Using IPA-KANO to discuss the Effect of Sustainable Circular Resource Strategies on the Evaluation Items of Environment, Society, Governance (ESG) in Taiwan

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Abstract

This study investigates the impact of sustainable circular resource strategies on the evaluation items of the Environment, Society, and Governance (ESG) criteria in Taiwan, using the IPA-KANO model. With Taiwan's goal of achieving net-zero carbon emissions by 2050, the research emphasizes the importance of adopting sustainable circular strategies, including energy efficiency, resource recycling, and the promotion of green consumption. The existing ESG evaluation systems, such as the MSCI ESG Index, predominantly focus on financial performance, which may not fully capture the unique sustainability efforts relevant to specific regions like Taiwan.

The research employs the IPA-KANO model to evaluate the effectiveness of these strategies, categorizing them into different levels of importance and performance. Through an expert questionnaire and factor analysis, the study develops a Sustainable Circular Resource Strategy Service Quality Scale, which includes 20 key factors. These factors are aligned with ESG criteria, identifying areas where improvements are needed. The study finds that certain strategies, like promoting green consumption and implementing economic initiatives, are crucial for improving societal and governance dimensions of ESG, while strategies like green building certifications and renewable energy installations are vital for environmental sustainability.

The findings suggest that current ESG evaluation tools need to be adapted to more accurately reflect local sustainability efforts. The study recommends integrating region-specific metrics into global ESG frameworks to improve their relevance and effectiveness. This framework can help policymakers and businesses in Taiwan align their sustainability strategies with ESG standards, supporting the country's long-term sustainability and carbon reduction goals. The study ultimately contributes to improving localized ESG evaluation systems for better strategic decision-making in the context of sustainable development.

Keywords: IPA-KANO, ESG, Kano, COVID-19, Two-Dimensional Quality Model

Introduction

The concept of ESG originated from the "Who Cares Wins" report by former United Nations Secretary-General Kofi Annan in 2004, which introduced "Environment," "Society," and "Governance" (ESG) as critical factors. The report proposed that companies should incorporate these three indicators—environment, society, and corporate governance—into their operational evaluation standards. This would not only support sustainable business practices but also yield positive benefits for society, the environment, and the economy. In Taiwan, the government has set a goal to achieve net-zero carbon emissions by 2050 and is committed to advancing sustainable energy management and a circular economy. Key strategies include the adoption of renewable energy, the development of smart grids, and the promotion of green consumption, all of which are essential elements of Taiwan's approach to achieving sustainable development through sustainable circular resource management.

However, current ESG evaluation tools, especially the widely-used MSCI ESG Index, focus primarily on financial performance and risk management, which may not fully reflect the unique sustainability demands and strategies of specific regions. Therefore, researching ways to improve existing ESG evaluation tools to more accurately reflect local sustainability strategies holds significant theoretical and practical value.

Most previous studies have concentrated on the theoretical aspects and indicator design of the ESG evaluation framework, with limited quantitative analysis of specific sustainability strategies. Particularly, there is a lack of empirical data on how sustainable circular resource strategies applied in Taiwan affect various dimensions of ESG evaluation. Thus, employing scientific quantitative models to analyze the impact of Taiwan's sustainable circular resource strategies on ESG evaluation items is a crucial topic in current localized ESG research.

To align with international ESG development trends, Taiwan has progressively used the Ministry of Education's "Energy Resource Education Center" project from 2007 to 2010, which involved the transformation of unused campus spaces (Shih et al., 2012). This platform connected nearby specialized schools, forming a network for sustainable development education (Shih et al., 2014). In 2018, recognizing the trend of sustainable development and ESG assessment indicators in environmental governance, particularly regarding energy resources, the original "Sustainable Campus" project was transformed into the "Sustainable Circular Campus" project. This shift focused on energy resource topics and significantly enhanced measures for resource improvements. However, current sustainable policy development has not actively applied ESG principles to studies of both existing and new buildings. To enhance the net-zero opportunities and strategies in the building sector related to ESG, this research further examines the four major circular systems of sustainable circular campuses (Shaowen Cheng, 2021), consolidating actions related to sustainability, resource management strategies, and greenhouse gas reduction.

The research utilizes the IPA-KANO model—a tool commonly applied in analyzing customer service quality and product attributes—to analyze the influence of different attributes on satisfaction and importance, thus prioritizing areas for improvement. Despite its potential, the model has not been widely applied in ESG evaluation or sustainable strategy research. However, this model can help identify priority areas for sustaining or improving localized sustainability strategies within ESG assessments and provide specific implementation suggestions. This lack of application within ESG evaluation represents a key gap in current research.

In summary, while sustainable circular resource strategies and ESG evaluations are gaining attention, significant gaps remain in research on their specific interrelations and on ways to improve the local adaptability of ESG evaluation tools. This study will use the IPA-KANO model to investigate the impact of Taiwan's sustainable circular resource strategies on ESG evaluation items, providing theoretical support for improving the existing ESG rating system and offering practical recommendations for policymaking. The main objectives are as follows:

1. To validate the impact of sustainable circular resource strategies on ESG.
2. Through IPA-KANO decision analysis, to summarize

the prioritized improvement and maintenance order of sustainable circular resource strategies, thereby promoting the localization of the ESG rating system.

Literature Review and Analysis

Application of the ESG Rating System

ESG is widely applied as a comprehensive tool for evaluating corporate performance in operational management, creating a more thorough and objective data analysis method. Roselle (2016) noted that companies focusing on ESG tend to increase their willingness for voluntary disclosures, using information platforms and independent institutions to publish measurement standards that aid decision-making. However, the current evaluation mechanisms lack unified principles and standards, leading to varied methods for assessing performance across different ESG rating systems. This inconsistency results in discrepancies in corporate evaluations, raising questions about the validity of these ratings, as each rating agency views ESG differently and applies different weighting strategies to calculate final scores (Louis et al., 2023; Saadaoui & Soobaroyen, 2018; Chatterji et al., 2016).

The widespread impact of the COVID-19 pandemic has driven companies and investors to pay more attention to social and governance measures. For instance, a higher ESG rating may indicate a company's stronger capacity to respond to crises, showcasing its ability to mitigate associated risks (Alan et al., 2023). Additionally, research by Antonios (2023) found that during periods of high uncertainty and pessimism, companies often improve their ESG performance to boost investor confidence. However, while strong ESG performance can enhance investor trust, it does not directly reduce the uncertainty around climate policy or impact CO_2 reduction performance. These findings may help managers and policymakers focus more on practical improvement efforts that align with ESG rating criteria, thus allowing them to benefit from ESG-related initiatives in times of climate policy uncertainty.

Notably, the MSCI ESG Index, issued by Morgan Stanley Capital International, the Dow Jones Sustainability Index (DJSI) jointly developed by the U.S.-based Dow Jones and Switzerland's RobecoSAM, the FTSE ESG Index and FTSE4Good Index from FTSE Russell, and the Corporate Sustainability Assessment (CSA) promoted by S&P Global are commonly used for corporate sustainability evaluations.

