

NEEDS ASSESSMENT OF SUSTAINABLE INTERIOR DESIGN CRITERIA BASED ON THE PERSPECTIVES OF TAIWANESE PROFESSIONAL OPINIONS

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Abstract

Following the Sustainable Development Goals of the United Nations, stakeholders, communities, and governments are aware that the greenhouse effect and nature's overexploitation, which have contributed to anthropogenic climate change and the depletion of natural resources, own a massive impact on the living environment. Furthermore, because of the COVID-19 pandemic, people are becoming increasingly conscious of human activities impacting the natural habitat. An increasing number of individuals are anticipating environmentally friendly, healthy, energy-efficient, and carbon-reducing indoor space. This research intends to provide green interior design criteria as a framework for the sustainable advancement of Taiwan's interior design practice. Therefore, the study develops green interior design criteria based on Resource Based View theory: 1) to construct a criteria framework and evaluate green indicators through the literature review, and 2) to assess the weighting and ranking of green criteria in the Taiwanese context. Using a mixed-method research design, the researchers gathered and analysed qualitative and quantitative data; following three phases of the Delphi method questionnaires and meetings with focus groups, a summary framework comprised eight main categories, seventy items, and their average weights. Based on the theoretical underpinnings, this research proposes a criteria framework for the sustainable growth of the interior design industry in Taiwan, giving a new strategy for green interior design practices. To limit climate change, protect the environment, and maintain social and economic growth, Taiwan's interior design industry should make practical efforts based on this result for sustainable interior design criteria to accomplish the 2030 Sustainable Development Goals of the United Nations and net zero emissions by 2050.

Keywords: Green criteria, Interior design industry, Resource based view, Sustainable interior design.

1. Introduction

According to the United Nations, rising greenhouse gas emissions and climate warming are expected to affect the supply of primary resources such as energy, food, and water. The UN Framework on Climate Change [1] mobilised solid global action to stabilise the continued rise of greenhouse gases in the atmosphere and to achieve a low-carbon, resilient society and a sustainable environment. Sustainable Interior Design (SID) is built on three central dimensions: ecological, social, and economic interiors [2]. SID must balance people, interior space, business, economy, society, and the natural environment. Also, as COVID-19 rules are relaxed, public spaces are gradually declassified. Hence, people look forward to learning, working, and living in public spaces that are good for the environment and healthy. Interior design is no longer aesthetic. Design firms and designers should use their expertise to promote green interior design and incorporate innovation that promotes health.

1.1. Background of the study

Taiwan is a small subtropical island in East Asia. Rising global temperatures, climate anomalies, rising sea levels and disappearing coastlines impact Taiwan significantly. Due to the limited land area and natural resources, energy, construction materials, and commodities must be imported. According to a study by the Ministry of Culture [3], the rapid growth of Taiwan's economic advancement in technology and international trade has led to the expansion of the interior design market. In the post-COVID-19 era, after the reopening of public places, people have become more concerned about the quality of the interior environment, which has increased the demand for numerous renovations and adaptations. Lin [4] contended that the service life of a 60-year building includes approximately 24 interior design renovations.

SID development is crucial for Taiwan. While the demand for eco-friendly and user-friendly interior design is increasing, the renovation also generates demand for reducing construction materials usage, air pollution and waste generation. Therefore, green interior design criteria should be adopted by the interior design industry in Taiwan to address sustainability holistically. According to Sami et al. [2], Lin [4] and Chen et al. [5], each regional country should develop a green interior design assessment system according to its geographic, cultural, and climatic context to achieve best practices for sustainable development. However, 20 years after developing the green building rating system in Taiwan in 1999 [6], the green interior design assessment standard still needs to be clearly defined and seen as part of the green building rating system. The lack of a green interior rating system leads to greenwashing by non-professionals. Thus, this was identified as the study gap.

The study aimed to develop commercial green criteria as a basis for the sustainable development of the interior design industry in Taiwan. The framework of green interior design criteria is based on 1) the analysis of components of green criteria according to the Resource Based View (RBV) theory [7, 8]; 2) the evaluation of the priority of the weighting of green criteria in Taiwan to improve the sustainable competitive advantage of future interior design practises and to implement the best sustainable development strategies.

