health innovation. As most people now spend more time in the built environment, architecture design that promote healthy lifestyles and health innovations are another important factor that will play a role. in caring for human health in the future (Joan Cahill, Sean Mc Loughlin, Delaine Blazek, 2017).

2.Objectives

The objectives of this research were: (1) to study the categories of the innovative products, classified by the demands of the customers in residential condominiums in Bangkok; (2) to analyze the effects on demands of the different customers' demographic factors on each type of product innovation. The studies shall help real estate developers select the innovative products in their condominium projects that stimulating the customers purchasing decisions.

3.Theories and concepts

3.1 Knowledges of product innovation

National Science and Technology Development Agency has defined "product innovation" as the development and introduction of new products technology or including improve product quality (Vorrakitpokatorn, 2004). Product innovations are the outputs of an organization or business, including goods or services, as mentioned in Smith (2006) and Schilling (2008), and product innovation capability is a reflection of the competence in businesses to create and implement new ideas in product innovation or services to economic benefits (Fritz, 1989). This must arise from the constant development of new products or services into the market, at optimal time of entry and create competitive advantage over competitors (Wang & Ahmed, 2004). In addition, Henard & Szymanski (2001) revealed that the idea of product innovation should consist of newness, uniqueness, and originality, both

from the consumers' and developers' perspectives. The topics cover several issues such as innovation features, usage risk from customers' point of view and the level of technology and marketing strategy with innovative products from developers' one. (Atuahene-Gima, 1995; Denneels & Kleinschmidt, 2001)

3.2 Concepts of consumer behaviors in purchasing decisions

Sproles & Kendall (1986) and Lynsonski & Durvasula (1996) characterized customer purchasing decisions as follows: 1) Quality: customers have a system for find the highest products and high expectations for products and services; 2) Brand: customers focused on getting expensive, well-known brands, looking at price as a measure of quality; 3) Modernity or novelty: consumers will pay attention to new and innovative products and modern new products; 4) Diversity: Consumers will be happy of various choices in their purchasing and shopping. 5) Price and value of money: consumers focus on getting lower prices, compared to other shoppers. 6) Stimulation: consumers who are not planning on shopping and are more likely to make a purchase usually do not focus on spending money, so there is a need to stimulate their shopping choices; 7) Consumer confusion in choosing the brand, store and information: consumers will feel that there are too many brands and stores available and need helps in making a purchase; 8) Customer's loyalty: Customers will adjust to preferences for brands and stores. They will select regular stores and tend to buy products under the same brand.

3.3 Innovation adoption

Roger (2003) said innovation adoption process is the decision to fully implement with the belief that the innovation is useful and the best way to use. The characteristics of innovation adoption can be divided into 5 aspects as follows: 1) Relative advantage, which is the perception that innovation is better than traditional practice methods; 2) Compatibility, which means the innovation is consistent with existing values, ideas and experiences; 3) Complexity, if the innovations are difficult, acceptance will be less. 4) Trainability, which means ability to test a part of innovation in short period; and 5) Observability, which means the result of innovation will make easier to embrace innovation.

4. Research scopes

This research studied the selection of innovative products in residential condominiums in Bangkok, Thailand. The researchers defined the scopes into 4 areas as follows.

4.1 Scope of content

The study considered only product innovation for residential condominiums and not considered, process and management innovation. In addition, it does not consider innovations in other type of projects.

4.2 Area of Studies

Study the types of product innovations in residential condominiums by selecting the sample project used in the study from the criteria for consideration as follows: It is a residential condominium project developed by a listed company in the Stock Exchange of Thailand, located in the inner Bangkok area, completely constructed by 2020 due to the time period that can find complete information and it is a project from the grade A level with an average selling price of 150,000 baht per square meter or more (Real Estate Information Center, 2020). From the data review during October 2020, it was found that there were 22 condominium projects that were in the criteria for analysis as product innovation variables.

