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Evaluating the Application of CSR in the High-Tech Industry during the COVID-19 Pandemic

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Abstract: Since its conception, corporate social responsibility (CSR) has seen continuous growth and become a highly discussed issue. In this paper, we propose an evaluation of how the COVID-19 pandemic could impact CSR applications. The pandemic has provided an opportunity for commerce to move on to being more authentic, to offer genuine CSR applications and to contribute toward dealing with pressing environmental and social issues. Hence, this purpose of the research is to obtain a better understanding of whether the integration of environment, social, corporate governance and economic (ESGE) aspects into CSR strategies can support sustainable development toward more sustainable growth during the COVID-19 pandemic. To meet this challenge, we offer a mixture multiple-criteria decision making (MCDM) model. Very few empirical studies have discussed CSR in the high-tech industry and proposed strategies and planning for ESGE efficiency. Using interviews with experts and a literature review, we identify the elements related to actual practices of the high-tech industry's appraisal and the integrated MCDM techniques to suggest efficient enhancement models. The best worst method (BWM) and modified VIKOR are implemented to estimate the strategic weights and the gaps of the aspiration value. The results are valuable for classifying the priorities of CSR and are therefore helpful for those who are associated with high-tech industry management, practices and implementation.

Keywords: corporate social responsibility (CSR), COVID-19 pandemic; MCDM (multiple-criteria decision making), best worst method (BWM), modified VIKOR method

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1. Introduction

The COVID-19 pandemic is one of the most important changes in the current industrial development environment and could have a profound effect on the fundamental philosophies of administration and corporate social responsibility (CSR). The acute influence of COVID-19 was felt immediately, owing to the extensive social distancing and lockdown measures enforced worldwide. While the crisis phase of the COVID-19 pandemic will eventually end, it will have enduring profound environmental, social, corporate governance and economic influences. The governments of the world have built economic aid packages, mostly to mitigate the pressure placed upon the weakest industries (e.g., hospitality, travel, tourism and small businesses). These measures need to encourage companies to fulfill their CSR commitments and maintain ethical business practices for their numerous stakeholders. Twitter has pledged to donate USD 1 billion to tackle the pandemic [1]. Hence, there is an excellent opportunity to investigate how the pandemic impacts industry CSR and its estimated factors.

CSR has its very foundation in the environment and ecosystems and has the capability to adjust or change environments [2]. CSR is a significant subject for the stakeholders, administrators, consumers and practitioners of current industries or companies [3]. The

issues of vertical integration and globalization have enhanced the concentration on CSR applications during the COVID-19 pandemic. It has been established that CSR can enhance the competitive advantages of industries or companies. The principles of CSR are implemented in many industries, which has led to the emergence of many conceptions of CSR [4]. In the past several decades, the CSR literature has demonstrated a tremendous improvement in the number of quantitative and qualitative works dealing with various subjects, such as improving green flexibility with advanced manufacturing technology, green supply chain management or environmental production and sustainability [5–7]. The goals of corporate CSR development involve a triple bottom line of research, mixing economic, environmental and social topics in the procedures. Moreover, corporate governance is also an important issue for CSR. These aspects (environment, social, corporate governance and economic) are indicators of the CSR performances of companies, such as the performances in terms of risk management and management capability in the COVID-19 pandemic [8–10]. The need to decrease human-induced environmental change in order to prevent the diminishing growth of economies is critical for maintaining sustainable growth. Studies on CSR flourished before the pandemic and could reasonably be claimed to be one of the most widely cited and read management fields.

Owing to the breakout of the COVID-19 pandemic, the rate of unemployment has increased and many areas of commerce have shut down. The World Health Organization (WHO) has stated that COVID-19 has become a major global crisis challenging the industrial environment, which could ultimately have a negative influence on business practices and CSR [11,12]. Until now, the high-tech industry has not had to plan for a pandemic. Furthermore, CSR has been marginalized due to governments, society and organizations struggling to survive during the pandemic. The pandemic is creating novel challenges for CSR, primarily because many companies are facing negative effects such as company bankruptcy, market downturn, revenue loss, employee resignations, etc. However, the high-tech industry has been less impacted during the COVID-19 pandemic in Taiwan; some big companies such as TSMC and Foxconn have offered to purchase and import the BioNTech COVID-19 vaccines to Taiwan's people for CSR. Hence, we see COVID-19 era as an opportunity for the high-tech industry to rethink their CSR practices concerning a shift in their sustainable development and CSR strategies. Therefore, the objective of our research is to extend our understanding of CSR by exploring the more current influences of the COVID-19 pandemic in the high-tech industry.

Here, we state some preliminary ideas about how the COVID-19 pandemic could impact the CSR field. In terms of CSR application, we evaluate the decision-making procedure of CSR in the high-tech industry. We focus on the potential consequences on key CSR viewpoints and the framework for a strategy addressing environment, social, corporate governance and economic (ESGE) aspects. The other main subject of this work is risk management and management capability. There has been limited attention in the CSR literature to similar risks and pandemics in the high-tech industry. Nevertheless, the COVID-19 pandemic has emphasized the role of high-tech industry as an actor that is extremely exposed to such needs and risks.