1.2. Theoretical framework

Asadi et al. [7] and Grant [8] emphasised that RBV is a management paradigm that can leverage physical or intangible resources to generate long-term competitive advantages. An organisation can develop a strategy based on its strengths to gain a sustainable competitive advantage through emerging competencies or resources. Future strengths should be developed from current resources and capabilities. Hence, design, management, strategy, and education are examples of intangible resources in the green criteria, while materials and equipment are tangible resources. The research framework for this study, which was based on the RBV hypothesis [8], is divided into five stages:

- Resource: The initial literature review identified and classified green standard items for better resource use.
- Capability: through the Modified Delphi method [9, 10] questionnaire, experts reviewed and classified appropriate green criteria based on the current resource and capacity development of the interior design industry in Taiwan.
- Competitive advantage: assess the potential of Taiwan's interior design resources and capabilities through expert focus group meetings of the Estimate-Talk-Estimate (ETE) Delphi method [9, 10]; categorise the items to maximise sustainable capabilities and enhance the potential for sustainable competitive advantage in future interior design to achieve an appropriate return on investment.
- Strategy: analyses the external opportunity strategies that best utilise the organisation's resources and capabilities based on the weighting of green criteria established by experts.
- Identify the limitation of resources: Summarise the expert opinions' findings and invest in replenishing, expanding, and upgrading the organisation's resource base.

2. Literature Review

The literature review aimed to identify the main issues and gain insights into the key sources related to the main arguments, assumptions and gaps in the field of research on SID to gain a comprehensive perspective on creating green criteria for Taiwan's interior design industry.

2.1. Systematic review of sustainable interior design literature

The systematic review aimed to comprehend global trends in SID and to adhere to global green interior design best practices. The assessment was conducted from 2011 to 2021 (with data collected up to October 2021) through the Scopus and Google Scholar databases. As shown in Table 1, 65 SID-related publications were identified, including five green interior design indicators (four green commercial interior criteria and one green residential interior indicator).

The remaining four were for commercial and mixed-use spaces (Table 2). Consequently, the development of green interior design criteria in Taiwan will be based on these four SID indicators, as determined by a review of the relevant literature.

Table 1. A systematic review of SID literature.

Research period	From 2011 to 2021 (Data collected until October 2021)
Research website	Scopus and Google Scholar databases
Research keywords (within the topic, abstract, keyword of articles)	Sustainable Interior /Architectural design; Green interior design; Sustainable/ Green interior design standards; Sustainable/ Green interior design policy; Sustainable/ Green interior design regulation; and Sustainable/ Green interior design rating system/Criteria/and Evaluation system
Number of publications	Total 65 publications, including five green criteria (four green commercial interior criteria and one green residential interior indicator)

Table 2. A systematic review of four criteria.

Author	Year	Description of Criteria	The reason for a green model for Taiwan
Sami et al. [2]	2020	The Middle East SID rating system	The SID criteria consider human, environmental, socio-economic, and cultural values.
Rashdan and Ashour [11]	2017	The SID criteria for selecting SID solutions	SID solutions through the choices during the design stage, including decisions on green materials, facilities selection, and construction methods.
Sarmiento and Souza [12]	2017	The SID criteria are based on the concept of social responsibility	The SID model considers the life cycle production during the design and construction phases.
Chen et al. [5]	2016	SID criteria for hotel projects	To assist decision-makers in understanding the priority of indicators to meet their budget.

2.2. Reviews of worldwide green interior design grading systems

Pursuing a low-waste society and environment requires significant green innovation policies [7]. SID assessment systems are being developed worldwide to respond to the integration of local economic, social, and environmental conditions. To maintain consistency with international green interior design standards, Taiwan's SID criteria will incorporate the six major international green interior design rating systems, such as The United States Leadership in Energy and Environmental Design (LEED) for Interior Design and Construction (ID+C) [13], The United Kingdom Building Research Establishment Environmental Assessment Method (BREEAM) Refurbishment and Fit-Out (RFO) Green Interiors (GI) [14], Canada Green Globes for Sustainable Interiors (SI) [15], The Japan Comprehensive Assessment System for Built Environment Efficiency (CASBEE) Commercial Interior for offices [16], Singapore Green Mark for Healthier Workplaces (WH) [17], and the Hong Kong Building Environmental Assessment Method (BEAM) Plus Interiors [18].

The US LEED, UK BREEAM, and Canada Green Globes green building rating systems are the pioneers and well-established models for green buildings worldwide. Japan CASBEE, Singapore Green Mark, and HK BEAM Plus are Asia's world's leading green building assessment systems. Because of its historical roots, Taiwan's building language, standards and codes are based on those of Japan.

In addition, Hong Kong, Singapore, and Taiwan are similar in topography, climate, and geographical location. Natural resources are limited by area and topography, and the economy is focused on commercial development.