Jain & Tripathi (2023) emphasize that ESG is an emerging field within sustainable finance and further research shows that ESG has a significant impact on company value. This means that companies with strong ESG performance may obtain capital at a lower cost. For managers, understanding the growing importance of ESG is crucial. Companies that invest in ESG-related activities may benefit from a better reputation, easier access to financing, and increased shareholder value (Binh & Lee, 2024). This suggests that companies should prioritize ESG reporting and integrate it into their business strategy, as it increasingly influences investor decisions and market value. Furthermore, Mercereau, Melin, & Lugo (2021) found that focusing on specific ESG variables, such as reducing carbon emissions, improving water efficiency, and promoting gender diversity, is directly related to improvements in company performance and stock prices. Managers can use ESG as a tool to enhance company health and shareholder value. Focusing on important ESG indicators can lead to financial returns and improve a company's performance in the stock market (Liu & Zhang, 2023). Therefore, ESG strategies should be tailored to each company's context and key performance areas.

The study by Yasmine & Kooli (2021) found that incorporating ESG factors into smart-beta investment portfolios neither significantly increases nor decreases returns. For asset management companies, adding ESG components does not result in major financial trade-offs. This means that integrating ESG factors can attract socially conscious investors without the risk of poor financial performance, aligning investment practices with both ethical and financial goals (Oprean-Stan et al., 2021).

Helliar, Petracci, & Tantisantiwong (2021) found that SRI (Socially Responsible Investment) funds typically have more diversified portfolios, lower cash holdings, and lower fees, without sacrificing financial returns. Fund managers can attract investors by promoting the diversification benefits of SRI funds, which demonstrate resilience without requiring high fees (He et al., 2023). Companies seeking to position themselves as socially responsible should focus on how to communicate the financial and ethical benefits of their operations in order to attract socially conscious long-term investors.

The MSCI ESG Index, established in 1972, began applying ESG indicators as a stock rating tool in 1999. The MSCI ESG rating system includes 10 relevant themes and 37 key ESG indicators, which are publicly available online, providing convenient and comprehensive information. The index also created the "MSCI Global Green Building Index," with major holdings including real estate investment trusts (REITs) such as Boston Properties and Nippon Building Fund. This system has garnered widespread consensus and contribution in the building and construction industries' ESG rating frameworks. Therefore, the MSCI ESG Index is used as the rating system for verification in this study.

In order to validate the impact of sustainable circular resource strategies on ESG evaluation items, this study applies the IPA and KANO importance-performance statistical methods, commonly used in international management studies, to establish the prioritization of improvements and maintenance for sustainable circular resource strategies.

Overview of the IPA and Kano Two-Dimensional Quality Model

Important Performance Analysis (IPA) was first introduced by Martilla and James (1977) for analyzing the automotive industry. Since its inception, IPA has been widely applied across various fields. It primarily uses a two-dimensional matrix structure based on importance and performance to identify strengths and weaknesses in service quality, providing recommendations for business improvements.

In recent years, Hu & Salim (2023) combined the IPA and Kano models with Failure Mode and Effects Analysis (FMEA) to assess the quality risks of Bangkok's public bus services. They identified safety, cleanliness, and punctuality as critical attributes requiring improvement, as there was a significant gap between their importance and performance. The study suggested that government actions in improving these areas could increase user satisfaction and encourage more citizens to use public transportation instead of cars.

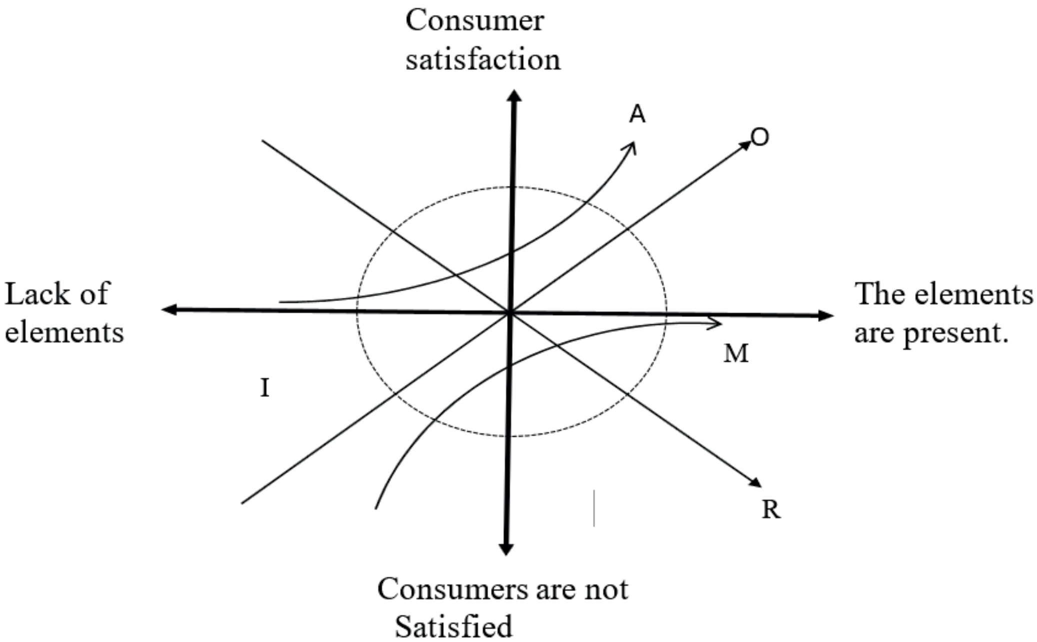
Chen et al. (2022) integrated the IPA and Kano models to explore students' needs in a synchronous remote learning environment. Their research showed that gamification elements could significantly enhance the learning experience. IPA helped identify priority areas for improving educational services, while the Kano model categorized students' needs based on whether their demands were being met.

In the airport service sector, Zeng et al. (2022) applied both IPA and the Kano model to classify and diagnose service attributes affecting passenger satisfaction. They found that certain attributes, such as timely service and efficient customer interaction, were categorized as "Must-be" requirements, while other attributes, such as in-flight entertainment, were classified as "Attractive" factors. These insights help managers focus on maintaining the "Must-be" attributes while enhancing the "Attractive" ones to improve passenger satisfaction.

Typically, IPA uses the average or median of importance and performance as reference lines. On a two-dimensional coordinate plane, it divides product perceived importance and product experience performance into four quadrants: Quadrant I "Keep Up the Good Work"; Quadrant II "Possible Overkill"; Quadrant III "Low Priority"; and Quadrant IV "Concentrate Here."

