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PREDICTION OF THE FUTURE TRENDS OF HOUSING PROJECT DEVELOPMENT WITH MODIFIED DELPHI TECHNIQUE

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Abstract

This research was initiated to study the trend of the housing projects in the next ten years (2022-2031), with the applied Modified Delphi Technique. The research was conducted by interviewing five experts with more than ten years of knowledge and experience in design, construction, technology, location, and marketing. The gathered trends were applied to create questionnaires in order to conduct two rounds of surveys to assess the consensus level of ten experts with at least ten years of experience in the real estate industry, according to the consensus analysis method from the Modified Delphi Technique. Thirteen trends were found from the study. There are four design trends: more beautiful façade, soundproof wall, universal design furniture, and universal design house building. In addition, eco-friendly materials and modular construction systems were found to be construction trends while smart home device installation and active air flow technology were found to be technology trends. Regarding the trend of the project location, the projects tend to be located in areas expanding into the suburbs. Finally, four marketing trends were also reported: Virtual Reality utilization in sales presentation, advertising to reach more customers, inviting social media influencers to play a role in reviewing projects, providing credit consulting services and refunding of reservation money if a customer's loan is not approved. The results of the study provide information to all parties involved in planning strategies and operating a business in developing housing estates in the future.

Keywords: Single-detached House, Land Subdivision Project, Development Trend, Modified Delphi Technique

1. INTRODUCTION

Housing projects have been ever-changing from the past to the present according to the trends of different eras. The key factors that are important to these changes include the ways of life, landscape characteristics and the tools or wisdoms invented to support livelihoods in different periods of time. Nowadays, one factor which plays a major role in the way of life of

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residents, especially those living in the Bangkok Metropolitan Region is technology, which is a matter that leads to many inventions and solutions to adapt and solve problems in human lives in the present. Technology not only develops the quality of life, but also prompts humans and the environment to coexist harmoniously. The continuous development of information technology has created a very new and complex environment, which greatly influences the world of our lives (Stolterman & Fors, 2004). It may either be new technological factors that are about to be invented or it may be a modification of the concepts or ways of human habitation already existing and waiting to be modified and adapted.

This prompted an interested in conducting a research study about the ten-year-trend (2022 - 2031) of housing (single-detached houses, twin houses, townhouses) projects in the Bangkok Metropolitan Region, the main location for subdivision project development in Thailand. The study was conducted in 2021, covering five areas of development trends as follows: (1) Trends in the physical design of the projects, (2) Trends of construction, (3) Trends of technology, (4) Trends of location and (5) Trends of marketing. The goal was to come to a conclusion regarding the experts' opinions of each trend, and its interesting issues, to be used as a guideline for housing developments to improve the quality of life of people in the Bangkok Metropolitan area over the next ten years, as this is the period in which organizations with a clear vision can plan long-term strategies to build competitiveness (Soloducho-Pele, 2015).

In performing this research, the Modified Delphi Technique was adopted due to its ability to find a solution for a problem with no definite answer, as revealed by Rescher (1998). However, in this research, the technique used is referred to as the Modified Delphi Technique, as it adapts the traditional Delphi Technique by limiting the rounds of expert opinion surveys to just two rounds and conducting a summary of the results.

Regarding the research question, nobody knows exactly what future will be, however the Modified Delphi Technique is able to allow people involved in the development of real estate projects in the category of single-detached houses, to use this study as operational information. For example, real estate developers, architects, engineers, innovators, marketers and any other interested parties, may use the findings of the study for the purposes of, efficiently formulating competitive strategies, or planning for business operations.

2. LITERATURE AND RELATED RESEARCH

This research categorized the trends of housing project developments into five trends, i.e., design, construction, technology, location, and marketing. With the multitude of problems being faced in today's world, there have been many impacts on both the quality of living and the economy. It is therefore important to formulate guidelines for studying future trends to find the most sustainable solutions.

2.1 Trends of Project Design

In addition to the beauty of a house and providing house layouts which meet the lifestyle needs of the homeowners who are the main residents, the beauty and functionality of a project's common areas will also affect the residents. The design is therefore important, both from a lifestyle perspective and from a marketing perspective, to persuade customers to buy a unit from a particular project. For example, in designing a home for elderly customers who have different living behaviors and requirements than other customers, these four principles must be considered to respond to their way of living: (1) Safety, such as the use of non-slip materials, removal of obstacles in the corridors and walkways inside the house, avoiding spiky plants indoors, installing handrails on stairs, avoiding stair designs that have no handrails or are not user-friendly, (2) Facilities, such as installing

automatic door opening and closing systems and also an elevator for going up and down in the house, (3) Preparation for emergencies such as providing a suitable escape route in the event of a fire, and (4) Organizing the environment in different living spaces, such as designing by creating symbols to enable self-help, providing places where things can be easily noticed, and removing sharp corners and edges on walls, columns or furniture for the safety of users (Sangsida, 2009). These principles can be extended and used in projects specifically made for the elderly (Glass, 2013). This shows that designing for specific customers not only affects the image of the house, but also the image of the project. It may also create opportunities for new projects with new customer groups. To respond to the lifestyles of residents for positive and sustainable living, design factors which promote sustainability must be used. The sustainability focused on here, can be divided into three aspects, namely: (1) Social sustainability including a design that can be used by all types of users and with consideration for safety; (2) Environmental sustainability, namely the use of appropriate materials, the selection of efficient resources in wastewater treatment, and the use of energy-saving materials; and (3) Economic sustainability, which helps to save costs over time (Alaghbari, et al., 2011)