2.3. Taiwan's green building and interior design policies

It has been 20 years since Taiwan promulgated the Green Building Assessment System in 1999 [6]. The Green Building Assessment System contains four major categories - Ecology, Energy Saving, Waste Reduction, and Health, abbreviated as EEWH, which contains nine indicators. The green building assessment system framework is well-developed and generally well-known in Taiwan, with 10,000 buildings receiving EEWH green building certification between 2000 to 2020. No rating system is available for SID, but only adherence to the Taiwan Interior Design Act 2021 [19] includes a requirement to use 60% green building materials for interior renovation projects. Therefore, resulting in non-holistic SID in Taiwan.

2.4. Summary of proposed items of SID criteria

Based on the above literature reviews, the Taiwan SID criteria were summarised as a possible set from six international green interior design rating systems and four green criteria from the literature review, totalling 352 indicator items. In the initial review, 30 semantically redundant items were eliminated. In the second review, 20 semantically redundant items were eliminated. After two cycles of literature review, 302 items have been summarised in this study. In addition, one open-end question was: "In terms of Taiwan's green building and interior design policies, which item should be included in the SID criteria?" The experts provided their input for the addition of items. In conjunction with the expert questionnaire, Taiwan's green building and interior design policies were made available for review by industry professionals.

3. Methodology

In this study, the researchers conducted an exploratory sequential mixed methods research design in four separate phases to obtain and analyse both qualitative and quantitative data based on the RBV theoretical framework [8] (refer to Fig. 1). Mixed methods research combines quantitative and qualitative approaches to gather, analyse, or interpret data. Quantitative and qualitative research complement or confirm one another.

As shown in Table 3, the process of research methods is divided into four steps as follows:

- Step one-Literature review: the research summarised 302 items.
- Step two-Modified Delphi method: The data on expert panels are shown in Table 4. After two sessions of anonymous voting, the experts identified eight primary categories. Of 114 items, 34 disagreed with them (validity 80%), and 13 needed to be combined and renamed. There was 80 % agreement on a total of 82 items (valid percentage >80%; >12 experts voted "agree") [20]. The value of Cronbach's Alpha for the survey questionnaire was $\alpha = 0.947$. The expert opinions have converged after revising the Delphi method's poll results in two phases.
- Step Two-ETE Delphi method: The ETE Delphi method expert meeting was held. The same 15 expert panels were invited (Table 4). The experts

summarised the SID criteria: eight main categories, seven interior categories, one "Green Transportation" category, and 70 items.

- Step Three-Questionnaires: Experts conducted a quantitative survey after the meeting to decide on the weighting. The value of Cronbach's Alpha for the survey questionnaire was $\alpha = 0.83$.
- Step Four-Conclusion: merging the datasets and summarising the results.

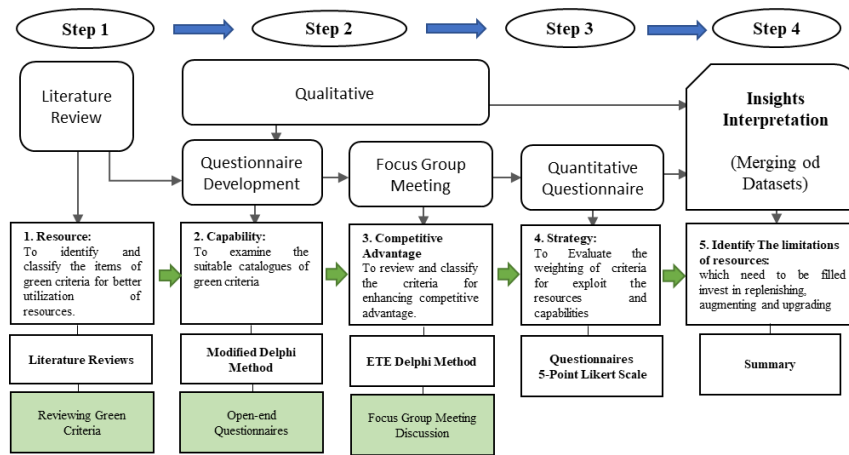


Fig. 1. The framework of the research method.

Table 3. Process of research methods.

	Step 1	Step 2		Step 3	Step 4
Research Method	Literature Review	Modified Delphi method (2 times)	ETE Delphi method	Questionnaire	Conclusion
Total Categories	8	8	8	8 (weighting)	
Total Items	352	302	141	82	70 (weighting)
Excluded items	50	161	59	12	
Renamed Items	0	1	17	6	
Final Agreed items	302	141	82	70	

Table 4. Expert panel.

