



## Location Selection Model for a Dental Clinic in a Low to Medium Rent Commercial Building

Umaporn Vimonkittipong<sup>1</sup>, Kongkoon Tochaiwat<sup>2\*</sup>,  
Suriya Sirithanyarat<sup>2</sup>, Varalee Thumvisuttivarakorn<sup>3</sup>

<sup>1</sup> College of Dental Medicine, Rangsit University, THAILAND.

<sup>2</sup> Faculty of Architecture and Planning, Thammasat University, THAILAND.

<sup>3</sup> Narai Property, Co. Ltd., THAILAND.

\*Corresponding Author (Tel: +66-9922893328, Email: kongkoon@gmail.com).

Paper ID: 13A1R

Volume 13 Issue 1

Received 14 August 2021  
Received in revised form 09  
November 2021  
Accepted 16 November  
2021  
Available online 21  
November 2021

**Keywords:**  
Modified Analytic  
Hierarchy Process;  
Dental clinic location;  
Commercial Building;  
Multi-Criteria Decision  
Making; Location  
selection.

### Abstract

As Thailand has the highest market share in dental services in Asia and the choice of business location is critical to the business success, the objective of this research was to create a model for selecting a suitable location for a dental clinic business in a commercial building in Bangkok with rent less than \$750 per month. The data were collected from 30 samples of owners, partners or dentists of dental clinics in commercial buildings in Bangkok with rents less than \$750 per month. The data were then analyzed by the descriptive statistics such as frequency, percentage, mean and Modified Analytic Hierarchy Process. The study results found that the priorities of the main criteria for selecting the location of commercial buildings in Bangkok are, respectively transportations, communities, parking, facilities and competitors. The first six sub-criteria of the most important are: adjacency to the main road, adjacency to the secondary road, parking in the clinic area, being near the residential area, being near residential condominium and fewness of competitors' clinics in the area, respectively. This research is an example of the application of the Modified Analytic Hierarchy model to quantify the level of importance to make a decision based on a variety of factors, or Multi-criteria Decision Making (MCDM), more efficiently.

**Disciplinary:** Business Management, Architectural Science & Spatial Planning.

©2022 INT TRANS J ENG MANAG SCI TECH

### Cite This Article:

Vimonkittipong, U., Tochaiwat, K., Sirithanyarat, S., Thumvisuttivarakorn, V. (2022). Location Selection Model for a Dental Clinic in a Low to Medium Rent Commercial Building. *International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies*, 13(1), 13A1R, 1-11. <http://TUENGR.COM/V13/13A1R.pdf> DOI: 10.14456/ITJEMAST.2022.18

# 1 Introduction

Location selection for business establishment is a complex and strategic decision. It may affect a company's future and profitability in the long run. Making a decision to select a location may be boiled down to a careful analysis of various economic factors done by the entrepreneurs who are driven by several significant contributions to choose the best location. One of the important characteristics of the promising location is that it should be situated in a low-wage area, leading to an increase in profits. Most entrepreneurs have been focusing on starting their businesses or relocating to areas of the like (Dixit et al., 2019). Location selection for a business establishment is therefore essential to the success of a business because it is the procurement of the most efficient business venue. Entrepreneurs must also take into account profits, expenses, employees, customer relations, convenience and a good environment throughout the business which must be carefully considered to minimize future problems (Wanitdee, 2022; Hellberg et al., 2021).

A dental service business is an important business according to Thailand's strategic plan for development to be Asia's healthcare hub and generates high income for the country. It is a business that grows by leaps and bounds. The factor that drives a large number of foreign customers, especially those from developed countries, to use dental services in Thailand is that it is highly costly and takes a long to be in waiting for queues to meet with dentists in the developed countries. In addition, some developed countries' health insurances do not cover dental services and Thailand is the top destination that foreigners choose to use dental services, making the country achieve the highest market share in dental services in Asia (Khaosod Online, October 10, 2019). These growth and business opportunities certainly incentivize more people to invest in this business.