Efficient design of a project's common areas influences decisions to buy a single-detached house in the project. It attracts buyers to be interested in moving in. Such design factors can be divided into four parts, namely: (1) The project entrance, which should focus on being safe, beautiful, conveniently accessible, with a pleasant atmosphere and environment, and with a clear view of the entrance, while the materials used must also be durable and of good quality; (2) Roads and pavements must be spacious with sufficient trees and shady landscaping; (3) Parks in the common areas should be designed to separate different usage and users since this is also a main concern of residents; and (4) the clubhouse should be equipped with a variety of facilities to meet the differing needs of people of all ages (Kaewprom, Suriyachan & Klongbessa, 2020).

2.2 Trends of Construction

Sustainable construction methods have become a central interest nowadays, since they cause less impacts on the environment without compromising the beneficial outcomes of construction. Such methods also create a competitive advantage in the market as they use an environmentally friendly construction approach throughout the building's lifecycle. There are three principles to sustainable construction including: (1) Resource conservation, (2) Cost savings and (3) Design for human adaptation, in order to achieve a sustainable future in the construction industry and take all areas of concern into consideration, such as energy saving, improved material usability, reduced material waste, pollution control and emissions (Akadiri, Chinyio & Olomolaiye, 2012).

One of the currently accepted construction techniques is the modular construction system. Almost all parts of the structure in the system are assembled and decorated at the factory. The efficiency of manufacturing and transporting a modular building depends on many factors, for example, the capability of production control (Theerapattrathamrong, 2016). Modular construction systems have the ability to reduce construction time by 20% to 50%. Moreover, in an efficient working environment, this method can reduce construction costs by up to 20%. Regarding the project design aspect, developing an application system which allows designers to plan their work along with a modular construction system, the consumption of time for designing can be reduced by up to 15%. Regarding the construction aspect, the modular construction parts are made lightweight for easy transport, resulting in a reduction in the size and complexity of the structures and foundations, and hence an ability to save more time. The shorter project construction

schedule offers developers an advantage of faster yield earnings, better cash flow and reduced market cycle risks (Bertram et al., 2019).

Modular construction systems are widely used all over the world in both low-rise and high-rise construction. The use of environmentally friendly materials and engineering equipment are invented to co-work with the modular system. This shows that modular systems are one of the techniques which have been developed over time to limit the problem of high costs. In the future, if the costs of modular system construction can be efficiently controlled, this technique will greatly help save the construction costs of future projects (Generalova, Generalov & Kuznetsova, 2016).

2.3 Trends of Technology

Technology plays an important role in supporting homeowners both physically and mentally. It also helps preserve the environment and leads to sustainable development. Smart home devices are an increasingly popular technology and are one of the components that must be present in a housing project to attract buyers. A smart home is a home that applies technology to help control devices and appliances. Some technologies offer the ability to control home devices even if the homeowner is not present. Nowadays, technologies related to smart homes have been developed in conjunction with the concept of the "Internet of Things" (IoT). These devices include any IT tools in our everyday life such as smart phones, tablets, and computers, including other home appliances. The technology links the devices, allowing them to share data via a wireless internet system. This makes it possible to command and control remote applications more quickly and conveniently. The purposes of smart home devices vary by the different types of technology, which can be categorized into 3 types as follows: (1) Technology that supports the comfort of residents, (2) Health, and (3) Safety (Alam & Ali, 2012).

Thailand is located in an area with a high potential for inexhaustible energy from solar sources. Using technology to install solar panels to receive natural energy from the sun is ever-renewing, as long as there is sunlight. This can help to reduce the use of electricity from other sources and cause less environmental impact, as well as reduce the cost burden on homeowners (Yiemwattana & Charenkit, 2018). This demonstrates human adaptation to use natural resources that do not cause negative effects on the environment. One Thai company launched an active air flow system, a technology that helps solve the problem of the sun's heat by ventilating homes to provide better airflow. This is another invention that applies a technology to aid humans in adapting to nature. The benefits of the system include ventilating the house to make the indoor air less hot and stuffy, cooling the house by two to five degrees, as well as reducing the incidence of mold or a damp smell in the house. From such ventilation, the system helps to make the house suitable for the elderly, children, or people with allergies as it is equipped with a filter for PM 10, PM 2.5, fine dust and insects. This also helps reduce the workload of air conditioners thereby reducing the use of electricity in the house (SCG Home, 2020).

