Original Article

Modified Analytic Hierarchy Process Site Selection Model for Dental Clinics in High-Rent Commercial Buildings

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ABSTRACT

Introduction: Location is a factor that highly influences a business’s ability to carry out various activities. Site selection, therefore, must take into account all the potential benefits. A dental clinic is an enterprise that should prioritize the site selection. In Thailand, many dental clinics operate in rented commercial buildings on a long-term lease basis. Objective: The objective of this research was to create a model for selecting suitable sites for dental clinic businesses in commercial buildings in Bangkok with rental fees exceeding $750 per month. Materials and Methods: The research was conducted by collecting data from a sample group consisting of 30 participants who were owners, partners, or dentists of dental clinics located in commercial buildings in Bangkok with rental fees more than $750 per month. Data were then analyzed with descriptive statistics: namely, frequency, percentage, mean, and modified analytic hierarchy process. Results: The results revealed the ranking of the main criteria, as well as their weights, for the site selection of commercial buildings in Bangkok with rents greater than $750 per unit per month to be used as a dental clinic: transportation (39.40%), neighborhood (23.61%), facilities (19.45%), parking (12.82%), and competition (4.72%), respectively, with three most important subcriteria: namely, being on a major road (19.00%), being near an electric express train station (9.10%), and being on the secondary road (8.92%), respectively.

Keywords: Commercial building, dental clinic, location, modified analytic hierarchy process, site selection model

INTRODUCTION

Dental practice is one of the most growing health service businesses. The approach popularly used by dental clinic entrepreneurs is providing dental specialist services along with developing marketing strategies suitable for the target market.[1] Choosing a commercial site is one of the first steps that must be taken before starting a business.[2] The purpose of the site selection is to determine the best location of the company or the place of business in order to ensure the smooth running of various activities, low-operating costs, ability to compete, and potential business expansion,[3] especially in the dental clinic business in Thailand that is growing and highly competitive as a result of the stronger and more dynamic dental service market. Hence, dental clinic entrepreneurs need some decision-making support tools for managing main resources both inside and outside the organization to achieve high efficiency, not only in the treatment process but also in an overall dental clinic management.[4]

Hence, the researchers were interested in investigating a model for selecting a suitable site for a dental clinic in a commercial building in Bangkok with a rental fee exceeding $750 per month (25,000 Baht per month when the exchange rate is 33.34 baht to the dollar[5]),

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so that entrepreneurs and those who are involved in the site selection of the dental clinics can use this study as a guideline in choosing a location that can potentially enhance the ability to compete and enable the business operations to reach their goals.

RELEVANT LITERATURE AND RESEARCH
SITE SELECTION
Site selection is an important factor that affects the success of a business. Inappropriate site selection will cause further problems to the organization, such as high shipping costs if the business establishment is far from the source of raw materials and markets and the shortage of qualified labor and raw materials, etc. In general, one seeks a location that will reduce the total production and service costs as much as possible; therefore, many factors must be taken into account. However, general attributes of a good location have not been clearly specified, as attributes of a good location differ according to the types of businesses. For this reason, the researchers reviewed relevant research studies to determine the criteria for site selection, as shown in Table 1. These criteria were used as the initial data for the questionnaire preparation.

MODIFIED ANALYTIC HIERARCHY PROCESS
Analytic hierarchy process (AHP), developed by Saaty in the 1970s, is one of the methods used in the analysis to determine the best alternative. Its principle is to create hierarchies of a problem: determining objectives, setting main criteria and subcriteria, and summarizing the options, respectively. The best options are then analyzed based on pairwise comparisons in order to make it easier to prioritize the criteria by rating the importance of each and every pair. If the rating is sound, it will allow you to rank alternatives to find the best option. AHP is therefore an analytical process that simplifies and facilitates choosing options or alternatives. As a result, AHP is a widely-used method for multi-criteria decision making.