Jain et al. (2018) revealed a precise and efficient selection of location and property for a dental business is one of the keys to success for a dental practice in India. For such service in Thailand, commercial building is a type of property mostly chosen and developed by dental clinic operators for dental business establishments. Therefore, the objective of this research was to study the criteria and the weight of criteria to select a suitable location for a dental clinic business which is a commercial building in Bangkok. Moreover, the development of a model for location selection can be demonstrated to be a guideline for dental clinic business entrepreneurs to choose the location of commercial buildings in Bangkok to become a potential establishment and support their business success.

## 2 Literature Review

### 2.1 Location Selection

Location refers to the place or situation of an establishment for carrying out activities that can promote and facilitate operations to achieve the set objectives by taking into account costs, profits and other related factors (Sricharoen, 2016). The location of the property is the point where the business starts and adheres to a long-term relationship and if a defect or error occurs, it will be

complicated to fix. The factors commonly used in the decision-making process to choose a location include environments, utilities, transportations, laws and taxes, and land, among others (Praneetpolgrang et al., 2000; Wattanachai, et al., 2021).

Location selection of a dental clinic depends on the target customer group, for example, if they are private office workers, the location should be in downtown or city-center area, meanwhile, if they are tourists, the clinic should be placed in touristy areas, etc. However, the good location for dental clinics is the area where customers can travel to and fro with convenience, such as the areas close to the BTS stations or near the expressway, among others. The convenience for customers includes travel patterns, parking, visibility and accessibility, as well as safety and comfort in using the service (Leenanuruksa, 2016). In this research, related works were studied to find the criteria for location selection by doing a literature review on related research as shown in Table 1.

**Table 1: Summary of criteria for selecting a location from the literature review**

Research	Criteria									
	Characteristics of Lands and Environments	Labour Resources	Raw Material Resources	Customers	Competitors	Transportation and Accessibility	Logistics	Facilities	Laws and Regulations	Growth Opportunity
Sirithananonsakun (2017)		✓				✓		✓		
Chaiyawong (2017)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Kongsuk (2015)		✓				✓		✓		
Jain et al. (2018)	✓					✓		✓		
Tochaiwat, et al. (2017)	✓	✓				✓	✓	✓		
Indarti (2004)	✓	✓	✓	✓		✓	✓	✓		
Halstead & Deller (1997)		✓	✓	✓			✓	✓	✓	

From Table 1, the main criteria can be summarized to be used in the study in five areas: (1) Transportation criterion (adjacency to the main road, being near the BTS or MRT, adjacency to a secondary road, being near a bus stop, van or motorcycle stations) (2) Community criterion (being near a residential area, condominium, office place, educational institute, industrial factories, government service center or hotel) (3) Daily-life facility criterion (being near shopping mall, convenient store or market, pharmacy, restaurant or beauty salon) (4) Parking criterion (parking near the clinic, free nearby parking, paid nearby parking or parking that requires the use of certain services in the facility) and (5) Competitor criterion (fewness of competitor clinic, hospital or health center). This is because the dental clinic is a service business that requires a lengthy time to serve and has a tendency of high competition. The researcher, therefore, took the main criteria of parking and competitors into consideration as well.

## 2.2 The Modified Analytic Hierarchy Process: Modified AHP

The Analytic Hierarchy Process (AHP) is a process for analyzing and determining the optimum solution or choice by using a set of criteria and dimensions (Vargas, 2010). It is a decision-making method done by evaluating multiple criteria by comparing the priorities of each of the criteria in pairs (pairwise comparison) to prioritize the criteria and find the best option (Aguezzoul, 2012). The Analytic Hierarchy Process is a method to weigh values of abstract opinions in numerical manner to make them concrete. There are five steps to the process including: (1) the

decision-making hierarchical structure which consists of the targets, the key criteria, the sub-criteria and the options, respectively, (2) considering and comparing the importance of the decision criteria in pairs by specifying numbers of the importance weight (3) determination of each criterion weight, (4) consistency ratio validation and (5) prioritizing options.