In 1984, Japanese quality control expert Noriaki Kano modified Herzberg's "Motivation-Hygiene Theory" and proposed the Kano Two-Dimension Quality Model, also known as the Kano model (as shown in Figure 1). The Kano model classifies quality attributes into five categories: Attractive Quality Element (A), One-Dimension Quality Element (O), Must-be Quality Element (M), Indifferent Quality Element (I), and Reverse Quality Element (R). Matzler and Hinterhuber (1998) classified quality attributes using five expressions: "I like it," "It must be that way," "I am neutral," "I don't mind," and "I dislike it" (as shown in Table 1). Gitlow (1999) recommended that the classification of attributes be determined by accumulating the frequency of responses, with the formula: Kano category = maximum (A, O, M) when $(A + O + M) > (I + Q + R)$, or Kano category = maximum (I, Q, R) when $(A + O + M) < (I + Q + R)$.

Figure 1. Conceptual Diagram of the Kano Two-Dimensional Quality Model



(Source: Kano, N., 1984; created by this study)

Table 1. Two-Dimensional Quality Attribute Classification Table

Quality Attribute Deficiency / Quality Attribute Presence		**Insufficient Quality Attribute**				
		I like it	It must be that way	I am neutral	I don't mind	I dislike it
Sufficient Quality Attribute	I like it	Q	A	A	A	O
	It must be that way	R	I	I	I	M
	I am neutral	R	I	I	I	M
	I don't mind	R	I	I	I	M
	I dislike it	R	R	R	R	Q

Note 1: A = Attractive Quality, O = One-Dimension Quality, M = Must-be Quality,
I = Indifferent Quality, R = Reverse Quality, Q = Questionable Quality
(Source: Matzler & Hinterhuber, 1998; compiled by this study)

Examining Sustainable Circular Resource Strategy Factors Using the MSCI ESG Index

Thematic Dimensions of Sustainable Circular Resource Strategies

Kjaer et al. (2019) explored the challenges faced by small and medium-sized enterprises (SMEs) when adopting circular economy strategies. The study emphasizes the integration of sustainable practices such as energy efficiency and material reuse, while also identifying barriers such as regulatory constraints and market readiness. The research highlights the importance of aligning circular economy models with broader sustainable development goals and identifies key dimensions, such as:

1. **Regulatory Challenges:** SMEs often face difficulties due to unclear or unsupported regulatory frameworks. Regulations may fail to incentivize recycling or the effective use of resources (Gupta & Agarwal, Geng & Doberstein, 2023).
2. **Market Readiness:** There is a gap between the development of sustainable products and market demand (Zhang & Zhao, 2020). Customers may not yet be ready to pay premium prices for sustainable products, which hinders widespread adoption (Rivas & Cruz, 2022).
3. **Technological Limitations:** SMEs often lack access to advanced technologies necessary for implementing efficient circular processes, such as resource recycling and energy reuse (Li et al., 2019).
4. **Resource Efficiency and Reuse:** SMEs should focus on improving energy efficiency, reducing waste, and creating a circular flow of materials in their operations (Egbue & Long, 2021).

Das et al. (2021) identified critical dimensions such as resource recycling, energy optimization, and waste reduction. They also emphasized the potential of closed-loop systems, which can maximize resource efficiency and minimize environmental impact, thus driving long-term sustainability. The key dimensions covered include:

1. **Resource Recycling:** Highlighting the need to develop technologies and processes to recover valuable materials from discarded energy systems, such as solar panels and wind turbines (Fraser et al., 2024).
2. **Energy Optimization:** Renewable energy systems should focus on maximizing energy production while minimizing waste and inefficiency (Sharma & Kumar, 2021).
3. **Waste Reduction:** Designing systems to minimize waste disposal is crucial for sustainable energy (Wang et al., 2023). This may include developing more durable materials or creating components that can be recycled or reused (Huang & Yang, 2022).
4. **Closed-Loop Systems:** Emphasizing the importance of transitioning from linear systems to circular systems, where products are designed with longer life cycles, and resources are continuously reused (Mont et al., 2021).

Velenturf & Purnell (2021) provided insights into the fundamental principles required for achieving a sustainable circular economy in the energy sector, focusing on the need for a systemic change in resource use. They emphasized the importance of integrating ecological and social dimensions to promote a circular bioeconomy and offered a comprehensive framework for establishing a circular economy in the energy field. The core dimensions outlined include:

1. **Systemic Change:** Achieving a reuse economy requires more than just technological innovation. It involves shifts in social values, business models, and policy frameworks to promote sustainability across all levels (Cramer, 2020).
2. **Ecological Balance:** Emphasizing the importance of aligning circular strategies with broader ecological goals, such as reducing greenhouse gas emissions and protecting natural resources.
3. **Cross-Sector Collaboration:** Energy reuse strategies cannot be implemented in isolation (Li & Umair, 2023). Instead, they require collaboration between governments, industries, and communities to create shared frameworks for resource management and energy use (Mohsin et al., 2022).
4. **Social Equity:** Sustainability and circular economy models must also address social aspects, ensuring that

all sectors of society can access and afford energy resources (Kovilage, 2021).

Blomsma & Brennan (2017) provided a comprehensive overview of the concept of the circular economy, with a particular focus on energy resource management. The discussion highlights strategies such as material reuse and energy recovery, which help extend the productivity of resources. The key thematic dimensions include:

1. **Material Reuse:** The authors emphasize how the reuse of energy models ensures that materials are reused and recycled at the end of their life cycle, thus reducing the demand for virgin materials (Ghisellini et al., 2022).
2. **Energy Recovery:** Capturing and reusing energy generated during the manufacturing or decommissioning phases of energy technologies, which makes the entire life cycle more energy-efficient (Cervantes Puma et al., 2024).
3. **Longevity Design:** Products in energy systems should be designed for extended use, ensuring that they can be maintained, repaired, and reused, contributing to the achievement of sustainable development goals (Zucaro et al., 2022).

According to the research by Oludolapo et al. (2022), buildings require adequate monitoring throughout their entire life cycle, and the concept of building sustainability assessment is crucial for mitigating global warming. Building certification assessments can serve as effective environmental management tools to reduce the transitional consumption of resources such as water and energy in buildings. When applied to a large number of buildings in urban areas, these tools can significantly reduce the city's demand for energy resources, thereby contributing to the region's overall sustainable development goals (Raissa et al., 2021).

In light of this, Liu et al. (2023) applied Domestic and International Sustainable Building Evaluation Index Certification Systems, further integrating Xu Fuxi's (2022) research on nine international indicator systems and eight regulations from Taiwan's sector, while also comparing 35 scholarly works on low-carbon studies, including those by Bernhard & Auer (2021), Pomponi & D'Amico (2020), and Griffiths & Sovacool (2020). This study selected key thematic topics for sustainable circular resource strategies, which include: "Energy Efficiency," "Energy Saving," "Water Resources," "Renewable Energy," "Resource Recycling," "Sustainable Management," "Green Buildings," "Indoor Environmental Quality," "Air Quality," and "Health and Hygiene."