This paper aims to overcome these challenges by developing a technique for CSR application making use of MCDM (multiple-criteria decision making). The output attained from the proposed approach will provide valuable input for CSR strategic procedures in the high-tech industry during the COVID-19 pandemic. This approach can overcome the problems of group opinion in specialists' responses by adopting the most consistent agreement regarding observations about the assessment factors [13]. The application of CSR assessments for the industry includes multiple elements of MCDM during the COVID-19 pandemic. Many approaches have been put forth aiming to address organizational performance, such as DEMATEL (Decision-Making Trial and Evaluation Laboratory) [14], AHP (analytic hierarchy process) [15] and DEA (data envelopment analysis) [16]. However, these CSR studies have numerous limitations. Since they focus on only one element, they cannot fuse several elements of performance. Likewise, they are insufficient

for understanding the effective weights of these factors and important aspects, and hence do not accurately assess gaps in performance. To resolve these shortcomings, we apply BWM (best worst method) and the modified VIKOR method to assess all performances [17–19]. This MCDM approach has two phases. First, the BWM technique is applied to analyze and prioritize the choice factor according to the CSR application, and VIKOR is used to rank and evaluate the best CSR performance. BWM is an innovative MCDM approach that offers better performance than ANP or AHP [17–19]. Next, to prevent the shortcomings of the conventional VIKOR method, we used a modified VIKOR method, replacing the relatively good through the aspirated levels in order to prevent the "stopgap piecemeal" complication. Modified VIKOR is an effective method applied in numerous research works to prioritize the alternatives with respective factors. Numerous studies have utilized integrated methods for choosing the best alternatives.

The chief contributions of this work are briefly stated below. Primarily, the study analyzes the influence weight of CSR's effects on the high-tech industry during the COVID-19 pandemic and studies how and to what extent CSR is connected with economic aspects affecting the high-tech industry. Second, this study integrates BWM and modified VIKOR approaches to enhance an estimation technique that ranks the comparative influential weights in combination with these aspects and elements. Lastly, the outcomes of this study offer pragmatic guidance for planning CSR implementation in the high-tech industry during the COVID-19 pandemic.

The remainder of this paper is organized as follows. Section 2 presents the findings of a literature review examining the elements that influence CSR issues. Section 3 provides the details of the proposed combined MCDM approach. A case study is presented, and an investigation of the outcomes is provided in Section 4. Section 5 draws conclusions from the work.

2. Literature Review

This section covers a selection of the CSR literature and the measures proposed in this paper.

2.1. Related Literature on Corporate Social Responsibility (CSR)

The improved consideration for CSR as a result of the COVID-19 pandemic led to market changes and demonstrates how CSR protects the values of companies in a crisis. The thought was caused in the theory of CSR, involving institutional, legitimacy and stakeholder theory, among others. The theory describes that the form of CSR engagement is determined through a business' relationships with its stakeholders, and it allows the company to legitimize and assist in the relationships with its stakeholders, and with the environment, social, corporate governance and economic aspects within the corporation's sphere of influence. [20–22]. Put distinctly, for a company to grow and survive, it must legitimize its actions as congruent with the objectives of society and the company, and as aligned with the interests of its numerous stakeholders [20,23]. These implications of the theory are that CSR actions are improving as they are congruent through the environment and these requirements of stakeholders.

The applications and consequences of CSR affect stakeholders and are scrutinized via numerous dissimilar parties. The important problem is whether companies influence their aims via improving sustainable development and promoting the necessary aspects (environment, social, corporate governance and economic aspects) in their CSR programs.

According to the World Business Council for Sustainable Development, corporate social responsibility is a business' responsibility to operate constantly via an ethics code, to contribute to the development of the economy and to improve the quality of life of its employees, as well as that of society at large and the local community. Hence, corporations need to maximize their profits and prompt the cares regarding stakeholders, socially vulnerable groups and the conservation environment [24,25]. At present, an increasing number of corporations are declaring CSR guarantees, as CSR has developed a significant role

in business governance [25,26]. Additionally, corporations are likely to maximize business performance in consideration of their responsibility to the environment and society. CSR has recently become a main concern [25,27].

With the growing knowledge economy and the COVID-19 pandemic, businesses are no longer just tracking proceeds. The value and competitiveness of firms now primarily come through the applications of CSR, namely, the CSR of intelligent capital, the administration of client relationships and the responsibilities to society. The high-tech industry is knowledge-centric. The continuous consideration of CSR in terms of production equipment, innovation strategy and other capital is needed. As a result of these activities, products have high added value, which increases profits for corporations. The profits of innovation produced through CSR activities are the driving force for businesses to sustain a competitive advantage [28–30].

Previous studies do not deal with interrelations and do not include market conditions in their evaluation. These studies indicate that there are interrelationships among environmental management, social impacts, corporate governance and economic performance, but have failed to investigate the influence of these interrelations. Previous research also neglects qualitative information and linguistic preferences [31–33]. For example, statistical approaches and panel data have helped in the investigation of this combination of ESGE strategies for a CSR strategy of sustainable development. Linear regressions through a panel of data can investigate data from listed companies and existing superior performance while controlling for companies' scope [31]. The technique for order preferences via comparison to ideal situations (TOPSIS) deals with the combination of CSR aspects into this assessment procedure [32]. A corporate sustainability strategy can use an illustrative statistical technique to understand how the approach impacts this corporate model in an effort to improve effectiveness [34,35].

2.2. Related Literature on the Elements Influencing CSR in High-Tech Industry

CSR is a strategic process with a latent positive effect on sustainability via the mixture of environment, social, corporate governance and economic aspects into CSR strategies. The description of these elements and aspects of the proposed measurement model are provided in Table 1.