However, many researchers have used the Modified Analytic Hierarchy Process in response to their research objectives such as Kallas et al. (2011) and Likitanupak & Tochaiwat (2012) who used the Likert Scale instead of the pairwise comparison scale to reduce the number of questions in the questionnaires, as well as the works of Kongsuk (2015) and Tochaiwat et al. (2021) which adopted the pairwise comparison and analysis of the original AHP but stopped the analysis once the weight of each criterion was achieved and consistency of rationality was verified. The process was done without prioritizing the alternatives in order since the researchers aimed to only acquire the weight of each criterion. In this research, the researchers modified the original Analytic Hierarchy Process by analyzing only some steps of the process to obtain the importance weight of the criteria for selecting the location of commercial buildings in Bangkok with rents less than \$750 per month for a dental clinic business, according to the guidelines of Kongsuk (2015) and Tochaiwat et al. (2021). It should be noted that the exchange rate used in this research was 33.34 baht per US dollar (Bank of Thailand, 2021).

### 3 Method

This research used mixed methodology by interviewing five experts who had past experiences in the location selection for more than three dental service establishments, in order to screen the criteria obtained from the literature review. The criteria were then included in the questionnaires to be used as a tool for data collection from 30 sample groups of owners, partners or dentists of dental clinics situated in commercial buildings with rents less than \$750 in Bangkok. The data analysis was done by using descriptive statistics such as frequency, percentage, mean and Modified AHP, which compared the weights of each main and sub-criteria in the pairwise comparison manner with scoring criteria as shown in Table 2.

**Table 2:** Comparison of each main and sub criterion in pairwise comparison (Adapted from Saaty (1994)).

Importance Level	Meaning	Description
1	Equally Important	Both factors being compared are equally important.
3	Less Important	The first factor being compared is slightly less or more important than another factor.
5	Moderately More Important	The first factor being compared is moderately less or more important than another factor.
7	Highly More Important	The first factor being compared is highly less or more important than another factor.
9	Ultimately More Important	The first factor being compared is ultimately less or more important than another factor.

In this regard, the researcher found the mean of importance scores of each criterion from a pairwise comparison of the samples, if criterion A was more important than criterion B that was being compared, the mean would be calculated using the score as shown in Table 2. But if criterion A was less important than criterion B that is being compared, the mean would be calculated using the reciprocal of the score as shown in Table 2. For example, if criterion A was significantly more

important than criterion B, the score would be seven. At the same time, if criterion A was significantly less important than criterion B, the score would be  $1/7$  and so on.

## 4 Result of the Study

### 4.1 Results of the Expert Interviews

The researcher screened the sub-criteria for selecting a location to be used in the pairwise comparison by considering the sub-criteria obtained from the experts' interview results and screening these sub-criteria with average importance scores at the medium to highest level according to Best (1977), of which the average score between 2.61 to 5.00. The sub-criteria for each main criterion can be summarized as follows.

(1) Main criterion of transportation consists of three sub-criteria including adjacency to the main road, being near the BTS or MRT, being near a bus stop, van or motorcycle stops and adjacency to the secondary road (with an average of 4.20, 3.80, 3.60 and 3.20 respectively).

(2) Main criterion of the community consists of six sub-criteria including being near a residential area, office place, educational institute, industrial factories, government service center or hotel (with an average of 4.60, 4.60, 4.20, 4.20, 3.60, 3.60 and 2.80 respectively).

(3) Main criterion of the daily-life facility consists of five sub-criteria including being near a shopping mall, convenience store or market, pharmacy, restaurant or beauty salon (with an average of 4.00, 3.80, 3.40, 3.20 and 3.00 respectively).

(4) Main criterion of parking consists of three sub-criteria including parking near the clinic, free nearby parking, paid nearby parking or parking that requires the use of certain services in the facility (with an average of 5.00, 4.80 and 3.60 respectively).

(5) Main criterion of competitor consists of two sub-criteria including the fewness of competitor clinic or hospital (with the average of 4.80 and 3.60 respectively).

### 4.2 Results of the Questionnaire Surveys

From the data collection done on 30 samples, general information of the respondents can be summarized as shown in Table 3.

From Table 3, it was found that most of the sample groups are dentists working in the dental clinics (56.67%) and have five to ten years of experience (60.00%). However, most of the sample groups' commercial buildings established as dental clinics are parental buildings (53.33%) of two units (63.33%).