On the other hand, although the potential impacts of climate change on the construction industry have not been fully researched, climate change has already had a significant impact on buildings, their environments, designs, and operations. Therefore, understanding these impacts is crucial (Zhiqiang & Jacob, 2019). A comprehensive comparison of international sustainable building evaluation certification systems shows the following weighted priorities for their respective assessment criteria: Health and Well-being, Energy (BREEAM); Energy and Air, Indoor Environmental Quality (LEED); and Energy, Indoor Environment (CASBEE).

Additionally, similar evaluations were conducted for Taiwan's Ministry of the Interior Green Building Evaluation System, Smart Building Label Certification System, Kaohsiung City Government Photovoltaic Smart Building Label Certification, and Kaohsiung City Government Kaohsiu Building Certification Label. The evaluation revealed that "Indoor Environmental Quality" and "Energy" received the highest scores, which were highly consistent with international sustainable evaluation certifications. This also corresponds with the top 10 thematic topics related to sustainable circular resource strategies. Subsequently, four major circular systems of sustainable circular campuses were introduced, with a focus on energy resource-related themes, defining three main thematic dimensions for "Sustainable Circular Resource Strategies": "Environment and Health," "Energy and Microclimate," and "Sustainable Circular System."

Thematic Factors of the Sustainable Circular Resource Strategy Service Quality Scale

This study examines the greenhouse gas control implementation plans by the Executive Yuan and policies related to sustainable circular campuses. Based on the attributes of the thematic items within the three main thematic dimensions, a preliminary "Sustainable Circular Resource Strategy Service Quality Scale" was developed, consisting of 20 factor items. Among these, the items with the most references were "Maintaining Indoor Environmental Quality and Cleanliness" and "Operating Circular Hydropower." The next most referenced items were "Planning Green Building Materials and Natural Material Applications," "Reusing Existing Building Old Facilities," and "Recycling and Reusing Equipment and Facility Materials." The relevant content is shown in Table 2.

Table 2. Listed of question factors and data sources for sustainable recycling energy resources strategy

Dimension Attribute	Code	Item Factor	Data Source
Environment and Health	EH1	Apply for Kaohsiu, Green Building, or other certifications	E02；E05
	EH2	Maintain indoor environmental quality and cleanliness (e.g., air purifiers, ventilation systems, etc.)	E01；E02；E03；E04；E05；E06；E07
	EH3	Plan for the use of green building materials and natural materials (e.g., low emission, low pollution, or low odor, etc.)	E01；E02；E03；E04；E05；E07
	EH4	Air pollution disaster perception and response (e.g., installation of air quality detectors, air quality monitors, etc.)	E01；E04；E05；E07；E03
	EH5	Install energy-saving lighting in existing buildings (e.g., full or partial replacement)	E01；E02；E04；E05；E07
	EH6	Design spaces for electric vehicle charging stations (e.g., charging stations or charging piles)	E02；E04
	EH7	Promote vertical greening in buildings (e.g., living walls, landscape balconies, or rooftop greening)	E01；E02；E05
Energy and Microclimate	EC1	Introduce campus energy management system (EMS)	E01；E04；E07
	EC2	Install renewable energy generation equipment (e.g., solar power, wind energy, etc.)	E01；E04；E07
	EC3	Install smart digital meters (e.g., smart green energy photovoltaic and cloud-based energy monitoring systems)	E01；E04；E07
	EC4	Operate circular hydropower (e.g., rainwater collection, purified water storage, water infiltration and retention, etc.)	E01；E02；E03；E04；E05；E06；E07
Sustainable Circular	SC1	Fully implement general resource recycling (e.g., advocacy or actions, etc.)	E01；E03；E04；E05；E07
	SC2	Reuse old facilities of existing buildings (e.g., self-use, storage, or repurpose for other uses, etc.)	E01；E03；E04；E05；E06；E07
	SC3	Recycle and repurpose materials from equipment and facilities (e.g., waste exchange or remanufacturing for reuse)	E01；E03；E04；E05；E06；E07
	SC4	Promote food and agriculture education in daily life (e.g., advocacy or actions, etc.)	E03；E04；E05
	SC5	Promote leaf and kitchen waste composting or recycling	E01；E03；E04；E05；E07
	SC6	Plan and implement economic regeneration actions (e.g., developing local economies based on regional characteristics, etc.)	E03；E04；E05；E07

Dimension Attribute	Code	Item Factor	Data Source
	SC7	Community sustainability human resources training (e.g., horizontal collaboration with community groups to create sustainable innovation)	E03；E04；E05；E07
	SC8	Implement green consumption by purchasing green products (e.g., carbon footprint reduction labels, environmental protection certifications, etc.)	E04；E05；E06
	SC9	Collaboration among industry, government, and academia to implement energy-saving, carbon-reduction, and campus environmental education policies	E04；E05；E07

Note 1：E01 =Green Building Standard（EEWH）、E02=Kaohsiung City Building Certification（KCBC）、E03=Sustainable Schools（SS）、E04=LEED (US)、E05=WELL (US)、E06=BREEAM (UK)、E07=CASBEE (Japan)

(Source: Compiled by this study)

Methodology

Implementation of the Sustainable Circular Resource Strategy Quality Scale Survey

To determine the usability and appropriateness of the research scale, feedback was gathered through an expert questionnaire process. The following suggestions were 1.Add an item factor: "Operating Circular Hydropower" (e.g., rainwater collection, purified water storage, and water retention). 2. Include Q&A explanations and definitions for the terms used in the scale. As a result, 20 item factors were finalized. A pretest was then conducted by distributing 50 questionnaires to carry out an Exploratory Factor Analysis (EFA) on the Sustainable Circular Resource Strategy Quality Scale. The EFA revealed a KMO value of 0.876 and a Bartlett's test of sphericity significance of 0.000. After the scale was reviewed and modified by experts, its validity and reliability were enhanced. The final EFA identified 3 main themes and 20 item factors. SPSS software was used to analyze the data, producing the following Cronbach's Alpha values: Environment and Health (Cronbach's Alpha: 0.818), Energy and Microclimate (Cronbach's Alpha: 0.705), Sustainable Circular System (Cronbach's Alpha: 0.887), The overall reliability of the scale, with a Cronbach's Alpha value of 0.930, indicates good reliability and validity for all the dimensions.

Next, a parallel comparison was made between the MSCI ESG rating system's 10 relevant themes and 37 key ESG rating items, and the 20 item factors of this study. The correspondence between the 20 item factors and ESG relevance is shown in Table 3. The findings are as follows: (1) Environment and Health: EH1 and EH6 (2) Energy and Microclimate: EC1, EC2, EC3 (3) Sustainable Circular System: SC6, SC8 Seven item factors from the Sustainable Circular System dimension correspond to the Environment, Society, and Governance themes and rating items. SC7 in the Sustainable Circular System dimension corresponds only to the Society aspect. SC9 in the Sustainable Circular System dimension corresponds to both the Society and Governance aspects. In summary, 18 item factors are linked to the Environment aspect of ESG, 20 item factors are linked to the Society aspect, and 8 item factors are linked to the Governance aspect. Seven item factors are linked to all three ESG dimensions.