In addition, producing household furniture using production technology with the aim to reduce by-product wastes and emissions at all stages of the product lifecycle is an alternative way to protect the environment. By using the following principles of production with the least impact on the environment, the objectives are: (1) to reduce the use of substances that can be harmful to the environment and human health, (2) to reduce material consumption, (3) to use packaging made from recycled materials or to facilitate recycling as well as to recycle packaging, (4) to extend product lifecycles, (5) to be able to dissemble product parts for recycling, (6) to safely dispose of the product, (7) to reduce energy consumption, and (8) to reduce the impact of transportation (Starčić and Domljan, 2006).

Nevertheless, there is also a concern that comes with smart home technology, namely the privacy of homeowners' information and the security of access to the living areas and houses, if any outsiders can penetrate the system that oversees the home applications. Therefore, smart home technology manufacturers should offer a warranty on problems that may occur to users, promoting this functionality to increase confidence among buyers. Positive perceptions of smart home technology devices include managing energy consumption, controlling the home environment and enhancing the safety of living (Wilson, Hargreaves & Hauxwell-Baldwin, 2017).

2.4 Trends of Location

Bangkok is a center of prosperity and a dense city. The economy, the workplaces and the opportunities attract many people from the rural population who wish to seek success or wealth, spurring them to decide to migrate to the capital. In the past, Bangkok has initiated a development plan to accommodate this growing and large number of residents, causing the development of many different types of housing. However, with the current economic recession, it has been found that labor wage growth in Bangkok and property price growth are at a different pace, resulting in reduced ability to buy houses or condominiums among the working people in Bangkok. Therefore, most developers are interested to expand the capital's prosperity to the suburbs, due to lower real estate prices but with more living space when compared to units in the city center. Furthermore, the new work-from-home behavior initiated during the Covid-19 pandemic situation has also driven employees to start looking for more suburban options (Prachatai, 2015).

An interesting point is that the need to expand residential areas from the heart of the city to the outskirts of the suburbs is a global phenomenon. For example, westerners migrate to live only out of the need for suburban housing (Beauregard, 2006), while people in China, a country which is densely populated, have a desire to relocate to the suburbs for several other reasons. These reasons include a more industrialized economy in the suburbs and a high demand for employment as well as an excessively high price of land within the city center that drives buyers without enough purchasing power to move to the outskirts. In the beginning, only low-paid laborers tended to move to the suburbs. Over time, people from the middle class to the wealthier upper class started to see the prosperity and the liveliness of the suburbs and wished to have their second or third home, or as an investment for future wealth. The same trend is also happening in western countries (Shen & Wu, 2013). When the wealthy of the middle class to the upper classes migrate to the suburbs, lifestyles and environments in those areas also need to change and develop according to the needs of the new residents (Zhou & Logan, 2008).

2.5 Trends of Marketing

In an era where technology plays a role in helping and supporting communication and information research, most people choose to search for online information first before going to actual sites. Therefore, marketing is the front line of selling a project even before consumers decide to visit the project. The focus on online marketing is thus imperative. In addition to using online marketing as a tool that organizations use to attract customers to book a project, it is also a tool that facilitates online word-of-mouth for customers. Positive reviews from customers who bought the project's house or criticism from social influencers also results in a boost in sales to customers who are looking for a house.

There are many aspects to study regarding the marketing factors which respond to consumers looking for housing, including gender, age, status, education level, occupation,

average monthly income, and the number of family members. The factors affecting the project's marketing are the project location, modern style, and good environment of the house, convenience to travel to the workplace or the children's school, and a variety of travel route options. Safety and security in life remains the most important factor for consumers (Thongmueangluang, 2011).

2.6 The Modified Delphi Technique

The Delphi Technique can study and analyze a body of knowledge that has no definite answer as yet, such as future trends, utilizing the principle that the predictions made by a structured group of individuals are more accurate than those made by an unstructured group (Rescher, 1998; Rowe & Wright, 2001). With Delphi Technique, the judgement of a group of experts will be structured by the repetitive feedback of the summaries of the group's answers, along with the reasons of the experts, and allowing the experts to revise their previous answers until the predetermined criterion is met (McLaughlin, 1990). The main characteristics of the Delphi Technique are: (1) Non-disclosure of a list of experts, (2) Provision of feedback for experts to review their opinions, and (3) Official diagnosis of the group's comments. It is believed that during this process, the range of opinions will narrow, and the group will converge towards a 'correct' answer. Ultimately, the process will cease after predefined criteria are met such as achievement of consensus or stability of findings, and the mean or median score of the final round will be examined to assess the results (Rowe & Wright, 2001).