The researcher verified the Consistency Ratio (C.R.) of the main criteria for the location selection which can be calculated from the comparison of ratios between the Consistency Index (C.I.) (Table 5) and the Random Consistency Index (R.I). In this research, the matrix size of the main criteria for the location selection was five with the Random Consistency Index of 1.12, and the Consistency Ratio should not exceed 0.1 (Saaty, 1994). The verification of the consistency can be displayed as follows.

**Table 3: General information of the respondents**

Information	Frequency (n=30)	Percentage
1. Type of sample		
1) Owner or partner of a dental clinic	13	43.33
2) Dentist working for a dental clinic	17	56.67
2. Related experiences		
1) 5 - 10 years	18	60.00
2) 11 – 15 years	9	30.00
3) 16 - 20 years	2	6.67
4) Over 20 years	1	3.33
3. Ownership of buildings		
1) Full ownership (not rented)	14	46.67
2) Rental	16	53.33
4. Number of building unit		
1) 1 unit	6	20.00
2) 2 units	19	63.33
3) 3 units	3	10.00
4) Over 3 units	2	6.67

**Table 4: Comparison of the main criteria importance for location selection**

Main Criteria	Transportations	Communities	Facilities	Parking	Competitors
Transportations	1.00	3.20	3.15	1.91	2.50
Communities	0.31	1.00	3.90	1.56	2.51
Facilities	0.32	0.26	1.00	0.79	2.05
Parking	0.52	0.64	1.26	1.00	3.85
Competitors	0.40	0.40	0.49	0.26	1.00
Vertical Sum	<u>2.55</u>	<u>5.50</u>	<u>9.80</u>	<u>5.52</u>	<u>11.91</u>

From the comparison result of the main criteria importance of the location selection (Table 4), the importance weight of the main criteria for the location selection can be calculated by adjusting the sum of columns to be 1.00 and dividing the result of the main criteria comparison by the vertical sum, for example, the comparison result of the main criteria of the transportations and transportations is 1.00, the importance weight can be calculated as  $1.00/2.55$ , resulting in 0.39, etc. The weight value is calculated by finding the average weight value of the main criteria in each row. The weight of importance of the main criteria for selecting the location can be displayed as shown in Table 5.

**Table 5: The importance weight value of the main criteria for location selection**

Main Criteria	Transportations	Communities	Facilities	Parking	Competitors
Transportations	1.00	3.20	3.15	1.91	2.50
Communities	0.31	1.00	3.90	1.56	2.51
Facilities	0.32	0.26	1.00	0.79	2.05
Parking	0.52	0.64	1.26	1.00	3.85
Competitors	0.40	0.40	0.49	0.26	1.00
Vertical Sum	<u>2.55</u>	<u>5.50</u>	<u>9.80</u>	<u>5.52</u>	<u>11.91</u>

The Consistency Index (C.I.) can be calculated by using

$$C.I. = \frac{\lambda_{max} - n}{n-1} = \frac{5.44-5}{(5-1)} = 0.11$$

Where  $\lambda_{max}$  is the Maximum Eigen Values which are the sum of the data in each vector which is calculated from the sum of each vertical column (Table 4) x weight values (Table 5) equals [(2.55 x 0.37) + (5.50 x 0.24) + (9.80 x 0.12) + (5.52 x 0.19) + (11.91 x 0.08)] equals 5.44

$n$  is the matrix size (which is 5 in this research)

The Consistency Ratio of the main criteria matrix can be calculated using the ratio between the Consistency Index (*C.I.*) and the Random Consistency Index (R.I.) suggested by Saaty (1994). Consequently, the result of consistency verification of the main criteria of the location selection in this research is 0.11/1.12 equals 0.098 which is less than 0.100, indicating that the experts' ratings were consistent.

The researcher applied the Modified Analytic Hierarchy Process which uses the pairwise comparison of the main criteria and sub-criteria importance weights to find the value of importance weight of criteria for location selection of the commercial buildings with rents less than \$750 per month in Bangkok to be used for dental clinic business establishments, see Table 6.