Expert's Information	Classification	Number	Percentage
Gender	Male	8	53.3
	Female	7	46.7
Education	College/University	3	20
	Master	10	66.7
	PhD	2	13.3
Working position	Director/Dean/CEO	7	46.7
	Manager	8	53.3
Working experience in relevant green environmental management, interior design, and architecture fields with the professional license	11~15 years	2	13.3
	16~20 years	6	40
	21~25 years	7	46.7
Total		15	100

4. Results and Discussion

4.1. Results and analysis of the weighting of main categories

In the previous section, experts summarised Taiwan SID criteria, including seven interior categories, one "Green Transportation" category, and 70 items. Since interior categories are the main factor for indoor commercial space, the analysis focused on assessing the weighting of Taiwan's seven main interior categories, as determined by the votes of 15 experts (shown in Table 5).

Table 5. Weighting and ranking of seven main interior categories.

Code	Main Category	Ranking	Mean Weighting%	
SD	Sustainable design	1	4.67	23.4%
SMP	Sustainable management and planning	2	4.60	20.3%
EE	Energy efficiency	3	4.53	17.2%
IEQH	Indoor environmental quality and health	4	4.47	14.1%
MRM	Material and resource management	5	4.33	9.4%
WRM	Water resource management	6	4.33	9.4%
WM	Waste management	7	4.27	4.7%

Experts consider SD (weighting=23.4%) and SMP (weighting=20.3%) the most significant main categories: green design and management at the onset can make the most of Taiwan's limited resources to steer the project toward a sustainable orientation. Therefore, the SD and SMP weighting sum is 43.7%, the most significant proportion of the overall categories.

Around 98% of Taiwan's energy depends on imports. Population growth and commercial development have led to energy shortages. Thus, EE (weighting=17.2%) was ranked third. Energy is the highest-weighting resource among building materials, water, and waste. IEQH (weighting=14.1%) is a significant concern in the post-COVID-19 era, ranked fourth in importance. According to the requirements of the interior design industry, MRM (weighting=9.4%), WRM (weighting=9.4%), and WM (weighting=4.7 per cent) ranked fifth, sixth, and seventh, respectively.

4.2. Results and analysis of the weighting of each category

As shown in Table 6, the results of the most significant in each category are as follows:

- SD category: SD10 (weighting=19%) "Accredited professional and education" was the most significant weighting item. Experts are aware of the competitive non-professional practice in Taiwan. Thus, this was scored high.
- SMP category: SMP5 (weighting=21%) "Construction environmental management" was ranked the highest weight and the most significant impact. During the construction stage, interior construction environmental management can prevent air and noise pollutants and lower the impact on the community and societal health.
- EE category: Experts indicate that designers should consider energy-saving strategies at the early stage of project design, including the procurement and use of green energy, the selection of energy-saving equipment, and the

reduction of equipment energy consumption to reduce energy costs. Therefore, EE2 (weighting=18.4%) "Energy efficient strategy was ranked first".

- IEQH category: IEQH2 (weighting=13.8%) "Air quality monitoring system" was ranked first. Air quality monitoring is an essential strategy for commercial spaces due to the building environment condition and people density.
- MRM category: MRM11 (weighting=16.7%) "Green interior material safety sheets and certifications" prevents greenwashing products and guarantees products are free of toxic emissions.
- WRM category: Experts valued and focused on water quality and health in a commercial environment. WRM3 (weighting= 26.5%) "Drinking water quality and water filter system" was ranked first.
- WM category: the most important item for experts is WM5 (weighting=36%), "Waste improvement plan". The large amount of construction waste generated is due to the lack of a comprehensive waste reduction improvement plan in the design and construction stage, resulting in the waste of construction materials.

Table 6. The most significant item of main interior categories.

Code	Main Category	Total of item	Most significant item
SD	Sustainable design	10	SD 10. Accredited professional and education
SMP	Sustainable management and planning	9	SMP 5. Construction environmental management
EE	Energy efficiency	11	EE 2. Energy efficient strategy
IEQH	Indoor environmental quality and health	14	IEQH 2. Air quality monitoring system
MRM	Material and resource management	11	MRM 11. Green interior material safety sheets and certifications
WRM	Water resource management	7	WRM 3. Drinking water quality & water filter
WM	Waste management	5	WM 5. Waste improvement plan

4.3. Summary of the framework of SID criteria

In addition to indoor environmental management and an external green transportation plan, the design framework for managing resources includes energy, water, building materials, waste, and energy, water, and waste management. It addresses the interior design lifecycle phases of design, construction, operation, and maintenance.