4.3 Respondents

This research study focuses on quantitative data by using questionnaires as a tool to collect data and using Judgmental Sampling. The questionnaire was distributed among 10 condominium sales offices in Bangkok, where the respondents were assigned to a group of 300 people who visited the project and were interested in buying a condominium for living.

4.4 Time

This research collected the research data during November 2020 to January 2021.

5. Research variables framework

Figure 1 shows the research variables framework. It consists of:

5.1 Independent Variables

The independent variables consist of 8 personal factors and type of residence. The dependent variables are the degrees of influence on purchasing decisions of 30 innovations.

5.2 Dependent Variables

The dependent variables consist of the degree of influence on the purchasing decisions of the samples group as mentioned in Section 5.1 and the results of grouping categorize product innovations into latent variables in research.

6. Methodology

6.1 Research methods

This quantitative research performed data collection from a sample group of residents in Bangkok by questionnaires with 5-level assessment of Likert (1967). The questionnaires were divided into three parts: Part 1 - general information, Part 2 - information on the demands for product innovations in residential condominiums, and Part 3 - information on the degrees of influences in the purchasing decisions of projects. In the analysis of data from questionnaires, the data collected from Part 1 and 2 were analyzed by finding their frequencies and percentages and the data from Part 3 were also analyzed by Exploratory Factor Analysis with Principal Component Analysis and rotated perpendicular component axis by Varimax. The indicators with element weights less than 0.4 or more than 1 cross loading shall be eliminated. In addition, the model must have Eigenvalue more than 1.0, according to Hair, Black, Babin and Tatham (2006)

Independent Variables	
Personal information	
1. Gender	5. Average monthly income
2. Ages	6. Type of present residence
3. Education	7. Number of people
4. Occupation	8. Room type
Product innovation list	
(x1) Home automation	(x18) Mutating nature material
(x2) Mail delivery robots	(x19) Reduce pollution and environment innovation
(x3) Facial recognition system	
(x4) Self-Locker with smart phone	(x20) Helping handle-absorbing floors
(x5) Universal design	(x21) CCTV
(x6) Internet of things	(x22) Sensor anti-theft motion detector alarm system
(x7) AI : Artificial intelligence	
(x8) Digital smart lock	(x23) Water recycling system
(x9) Energy-efficient products	(x24) Modern equipment and first aid
(x10) Air circulation system	(x25) Device to protect and decrease exposure
(x11) Prefabrication	
(x12) Robotics in construction	(x26) High technology of design & construction
(x13) Home control system	
(x14) Virtual reality	(x27) High-speed Communications
(x15) Reducing heat entering the building	(x28) Auto parking
(x16) Fire detection system	(x29) EV charger
(x17) Modula Bathroom	(x30) Solar cell

Dependent Variables
1. Degree of influence in the purchasing decisions of the samples group 30 type
2. The results of grouping categorize product innovations to find latent variables

Figure 1. Research variables framework

Table 1. General information of the respondents

Personal information	Number of respondents
Gender	
Male	168 (56%)
Female	132 (44%)
Ages	
Lower 25 years	15 (5%)
25–30 years	138 (46%)
31–35 years	90 (30%)
36–40 years	24 (8%)
40–50 years	6 (2%)
Over 50 years	27 (9%)
Education	
Below a bachelor's degree	-
Bachelor's degree	198 (66%)
Master's degree	180 (30%)
Higher than Master's degree	12 (4%)
Occupation	
Graduated level	21 (7%)
Company employee	240 (80%)
Business owner	18 (6%)
Government officials / state enterprises	21 (7%)
Average monthly income	
Lower 25,000 Baht	30 (10%)
25,001-50,000 Baht	147 (49%)
50,001-75,000 Baht	84 (28%)
75,001-100,000 Baht	27 (9%)
100,001-200,000Baht	9 (3%)
over 200,000 Baht	3 (1%)
Type of present residence	
Home	33 (11%)
Apartment	30 (10%)
Condominium	237 (79%)
Number of people	
1 person	54 (18%)
2 persons	147 (49%)
3-4 persons	96 (32%)
5 more people	3 (1%)
Room Types	
Studio	96 (32%)
1 bedroom	105 (35%)
2 bedrooms	90 (30%)
3 bedrooms	9 (3%)