Environment aspect (A_1): the environment aspect is a practical and systematic approach to finding water and saving energy, which can decrease negative influences of business practices on the environment in order to minimalize any irreparable ecological damage while aiding in emissions and resources [36]. For example, the high-tech industry constantly considers its energy efficiency, which is applied for improving production innovation and procedures. This aspect also classifies attributes which increase the protection of resources. Consequently, proactive environmental management is an important issue because it helps to protect and preserve distinct CSR destinations and attain recognition for environmental stewardship [37]. Resource reduction (RR), product innovation (PI) and emission reduction (ER) are the most important sub-factors in the environment aspect.

Social aspect (A_2): undertaking social initiatives is an important CSR activity and appeals to the social awareness of employees and consumers. This social influence is stated as the quality of employee alive values made from the industry through building up social changes with profits, practices and goals. The role of these industries is to benefit the stakeholder community and offer green services and products through green responsibility. Industry practices its social influence through providing resources such as services, products, or money to social causes [34]. Generally, bigger companies have more resources that can provide assistance to local community stakeholders and charities. Industries must still improve the percentage allocated for philanthropic contributions. Workers are the qualified actors under the regulations and laws, and have a positive influence on

this stakeholder community. Hence, product responsibility (PR), community (CO), human rights (HR) and employment quality (EQ) are the most important sub-factors in the social aspect.

Corporate governance aspect (A_3): corporate governance identifies the distribution of responsibilities and rights amongst stakeholders such as shareholders, managers, regulators, creditors, boards of directors and others, and comprises the procedures and rules for making choices in company matters [34]. All of the stakeholders are topic to comprise procedures by compensation policy (CP), board functions (BF), vision and strategy (VS) and shareholder rights (SR), and the objects are pursued and set in the background of the market regulatory and social environment.

Economic aspect (A_4): the economic aspect exists as there is the opportunity for the industry to experience losses owing to risks which impact the performance of the entire marketplace [38]. Specific risk and market risk are determined as shareholder loyalty (SL), firm performance (FP) and client loyalty (CL), and are also the important factors of economic aspect. Nevertheless, the risks of market are according to the performance of corporate governance.

Table 1. CSR measurement model.

Aspect	Element	Description
Environment aspect (A_1)	Resource reduction (RR)	Minimizing the resources used to produce a product
	Product innovation (PI)	Firm innovation performance
	Emissions reduction (ER)	Emissions produced by a firm
Social aspect (A_2)	Product responsibility (PR)	Provide services and products by green concepts
	Community (CO)	The role of the company in the community
	Human rights (HR)	The staff are qualified per the law
	Employment quality (EQ)	The quality of employment required for living standards is obtained through the company
Corporate governance aspect (A_3)	Compensation policy (CP)	The ratio to pay the compensation and executive strategy
	Board functions (BF)	The functions of the trustee board in the company
	Vision and strategy (VS)	Vision and strategy in the company
	Shareholder rights (SR)	The rights of the shareholders in the firm
Economic aspect (A_4)	Shareholder loyalty (SL)	The loyalty of shareholders to CSR
	Firm performance (FP)	The economic performance of the company each month
	Client loyalty (CL)	Clients' loyalty to the investors

3. Establishing This CSR Application Based on an Integrated MCDM Model

This section presents the procedure and summarizes the proposed approach to the evaluation of CSR elements using the MCDM model. There is a set of CSR activities for a company to implement green concepts, but because of constraints in financial capital, human resources, etc., numerous alternatives (i.e., CSR portfolios) might be implemented in this phase. Multiple methods have been used to consider environment, social, corporate governance and economic aspects, owing to their multidimensionality as a resolution to the issues experienced via administrators as challenging this compound conception [31–33].

Supervisors in the high-tech industry in Taiwan during the COVID-19 pandemic have faced many challenges. When the industry's CSR application triggers greater attention, most studies focus on the ability of players involved in the adoption of CSR instead of the compatibility of management with the related operational context. We therefore propose an MCDM that assesses the degree of element preferences to judge the weights

of the effects of numerous elements, and to classify the most influential factors in CSR implementation during the COVID-19 pandemic. Empirical research is employed to exemplify these applications of the proposed mixture MCDM approach for selecting and estimating this optimal improvement approach. This approach will also support managers in understanding how to develop their assessment of CSR applications, through this object of realizing the aspersion value to CSR performance in relation to dissimilar elements and aspects during the COVID-19 pandemic. Given that CSR application development frequently happens well before there are enough points to precisely assess CSR alternatives, an expert questionnaire is introduced to grade each perspective. The data collected from these CSR expert appraisers are analyzed by integrated MCDM models. First, BWM is applied to construct the ranking. The modified VIKOR (m-VIKOR) model is used to find these performance values at the target level. Finally, the outcomes are presented in useful models for decision-making.

MCDM is an approach that can study multiple elements simultaneously and supports administrators in evaluating a better situation according to these features, but it is limited by available circumstances [17–19]. This study uses an application of MCDM that is fit for evaluating CSR because it enables the measurement of multidimensional concepts such as CSR, applying both quantitative and qualitative elements while considering expert knowledge. Integrated MCDM investigative tools are applied in this study, including BWM and the modified VIKOR approach.