In this research, the technique adopted in finding future trends from the group of experts was called the "Modified Delphi Technique" as the Delphi Technique was applied with a limited number of questionnaires and two rounds of interview, so as not to unnecessarily disturb the experts, which would affect their response rate.

3. METHODOLOGY

A total of three rounds of data collection were conducted in this study, during March to June 2021. The set criteria for the selection of experts in the study were divided into two groups, consisting of a group of interviewees in round one to collect the future trends, and a group of respondents in round two and three utilizing the Modified Delphi Technique. The selection of participants focused on the qualifications of the experts which must be consistent with the research variables framework. The research methodology was as follows.

1) Perform a Literature Study and Review

Study and review the literature and research related to the trends of single-detached houses in housing estate projects for the next ten years.

2) Perform Round 1 of the Data Collection Process

Prepare an interview on the trends of housing project development over the next ten years. The interviews were divided into five sets with different topics according to the five trends to be used with five majors of experts who are knowledgeable with at least ten years of work experience in the field related to the subject matter of the interview, and who must possess the following qualifications:

(1) Be in an organization that is related to the subject of the interview.

(2) Work in a position of university professor, or general manager (GM), managing director (MD), or higher in the specified industry.

To examine the quality of the interview tool in round one, the Item-Objective Congruence (IOC) must be determined by an expert (Rovinelli & Hambleton, 1976; Ongiem & Vichitvejpaisal, 2018). The accuracy value of the questionnaire or the corresponding value

between the questions and the purpose or content can be found under the following criteria.

Score +1, if certain that the questions measure up to the objectives.

Score 0, if uncertain that the questions measure up to the objectives.

Score -1, if certain that the questions do not measure up to the objectives.

The results obtained from the experts are taken to calculate the IOC value according to the following formula IOC = ΣR / N, where IOC is the item-objective congruence; ΣR is the sum from all experts' ratings; and N is the number of experts. The questionnaires used in this study have an IOC value of more than 50%, which is higher than the criteria recommended by Tirakanan (2008) and Panthai (1996).

3) Perform Round 2 of the Data Collection Process

Prepare a questionnaire for the second group of experts using the Modified Delphi Technique, based on the data obtained from literature reviews and interviews with the experts in group one. In the second and third rounds of interviews, a total of ten real estate professionals were involved. These professionals must have at least ten years of work experience in the field related to the subject of the interview and must have one of the following qualifications:

(1) Be in an organization related to real estate

(2) Work in a position of a general manager (GM), project manager (PM) or higher, or work in a position of similar practice.

Real estate experts in rounds two and three rated all five trends in the questionnaire and provided reasons to support or oppose each predicted trend of the single-detached house models in housing estate projects over the next ten years.

Expert rating was considered from the appropriateness of using the Delphi Technique. The criteria for determining the consensus trend of the majority of experts must be at level of four or higher, from a 5-point Likert estimation scale (Best, 1977). The score intervals were divided as follows: 1.00 – 1.80 = Very low likelihood to occur, 1.81 – 2.60 = Low likelihood to occur, 2.61 – 3.40 = Medium likelihood to occur, 3.41 – 4.20 = High likelihood to occur, and 4.21 – 5.00 = Very high likelihood to occur.

4) Perform Round 3 of the Data Collection Process

When the scores from the second round of questionnaires of the second group of experts were received, the average of each trend's probabilities was arranged. The trend probability scores and experts' supportive or opposing opinions were then sent back to each expert again. In doing so, the real estate experts could determine the average of probabilities, the supporting or opposing reasons for each predicted trend from other experts, and then rescore.

5) Analyze the experts' consensus

The results were then summarized and the recommendations were prepared for trends of housing projects that are suitable for single-detached houses in the future, with the methods for finding consensus as follows:

(1) While examining consensus by the percentage ratio, if any item had a total average of not less than 60%, it was considered to be in consensus (Flanders, 1988; Barrios *et al.*, 2021).

(2) While examining the stability value of the answers, when there was not more than 20% change from the previous round (Murry & Hammons, 1995).

(3) Using statistics that measure trends towards the center, to find consistency of answers by examining the median, which should be not less than 3.5, while the absolute value between the mode and the median should not exceed 1.00, and the interquartile range should not exceed 1.50 (Charernputh & Chirinang, 2015).

Therefore, the average results may end up with some inconclusive trends, but it is found that any trend with a high total score indicates high potential to be the genuine trend of single-detached house projects over the next ten years.

4. RESEARCH RESULTS

Based on interviews with five industry experts regarding the trends of single-detached housing developments in land development projects in Bangkok over the next ten years (2022-2031), covering all five trends of design, construction, technology, location, and marketing as described in Table 1, in order to forecast the trends of single-detached housing development of future projects, when combined with trends from the literature review, 40 trends were able to be identified. The trends can be divided into 17 trends in design, four trends in construction, seven trends in technology, two trends in location, and 10 trends in marketing. When the second group of ten experts was surveyed with two rounds of a questionnaire using a 5-point Likert scale and consensus analysis was performed according to the Modified Delphi Technique. The mean was then interpreted according to the Best (1977) method. The result of this analysis is shown in Table 2. It should be noted that only thirteen trends reached consensus from the experts; i.e., met all screening criteria of the Delphi Technique, as shown in Table 2.