Based on the RBV theory, the 70 items of criteria are classified into intangible resources and tangible resources, as shown in Table 7. Among the 70 items, the total of intangible resources is 52 (weighting=71%), including Management/Strategy (total=34, weighting=49%) as the most frequent item, Design (total=15) and Education (total=3). It is believed that the SID criteria are a management tool—a framework for achieving the goal of green interior design. The intangible resource is the most critical value of the green criteria.

Table 7. The analysis of items of green criteria based on RBV.

Code of Main Category	Number of Items	Intangible Resources			Tangible Resources	
		Design	Management / Strategy	Education	Material / Resources	Facilities
SD	10	8	1	1	0	0
SMP	9	0	9	0	0	0
EE	11	2	6	0	1	2
IEQH	14	5	4	2	0	3
MRM	11	0	5	0	6	0
WRM	7	0	3	0	0	4
WM	5	0	4	0	0	1
ST	3	0	2	0	0	1
Total Items	70	15	34	3	7	11
Weighting	100%	21%	49%	4%	10%	16%

4.4. Summary of the weighting of SID criteria

Based on the discussion at the expert meeting, experts voted on the priority of the criteria and proposed the development of strategic SID criteria, summarising the expert opinions as follows:

- **Resources management:** Integrated sustainable design and management are the best strategies for an interior design firm to manage resources-energy, water, materials, and waste. Sustainable design strategies should be a long-term consideration of the life circle assessment of a project.
- **Capability improvement:** Green interior design education is the core of the development of SID. From the initial design and management planning stages, design firms must educate designers on sustainability and the management regulations that should align with it.
- **Competitive advantage:** The budget is always the top priority when renovating a commercial space [5]. Commercial space design trends are changing rapidly. To reduce unnecessary decorative construction, it is essential to implement green design criteria during the preliminary design phase. Additionally, designers can integrate users' requirements and suggest a long-term green plan for business operations and future development. The best competitive strategy is to provide a healthy green space within the client's budget.
- **Sustainable strategies:** For sustainable business development of design companies, designers can implement green interior design criteria with their professional green knowledge on projects and lead and build the customer green concept. Sustainable products need clients' support; therefore, the industry can continue to innovate and provide green products.

Finally, experts expressed concern that SID development and education would be challenging to promote to governments because the acts would have to pass scrutiny and be time-consuming. Experts also pointed out that green interior design awareness is the first step in forming a prototype for sustainable development. The formation of green public opinion will influence the government and population to support Taiwan's SID development.

5. Conclusion

Interior design firms and designers can practise design projects based on the weighting of SID criteria, consider the project's reality, and successfully implement methods to allocate the most advantageous use of resources while decreasing construction costs. The following summarises the strategies that should be strengthened in the future development of SID in Taiwan's interior design industry while implementing the three dimensions of green interior design targets.

- **Eco-Interiors:** The SID environment builds on implementing green criteria to provide customers with a healthy, eco-friendly interior environment. By implementing green interior design criteria in pre-design, integrated design, and management to control resources, the interior design life cycle is considered during the design, construction, operation, and maintenance phases to reduce construction costs and provide clients with the most effective green design strategy.
- **Economic Interiors:** Developing a sustainable performance that improves social and environmental sustainability and realises the benefits of a sustainable economy is crucial. Therefore, designers can advise their clients to stay within budget based on the weighted ranking of priorities to accomplish green interior design objectives.
- **Social Interiors:** To promote SID as a common language for society. Green interior design education is not only for professional interior designers. It can be extended to the public. It is critical to instil the concept of actual SID criteria.

The growth of global interior design will inevitably go in the direction of SID since it is the future trend. For Taiwan to reach the UN Sustainable Development Goals by 2030 and net-zero emissions by 2050, the interior design industry must take concrete steps to accomplish the green interior design criteria.

Nomenclatures

ID+C Interior Design and Construction

Abbreviations

BEAM	Building Environmental Assessment Method
BREEAM	Building Research Establishment Environmental Assessment Method
CI	Commercial Interior
EEWH	Ecology, Energy Saving, Waste Reduction, and Health
ETE	Estimate-Talk-Estimate
GI	Green Interior
HK	Hong Kong
LEED	Leadership in Energy and Environmental Design
RFO	Refurbishment and Fit-Out
RBV	Resource Based View
SID	Sustainable Interior Design
SI	Sustainable Interiors
UK	United Kingdom
UN	United Nations
US	United States
WH	Healthier Workplaces

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