First, experts (including industry academicians and professionals) finalized and identified the assessment factors with the support of discussions and the recent literature. Next, the chosen factors were assessed and the respective weights of the factors and subfactors were determined by applying BWM; next, ranking of the CSR application was carried out by applying the m-VIKOR method. Even though factor assessment and alternative choice can be accomplished via other MCDM approaches (TOPSIS, AHP, DANP, etc.), these methods include numerous pairwise comparisons that need frequent consistency checks and huge amounts of data [39–41]. To solve this matter the best worst method was used here [42,43]. This method offers more consistent outcomes as compared to AHP, and requires less data [42,43]. Moreover, numerous researchers have used the BWM method in many applications, such as sustainable outsourcing partner selection, service quality, etc. [41,44]. Moreover, the m-VIKOR method has been broadly applied for the evaluation of alternatives [17–19]. It works on a compromise program design that leads to superior outcomes in comparison to other methods. M-VIKOR is preferred in alternatives evaluation as compared to other approaches (ELECTRE, TOPSIS, etc.), since it measures closeness to positive ideal points, which decreases the gap in decisions and improves managers' decision making [17–19]. The m-VIKOR technique optimizes the consequences and selects the best alternative with high accuracy. The evaluation of CSR application can be accomplished by a single approach [45] but mixing one approach with other decision support systems can enhance the decision quality. This led us to apply these methods in the present work.

A flow diagram of the research process is illustrated in Figure 1.

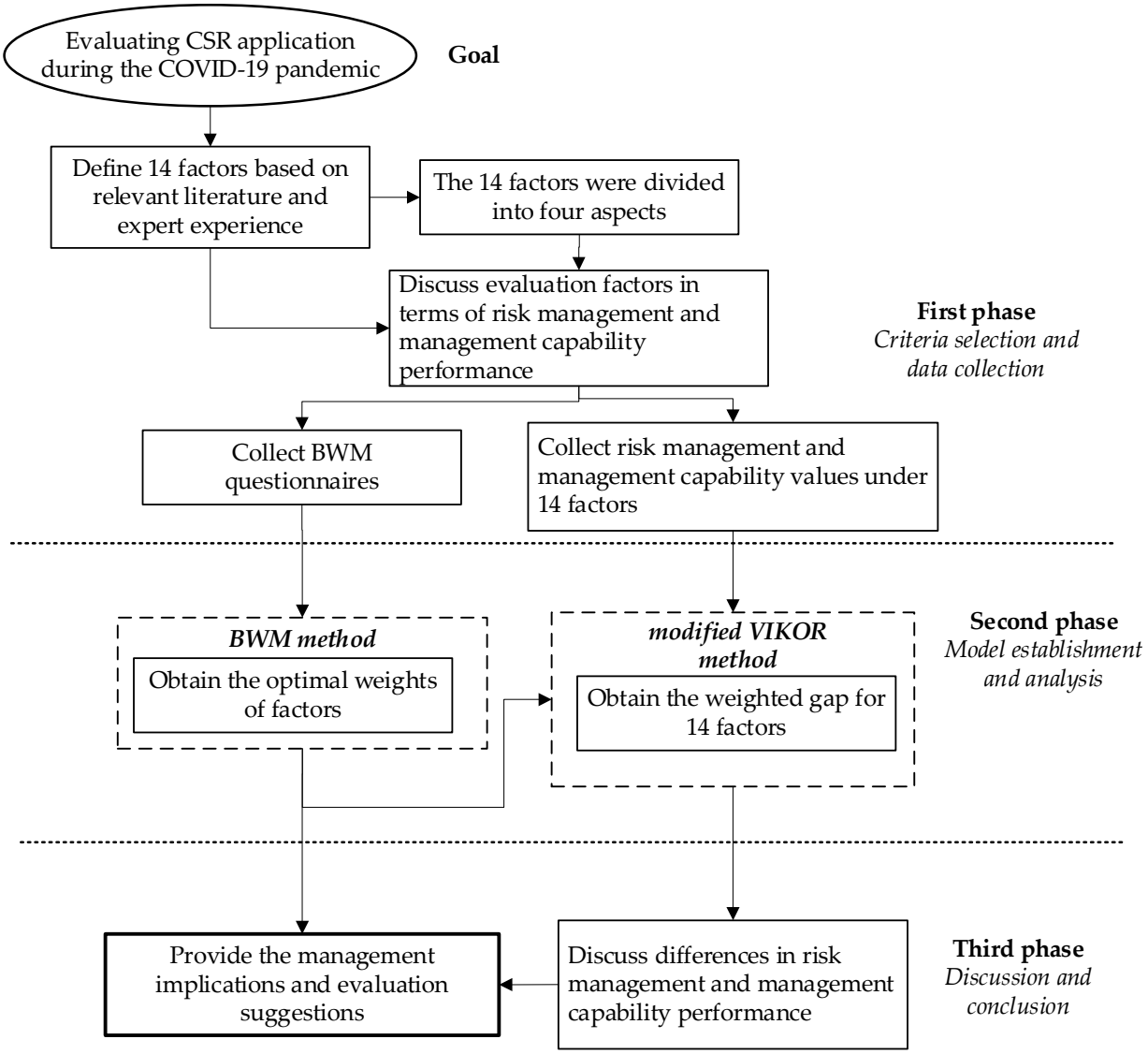

Figure 1. Procedure of the current study.

3.1. Establishing the Ranking and Significant Weight with the BWM

The BWM method proposed by Rezaei [42,43] is one of the numerous ways to apply MCDM in order to define the weights of elements. Compared with an AHP survey, the users of BWM need to answer fewer questions and therefore need to study the consistency of these outcomes for longer. This approach has been broadly applied in strategic issues in numerous fields, including the food supply chain context [46], machinery manufacturing [47], education [48], environmental protection and CSR [49], government policy [50], energy [51], aviation [52], etc. The frequency with which the method is applied is dramatically increasing over time. BWM develops the weights by best pairwise comparison and the worst elements according to other elements [42,43]. The BWM method is described in the following.

Phase 1. Define a series of estimation factors.