6.2 Population and sample groups

A total of 30 product innovations were selected from 22 condominium projects that meet the selection criteria detailed in Section 4.2 as variables in the questionnaire in order to obtain the results of the questionnaire consistent with the research topic. Therefore, the questionnaires were distributed at 10 condominium project sales offices, where the respondents were visiting the project and had a real desire to buy a condominium.

7.Results

The results of the analysis of personal factors affecting the decision to purchase innovative condominiums. Details can be summarized as follows.

7.1 Personal Factors of Respondents

The data from the questionnaires were collected from 300 respondents. It was found that the majority are males (56%), 25-35 years of age (76%), private company employees (80%), have Bachelor's Degree graduates (66%), 25,000 – 75,000 Baht average monthly income (77%), and live in Studio, 1 Bedroom and 2 Bedroom in similar proportion, as shown in Table 1.

7.2 Demands on innovative condominium projects

The answers from the respondents for 3 questions about their demands on innovative condominium projects were as follows:

7.2.1 Do they want product innovation in projects?

The results were divided into 5 levels of purchasing decisions and the questionnaire results showed strongly agree with product innovation 40%, followed by agree
25%, undecided 18% and disagree17%. This showed the majority of respondents require any product innovation
in their condominiums, if possible.

7.2.2 Does the product innovations of the project affect purchasing decisions?

The research found strongly agree 43%, followed by agree 27%, undecided 16% and disagree 14%, respectively. The researchers found that majority of them strongly agree or agree that innovations have effect on their purchasing decisions.

7.2.3 The Willingness to pay for innovations.

The result found strongly agree 32%, followed by agree 24%, undecided and disagree were 22%. This revealed majority of the respondents were strongly willing or willing to pay more for product innovations.

7.3 Categories of Innovation.

7.3.1 KMO and Bartlett's Test

The results of Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) was 0.871 (over 0.80), showed that the variables were suitable for analyzing the composition at a good level according to the criterion of Kim and Mueller (Wiratchai, 1995). The results of Bartlett's Test of Sphericity showed the variables are statistically significant at 0.05 confidence level as shown in Table 2.

Table 2. Results of KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.871
Bartlett's Test of Sphericity	Approx. Chi-Square	3000.935
	df	443
	Sig.	0.000

7.3.2 Exploratory Factor Analysis with Varimax Rotation Method

The results of the analysis of product innovation categories by Exploratory Factor Analysis with Varimax Rotation Method are shown in Table 3.

As the results shown in Table 3, it was found that there were 30 variables (innovations) used in the analysis, 5 components were grouped with Eigenvalue exceeded 1.00. This showed that each component can explain the variance of all 30 variables at 74.22%. Then, the similar innovations were grouped into the same single component and the components were renamed, as shown in Table 4.

Data from the component grouping of 30 items of product innovations were shown in Table 4. They were divided into 5 categories, e.g., Category 1: Health and Safety Innovation (8 items), Category 2: Digital Innovation and Intelligent Systems (9 items), Category 3: Construction Innovation (4 items), Category 4: Energy Innovation (7 items), and Category 5: Automotive Application Innovation (2 items). The variable list of each category corresponds to the element naming. Then, the components were renamed in accordance with the innovations within. Health and safety, Digital innovation and intelligent system, and Energy Innovation are the top three categories with a combined influence of more than 80% according to Pareto (Pareto, 1895). These findings guide condominium developers what categories of the product innovations they should bring to their condominium projects.