**Table 6: Importance weight of the main criteria for location selection**

Main Criteria	Importance Weight	Sub-Criteria	Local Importance Weight	Global Importance Weight
1. Transportations	0.37	Adjacency to Main Road	0.39	0.14
		Being Near the BTS of MRT	0.13	0.05
		Adjacency to Secondary Road	0.37	0.14
		Being Near a Bus Stop, Van or Motorcycle Stops	0.11	0.04
Communities	0.24	Being Near Residential Area	0.31	0.07
		Being Near Condominium	0.27	0.06
		Being Near Office Place	0.16	0.04
		Being Near Educational Institute	0.12	0.03
		Being Near Industrial Factories	0.06	0.02
		Being Near Government Service Center	0.04	0.01
		Being Near Hotel	0.04	0.01
Daily-Life Facilities	0.12	Being Near Shopping Mall	0.41	0.05
		Being Near Market	0.23	0.03
		Being Near Pharmacy	0.17	0.02
		Being Near restaurant	0.12	0.01
		Being Near Beauty Salon	0.07	0.01
Parking	0.19	Parking in Clinic Area	0.65	0.13
		Free Nearby Parking	0.28	0.05
		Paid nearby parking or parking that requires the use of certain services in the facility	0.07	0.01
Competitors	0.08	Fewness of Competitor Clinics in the Area	0.80	0.06
		Hospital	0.20	0.02
Total	1.00	Total	5.00	1.00

From Table 6, when considering the main criteria of the location selection for dental clinic business establishments in commercial buildings with rents less than \$750 per month in Bangkok, it is found that the transportations aspect has the highest importance weight (with the importance weight equals 0.37), followed by the communities, parking, daily-life facilities aspects which bear

the importance weights of 0.24, 0.19 and 0.12, respectively, while the competitor criterion has the least importance weight at 0.08.

If we consider the overall picture of the sub-criteria for the location selection of dental business establishments in commercial buildings with rents less than \$750 per month in Bangkok, it was found that the first six sub-criteria with the highest importance weights are adjacency to the main road, to a secondary road, parking in the clinic area, being near a residential area and fewness of competitor in the area, all of which yield a total of 60 percent of the importance weight. Each sub-criterion bears importance weight of 0.14, 0.14, 0.13, 0.07, 0.06 and 0.06, respectively). It should be noted that the global importance weight of each sub-criterion was calculated from the local importance weight of each sub-criterion multiplied with the importance weight of its main criterion, for example, the global importance weight of the sub-criterion of an adjacency to the main road is  $0.47 \times 0.38$  which equals 0.18, meaning that the sub-criterion of an adjacency to the main road has an important weight of 47 percent, comparing to other sub-criteria in the main criterion of transportations and has an important weight of 18 percent, comparing to all other sub-criteria, etc.

However, considering the global importance weight of each sub-criterion in the main criteria is considered, the result can be displayed individually as follows.

(1) The transportation criterion: It was found that the sub-criteria of the highest importance weight is the adjacency to the main road and secondary road (with the importance weight of equally 0.14), followed by being near the BTS or MRT, a bus, van or motorcycle stations, which have the importance weights of 0.05 and 0.04, respectively.

(2) The community criterion: It was found that the sub-criterion of the highest importance weight is being in a residential area (with the importance weight of 0.07), followed by being near condominium, office place, educational institute, industrial factory, government service center and hotel, which have the importance weights of 0.06, 0.04, 0.03, 0.02, 0.01 and 0.01, respectively.

(3) The daily-life facilities criterion: It was found that the sub-criterion of the highest importance weight is being near a shopping mall (with an importance weight of 0.05), followed by being near a convenience store or market, pharmacy, restaurant and beauty salon, which have the importance weights of 0.03, 0.02, 0.01 and 0.01, respectively.

(4) The parking criterion: It was found that the sub-criterion of the highest importance weight is the parking in the clinic's area (with the importance weight of 0.13), followed by free nearby parking, and paid nearby parking or parking that requires the use of certain services in the facility, which have the importance weight of 0.05 and 0.01, respectively.