Table 3. Analysis of the Correlation Between Sustainable Circular Resource Strategies and ESG

37 Key Topics by ESG Rating / 代碼				Environment		Society		Governance		Total Sum Percentage of ESG
				Climate Change Natural Capital Pollution and Waste Environmental Opportunity	Percentage of ESG	Human Capital Product Responsibility Stakeholder Objections Social Opportunities	Percentage of ESG	Corporate Governance Corporate Behaviour	Percentage of ESG	
	Environment (E)	Society (S)	Governance (G)	13 indicators		15 indicators		9 indicators		
EH1	★	★	★	84.6%	29.7%	33.3%	13.5%	33.3%	8.1%	51.4%
EH2	★	★		38.5%	13.5%	26.7%	10.8%	0.0%	0.0%	24.3%
EH3	★	★		69.2%	24.3%	33.3%	13.5%	0.0%	0.0%	37.8%
EH4	★	★		30.8%	10.8%	26.7%	10.8%	0.0%	0.0%	21.6%
EH5	★	★		46.2%	16.2%	20.0%	8.1%	0.0%	0.0%	24.3%
EH6	★	★	★	46.2%	16.2%	26.7%	10.8%	11.1%	2.7%	29.7%
EH7	★	★		38.5%	13.5%	13.3%	5.4%	0.0%	0.0%	18.9%
EC1	★	★	★	38.5%	13.5%	26.7%	10.8%	22.2%	5.4%	29.7%
EC2	★	★	★	38.5%	13.5%	20.0%	8.1%	22.2%	5.4%	27.0%
EC3	★	★	★	30.8%	10.8%	26.7%	10.8%	22.2%	5.4%	27.0%
EC4	★	★		38.5%	13.5%	13.3%	5.4%	0.0%	0.0%	18.9%
SC1	★	★		46.2%	16.2%	13.3%	5.4%	0.0%	0.0%	21.6%
SC2	★	★		61.5%	21.6%	13.3%	5.4%	0.0%	0.0%	27.0%
SC3	★	★		61.5%	21.6%	13.3%	5.4%	0.0%	0.0%	27.0%
SC4	★	★		23.1%	8.1%	60.0%	24.3%	0.0%	0.0%	32.4%
SC5	★	★		30.8%	10.8%	20.0%	8.1%	0.0%	0.0%	18.9%
SC6	★	★	★	38.5%	13.5%	66.7%	27.0%	100.0%	24.3%	64.9%
SC7		★		0.0%	0.0%	40.0%	16.2%	0.0%	0.0%	16.2%
SC8	★	★	★	38.5%	13.5%	40.0%	16.2%	22.2%	5.4%	35.1%
SC9		★	★	0.0%	0.0%	40.0%	16.2%	33.3%	8.1%	24.3%

Note 1: The 20 item factors' data sources are compared with the 37 ESG indicators. If a keyword matches, a ★ symbol is used to indicate the correlation.
Note 2: The higher the frequency of the corresponding keywords in the indicators, the higher the percentage.
(Source: Compiled by this study)

Application of the IPA-Kano Model for Sustainable Circular Resource Strategies

Based on the literature review and analysis, this study uses the IPA or KANO methods for analysis. However, to avoid the shortcomings of the Kano two-dimensional classification, which neglects the importance and performance of quality, and to exclude the limitation of IPA, which only considers One-Dimension Quality, this study integrates the IPA-Kano model as the primary research methodology. The approach is as follows:

According to Kuo et al. (2012), the IPA-Kano model integrates the IPA and Kano two-dimensional quality models, classifying quality attributes into three series: The Hygiene Series, The War Series, and The Treasure Series. These series are further divided into 12 categories: Survival, Chronic Disease, Fatal, Fitness, Major Weapon, Supportive Weapon, Defenseless Strategic Point, Defenseless Zone, Rough Stone, Precious Treasure, Dusty Diamond, and Beginning Jewelry.

Following the IPA-Kano model proposed by Kuo et al. (2012), satisfaction is compared to the average to determine the order for maintaining or improving quality. High satisfaction corresponds to strategies that should be maintained. The maintenance order is as follows: Survival, Fitness, Major Weapon, Supportive Weapon, Precious Treasure, and Beginning Jewelry. Low satisfaction corresponds to strategies that need improvement. The improvement order is as follows: Fatal, Chronic Disease, Defenseless Strategic Point, Defenseless Zone, Dusty Diamond, and Rough Stone. The diagnostic analysis of strategy quality attributes for maintenance and improvement is shown in Table 4.

Table 4. Series, Categories, and IPA-Kano Model Strategy Priority Order

series	Attention	performance level	IPA	IPA-Kano model	strategy sequence	
					improve	maintain
Hygiene Health factors(must-be)	High	High	Maintain	Survival		1
	High	Low	Improve	Fatal	1	
	Low	Low	Minor Improvement	Chronic disease	2	
	Low	High	Overemphasis	Fitness		2
War (Performance)	High	High	Maintain	Major weapon		3
	High	Low	Improve	Defenseless strategy point	3	
	Low	Low	Minor Improvement	Defenseless zone	4	
	Low	High	Overemphasis	Supportive weapon		4
Treasure ((Attractive)	High	High	Maintain	precious treasure		5
	High	Low	Improve	Dusty diamond	5	
	Low	Low	Minor Improvement	Rough stone	6	
	Low	High	Overemphasis	Beginning jewellery		6

(Source: Kuo et al., 2012)

Based on the results of the IPA-Kano attribute classification, an interpretation of the actual value, improvement, and maintenance needs of each item factor was conducted. The analysis revealed that traditional Kano quality elements and IPA-Kano attribute classification methods have limitations in accuracy (Berger et al., 1993). Using the method proposed by Wu et al. (2010), the importance of each factor was analyzed in relation to its impact on satisfaction. Higher importance indicates a greater influence. By ranking the factors within the same IPA-Kano attribute, their impact levels were assessed to guide decision-making adjustments: identifying strategy qualities that require priority maintenance or improvement, evaluating resource conditions before implementing improvements, and determining the reallocation of resources to prioritize enhancement of specific items.