In this study, the researchers modified AHP in that only a few steps of the process were analyzed to obtain the weights of the criteria for the site selection of a dental clinic in a commercial building in Bangkok with a rental fee exceeding $750 per month. Many researchers in the past have modified AHP to suit their research objectives; for instance, using a Likert scale instead of pairwise comparison to reduce the number of items in Kallas et al. and Çalışkan et al. and using traditional pairwise comparison and AHP and stopping the analysis when the weights of the criteria were obtained without taking alternatives into consideration in Tochaiwat et al. and Tochaiwat et al.
MATERIALS AND METHODS
This research is mixed-methodology research, which uses both qualitative and quantitative research methodologies. After conducting the literature review, the researchers interviewed five experts who had experience in selecting at least three dental clinic sites in order to screen the criteria affecting the site selection. The criteria obtained were then used to create a questionnaire to be used as a tool in the data collection from a sample of 30 owners, partners, and dentists of dental clinics located in commercial buildings with rents more than $750 per month in the Bangkok area. It should be noted that the sample size used in this research (30 respondents) is the smallest sample size for parametric statistics that suggested by Student,[25] and there was no drop-out informant or respondent because of the short period of data collection. All experts were asked for their consents to disclose the data before the beginning of each interview, whereas all questionnaires had a data disclosure consent question at their cover letters. This research was done in 2020, and the data collection process was performed during April to June 2020.

In analysis, the questionnaire data were analyzed using descriptive statistics, and then the site selection model was created using modified AHP, which compared the weights of the main criteria and the subcriteria that factor into the site selection of dental clinics in pairwise comparison, according to the method proposed by Saaty.[19] If criterion A being compared was more important than criterion B, the mean was calculated using the intensity of importance value of 1 (the two criteria are equally important) to 9 (criterion A is extremely more or important than criterion B.). On the other hand, if criterion A was less important than criterion B, the mean was calculated using the reciprocal of the score values. These scores were then used in modified AHP calculation until all weights were derived, and the consistency ratios (CR) of all modified AHP models were calculated to confirm the consistency of the model.

RESEARCH FINDINGS

MAIN CRITERIA AND SUBCRITERIA AFFECTING THE SITE SELECTION OF A DENTAL CLINIC
From the interviews, the main criteria and their respective subcriteria can be summarized as in Figure 1. The numbers in parentheses are the arithmetic means of the important scores from the experts’ opinions, where the mean more than 2.61 shows the subcriterion has medium to the highest importance. Figure 1 shows that there were five criteria with 21 subcriteria, e.g., transportation (four subcriteria), neighborhood (seven subcriteria), facilities (five subcriteria), parking (three subcriteria), and competition (two subcriteria).

CHARACTERISTICS OF THE PARTICIPANTS
From the data collected from the sample of 30 respondents, the most of the respondents were

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**Figure 1:** Modified AHP network of this study
owners or partners (80%) of dental clinics and have no more than 10 years of relevant experience (a total of 73.33%). Moreover, most of the commercial buildings are rented (76.67%) and have two units per clinic in average (50.00%).

Weights of criteria and subcriteria

To illustrate the modified AHP calculation process, the authors explained how to calculate the weights of all main criteria. The calculation results are presented in Tables 1–3, and the weights of the main criteria for the site selection are summarized in Table 4.

The arithmetic means of the pairwise comparison of importance of the main criteria for the site selection obtained from the questionnaire [Table 2] can be used to calculate the importance weights of the main site selection criteria when the total of each column is adjusted to 100.00%, comparing the importance of the main criteria with the vertical sum. For instance, the result of the comparison of the importance of the transportation criterion with itself equals to 100.00%. This can be converted to the importance weight in Table 4; thus, 100.00%/229.47% = 43.58%. The importance weight of each site selection criterion was calculated in the same method, and the total weight of each criterion was calculated from finding the average of all values in the same row, as shown in Table 3.