(5) The competitor criterion: It was found that the sub-criterion of the highest importance weight is the fewness of competitor clinics in the area (with the importance weight of 0.06), followed by the hospital which has an importance weight of 0.02.

The acquired results suggested that the main criterion of transportations has the highest importance weight for the location selection of commercial buildings with rents less than \$750 per



month to be developed to dental clinic business establishments in Bangkok. The first five sub-criteria with the highest importance weights are adjacency to main and secondary roads, parking in the clinic area, being in a residential area and being near condominium, respectively. This result is consistent with the work of Leenanuruksa (2016) who stated that an efficient location of a dental clinic is a point where customers can travel to and fro conveniently such as an area close to main roads, sky trains or expressways, etc. This inclusively refers to transportation means, parking, visibility, accessibility, as well as safety and comfort for the users or customers. This research identified the importance weight of each criterion in the form of numerical weight value, which clearly emphasizes the importance level of the decision to select the location of a commercial building in Bangkok to be developed as a dental clinic business. For the competitor sub-criterion, it appears to be an important factor for business operation (Porter, 1996). However, the research results found that the entrepreneurs also focus on the issue, but not as much as they should.

## 5 Conclusion

The main criterion of transportations has the highest importance weight on the location selection for dental clinic business establishments developed in a commercial building with rents less than \$750 per month in Bangkok, followed by the communities, parking, daily-life facilities and competitor criteria. The first six sub-criteria with the highest importance weight are adjacency to main and secondary roads, parking in the clinic area, being in a residential area, being near condominium and fewness of competitor establishments in the area, respectively. Those who are interested to invest in the dental clinic business, aiming to develop a unit of commercial buildings with rent less than \$750 per month in Bangkok, should choose the location with easy access and a building with high visibility. The place should provide ample parking spots which will result in the customers' convenience and help build awareness of passersby or residents in the area. However, the entrepreneurs should select the most suitable location by applying the research result as a guideline for consideration along with other factors such as rental rates, target customer groups, etc. Moreover, interested investors should study consumer demand to compare with the results obtained in this research. This study is an example of the application of the Analytical Hierarchy Analysis model to quantify the importance of weight to increase the efficiency of the Multi-criteria Decision Making (MCDM).

## 6 References

- Aguezzoul, A. (2012). Overview on supplier selection of goods versus 3PL selection. *Journal of Logistics Management*, 1(3), 18-23.
- Bank of Thailand. (2021). *Exchange Rates*. Retrieved on September 2021, from [www.bot.or.th/english/statistics/financialmarkets/exchangerate/\\_layouts/application/exchangerate/exchangerate.aspx](http://www.bot.or.th/english/statistics/financialmarkets/exchangerate/_layouts/application/exchangerate/exchangerate.aspx)
- Best, J. W. (1977). *Research in Education*. 3rd Ed. New Jersey: Prentice Hall Inc.
- Chaiyawong, K. (2017). *A Guideline for Selecting the Location of Super Store*. (Master's Thesis). Thammasat University, Faculty of Architecture and Planning, Innovative Real Estate Development Program.