Results and Discussions

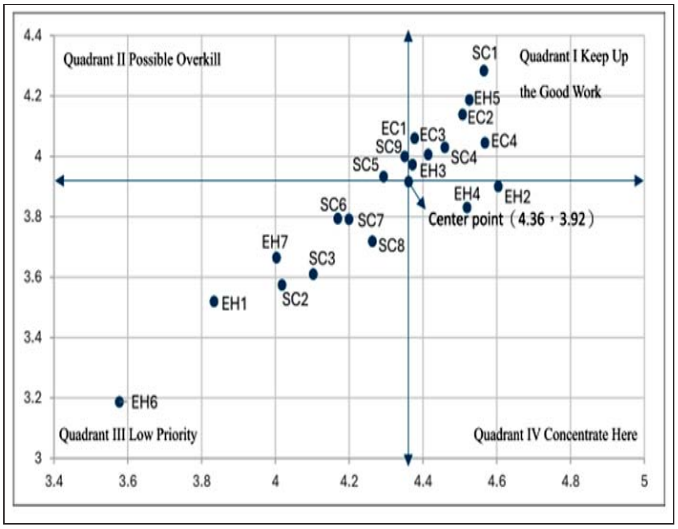
Basic Statistics of the Sustainable Circular Energy Resource Strategy Quality Scale

This study collected 338 survey responses, excluding 7 incomplete or invalid questionnaires, resulting in 331 valid samples. The target population consisted of faculty and staff from various levels of schools below senior high school. Convenience sampling was employed, with the questionnaires distributed via email to public and private schools. Data collection was conducted in two stages: a pre-test phase and the main survey phase, using an online survey format. Google Forms was used to design the questionnaire, enhancing the interface for mobile and computer users and improving the respondents' operational experience and satisfaction. Among the valid responses, 99.1% of participants had educational qualifications above the college level. Elementary schools accounted for the highest proportion (51.4%) of respondents, with most respondents coming from medium-sized schools (13 to 48 classes), representing 62.2% of the total.

IPA and KANO Attribute Classification of the Sustainable Circular Energy Resource Strategy

Statistical analysis was conducted following the methodology of Martilla and James (1977). The average scores for IPA importance ranged from a minimum of 3.58 to a maximum of 4.6, while satisfaction scores ranged from 3.19 to 4.28. Oh (2001) suggested that for non-normal distributions, using the median as the boundary is more appropriate than the mean when interpreting the IPA model. Therefore, the median was set as the boundary for the IPA model. Further evaluation of the IPA attributes and quadrant classification of item factors was conducted, with the X-axis representing Importance and the Y-axis representing Performance. Using the medians of Importance (4.36) and Performance (3.92) as the origin, the IPA matrix was divided into four quadrants. The positions of the items were determined by averaging their Importance and Performance scores, resulting in the distribution shown in Figure 2.

Figure 2. IPA Matrix of the Quality of Sustainable Circular Energy Resource Strategies



(Source: Shih, 2023)

The Kano scale investigates the impact of different strategy qualities on performance, both when present and absent. A higher impact indicates a need for alertness, improvement, or reinforcement. The next step involved applying the Kano two-dimensional quality attribute classification table to compare the positive (presence) and negative (absence) questions for each item, classifying their Kano quality attributes.

Matzler and Hinterhuber (1998) emphasized that the classification of strategy qualkity attributes is determined using a majority vote from the statistical results. Based on this analysis: 1 item factor (SC9) was classified as a Must-be Quality Element (M). 11 item factors were classified as One-Dimension Quality Elements (O): EH2, EH3, EH4, EH5, EC2, EC4, SC1, SC5, SC6, SC7, and SC8; 6 item factors were classified as Attractive Quality Elements (A): EH1, EH7, EC1, EC3, SC3, and SC4. 2 items factors (EH6 and SC2) were classified as Indifferent Quality Elements (I) and excluded from the IPA-Kano model.

(Refer to Table 5 for details.)

Table 5. Kano quality factor attribute classification and numerical analysis

構面	題項因子	O	M	A	I	R	Q	AOM	IRQ	屬性
Environment and Health	EH1 Obtain Kaohsiung Green Building Certification	70	27	81	142	8	3	178	153	A
	EH2 Maintain Indoor Air Quality and Cleanliness	135	38	89	63	1	5	262	69	O
	EH3 Plan for Green Building Materials Usage	111	25	75	115	0	5	211	120	O
	EH4 Air Pollution Awareness and Response	129	27	109	60	1	5	265	66	O
	EH5 Install Energy-Saving Lighting	135	19	70	103	0	4	224	107	O
	EH6 Configure EV Charging Stations	66	17	59	127	58	4	142	189	I
	EH7 Promote Vertical Greening	81	11	92	130	11	6	184	147	A
Energy and Microclimate	EC1 Introduce Campus Energy Management Systems	65	31	78	154	2	1	174	157	A
	EC2 Install Renewable Energy Equipment	117	24	102	83	1	4	243	88	O
	EC3 Install Smart Digital Meters	70	22	89	144	4	2	181	150	A
	EC4 Operate Water Cycling Systems	132	9	125	59	3	3	266	65	O
Sustainable Circular System	SC1 General Resource Recycling	154	31	56	86	0	4	241	90	O
	SC2 Reuse Old Building Facilities	66	15	74	161	12	3	155	176	I
	SC3 Recycle Materials for Facilities	76	21	84	140	8	2	181	150	A
	SC4 Promote Food and Agriculture Education	104	14	126	85	0	2	244	87	A
	SC5 Promote Leaf and Food Waste Composting	107	14	77	128	1	4	198	133	O
	SC6 Plan and Implement Economic Initiatives	90	11	84	144	0	2	185	146	O
	SC7 Train Community for Sustainability	89	10	87	142	1	2	186	145	O
	SC8 Promote Green Consumption	118	10	76	108	16	3	204	127	O
	SC9 Government-Industry-Academia Collaboration	79	80	58	112	1	1	217	114	M

Notes:

1. A = Attractive Quality, O = One-Dimension Quality, M = Must-be Quality, I = Indifferent Quality, R = Reverse Quality, Q = Questionable Quality

2. When numerical ratios are equal, the classification priority is M > O > A > I.

(Source: Compiled from this study)

IPA-KANO Model Attribute Classification and Priority Maintenance and Improvement Order of Sustainable Circular Energy Resource Strategies

Based on the IPA attributes and Kano quality classification of the sustainable circular energy resource strategy, the IPA-Kano classification results (see Table 6) are as follows:

- **Must-be Quality:** Only one strategy (SC9) falls into the M-II quadrant.
- **One-Dimension Quality:**
  - o Five strategies (EH3, EH5, EC2, EC4, SC1) are in the O-I quadrant.
  - o One strategy (SC5) is in the O-II quadrant.
  - o Three strategies (SC6, SC7, SC8) are in the O-III quadrant.
  - o Two strategies (EH2, EH4) are in the O-IV quadrant.
- **Attractive Quality:**
  - o Three strategies (EC1, EC3, SC4) are in the **A-I quadrant.**
  - o Three strategies (EH1, EH7, SC3) are in the **A-III quadrant.**

No strategies are distributed in the following quadrants:

- **For Must-be Quality:** M-I, M-III, and M-IV quadrants.
- **For Attractive Quality:** A-II and A-IV quadrants.

Based on the importance values, the priority improvement order is identified as:

EH2 > EH4 > SC8 > SC7 > SC6 > SC3 > EH7 > EH1.

Similarly, the priority maintenance order is:

SC9 > EC4 > SC1 > EH5 > EC2 > EH3 > SC5 > SC4 > EC3 > EC1.

From the IPA-Kano classification and ranking results, the proportion of ESG indicators in the improvement priorities reveals:

- The highest proportion is SC6 (64.9%), while the lowest is SC7 (16.2%).