After that, the researchers inspected the CR of the site selection criteria by comparing the consistency index (CI) against the random consistency index (RI) of 1.12 for the 5 × 5 matrix size, suggested by Saaty. The details of calculation are shown below:

(1) The CI can be calculated from the formula below:

\[
CI = (\lambda_{\text{max}} - n) / (n-1) = (5.44 - 5) / (5 - 1) = 0.11,
\]

where \(\lambda_{\text{max}}\) is the maximum Eigen values, derived from the vector of the vertical sum (Table 2) × the weight vector (Table 3) is equal to \([(229.47% \times 39.40%) + (484.03% \times 23.61%) + (627.39% \times 19.45%) + (954.35% \times 12.82%) + (2013.42% \times 4.72%)\] = 544.13% or 5.44% approximately; n is the matrix size (n = 5 in this research).

(2) The CR can be derived from the ratio between the CI and the RI, or 0.11/1.12 = 0.09, which is less than 0.10, indicating that the experts’ rating was consistent.

All in all, the researchers performed the said modified AHP by calculating the weights of each subcriterion under each main criterion, and the overall importance weight of each subcriterion by multiplying the importance weight of each subcriterion with that of the main criterion. For instance, the aggregated importance weight of being on a major road is 48.22% × 39.40% = 19.00%, which means that the subcriterion of being on a major road has importance weight of 48.22% when compared with other subcriteria under the main transportation criterion, and 19.00% compared with all subcriteria.

From the same calculation process, the researcher was able to summarize the importance weights of the site selection subcriteria, as shown in Table 4.

From Table 4, regarding main criteria, it was found that transportation was of the greatest importance weight (39.40%), followed by neighborhood, facilities, and parking, which had the importance weight of 23.61%, 19.45%, and 12.82%, respectively, whereas competition had a least importance weight of 4.72%.

| Table 2: Comparison of the importance of the main criteria for site selection |
|-----------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Main criteria                             | Transportation (%) | Neighborhood (%) | Facilities (%) | Parking (%) | Competition (%) |
| Transportation                           | 100.00            | 272.44          | 238.92         | 310.67       | 534.03          |
| Neighborhood                             | 36.70             | 100.00          | 233.33         | 222.48       | 420.51          |
| Facilities                               | 41.85             | 42.86           | 100.00         | 301.33       | 455.51          |
| Parking                                  | 32.19             | 44.95           | 33.19          | 100.00       | 503.37          |
| Competition                              | 18.73             | 23.78           | 21.95          | 19.87        | 100.00          |
| Vertical sum                             | 229.47            | 484.03          | 627.39         | 954.35       | 2013.42         |

| Table 3: Importance weights of the site selection criteria |
|----------------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Main criteria                             | Transportation (%) | Neighborhood (%) | Facilities (%) | Parking (%) | Competition (%) | Weights (%) |
| Transportation                           | 43.58            | 56.29           | 38.08           | 32.55         | 26.52           | 39.40          |
| Neighborhood                             | 15.99            | 20.66           | 37.19           | 23.31         | 20.89           | 23.61          |
| Facilities                               | 18.24            | 8.85            | 15.94           | 31.58         | 22.62           | 19.45          |
| Parking                                  | 14.03            | 9.29            | 5.29            | 10.48         | 25.00           | 12.82          |
| Competition                              | 8.16             | 4.91            | 3.50            | 2.08          | 4.97            | 4.72           |
| Vertical sum                             | 100.00           | 100.00          | 100.00          | 100.00        | 100.00          | 100.00         |
Concerning the overall picture of the subcriteria, it was found that the top five subcriteria with the most importance weights and with the sum total of the importance weights greater than 50% were: (1) being on a major road, (2) proximity to an electric express train station, (3) being on a secondary road, (4) proximity to shopping malls, and (5) parking at the site, with the importance weights of 19.00%, 9.10%, 8.92%, 8.09%, and 7.59%, respectively. Moreover, the results of the study also showed that.