Let there be n separate estimation elements $\{b_1, b_2, \ldots, b_n\}$ as determined by review of the related literature and expert experience. These elements for estimating alternatives are critical, and they meaningfully influence the outcome of decisions.

Phase 2. Define the best and worst elements.

The managers choose the elements which they consider to be the best. The worst elements are also defined. In this phase, only the elements are considered, not their weights.

Phase 3. Conduct comparisons to find the best element.

The administrators identify the best element b over the other factors j on a 1 to 9 ranking scale. This subsequent best-to-others (BO) vector is

$$D_C = \left(d_{C1}, d_{BC2}, \ldots, d_{Cn}\right),$$

where d_{Bj} is the favor of the best element b over elements j. Obviously, $d_{CC} = 1$.

Phase 4. Conduct the favor comparisons for the worst element.

The correlative significance of the other factors j to the worst factor W is given by these managers on a 1 to 9 ranking scale. This subsequent others-to-worst (OW) vector is

$$D_W = \left(d_{1W}, d_{2W}, \ldots, d_{nW}\right)^E$$

where d_{jW} is the favor of element j over the worst element W. Obviously, $d_{WW} = 1$.

Phase 5. Find the optimal weights: $\left(w_1^*, w_2^*, \ldots, w_n^*\right)$

The optimal weights are achieved when the maximum absolute dissimilarities $\left|\frac{w_C}{w_j} - d_{Cj}\right|$ and $\left|\frac{w_j}{w_W} - d_{jW}\right|$ for all j are minimized, as interpreted in the following min–max model, as expressed in Equation (1):

$$\min_j \max \left\{\left|w_C - d_{Cj} w_j\right|, \left|w_j - d_{jW} w_W\right|\right\}$$

s. t.

$$\sum_j w_j = 1,$$

$$w_j \geq 0, \text{ for all } j. \tag{1}$$

Model (1) is equal to next typical, as expressed in Equation (2):

min z;

s. t.

$\left|w_C - d_{Cj} w_j\right| \leq y$, for all j,

$\left|w_j - d_{jW} w_W\right| \leq y$, for all j,

$$\sum_j w_j = 1,$$

$$w_j \geq 0, \text{ for all } j. \tag{2}$$

For any level of z, increasing these initial series of the limitations of model (2) via w_j and the next series of limitations by w_W, the result space of model (2) is an intersection of $4n - 5$ linear limitations (2 ($2n - 3$) assessment limitations and 1 limitation for these sums of weights); therefore, assuming an adequately large z, this resolution space is nonempty. Resolving model (2), the weights of optimum $\left(w_1^*, w_2^*, \ldots, w_n^*\right)$ and z^* can be obtained. The sum of elements' weights is 1 and this criterion weight is greater than or equal to 0.

3.2. Establishing the Weighted-Gap Levels by Modified VIKOR

Modified VIKOR is applied to solve discrete data MCDM problems. The method's purpose is to determine the compromise solution which is the nearest to this ideal point. According to the review article published by Lu et al. [17], VIKOR has been implemented for many years, in applications such as sustainable performance evaluation for Industry 4.0 [19], green performance [53] and mobile banking implementation [54]. We offer a modified VIKOR model to define the weighted gaps of performance under each element to realize the improved space. This study utilizes the "target quality" to substitute the concept of "relative good" used in the modified VIKOR through investigation of weighted gaps [55–58].

Phase 1. Decide the best and worst performance values under each element (h_j^* and h_j^-)

The types of evaluation factors can be separated into cost and benefit; if the *j*th factor represents a benefit, $h_j^- = \min_i h_{ij}$ and $h_j^* = \max_i h_{ij}$. Conversely, if the *j*th criterion constitutes a cost, $h_j^* = \min_i h_{ij}$ and $h_j^- = \max_i h_{ij}$.

Phase 2. Find the gap-ratio values

This concept of applying VIKOR to define these weighted-gap values was followed by Opricovic and Tzeng [59]. Hence, we modified the conventional VIKOR to replace the relative good notion with the target values. In this way, each alternative can acquire more objective and meaningful gap-ratio values. The decision system consisted of *j* elements and *g* alternatives, each of which had a performance value denoted as h_{gj}. This weight of element *j* is expressed as w_j, which is defined through this BWM. The development of this VIKOR technique began with the next conventional plus-modus of this L_v metric, as expressed in Equation (3).

$$L_g^v = \left\{ \sum_{j=1}^{n} [w_j(|h_j^* - h_{gj}|)/(|h_j^* - h_j^-|)]^v \right\}^{1/v} \quad (3)$$

where *n* is the number of factors, $1 \le v \le \infty$ and $g = 1,2,\ldots,m$. Formulating these weighted gaps and ranking, the measurements $L_g^{v=1}$ and $L_g^{v=\infty}$ are applied in this VIKOR technique, as expressed in Equations (4) and (5) [60,61].

$$L_g^{v=1} = Q_i = \sum_{j=1}^{n} [w_j(|h_j^* - h_{gj}|)/(|h_j^* - h_j^-|)] \quad (4)$$

$$L_g^{v=\infty} = S_i = \max_j \left\{ (|h_j^* - h_{gj}|)/(|h_j^* - h_j^-|) \middle| j = 1,2,\ldots,n \right\} \quad (5)$$

and they can be defined as $r_{gj} = \left(\left|h_j^* - h_{gj}\right|\right)/\left(\left|h_j^* - h_j^-\right|\right)$ to indicate the alternative's gap ratio *k* for element *j* as a gap. This compromise resolution $min_k L_k^v$ illustrates this integrates the ratio of the gap to be minimized via the adjunct by Equation (4), as $L_g^{v=\infty}$ illustrates this precedence to enhance the maximal gap ratio for the factors in each aspect, or for all elements (Equation (5)). The best h_j^* levels are then built to be the target value and the worst h_j^- levels as the tolerable value for all elements, $j = 1,2,\ldots, n$. In this research, we build $h_j^* = 5$ as the target value and $h_j^- = 0$ as the worst level, with all levels presented as gaps to better reflect ambiguity, which differs from the conventional method. These last weighted gaps can be considered via Equation (6).