- Dixit, A., Clouse, C. & Turken, N. (2019). Strategic Business Location Decisions: Importance of Economic Factors and Place Image. *Rutgers Business Review*, 4(1), 73-91.
- Halstead, J., & Deller, S. (1997). Public Infrastructure in Economic Development and Growth: Evidence from Rural Manufacturers. *Community Development*, 28, 149-169.
- Hellberg, R., Guaralda, M. & Rinchumphu, D. (2021). Urban Walkability Profiles in Brisbane. *International Review of Spatial Planning and Sustainable Development*, 9(3), 1-15.
- Indarti, N. (2004). Business Location and Success: The Case of Internet Café Business in Indonesia. *Gadjah Mada International Journal of Business*, 6(2), 171-192.
- Jain, S. *et al.* (2018). Strategic Planning of a Dental Clinic in India. *International Dental Journal of Student's Research*, 6(4), 74-76.
- Kallas, Z., Lehnhardt, F., & Gil, J. M. (2011). A Stated Preference Analysis Comparing the Analytical Hierarchy Process versus Choice Experiments. *Food Quality and Preference*, 22(2), 181-192.
- Khaosod Online. (2019). *Doctorate Degree of Communication, University of Thai Chamber of Commerce Reveals Research Results of Thai Dental Tourism Industry Is the Biggest in Asia*. Retrieved from [www.khaosod.co.th/pr-news/news\\_2963295](http://www.khaosod.co.th/pr-news/news_2963295)
- Kongsuk, S. (2015). *The Location Selection Model for Condominiums Development in Bangkok*. Master's Thesis, Thammasat University, Faculty of Architecture and Planning, Innovative Real Estate Development Program.
- Leenanuruksa, A. (2016). *Dental Business*. Retrieved from <http://dentalbusinessblog.com>
- Likitanupak, W., & Tochaiwat, K. (2012). Criteria for Infrastructure Contractor Selection in Housing Projects. *KMUTT Research and Development Journal*, 35(2), 235-251.
- Porter, M.E. (1996). The Five Competitive Forces That Shape Strategy. *Havard Business Review: HBR's Must-Reads on Strategy*. United States: Booz & Company.
- Praneetpolgrang, P. (2000). *Production and Operations Management*. Bangkok: Thanatat Printing.
- Saaty, T. L. (1994). How to Make a Decision: The Analytic Hierarchy Process. *Interfaces*, 24, 19-43.
- Sirithananonsakun, N. (2017). *The Location Selection Model for Housing Development in Bangkok*. Master's Thesis, Thammasat University, Faculty of Architecture and Planning, Innovative Real Estate Development Program.
- Sricharoen, W. (2016). *Factors Affecting the Decision to Purchase Homes in Housing Estates of Civil Servants and State Enterprise Employees in Nonthaburi*. Master's Independent Study, Bangkok University, Graduate School.
- Tochaiwat, K., Hankamolsiri, N., & Larpcharoen, V. (2021). Development of Balanced Scorecard for Real Estate Development Companies by Modified Analytic Hierarchy Process. *International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies*, 12(8), 12A8G, 1-10.
- Tochaiwat, K., Likitanupak, W., & Kongsuk, S. (2017). Location Selection Models for Low-rise Condominium Development in Bangkok. *Veridian E-Journal, Silpakorn University*, 10(5), 266-280.
- Vargas, R. V. (2010). Using the Analytic Hierarchy Process (AHP) to Select and Prioritize Projects in a Portfolio. *Proc. PMI Global Congress 2010-North America*, held by Project Management Institute, Washington DC, 9-12 October 2010.

Wanitdee, W. (2002). *General Business*. Bangkok: Prasanmit Printing House.

Wattanachai, P., Sundaranga, C., Kridakorn Na Ayutthaya, T., Phichetkunbodee, N. & Rinchumphu, D. (2021). *Study of Universal Thermal Comfort Index in Housing Estate Public Space in Bangkok, Thailand*. *Journal of Design and Built Environment*, 21(2), 10-18.

---



**Umaporn Vimokkittipong** is an Assistant Professor at the College of Dental Medicine, Rangsit University, Thailand. She received a Diploma of Thai Board of Prosthodontics. She has many years of experience working in several clinics and hospitals. Her research focuses on dental materials.



**Dr. Kongkoon Tochaiwat** is an Associate Professor at the Faculty of Architecture and Planning, Thammasat University, Thailand. He received Ph.D. in Civil Engineering (Construction, Engineering and Management) from Chulalongkorn University, Thailand. His research focuses on Real Estate Business and Development.



**Suriya Sirithanyarat** is a graduate of the Master's Degree of Innovative Real Estate Development Program, Faculty of Architecture and Planning, Thammasat University, Thailand. His research focuses on the Location Selection Model.



**Varalee Thumvisuttivarakorn** is an Assistant Manager of Design Department at Narai Property Co., Ltd. She received a Master's Degree in Innovative Real Estate Development Program, Faculty of Architecture and Planning, Thammasat University, Thailand. Her research focuses on the Factors Affecting Real Estate Buying Decisions.

---