Table 1 Summary of Expert Qualifications

	Interview	Questionnaire
1. Number	5 Experts	10 Experts
2. Qualifications	• Have a career that is related to the trends studied • Be in a position of managing director, business owner or university professor • Have more than 10 years of working experience	• Work in real estate development • Have a position of department manager or above • Have more than 10 years of working experience
3. Details of the informants	• 1 Shareholder of a design company • 1 Owner of a construction company • 1 University professor • 2 Owners of real estate development companies	• 5 experts from design department • 1 expert from marketing department • 2 experts from management department • 2 experts from engineering or construction supervising departments

5. DISCUSSION AND SUMMARY OF THE RESEARCH RESULTS

From the summary of the research results from the items that received a consensus score, as shown in Table 2, the researchers considered the trends that the experts thought to be highly likely or very highly likely to occur in the future (with a combined average score of 3.41 and 4.21 or more, respectively) from the Modified Delphi Technique, limiting the number of rounds of asking for expert opinions and from literature review. These results consider the principles regarding planning for the future with resilience theory. Looking at the big picture, it should be noted that some of the matters of consensus are already happening today as the experts regard them as good starting points which should continue to develop. Some issues have been in the spotlight for a long time but the solution has only recently been developed. Some are new ideas that the experts find interesting and which should be further studied to actualize the concepts. From the research results of each trend where the experts had consensus on the likelihood to occur in the next ten years, the summary can be described as follows.

Table 2 Results from the Two Rounds of Questionnaires of the Second Group of Experts

Trend	Mean (Value not less than 60%)	Mode (Percentage of all experts)	Change of from the Previous Round (Not exceeding 20%).	Median (Not less than 3.50)	|Mode - Median| (Not exceeding 1.00)	Interquartile Range (Not exceeding 1.50)	High Likelihood to Occur (Mean Score of 3.41 – 4.20)	Very High Likelihood to Occur (Mean Score of 4.21 – 5. 00)
Trend of Design								
1. More beautiful façade	3.8	4 (80%)	20%	4	0	0	✓	
2. Soundproof wall	3.5	4 (60%)	0%	4	0	1	✓	
3. Universal design furniture	3.8	4 (60%)	0%	4	0	0	✓	
4. Universal design house building	3.6	4 (40%)	0%	5	0	1		✓
Trend of Construction								
1. Eco-friendly Materials	4.0	4 (80%)	0%	4	0	0	✓	
2. Modular Construction	4.0	4 (80%)	0%	4	0	0	✓	
Technology Trend								
1. Smart home devices installation	4.2	4 (80%)	20%	4	0	0	✓	
2. Active Air Flow Technology	4.2	4 (60%)	10%	4	0	1	✓	
Location Trend								
1. Expanding to the Suburb	3.6	4 (70%)	20%	4	0	0	✓	
Marketing Trend								
1. Virtual Reality (VR) in Sales Presentation	4.0	4 (80%)	10%	4	0	0	✓	
2. Advertising to Reach More Customers	3.9	4 (70%)	10%	4	0	0	✓	
3. Influencers or Celebrities to Review Projects	3.9	4 (60%)	0%	4	0	1	✓	
4. Loan Consultancy Service and Refund of Deposit in Case of Loan Rejection	4.2	4 (80%)	20%	4	0	0	✓	

1) Design issues focused on adding more beauty to the front part of houses (façade), changing the walls to soundproof materials, adding more furniture that are elderly-friendly, using smart home devices and adding ramps for the elderly and the disabled in the projects. Due to the design of the interior space aiming for flexibility and adaptability, this may thus reduce the design dedicated for aesthetic purposes. To be precise, this trend suggests that in the next ten years, the house design will focus on the functionality of the interior space, application of technology into different parts of the house and material selection that is more elderly-friendly, rather than focusing on the sake of appearance alone. Therefore, the beauty element is likely to be moved to the front or façade of the house instead. This is related to the probability that the elderly population will increase in the future, resulting in a trend for furniture design and ramps in projects for seniors, including the use of smart home technology to help and care for them. This idea has arisen from the analysis of problems and trends for elderly care, which can be extended to a project made for seniors as a community where individuals can take care of each other (Glass, 2013). The introduction of smart home technology as a life support for the elderly must take these three concerns into consideration: (1) Support for convenience, (2) Health, and (3) Safety (Alam & Ali, 2012). As a consequence of the Covid-19 epidemic, there is a new behavior of working from home or online education, resulting in an increasing need for smart home devices which connect to the outside world. The use of soundproof materials for the houses is also becoming more important, since residents require more privacy as they spend more time at home. From the results of the scoring consensus, it was also observed that some of the design issues with the highest numbers failed to achieve a unanimous consensus. This notion can be added to the result analysis to see if the design issue will become less important in the future, or not important enough to be in the development interests when compared to other issues. A notable aspect in this finding is the elderly who have become a central interest, differing from the current target groups of other ages. Nevertheless, the issue of an aging society has long been a topic of interest. The experts' consensus is the result that supports the idea of an increasing aging population. As a result, it is likely that a growth of real estate that targets the elderly will rise far faster than how it does in the present.