In the maintenance priorities, the highest proportion is EH3 (37.8%), while the lowest is EC4 (18.9%) and SC5 (18.9%) (see Table 3).

The most frequent overlaps occur in the following ESG themes:

- **Climate Change:** Carbon emissions, product carbon footprint, and climate change response.
- **Product Responsibility:** Product safety and quality, responsible investments.

Summary:

Among the 18 item factors for sustainable circular energy resource strategies:

- Eight items are ranked as priority improvements.
- Ten items are ranked as priority maintenance.

All factors show relevance to ESG. However, ESG indicators should include suitable evaluation criteria for sustainable circular energy resources and building management, particularly in the Society and Governance dimensions. This would align evaluations with net-zero carbon policies.

Table 6. Summary of key points of sustainable recycling energy resource strategy quality IPA-Kano model

Dimension	Code	Item Factor	IPA-KANO Attribute	Improvement Order	**Priority Improvement**	Maintenance Order	**Priority Maintenance**
Environment and Health	EH1	Obtain Kaohsiung Green Building Certification	A-Ⅲ Quadrant	6	**8**		
	EH2	Maintain Indoor Air Quality and Cleanliness	O-Ⅳ Quadrant	3	**1**		
	EH3	Plan for Green Building Materials Usage	O-Ⅰ Quadrant			3	**6**
	EH4	Air Pollution Awareness and Response	O-Ⅳ Quadrant	3	**2**		
	EH5	Install Energy-Saving Lighting	O-Ⅰ Quadrant			3	**4**
	EH6	Configure EV Charging Stations	I		—		—
	EH7	Promote Vertical Greening	A-Ⅲ Quadrant	6	**7**		
Energy and Microclimate	EC1	Introduce Campus Energy Management Systems	A-Ⅰ Quadrant			5	**10**
	EC2	Install Renewable Energy Equipment	O-Ⅰ Quadrant			3	**5**
	EC3	Install Smart Digital Meters	A-Ⅰ Quadrant			5	**9**
	EC4	Operate Water Cycling Systems	O-Ⅰ Quadrant			3	**2**

Dimension	Code	Item Factor	IPA-KANO Attribute	Improvement Order	**Priority Improvement**	Maintenance Order	**Priority Maintenance**
Sustainable Circular System	SC1	General Resource Recycling	O-Ⅰ Quadrant			3	**3**
	SC2	Reuse Old Building Facilities	I		—		—
	SC3	Recycle Materials for Facilities	A-Ⅲ Quadrant	6	**6**		
	SC4	Promote Food and Agriculture Education	A-Ⅰ Quadrant			5	**8**
	SC5	Promote Leaf and Food Waste Composting	O-Ⅱ Quadrant			4	**7**
	SC6	Plan and Implement Economic Initiatives	O-Ⅲ Quadrant	4	**5**		
	SC7	Train Community for Sustainability	O-Ⅲ Quadrant	4	**4**		
	SC8	Promote Green Consumption	O-Ⅲ Quadrant	4	**3**		
	SC9	Government-Industry-Academia Collaboration	M-Ⅱ Quadrant			2	**1**

Notes:

1. Improvement strategy qualities lack attributes ranked 1, 2, and 5.
2. Maintenance strategy qualities lack attributes ranked 1 and 6.
3. Some items overlap between improvement and maintenance, and their importance scores were further refined to determine the order.
4. A = Attractive Quality, O = One-Dimension Quality, M = Must-be Quality, I = Indifferent Quality, R = Reverse Quality, Q = Questionable Quality.

(Source: Compiled from this study)

IPA-KANO Model Decision Analysis for Sustainable Circular Energy Resource Strategies

By comparing the importance of various strategy attributes, the results identified eight item factors with low satisfaction, prioritized for improvement in the following order:1. EH2 (Maintain Indoor Air Quality and Cleanliness)；2.EH4 (Air Pollution Awareness and Response); 3. SC8 (Promote Green Consumption), 4. SC7 (Train Community for Sustainability), 5. SC6 (Plan and Implement Economic Initiatives); 6.SC3 (Recycle Materials for Facilities); 7.EH7 (Promote Vertical Greening). 8. EH1 (Obtain Kaohsiung Green Building Certification).

For strategies with high satisfaction, ten item factors were prioritized for maintenance in the following order: 1. SC9 (Government-Industry-Academia Collaboration); 2.EC4 (Operate Water Cycling Systems);3. SC1 (General Resource Recycling)

1. EH5 (Install Energy-Saving Lighting)
2. EC2 (Install Renewable Energy Equipment)
3. EH3 (Plan for Green Building Materials Usage)
4. SC5 (Promote Leaf and Food Waste Composting)
5. SC4 (Promote Food and Agriculture Education)
6. EC3 (Install Smart Digital Meters)
7. EC1 (Introduce Campus Energy Management Systems)

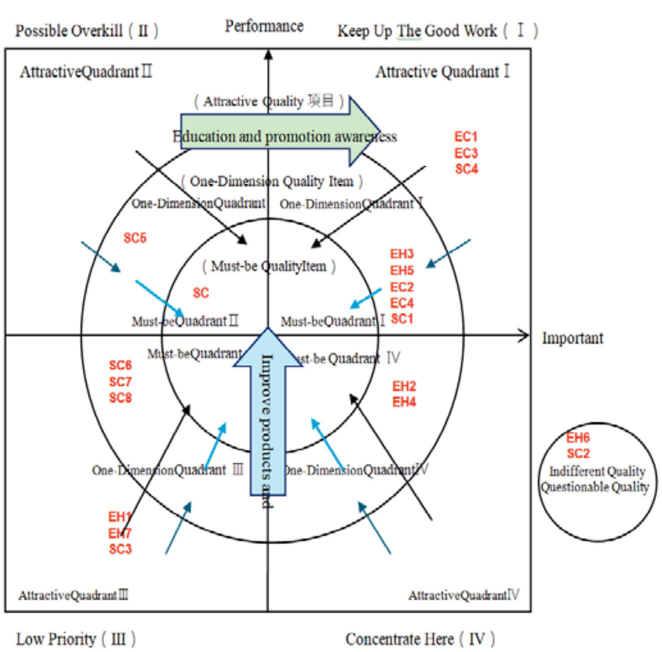
Decision Analysis Based on IPA-KANO Results

The classification of strategy qualities using the IPA-Kano model (see Figure 3) allows for a comprehensive evaluation of strategic development dimensions. The approach emphasizes:

- Increasing Importance: Through education and awareness initiatives, ensuring that stakeholders recognize the value of specific strategies.
- Improving Satisfaction: By enhancing product features and service functionalities to meet stakeholder expectations.

This analysis provides decision-makers with actionable insights to allocate resources effectively, focus on maintaining high-impact strategies, and prioritize improvements where satisfaction levels are low. By applying these findings, organizations can enhance the importance and satisfaction levels of sustainable circular energy resource strategies, ultimately transforming these into a competitive advantage.