$$R_i = \alpha(Q_i - Q^*)/(Q^- - Q^*) + (1-\alpha)(S_i - S^*)/(S^- - S^*) \quad (6)$$

where α and $(1-\alpha)$ represent the comparative weights of Q_i and S_i, and α is usually set to 0.5.

Phase *3:* Offering an overall factor of individual choice

Finally, this comprehensive score of each alternative F_g is combined via Equation (7). We can detect how each alternative can be improved to reduce these gaps in elements in sequence to realize the ideal level.

$$F_g = v\frac{Q_g - Q^{aspired}}{Q^{worst} - Q^{aspired}} + (1-v)\frac{U_g - U^{aspired}}{U^{worst} - U^{aspired}} \quad (7)$$

where $Q^{aspired} = 0$ (attaining the ideal level), $Q^{worst} = 1$ (the worst status); $U^{aspired} = 0$ (attaining the ideal level) and $U^{worst} = 1$ (the worst status). Therefore, Equation (7) can be modified as: $F_g = vQ_g + (1-v)U_g$, where v is the weight for this decision-making task.

4. Case Analysis

This section assesses CSR practices overall to propose strategies for more efficient CSR by using an empirical case in Taiwan's high-tech industry during the COVID-19 pandemic.

4.1. Data Collection

For this study, we recruited six high-tech proprietors, three government officials in charge of the high-tech industry, and three scholars of the high-tech industry to complete a questionnaire during the COVID-19 pandemic. First, from the perspective of the ESGE measurement model (Table 1), the specialists were questioned to evaluate the effects of the elements on a 9-point Likert scale ranging from very strong impact (9) to no impact (1). The consensus rate of significant confidence was 97.38%, exceeding the 95% confidence level (the gap-error rate was 2.62% which is less than 5%).

4.2. The Weight of Elements in CSR Application

BWM was used to define the weights of elements in this assessment system and to examine 14 elements in order to evaluate the strategy's performance within four aspects of the CSR application. Based on the results from the BWM surveys by 15 experts, Equations (1) and (2) generated 14 series of elements' weight, and the final optimal weights were integrated via the arithmetic average method [42,43]. Each consistency ratio (*CR*) of the 15 BWM surveys was less than 0.01, and the average *CR* was 0.009, indicating that the questionnaires had credibility [42,43]. Since the assessment elements are assumed to be independent in our approach, aspects or elements do not affect each other. As can be seen from Table 2, the economic aspect (A_4) had a higher weight (w_A = 0.359) than the other aspects, and the ranking of aspects under it were also in the top four. The top four aspects' rankings were focused on environment, corporate governance, social and economic aspects: firm performance (FP), vision and strategy (VS), shareholder loyalty (SL), employment quality (EQ), resource reduction (RR) and client loyalty (CL). The weight of each aspect is equal to the total weight of its corresponding elements. For example, the economic aspect includes shareholder loyalty (SL), firm performance (FP) and client loyalty (CL), and the total weight of the three elements was 0.359. Next, we used the modified VIKOR model to consolidate the performance value and weighted gaps of elements for CSR application evaluation during the COVID-19 pandemic.

Table 2. The weights evaluation of CSR application in Taiwan during the COVID-19 pandemic.

Aspects/Elements	Local Weight	Local Rank	Global Weight	Global Rank
Environment aspect (A_1)	0.147			
Resource reduction (RR)	0.569	1	0.084	5
Product innovation (PI)	0.222	2	0.033	11
Emissions reduction (ER)	0.209	3	0.031	13
Social aspect (A_2)	0.206			
Product responsibility (PR)	0.182	2	0.037	10
Community (CO)	0.089	3	0.018	14
Human rights (HR)	0.291	2	0.060	7
Employment quality (EQ)	0.438	1	0.090	4
Corporate governance aspect (A_3)	0.288			
Compensation policy (CP)	0.204	2	0.059	8
Board functions (BF)	0.162	3	0.047	9
Vision and strategy (VS)	0.526	1	0.152	2
Shareholder rights (SR)	0.108	4	0.031	12
Economic aspect (A_4)	0.359			
Shareholder loyalty (SL)	0.354	2	0.127	3
Firm performance (FP)	0.427	1	0.153	1
Client loyalty (CL)	0.219	3	0.079	6

4.3. Estimating and Mixing These Gaps in Performance with Modified VIKOR

Gap performance values we obtained through the second survey. To explore the elements, we divided them into the gaps among the risk management and management capability. A scale from 1 to 9 was used to represent the degrees of importance from "not important" to "extremely important" in natural language, using the initial decision matrix data. Modified VIKOR was then employed to the weights derived by the BWM to assess each element's weighted gap. In this study, the target value was set to the highest level of assessment scale (9).