2) The construction issue is focused on becoming more eco-friendly in process. This is an interesting aspect that differs from the current construction method which still requires heavy use of materials that pollute the environment. The future of material selection may include more reused and reusable material or newly invented materials that are environmentally friendly. There is no definitive answer to this issue at the moment as there is yet no significant difference to the cost of both of options. From an interest of environmental protection, the trend for construction aims to use eco-friendly materials that help reduce pollution, as well as technology that helps to control air quality. This is to create a good environment for residents with sustainable construction methods and to have less environmental impact without compromising the beneficial outcomes of construction. The use of environmentally friendly construction approaches throughout the building's lifecycle will be implemented in order to achieve a sustainable future of the construction industry and to take more matters into consideration, whether it be energy saving, improving the material usability, reducing material waste, or controlling emissions of pollution (Akadiri, Chinyio & Olomolaiye, 2012).

3) For the technology issue, the experts agreed that modular construction techniques will help to save both labor costs and working time, consistent with the construction issue. Reducing costs and controlling work time lead to marketing advantages in the ability to guarantee the period of home delivery to buyers. If a project is capable of good sales, modular systems can be applied to expedite project closure. This method is also environmentally friendly as it requires shorter production time and can be manufactured at the factory, hence less air or noise pollution on site that would disturb residents and the neighborhood (Theerapattrathamrong, 2016). This is related to the use of environmentally friendly

construction materials and engineering equipment invented to be incorporated with the modular system, showing that this method has been continuously developed to limit the problem of high costs. In the future, if the cost of the modular construction system subsides, this technique will greatly help to save construction costs (Generalova, Generalov & Kuznetsova, 2016). Due to the Corona virus pandemic, people have become more interested in air conditioning and living at home. The use of cool house technology to control interior air temperature and reduce the workload of air conditioners and air pollution, as well as to improve indoor air quality for residents, will help to solve these problems. For example, the active air flow cool house technology helps ventilating the air to create comfortable living conditions. The technology offers several benefits which include helping to ventilate the house, solving the problem of hot and stuffy air, cooling the house by 2-5 degrees, reducing mold and a musty smell, and easing the workload of air conditioners, thereby reducing the use of electricity in the house (SCG Home, 2020).

4) The location issue is a matter of expanding land area outside the city which focuses on the eastern regions, namely Min Buri, Klong Sam Wa, Nong Chok, and Lad Krabang districts, and the western regions, namely Bang Bon and Bang Khun Thian districts. Some companies have already begun focusing on this strategy, moving out to the suburbs. Residence options have been increasing due to the growing demand of housing since people were required to stay indoors after the pandemic hit. People do not need to live close to their workplaces due to the new work-from-home way of live. With the unstable economy in contrast to the high price of land in the city center, more buyers with lower purchasing power are attracted to move out to the suburbs (Shen & Wu, 2013). When people in the middle or upper classes migrate to the suburbs, they will also cause development in these areas (Zhou & Logan, 2008), as well as contributing to the added value of real estate.

5) The marketing issue aims for greater use of the virtual reality (VR) technology to increase the potential of a online show house visits. This will also reduce the difficulty of traveling to the project in both distance and time, as well as a feeling of discomfort in some customers when faced with a salesperson. Advertising must reach more customers. Using celebrities and social influencers will also help convince clients to be interested in the projects. Provision of consulting services on bank mortgage loans is also necessary. Technology offers more channels to connect with people; it is therefore a necessity for marketing to use technology to reach clients through various channels. Marketing is considered a frontline of sales that consumers encounter even before they decide to visit the project. The focus on online marketing is imperative. The use of technology that facilitates communication with customers will result in positive reviews from the first customers of the project. Positive criticism from social influencers will also lead to a sales boost (Park, Lee & Han, 2007).

6. SUGGESTIONS FROM THE RESEARCH

This research identified the real estate development trends that are likely to occur in the future, based on numerous current real estate development trends, using the systematic approach of a Modified Delphi Technique. Following the research results, a number of suggestions are proposed for the involved parties:

1) Suggestions for real estate developers

The proposed trends can be used as guidelines for real estate developers, presenting the approach from an entrepreneurial perspective. If entrepreneurs are to adopt the proposed trends of single-detached houses in housing projects, the views and needs of the customers should also be taken into account. In addition, customers' willingness to pay should be keep in mind for every decision to change as changes in cost, normally lead to changes in the price of the house that may cause a change in mind of the customers.