The results of the comparison of personal data from 300 respondents and the analysis of the components of the product innovation in 5 groups showed the score of results from variables in percentages. It was found that there was a significant consistency. All personal and living behavior factors showed the degree of influence in the purchasing decisions of condominium as follows: (1) Digital innovation and intelligent systems, (2) Health and safety innovation, (3) Energy innovation, (4) Construction innovation, and (5) Automotive application innovation, respectively. In addition, Digital innovation and intelligent systems, health and safety innovation, and energy innovation are the top three categories with combined influences of more than 80%. These findings guide condominium developers

Table 3. Results of the innovation categories

Product innovation list	Category				
	1	2	3	4	5
(x21) CCTV	0.821				
(x24) Modern equipment and first aid	0.715				
(x20) Helping handle - absorbing floors	0.694		0.393		
(x16) Fire detection system	0.687				
(x25) Device to protect and decrease exposure	0.653			0.527	
(x5) Universal design	0.635				
(x22) Motion detector system	0.592		0.531		
(x10) Air circulation system	0.581				0.365
(x8) Digital smart lock		0.823			
(x6) Internet of things		0.775			
(x1) Home automation		0.721		0.341	
(x3) Facial recognition system		0.670		0.476	
(x27) High-speed communications		0.618			0.595
(x7) AI : Artificial intelligence		0.599	0.536		
(x4) Self-Locker with smart phone	0.542	0.538	0.419		
(x2) Mail delivery robots	0.420	0.508	0.369		0.339
(x14) Virtual reality	0.385	0.478	0.446	0.445	
(x17) Modula bathroom		0.356	0.817		
(x26) High technology of design & construction			0.779		
(x12) Robotics in construction	0.403		0.732		
(x11) Prefabrication			0.686	0.399	
(x13) Home control system	0.324			0.762	
(x30) Solar cell				0.745	0.368
(x23) Water recycling system		0.430		0.710	
(x9) Energy-efficient products		0.445		0.683	
(x18) Mutating nature material		0.496	0.315	0.627	
(x15) Reducing heat entering the building			0.532	0.582	
(x19) Reduce pollution and environment innovation	0.338	0.439		0.546	
(x29) EV charger	0.589				0.722
(x28) Auto parking			0.481		0.688
Eigen Value	14.482	2.895	2.049	1.486	1.259
Percentage variance explained	48.523	9.721	6.812	4.992	4.195
Cumulative percentage	48.523	57.982	64.788	69.786	74.220

Composition	Variable
Health and safety innovation	1. CCTV
	2. Modern equipment and first aid
	3. Helping handle-absorbing floors
	4. Fire detection system
	5. Device to protect and decrease exposure
	6. Universal design
	7. Motion detector system
	8. Air circulation system
Digital innovation and intelligent systems	1. Digital smart lock
	2. Internet of things
	3. Home automation
	4. Facial recognition system
	5. High-speed communications
	6. AI: Artificial Intelligence
	7. Self-locker with smart phone
	8. Mail delivery robots
	9. Virtual Reality
Construction innovation	1. Modula bathroom
	2. HIGH TECH design & construction
	3. Robotics in construction
	4. Prefabrication
Energy innovation	1. Home control system
	2. Solar cell
	3. Water recycling system
	4. Energy-efficient products
	5. Mutating nature material
	6. Reducing heat entering the building
	7. Reduce pollution and environment innovation
Automotive application innovation	1. EV charger
	2. Auto parking

Table 4. Compositions of product innovations

Table 5. Degree of influence in the purchasing decisions, classified by personal information.