According to Equations (3)–(7), the weighted gaps for each element from risk management and management capability were obtained, as shown in Table 3. The weighted gap in each element indicates how much space for improvement can be achieved in the target value. Compared to the traditional VIKOR approach, this study does not discuss the priorities of alternatives. The proposed model uses different aspects to explore the evaluation performance in each element and to further obtain information on which indicators have the priority to be enhanced. The results from the risk management performance perspective indicate that community (CO) had the largest weighted gap at 0.570, followed by shareholder rights (SR) at 0.500. From the management capability performance viewpoint, the element requiring priority improvement was still community (CO) (0.540). In other words, current decision makers believe that community (CO) is an indicator that needs urgent review and enhancement. All orders of element enhancement can be identified from their weighted gap, and the ranking index runs from 1 to 14.

The weighted gap for each aspect can be derived by the weighted gap of each element. Table 3 shows the weighted gaps and crisp values generated by the parameters (Q_i and S_i) of VIKOR for four aspects. The ranking of aspects based on risk management performance was $A_2 \succ A_3 \succ A_1 \succ A_4$. The social aspect ($A_2$) had the largest weighted gap (0.328) while the economic aspect (A_4) had the smallest weighted gap (0.253). This result echoes part of the criteria's weighted gaps (Table 3). Correspondingly, we also calculated aspects' weighted gaps for management capability. The above BWM weight and weighted gap analysis integrated with BWM and modified VIKOR results provide reliable information that can assist and support decision makers in formulating strategies to improve CSR management performance during the COVID-19 pandemic. We explain and discuss

some management implications in Section 4.4, based on different performance perspectives.

Table 3. Gap performance evaluation of CSR application in Taiwan during the COVID-19 pandemic.

Aspects/Elements	Local Weight	Global Weight	CSR Performance Gap	
			Risk Management (S_1)	Management Capability (S_2)
Environment aspect (A_1)	0.147		0.304	0.253
Resource reduction (RR)	0.569	0.084	0.370	0.290
Product innovation (PI)	0.222	0.033	0.120	0.150
Emissions reduction (ER)	0.209	0.031	0.320	0.260
Social aspect (A_2)	0.206		0.328	0.321
Product responsibility (PR)	0.182	0.037	0.360	0.290
Community (CO)	0.089	0.018	0.570	0.540
Human rights (HR)	0.291	0.060	0.290	0.260
Employment quality (EQ)	0.438	0.090	0.290	0.330
Corporate governance aspect (A_3)	0.288		0.308	0.249
Compensation policy (CP)	0.204	0.059	0.380	0.330
Board functions (BF)	0.162	0.047	0.340	0.300
Vision and strategy (VS)	0.526	0.152	0.230	0.170
Shareholder rights (SR)	0.108	0.031	0.500	0.400
Economic aspect (A_4)	0.359		0.253	0.236
Shareholder loyalty (SL)	0.354	0.127	0.240	0.220
Firm performance (FP)	0.427	0.153	0.210	0.200
Client loyalty (CL)	0.219	0.079	0.360	0.330
S_A	Total gaps		0.279	0.242

4.4. Outcomes and Discussion

We examined an empirical example of our proposed approach to evaluating CSR application strategy in the high-tech industry in Taiwan during the COVID-19 pandemic. There are several significant results of our study. First, based on BWM results, firm performance (FP) was the most significant element for assessing CSR application by its weight of influence (0.153; Table 3). Similar to other industries' research results regarding CSR application, our results indicate that critical firm performance converts CSR application into main competence and that firm performance (FP) is the most important element when assessing CSR application in the high-tech industry during the COVID-19 pandemic.

Second, vision and strategy (VS) were the next most significant elements, with an influential weight of 0.152. The result also agrees with the outcomes attained in previous research, where vision and strategy (VS) were found to be the main elements in conquering alternatives produced through CSR application and sustainable development. Therefore, administrators need to gain solid support and commitment within top management for effective CSR application in the high-tech industry during the COVID-19 pandemic.

Third, according to recommendations from the experts in the high-tech industry during the COVID-19 pandemic, the proposed context includes environment, social, corporate governance and economic (ESGE) aspects to examine the elements affecting CSR performance. These outcomes also determine the elements considered within the individual aspects. Table 4 summarizes the gap performance for elements for each aspect. For the individual economic aspect (A_1), firm performance (FP) was the most influential element and must be improved with priority, followed by via vision and strategy (VS), shareholder loyalty (SL) and employment quality (EQ). After using the gap performances offered via the panelists of specialists, the important modes of improvement are considered to be

comprehensive and unique, in terms of both holistic and separate aspects. For the managers in the Taiwanese high-tech industry, realizing the improvement priorities for meeting CSR needs is significant. Most studies focusing on CSR elements and evaluation have not discussed the assembly among CSR and strategic application. Given the outcomes illustrated in Table 4, the empirical outcomes relate to the purpose of this study to offer priorities for enhancement to influence the risk management performance and management capability performance. For example, in order to decrease the gaps in performance between the existing state and the target CSR performance, the priorities for improvement are the social aspect (A_2), corporate governance (A_3), environment (A_1) and economic aspect (A_4) in risk management performance (S_1); aspects are ranked as $A_2 \succ A_1 \succ A_3 \succ A_4$ *i*n management capability performance (S_2). Nevertheless, managers in the high-tech industry need to be cautious as using the MCDM approach. These findings regarding the 14 elements under study may differ according to specific circumstances, and administrators must evaluate these CSR approaches and indicate the performance gaps before making choices.

Finally, for long-term development, the administrators of CSR applications should sensibly take note of firm performance, as noted earlier. This work's inspection of the proposed CSR application evaluation model can be broadly applied to most of the high-tech industry during the COVID-19 pandemic.

Table 4. Sequence of improvement priorities for CSR strategy.

