Exploration of key commercial space design indicators

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Abstract. The designs of commercial spaces change with time. This study explored competitive factors that affect commercial space development by using the Delphic hierarchy process with the aim of enhancing the overall performance of commercial spaces in a highly competitive retail market. The findings provide key factors that can be used by shopping center operators when selecting commercial space designers. Competitiveness indices were proposed by referring to the literature and conducting interviews with industry experts, scholars, and practitioners. Subsequently, hierarchy structures and indices were established, and relative weights were allocated to each dimension and index. Finally, the evaluation data were calculated and consistency tests were conducted. This study adopted 18 performance indicators to demonstrate the validity of the overall competitiveness indicators, which were verified as possessing high validity.

1. Introduction
Construction of commercial spaces in buildings is a worldwide trend, including in the United States and Europe; these spaces serve as representative and prominent landmarks of a city or country. Presentations of commercial and corporate cultures in commercial spaces vary depending on the shopping center operator, with the design of commercial spaces being a topic that warrants investigation. This study sought to determine the key indicators for commercial space design in buildings, with the results able to serve as a reference for shopping center operators.

2. Research Motivation and Objectives
Commercial space design is critical for attracting businesses to shopping centers and maintaining profitable operations. Shopping centers not only serve as commercial hubs but also as diverse cultural spaces. Therefore, each shopping center has unique characteristics and a sense of place that integrates local ethos. Consumers may visit shopping centers for both the products available and the sense of place conveyed. Maximizing a center’s sense of place is becoming a crucial strategy for management because shopping centers increasingly emphasize their integration with local cultures and highlight their distinctive features to attract a diverse customer base [1].

The present study can serve as a useful reference for investors and operators of shopping centers to select appropriate commercial space designers capable of creating landmarks that are unique while combining local and corporate culture.

Alongside a literature review, this study conducted in-depth interviews with experts and practitioners in various fields related to interior design and referred to actual cases of interior design for commercial spaces to construct an indicator framework, and the weights of the indicators were subsequently analyzed. The results can serve as a reference for shopping center investors and operators to evaluate weight distributions and formulate management strategies. Investors and operators of well-known
shopping centers in Taiwan, international brand extension project operators, and commercial space designers were invited to share their experiences and provide opinions. The Delphic hierarchy process was adopted to establish an evaluation indicator framework for use by shopping centers in selecting commercial space designs. The percentage distribution of the evaluation indicators was determined for shopping centers to select designers for interior space design. The objectives of this study were as follows:

To explore the evaluation indicators for commercial space design.
To establish a design framework for commercial space and analyze the priorities and weights of key indicators.

3. Literature Review

Shopping centers adopt a variety of methods to create connections with the local sense of place [1]. Place attachment is formed through material and local characteristics [2]. Place meaning can be realized through the creation of an attractive space, and sense of place and social awareness can be achieved through social and promotional activities.

That these consumers live between two worlds span two cultures or have to continuously cross borders [2].

A commercial space can be adjusted and modularized dynamically in response to interference and thresholds on a spatial scale [3].

As one of the important components of comprehensive space development, the mall played an increasingly important role in the development process in recent years, and its design. The program has been continuously improved and improved, and the huge social effects it produces and economic effects have a great impact on consumer behavior [4].

Macao is adjusting its tourism appeal. It should also adjust Macau's shopping methods and habits to create a variety of shopping malls. This is not far from the goal of “suitable tourism”. After all, shopping is indispensable for tourists [5].

Considering the idle business in Macau, what is the current situation, whether it has potential, and whether it has its own personality. These are the factors that should be referenced in the future [6].

Another strategy adopted by shopping centers is multiple combinations of stores. This strategy is primarily used to control which stores can open in a shopping center in order to attract a specific type of consumer. Guimarães [7] noted that the design of a shopping center must consider the following factors: the (1) innovation, (2) uniqueness, (3) ease of maintenance, (4) maintenance cost, and (5) modularizability of a space.