It was found that the transportation criterion had the most importance weight. The three top-ranking subcriteria with the most importance weights were being on a major road, proximity to an electric express train station, and being on a secondary road. This corresponds to Leenanuruksa,\[26\] which stated that a good location for a dental clinic was one that was conveniently accessible by clients, namely proximity to a road, electric express train station, or expressway, and KongCU and Tochaiwat,\[27\] which stated that their site selection model for condominium development in Bangkok prioritized transportation, whereby the most preferred locations were near a mass transportation system, followed by locations near a major road or expressway. In addition, Sirithananonsakun\[10\] stated that being on a major road was among the top three criteria in the location selection model for housing development in Bangkok.

**Summary and Future Scope**

This research presented the main criteria along with their subcriteria and their weights influencing the site selection of a dental clinic in a commercial building with more than $750 per month rent in Bangkok, as follows:

Location attribute = 39.40% (transportation) + 23.61% (neighborhood) + 19.45% (facilities) + 12.82% (parking) + 4.72% (competition) \[1\]
Transportation attribute = 48.22% (being on major road) + 23.10% (proximity to electric express train station) + 22.64% (being on secondary road) + 6.04% (proximity to bus stop, van stop, or motorcycle taxi rank) \[2\]
Neighborhood attribute = 22.67% (proximity to residential home) + 27.14% (proximity to condominium) + 19.36% (proximity to office building) + 14.01% (proximity to educational institution) + 8.49% (proximity to industrial estate) + 5.33% (proximity to government service center) + 5.35% (proximity to hotel) \[2\]
Facilities attribute = 41.60% (proximity to shopping mall) + 29.63% (proximity to convenience store or fresh market) + 15.47% (proximity to pharmacy) + 8.92% (proximity to restaurant) + 4.38% (proximity to beauty salon) \[4\]
Parking attribute = 59.24% (parking at the clinic site) + 34.76% (free parking in the vicinity) + 6.00% (fee-paying parking nearby) [5]  
Competition attribute = 86.51% (few competing clinics in the vicinity) + 13.49% (being far from the hospital) [6]

Regarding the overall importance weight, it was found that the transportation was the main criterion with the greatest importance weight in the site selection. The reason behind this is that commercial buildings with high rental rates are usually located in the city center with high land prices and busy traffic. This research finding was consistent with Turhan et al. [14] and Chou et al. [15] The next criteria in the order of the highest importance weight were neighborhood, facilities, parking, and competition, respectively. The fact that competition was not given a lot of importance weight reflects the investment perspective that prioritizes customers over competitors. The top five subcriteria with the most importance weights and influence on site selection (with the total weights of over 50%) are being on a major road, near an electric express train station, on a secondary road, near a shopping mall, and parking at the clinic site, respectively. Therefore, those interested in investing in the dental clinic business in a commercial building in Bangkok should choose primarily a commercial building in a location conveniently accessible by target customers. This finding is consistent with Singh [16] and Chou et al., [15] which prioritized locations near roads and rail transport. Nevertheless, factors other than location may also affect the site selection of a dental clinic, such as the function of the buildings, the size of the usable areas, and rental rates, according to Turhan et al., [14] Chou et al., [15] and Rymarzak and Siemińska. [18] Entrepreneurs should consider these factors along with the suitability to the context of their clinics. A feasibility study should be conducted in the site selection of a commercial building, both to rent and to purchase, to be used as a dental clinic before making investment decisions. In addition, scholars or those interested in investing in the dental clinic business should examine the site selection potentials in other types of properties, such as a shopping mall, office building, or commercial space in a condominium or apartment building in order to have a variety of options appropriate to the target group.

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Nil.

**CONFLICTS OF INTEREST**

There are no conflicts of interest.

**AUTHORS’ CONTRIBUTIONS**

Not applicable.

**ETHICAL POLICY AND INSTITUTIONAL REVIEW BOARD STATEMENT**

This study did not have the effect on human body nor human mind.

**PATIENT DECLARATION OF CONSENT**

Not applicable.

**DATA AVAILABILITY STATEMENT**

The data set used in the current study is available on request from Associate Professor Dr. Kongkoon Tochaiwat; e-mail: kongkoon@tu.ac.th.

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