2) Suggestions for designers

Although this research presents various design trends related to housing projects, such as enhancing exterior wall aesthetics, using soundproof materials, designing with the universal design concept, and incorporating smart home devices, designers should not adopt every trend as some may increase the cost and price of the houses, or may not align with the needs of the customers in the project's market segment. Therefore, designers should understand the customers' needs to select the most effective design trends from those presented.

Moreover, over the next ten years, human behaviors may change due to an encounter with an unexpected way of life that leads to behavioral shift, or an invention of technology that responds to a way of living that is totally different from how it is today, which will also affect the future trends of residential design. Designers must therefore continually observe and track the changes that could change the trends of residential projects.

3) Suggestions for marketing specialists

This research was conducted without consideration of organizations' brand image strategies, which is a key strategy for reaching customers. Therefore, it is suggested that before applying the trends of housing projects mentioned in this research into any works, careful consideration of organization specific guidelines should also be conducted. Further study regarding the preferences of new generations and global trends of high interest in technology should also be applied alongside marketing strategies to achieve strength to compete in the market.

4) Suggestions for inventors

Designing new technologies should be mainly based on the aim to support safety and comfort. Inventors should also be careful in the matter of data privacy since there is a possible chance of data interference and theft. Furthermore, each customer has different levels of awareness and interest in innovation or technology. Therefore, when incorporating technology and innovation, this aspect should also be taken into consideration.

Finally, it should be noted that there are a few limitations of this research. As the researchers decided to limit the number of questionnaire surveys in Delphi process to only two rounds, certain trends have a high score yet did not achieve unanimous agreement, resulting in fewer trends achieving consensus. This limitation can be addressed by information technology, such as conducting expert opinion surveys through online systems, which can significantly reduce the time required for collecting and processing responses. Finally, this research predicts the possible future trends of housing estate projects to make stakeholders aware and prepared. However, to adapt the project according to the proposed trends, stakeholders must conduct feasibility and suitability studies, as well as assess the risks in detail beforehand.

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8. REFERENCES

Akadiri, P.O., Chinyio, E.A. & Olomolaiye, P.O. (2012). Design of a sustainable building: a conceptual framework for implementing sustainability in the building sector. *Buildings*, 2(2), 126-152. https://doi.org/10.3390/buildings2020126.

Alaghbari, W., Salim, A., Dola, K. & Abdullah Abang Ali, A. (2011). Developing affordable housing design for low income in Sana'a, Yemen. *International Journal of Housing*

Markets and Analysis, 4(1), 84 -98. https://doi.org/10.1108/17538271111111857.

Alam, M. & Ali, M. (2012). A review of smart homes – Past, Present, and Future. *IEEE Transactions on Systems Man and Cybernetics Part C* (Applications and Reviews), 42(6), 1190-1203. https://doi.org/10.1109/TSMCC.2012.2189204.

Barrios, M., Guilera, G., Nuño, L., Gómez-Benito, J. (2021). Concensus in the Delphi Method: What Makes a Decision Change? *Technological Forecasting and Social Change*, 163, 1-10. https://doi.org/10.1016/j.techfore.2020.120484.

Beauregard, R. (2006). *When America Became Suburban*. Minneapolis, MN: University of Minnesota Press.

Bertram, N., Fuchs, S., Mischke, J., Palter, R., Strube, G. & Woetzel, J. (2019). *Modular Construction: From Projects to Products*. Retrieved on 10 August 2023 from https://www.mckinsey.com/capabilities/operations/our-insights/modular-construction-from-projects-to-products

Best, J.W. (1977). *Research in Education* (3rd ed). Englewood Cliffs, New Jersey: Prentice Hall, Inc.

Charernputh, V. & Chirinang, P. (2015) Future Research Techniques; Delphi Technique . *Western University Research Journal of Humanities and Social Science*, 1(3): 40 – 26.

Flanders, F.B. (1988). *Determining Curriculum Content for Nursery / Landscape Course Work in Vocational Agriculture for the 21st Century: A Futures Study Utilizing the Delphi Technique.* Published Doctoral Dissertation, The University of Georgia, Athens, Retrieve on 31 October 2023 from https://www.proquest.com/docview/303556966.

Generalova, E.M., Generalov, V.P. & Kuzmetsova, A.A. (2016). Modular Building in Modern Construction. *Procedia Engineering*, 153, 167-172. https://doi.org/10.1016/j.proeng.2016.08.098.

Glass, A.P. (2013). Lessons learned from a new elder cohousing community. *Journal of Housing for the Elderly*, 27:4, 348-368. https://doi.org/10.1080/02763893.2013.813426.

Kaewprom, K., Suriyachan, C. & Klongvessa, N. (2020). Landscape Design of Public Areas Influencing Buying Decision for Single Housing Projects in Bangkok: Case Studies of the Perfect Place Projects. *Sarasatr*, 3(3): 707-720.