3.1 Delphi method

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3.1.1 Characteristics of the Delphi method.

1. Anonymity.
2. Controlled feedback.
3. Statistical group response.

3.1.2 Steps of the Delphi method.

1. Experts who specialize in topics related to the questions to be investigated are invited as questionnaire respondents.
2. A questionnaire is designed for the first stage of the questionnaire survey.
3. Expert opinions collected from the first stage of the questionnaire survey are compiled and the median of these opinions is determined. The compiled data are provided for the experts as a reference, and they are then asked to complete the questionnaire again based on these reference data.
4. The experts’ revised opinions are summarized and explained.
5. Whether the experts’ opinions converge within an acceptable range is determined. Steps 3–5 are repeated until consensus is reached or the participants are unable to further revise their opinions. Questionnaire results Table 1.

3.1.3 Shortcomings of the Delphi method.
1. Cognitive aspects.
During the questionnaire survey, the ambiguity in questions may cause experts to interpret the questions differently. In addition, the experts are not allowed to communicate with one another when completing the questionnaire. Therefore, their opinions may not reach consensus. When compiling expert opinions, the decision makers may have preconceptions that cause them to filter out correct opinions. That is, different opinions may be systematically reduced or even eliminated. When seeking consensus, the experts are asked to revise their opinions based on the median of the group’s opinions. This may distort the experts’ original thoughts.
2. Cost-related aspects.
When consensus cannot be reached among the expert opinions, the questionnaire survey must be conducted several times. However, this may increase the time and monetary costs and reduce the response rate, which can result in an excessively low response rate or the inability to retrieve responses.

3.2 Analytic hierarchy process
The analytic hierarchy process (AHP) systematizes complex decisions into a hierarchical system of simple elements through collection and evaluation of expert opinions. Operators must decompose complex decision problems and construct a hierarchical relationship to compare and evaluate the elements of said problem. After expert evaluation and mathematical calculation, solutions are prioritized based on the numerical values of factors to serve as a reference for operators to make final decisions [8]. However, when operators face highly diversified alternative solutions and must consider many factors, they may have difficulty making correct decisions through simple analysis or according to rule of thumb. Therefore, the objective of the AHP is to decompose a problem into a tree-structure hierarchy and to establish a hierarchical structure outlining the mutual influence of the constituent elements. Through quantitative judgment, the context can be identified and evaluated to provide sufficient information for decision makers to choose optimal solutions, thereby reducing the risk of errant decision-making [9].

Questionnaire results Table 2. AHP questionnaire implementation process Figure 1.

![Figure 1. AHP questionnaire implementation process [8]](image-url)
4. Data analysis and reviews

Table 1. AHP questionnaire data.