Figure 3. IPA-Kano Decision Analysis Chart for the Quality of Sustainable Circular Energy Resource Strategies



(Source: Shih, 2023; Compiled and illustrated from this study)

Conclusions

Summary

This study confirms the impact of sustainable circular energy resource strategies on ESG evaluation items by using the IPA-KANO statistical model to establish priority sequences for improvement and maintenance. However, the research revealed that the existing MSCI ESG Index heavily emphasizes financial risks and returns in corporate operations. As a result, even though certain item factors show high priority for maintenance and improvement, their overall ESG weighting remains low. This finding highlights the need to revise and expand ESG evaluation tools to address the localized sustainability reporting needs of various industries.

The primary contribution of this study is the development of a preliminary framework for a localized ESG evaluation tool for Taiwan's sustainable circular energy resource strategies. This framework incorporates the dimensions of society and governance, with the goal of broad application in policy implementation and outcome evaluation, contributing to Taiwan's achievement of the 2050 net-zero carbon emissions goal.

The specific conclusions are as follows:

1. Strategy Prioritization and ESG Evaluation Impact

- **Recommendations for Strategy Evaluation:** Analysis of the priority maintenance and improvement sequences reveals that except for SC6 (ranked 5th) and EH1 (ranked 8th), which each account for over 50% of ESG indicators, other item factors, despite high priority rankings, contribute less than 40%. For instance, EC4 (ranked 2nd for maintenance) and SC5 (ranked 7th for maintenance) each account for only 18.9%, while SC7 (ranked 4th for improvement) and EH7 (ranked 7th for improvement) each account for 16.2% and 18.9%, respectively. This highlights the inadequacies of the MSCI ESG Index in evaluating sustainable circular energy resource strategies. Adding these high-ranking but low-contributing factors to ESG evaluation tools is recommended, particularly for expanding "Society" and

"Governance" dimensions.

- **Impact on ESG Evaluation:** The study identifies 18 strategies with relevance to environmental dimensions, with 7 strategies—such as obtaining green building certifications, configuring EV charging stations, introducing campus energy management systems (EMS), installing renewable energy equipment, installing smart digital meters, implementing economic initiatives, and promoting green consumption—correlating with the dimensions of Environment, Society, and Governance.

Priority Improvement and Maintenance of ESG Evaluation Systems

The IPA-KANO model excludes two "Indifferent Quality" strategies (SC2 and EH6). Among the remaining 18 strategies:

- For maintenance priorities, EC2 (renewable energy equipment), EC3 (smart digital meters), and EC1 (EMS) align with all ESG dimensions.
- For improvement priorities, SC8 (green consumption), SC6 (economic initiatives), and EH1 (green building certifications) also align with all ESG dimensions.

This establishes that 6 strategies comprehensively impact localized ESG evaluation indicators. Businesses and governments should allocate resources to prioritize strategies accordingly. For example, maintaining strategies like "installing renewable energy equipment" ensures long-term impact, while improving strategies like "green consumption" and "economic initiatives" provides higher benefits in social and governance dimensions.

Limitations of the MSCI ESG Index and the Need for Localization

The study reveals that the MSCI ESG Index focuses heavily on financial risks and returns, which inadequately reflects localized sustainable circular energy resource strategies. High-priority items in maintenance or improvement often have low weights in ESG evaluations. This highlights the need to optimize ESG evaluation tools by adding region-specific and industry-tailored metrics. The study proposes a localized ESG evaluation framework, providing a practical strategic framework for Taiwan's sustainability policies.

Integrating Environment, Society, and Governance Dimensions

The six strategies identified with priority for improvement and maintenance comprehensively cover ESG's three dimensions. This confirms the holistic impact of sustainable circular energy resource strategies on ESG evaluations, particularly strategies such as green building certifications, green consumption, and renewable energy equipment, which enhance environmental protection, social responsibility, and corporate governance.

Contribution to the 2050 Net-Zero Carbon Goal

The sustainable circular energy resource strategy framework proposed in this study not only offers a basis for optimizing ESG evaluation systems but also directly supports Taiwan's 2050 net-zero carbon policy objectives. Future policy development and implementation should consider the localized ESG evaluation indicators proposed in this study to facilitate policy realization and achieve specific targets, promoting Taiwan's sustainable development progress.

Feasibility for Policy and Practical Applications

The findings provide policymakers and businesses with concrete guidelines, particularly for resource allocation and strategy development. Priority should be given to strategies identified for improvement and maintenance to ensure effective resource utilization and maximize the positive impact of ESG evaluations. Additionally, businesses should reference the evaluation tools proposed in this study to more accurately reflect the implementation and effectiveness of their localized sustainability strategies in ESG reports.

Recommendations

1. **Adjust ESG Evaluation Frameworks to Fit Industry and Regional Needs:** While the MSCI ESG Index serves as a global evaluation tool with universal applicability, this study highlights its limitations in addressing region-specific sustainability strategies. It is recommended to design localized evaluation frameworks based on global standards. For instance, in Taiwan, industries with unique local economic and

environmental characteristics could benefit from tailored adjustments to indicator weighting and further expansion of the "Society" and "Governance" dimensions of ESG. This approach would encourage businesses to actively engage in localized sustainable development.

2. **Promote Comprehensive Implementation of Sustainable Circular Energy Resource Strategies:** These strategies should not be confined to environmental dimensions but should also incorporate social and corporate governance aspects, forming an integrated implementation plan. Businesses should balance the three ESG dimensions when setting sustainability goals, especially by considering the positive impacts on society and the local economy, such as promoting green consumption, obtaining green building certifications, and implementing innovative economic initiatives.

3. **Enhance Collaboration Between Businesses and Governments:** Sustainable development relies not only on corporate actions but also on governmental support and policy guidance. Governments are encouraged to consider corporate needs and challenges when formulating policies and provide appropriate incentives, such as tax breaks or green subsidies, to motivate more sustainable corporate actions. Simultaneously, businesses should actively participate in the policymaking process to ensure effective implementation of sustainability policies.

4. **Establish Monitoring and Evaluation Mechanisms to Ensure Continuous Improvement:** The effectiveness of different sustainability strategies may change over time. Therefore, regular monitoring and evaluation mechanisms should be established to dynamically adjust ESG evaluation tools and sustainability strategies. This would help businesses and governments revise their sustainability goals and action plans in response to future challenges and changes, ensuring ongoing relevance and impact.

Research Limitations

Inconsistency of Current Standards:Globally recognized ESG frameworks, such as the GRI Standard, SASB Standard, Measuring Stakeholder Capitalism Towards Common Metrics and Consistent Reporting of Sustainable Value Creation, Task Force on Climate-related Financial Disclosures, and the Carbon Disclosure Project (CDP), focus predominantly on corporate, accounting, and financial sectors. However, there is limited development and application of these standards for the construction industry. This remains an area for further exploration and refinement.

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