McLaughlin, M.W. (1990). The Rand Change Agent Study Revisited: Macro Perspectives and Micro Realities. *Educational Researcher*, 19(9): 11-16.

Murry, J.W. & Hammons, J.O, (1995). Delphi: A Versatile Methodology for Conducting Qualitative Research. *The Review of Higher Education*, 18(4), 423-436. https://doi.org/ DOI:10.1353/rhe.1995.0008.

Ongiem, A. & Vichitvejpaisal, P. (2018). Validation of the Tests. *Thai Journal of Anesthesiol*, 44(1): 36-42.

Panthai, B .(1996) .*Introduction to Educational Research Methodology*. Bangkok: Ramkhamhaeng Press.

Park, D.H., Lee, J. & Han, I. (2007) The Effect of Online Consumer Reviews on Consumer Purchasing Intention: The Moderating Role of Involvement. *International Journal of Electronic Commerce*, 11(4), 125–148. https://doi.org/10.2753/JEC1086-4415110405.

Prachatai. (2015). Launching "Bangkok 250", Predicting 10 Trends, 8 Areas, And 6 Changes in Bangkok in 2032. Retrieved on 10 August 2023, from https://prachatai.com/journal/2015/05/59275.

Rescher, N. (1998). *Predicting the Future: An Introduction to the Theory of Forecasting*. Albany NY: State University of New York Press.

Rowe, G. & Wright, G. (2001). Expert Opinions in Forecasting: The R of the Delphi Technique. In: Armstrong, J., Ed., *Principles of Forecasting: A Handbook for Researchers and Practitioners*, Kluwer, Boston, 125-144. Retrieved on 3 January 2024, From

http://www3.nd.edu/~busiforc/handouts/Other%20Articles/expertopinions.pdf.

Rovinelli, R.J. & Hambleton, R.K. (1976). On the Use of Content Specialists in the Assessment of Criterion-referenced Test Item Validity. *Proceedings of the 60th Annual Meeting of the American Educational Research Association*, California, USA, April 19-23, 1976.

Sangsida C.) 2009). *Living Condition of Elderly with Dementia at Home: A Case Study of the Alzheimer's Disease and Disorder Association Elderly, Bangkok Metropolis*.Master's Degree Thesis, Chulalongkorn University, Bangkok.

SCG Home. (2020). *Innovative Ventilation for a Comfortable Home by the Ventilation System Active AIRflow System*. Retrieved on 9 May 2020. from https://scghome.com/assistance/solutions.

Shen, J. & Wu, F. (2013) Moving to the Suburbs: Demand-side Driving Forces of Suburban Growth in China. *Environment and Planning A* 2013, 45, 1823 – 1844. https://doi.org/10.1068/a45565.

Soloducho-pele, L. (2015). Planning Horizon as a Key Element of a Competitive Strategy. *Journal of Economics, Business and Management*, 3(2), 161-166. https://doi.org/10.7763/JOEBM.2015.V3.174.

Starčić T. & Domljan D. (2006). Environmental Standards in Eco-furniture and Eco-equipment Making. *European Union International Counselling* (AMBIENTA 2006), Zagreb, Croatia, 11-15 October 2006.

Stolterman, E. & Fors, A.C. (2004). Information Technology and the Good Life. In: Kaplan B., Truex D.P., Wastell D., Wood-Harper A.T., DeGross J.I. (eds) *Information Systems Research. IFIP International Federation for Information Processing*, Vol 143. Springer, Boston, MA. https://doi.org/10.1007/1-4020-8095-6_45.

Theerapattrathamrong, W. (2016). *A Study of the Acceptance of Modular Construction System in Real Estate Development of Housing Project in Bangkok and Its Vicinity*. Master's Degree Thesis, Thammasat University, Pathum Thani.

Thongmueangluang, A. (2011). *Market Factors that Influence on Buying Decision Process the Detached House of Pruksa Real Estate Public Company Limited*. Master's Degree Independent Study, Rajamangala University of Technology Thanyaburi, Pathum Thani.

Tirakanan, S. (2008). *Research Tool Building in Social Research: Implementation Guidelines*, Bangkok: Chulalongkorn Press.

Wilson, C., Hargreaves, T. & Hauxwell-Baldwin, R. (2017). Benefits and Risks of Smart Home Technologies. *Energy Policy*. 103, 72-83. https://doi.org/10.1016/j.enpol.2016.12.047.

Yiemwattana, S. and Charenkit, S. (2018). *The Prototype Solar House for Tropical Climate of Thailand.* Master's Degree Thesis, Faculty of Architecture Naresuan University, Phitsanulok.

Zhou, Y. & Logan J.R. (2008). Growth on the Edge: The New Chinese Metropolis. In *Urban China in Transition*. Eds Logan, J.R. Blackwell Publishing. Oxford, 140–160.