| Criteria                          | Expert number / subcriteria | Total T | Mean M | Standard deviation SD | Mode MO | Absolute value (MO - M) |
|-----------------------------------|----------------------------|---------|--------|-----------------------|---------|-------------------------|
| 1 Value creation                  | Corporate identity system  | 134     | 4.47   | 0.6288                | 5       | 0.533                   |
| 2 Cross-industry cooperation      |                            | 136     | 4.53   | 0.6814                | 5       | 0.467                   |
| 3 Neighborhood connection         |                            | 137     | 4.57   | 0.504                 | 5       | 0.433                   |
| 4 Introducing resources           |                            | 137     | 4.57   | 0.5683                | 5       | 0.433                   |
| 5 Creative revenue streams        |                            | 136     | 4.53   | 0.5074                | 5       | 0.467                   |
| 6 Budget and schedule control     |                            | 139     | 4.63   | 0.5561                | 5       | 0.367                   |
| 7 Easy to maintain                |                            | 134     | 4.47   | 0.7303                | 5       | 0.533                   |
| 8 Low operation cost              |                            | 134     | 4.47   | 0.5713                | 5       | 0.533                   |
| 9 Space modularization and easy adjustment |        | 132     | 4.40   | 0.724                 | 5       | 0.600                   |
| 10 Potential for renting for multiple purposes |    | 128     | 4.27   | 0.6915                | 4       | 0.267                   |
| 11 Characteristic design company’s experience |      | 132     | 4.40   | 0.6215                | 5       | 0.600                   |
| 12 Impressive presentation        |                            | 131     | 4.37   | 0.7649                | 5       | 0.633                   |
| 13 Regulation compliance          |                            | 134     | 4.47   | 0.5713                | 5       | 0.533                   |
| 14 Word of mouth                  |                            | 134     | 4.47   | 0.5074                | 4       | 0.467                   |
| 15 Green material                 |                            | 129     | 4.30   | 0.7497                | 5       | 0.700                   |
| 16 Energy saving                  |                            | 134     | 4.47   | 0.5713                | 5       | 0.533                   |
| 17 Water saving                   |                            | 133     | 4.43   | 0.6261                | 5       | 0.567                   |
| 18 Material recycling and reuse   |                            | 135     | 4.50   | 0.5724                | 5       | 0.500                   |
Table 2. AHP questionnaire data.

| Criteria                      | Level (1) Wi | Sub-Criteria                        | Level (2) Wi | Overall Wi | Overall Criteria |
|-------------------------------|--------------|-------------------------------------|--------------|------------|------------------|
| Value creation                | 29.5297%     | 1 Corporate identity system         | 35.0960%     | 8.7740%    | 2                |
|                               |              | 2 Cross-industry cooperation         | 23.4047%     | 5.8512%    | 7                |
|                               |              | 3 Neighborhood connection           | 18.6948%     | 4.6737%    | 12               |
| Value creation                |              | 4 Introducing resources              | 13.0362%     | 3.2591%    | 13               |
| Value creation                |              | 5 Creative revenue streams           | 9.7682%      | 2.4421%    | 16               |
| Economic advantages           | 35.3070%     | 6 Budget and schedule control       | 24.8005%     | 6.2001%    | 6                |
| Economic advantages           |              | 7 Easy to maintain                   | 32.5157%     | 8.1289%    | 5                |
| Economic advantages           |              | 8 Low operation cost                 | 22.9786%     | 5.7447%    | 8                |
| Economic advantages           |              | 9 Space modularization and easy adjustment | 12.8343% | 3.2086% | 14               |
| Economic advantages           |              | 10 Potential for renting for multiple purposes | 6.8708% | 1.7177% | 18               |
| Tender characteristics        | 24.2879%     | 11 design company’s experience      | 34.5932%     | 8.6483%    | 3                |
| Tender characteristics        |              | 12 Impressive presentation           | 32.9946%     | 8.2486%    | 4                |
| Tender characteristics        |              | 13 regulation compliance            | 21.9549%     | 5.4887%    | 9                |
| Tender characteristics        |              | 14 word of mouth                     | 10.4573%     | 2.6143%    | 15               |
| Tender characteristics        |              | 15 green material                   | 21.4589%     | 5.3647%    | 10               |
| Tender characteristics        |              | 16 energy saving                    | 46.8084%     | 11.7021%   | 1                |
| Tender characteristics        |              | 17 water saving                     | 21.4107%     | 5.3527%    | 11               |
| Tender characteristics        |              | 18 Material recycling and reuse      | 10.3219%     | 2.5805%    | 15               |
| overall sequence              |              |                                     |              |            |                  |
| 5. Conclusion                 |              |                                     |              |            |                  |
| 5.1 Strength of the top five most crucial factors | Overall Sequence | NO.01 energy conservation-------------(11.7021%) | NO.02 Corporate identity system---------( 8.7740%) | NO.03 design company’s experience-----( 8.6483%) | NO.04 Impressive presentation---------( 8.2486%) | NO.05 Easy to maintain-----------------( 8.1289%) |