Personal information	Percentage of product innovation component group				
	1. Health and safety	2. Digital innovation and intelligent system	3. Construction innovation	4.Energy innovation	5. Automotive application
Gender					
Male	25.8	31.3	11.4	24.8	6.7
Female	26.2	30.6	12.2	24.4	6.6
Ages					
Lower 25 years	25.7	31.4	11.8	23.4	7.7
25–30 years	25.2	33.3	8.9	25.9	6.7
31–35 years	24.5	32.9	11.8	24.3	6.5
36–40 years	30.4	34.2	13.2	26.8	7.4
40–50 years	33.8	25.8	10.1	24.0	6.3
Over 50 years	30.8	24.8	10.9	28.7	4.8
Study					
Below a bachelor's degree	25.3	32.5	11.4	26.0	4.8
Bachelor's degree	26.8	30.4	11.5	24.4	6.9
Master's degree	26.1	30.1	11.9	25.3	6.6
Higher than a master's degree	26.3	29.7	12.0	27.5	4.5
Occupation					
Graduated Level	25.3	31.3	11.4	24.0	7.9
Company employee	26.6	30.3	11.6	24.7	6.8
Business owner	26.7	29.5	12.4	26.2	5.2
Government officials / state enterprises	26.2	29.3	13.1	24.8	6.6
Average monthly income					
Lower 25,000 Baht	26.0	30.8	12.4	23.5	7.3
25,000-50,000 Baht	26.0	30.7	11.6	25.1	6.6
50,001-75,000 Baht	26.1	30.4	12.4	24.6	6.5
75,001-100,000 Baht	27.8	30.6	9.8	23.6	8.2
100,001-200,000Baht	26.3	29.7	12.0	27.2	4.8
over 200,000 Baht	27.6	29.4	12.6	27.7	4.7
Type of present residences					
Home	26.1	29.7	13.0	24.6	6.6
Apartment	26.5	30.7	11.6	24.5	6.7
Condominium	26.6	30.4	11.5	24.8	6.7
Number of people					
1 person	25.6	30.3	11.7	25.1	7.3
2 persons	26.1	30.7	11.9	24.9	6.4
3-4 persons	27.4	29.8	11.5	24.4	6.9
More than 5 people	27.5	28.9	11.9	24.3	7.4
Room Types					
Studio	25.4	30.5	11.9	25.4	6.8
1 bedroom	26.4	30.5	11.8	24.5	6.8
2 bedrooms	27.7	30.1	11.0	24.5	6.7
3 bedrooms	26.6	31.3	12.4	23.3	6.4
penthouse	26.4	29.5	12.0	27.4	4.7

what categories of the product innovations they should bring to their condominium projects in case of limited budgets. However, the results of the questionnaire survey have additional points worth noting. In terms of age, people over 40 are more likely to make a condominium purchase decision and place greater emphasis on health and safety innovations than other innovations.

8.Conclusion

This research was conducted on the key concepts of Exploratory Factor Analysis. This statistical process gives latent variables by studying the observed variables. This method is very useful in studying complex problems, especially behavioral science. In this research, the results were analyzed as follows: demographic data and preliminary comments on innovation, summarized in Section 7.1 and 7.2, showed that product innovation are a key success factor in the development of residential condominiums. From customer perspective, product innovation affects purchasing decisions and willingness to pay. The product innovation can be divided into 5 categories as follows: (1) Digital innovation and intelligent system, (2) Health and safety innovation, (3) Energy innovation, (4) Construction innovation, and (5) Automotive application innovation. Furthermore, when applying the concept of 80/20 Rule of Pareto Principle (1895), three categories of product innovations should be firstly selected to satisfy the residents in condominium projects: Digital innovation and intelligent systems, Health and safety innovation, and Energy innovation, respectively.

Therefore, if real estate developers have limitation in the selection of innovative types to include in the project, such as cost constraints. This research can help in deciding which category of product innovations to choose first in order to truly meet consumer needs.

Innovation plays an important role and is a support in every sector for every business to develop its business to grow by leaps and bounds, especially in conditions of intense competition that organizations focus on adding value to their own products and products because real estate business is a business that integrates a lot of knowledge. Therefore, if real estate business has adopted innovative ideas, it will lead to the development of a wide range of systems related to this business, which will affect sustainable growth create a real competitive advantage.

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