According to the results of the questionnaire analysis, commercial space designers and operators contended that the most crucial factor for the design and management of commercial space was energy conservation, followed by a strong corporate identity system and the experience of the design.
company. This indicates that both designers and shopping center operators recognize the importance of environmental consciousness and pay attention to the effectiveness of corporate identity systems. The experience of the design company was also a vital factor, which was expected to be supplemented by an impressive presentation to set out the content and benefits of the design proposal. The experts also noted the importance of maintenance because related costs influence future operations. Therefore, in addition to environmental consciousness and corporate identity, design companies should consider shopping center operating costs and cases in other industries to propose unique and novel planning suggestions that can create value for shopping centers. Only by implementing such measures are design companies likely to win design bids.

5.2 Sixth to tenth most crucial factors
The sixth to tenth most crucial factors were budget and schedule control (6.2001%), cross-industry cooperation (5.8512%), low operation cost (5.7447%), regulation compliance (5.4887%), and green building materials (5.3647%). Budget control directly influences investor costs and profits. Cooperation with other industries is a modern trend; building cross-industry alliances can yield considerable benefits. Operation cost in conjunction with ease of maintenance (the fifth priority) can substantially reduce regular maintenance costs. Codes and regulations in different countries regarding shopping centers vary; running shopping centers in a manner that conforms to local codes and regulations is a basic requirement for operators. Environmental protection serves to protect the natural environment at individual, organizational, and governmental levels for the well-being of nature and humans. Industrial development has caused serious environmental pollution and damaged ecosystems to an almost irreparable degree. This has resulted in many industrialized countries emphasizing environmental protection by imposing laws to regulate and control pollution and by raising social awareness of the profound influence of pollution on the environment. Since the 1960s, environmental movements have raised public awareness regarding numerous environmental problems. Academic institutes provide courses regarding the history and methods of environmental protection, such as environmental studies, environmental management, and environmental engineering. Environmental protection requires the public to participate in various related activities. Waste products, air pollution, and the loss of biodiversity (due to invasive alien species and extinction) are all environmental protection–related topics. The three main factors of environmental protection, namely environmental legislation, morality, and education, all influence countries’ environment-related decisions and individual people’s environmental values and behaviors.

5.3 Comprehensive analysis
In this study, the key factors for commercial space design were determined using the Delphic hierarchy process. These methods are explorative and quantitative, with the aim of substantially increasing the use efficiency and popularity of commercial space. The questionnaire results revealed that the key factors for commercial space design considerably influence the success of shopping center development and operation. In addition to selling products, shopping centers typically provide various leisure facilities or even dining services, high-end accommodation, wedding and banquet venues, and conference rooms. They can also serve as major resorts and landmarks. The rationality of circulation, the convenience of the various facilities on offer, and the refinedness of the spaces within all serve to increase the popularity of commercial spaces and provide customers with a sense of added value. Using customer satisfaction to enhance customer retention and application of information technology is highly conducive to the development of commercial spaces. This study determined the key factors of commercial space design that influence renovation of commercial spaces; based on the results, a sustainable operation model for commercial space can be constructed.

5.4 Research limitations and directions for future research
The importance of integrating water conservation with the concept of environmental protection should not be overlooked. Determining how to create a unique shopping center that incorporates local culture
and can be integrated into the surrounding environment while introducing external resources to increase revenue from other sources is a potential direction for research on space modularization.

 Regarding the increasing trend for shopping centers, future studies should use real-world cases for evaluation (e.g., Taipei 101) and investigate shopping centers throughout Asia. Taiwan’s application of design aesthetics is frequently recognized by the international community, showing that the country is a design center capable of knowledge management in the Asia-Pacific region and a leader of design development among global Chinese communities. Shopping center design is manifested in Taiwan’s strong design capacity and enables Taiwan to compete in the global market.

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