Formula	Sequence of Improvement Priority	
F1: Sequence of aspects to reach target levels in two CSR performance areas (from high to low, via gap performances)	Risk management performance (S_1)	(A_2) > (A_3) > (A_1) > (A_4)
	Management capability performance (S_2)	(A_2) > (A_1) > (A_3) > (A_4)
F2: Sequence of elements to reach the target level within individual aspects (from high to low, via gap performances)	Risk management performance (S_1) (A_1): (RR) > (ER) > (PI) (A_2): (CO) > (PR) > (EQ) > (HR) (A_3): (SR) > (CP) > (BF) > (CS) (A_2): (CL) > (SL) > (FP)	
	Management capability performance (S_2) (A_1): (RR) > (ER) > (PI) (A_2): (CO) > (EQ) > (PR) > (HR) (A_3): (SR) > (CP) > (BF) > (CS) (A_2): (CL) > (SL) > (FP)	

5. Conclusions

We proposed an integrated MCDM approach integrating BWM and modified VIKOR to explore the interdependence and feedback among numerous elements influencing CSR performance in the high-tech industry in the context of the COVID-19 pandemic. The proposed structure integrates the environment, social, corporate governance and economic aspects with the CSR aspects. The outcomes indicate that the economic aspect had the highest net influence of 0.079 and should be improved first. Firm performance, which had the highest global weight of 0.153, was the most significant element for evaluating CSR performance in the high-tech industry. The gap values of total performance representing the range for enhancement were 0.279 for risk management (S_1) and 0.242 for management capability performance (S_2). The community factor showed the largest gap (0.570) in risk management performance (S_1) and the largest gap (0.540) in management capability performance (S_2). The social aspect must be the primary priority to be enhanced if the managers hope to understand the desired levels of performance. Furthermore, these outcomes suggest that managers should appropriately prioritize elements in their CSR performance enhancement strategies during the COVID-19 pandemic.

This research's aspects and elements act as connecting devices, which can help in CSR estimation in the high-tech industry during the COVID-19 pandemic. The key contributions of the research are twofold. Primarily, the assessment of CSR application can be a strategic issue of compound interactions and dependencies during the COVID-19 pandemic. We executed a review of the literature and interviewed experts to categorize 14 elements in 4 CSR application aspects to calculate performance estimations of CSR in the high-tech industry during the pandemic. Second, this study integrated BWM and modified VIKOR to develop a CSR estimation pattern that focuses on the relation weights of the implementation perspectives of CSR and its elements during the COVID-19 pandemic. The proposed technique can be applied not only as a method to process the dependence and interaction contained within a series of elements and aspects, but also as an approach for creating more useful information to determine the ranking and influence weights for management strategy estimation. These research findings are valid outcomes with respect to the estimation. The investigation of the estimation outcomes allows the formulation of advice for administrations in classifying the main conditions facilitating CSR estimation and presents outcomes indicating the best approach for enhancing the existing administration in the high-tech industry during the COVID-19 pandemic.

There are some limitations to the research that require further examination. First, in this study the estimation elements were designated based on a literature review and discussed with experts in regards to the estimation of CSR applications as well as reviews that offered some probable effects on such estimations during the COVID-19 pandemic. Future research needs to apply different approaches, such as longitudinal analysis, to identify other elements. Second, the study used high-tech industry in the COVID-19 pandemic as a case study to develop a CSR estimation model with assistance from management to realize the important elements when applying CSR assessments. Future research can apply other multiple-criteria methods (e.g., TOPSIS and outranking approaches) to evaluate these relative influence weights in CSR estimation. It would be valuable to compare the results of future research with those presented herein. Lastly, this paper was conducted in a sample group of experts. A larger sample that confers more explanatory power could be beneficial for a more sophisticated assessment of the topic at hand. The research findings thus need to be proved with more samples in order to enhance generalizability.

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References

1. BBC. Coronavirus: Twitter Boss Pledges $1bn for Relief Effort. The BBC. Available online: https://www.bbc.co.uk/news/technology-52209690 (accessed on 18 April 2020).
2. Seuring, S.; Müller, M. From a literature review to a conceptual framework for sustainable supply chain management. *J. Clean. Prod.* **2008**, *16*, 1699–1710.
3. Rajesh, R. Exploring the sustainability performances of firms using environmental, social, and governance scores. *J. Clean. Prod*. **2020**, *247*, 119600.
4. Rajeev, A.; Pati, R.K.; Padhi, S.S.; Govindan, K. Evolution of sustainability in supply chain management: A literature review. *J. Clean. Prod*. **2017**, *162*, 299–314.

5. Sarkis, J.; Zhu, Q. Environmental sustainability and production: Taking the road less travelled. *Int. J. Prod. Res*. **2018**, *56*, 743–759.
6. Bai, C.; Sarkis, J. Improving green flexibility through advanced manufacturing technology investment: Modeling the decision process. *Int. J. Prod. Econ*. **2017**, *188*, 86–104.
7. Brandenburg, M.; Govindan, K.; Sarkis, J.; Seuring, S. Quantitative models for sustainable supply chain management: Developments and directions. *Eur. J. Oper. Res*. **2014**, *233*, 299–312.
8. Dubey, R.; Gunasekaran, A.; Papadopoulos, T.; Childe, S.J.; Shibin, K.T.; Wamba, S.F. Sustainable supply chain management: Framework and further research directions. *J. Clean. Prod.* **2017**, *142*, 1119–1130.
9. Rajesh, R. Social and environmental risk management in resilient supply chains: A periodical study by the Grey-Verhulst model. *Int. J. Prod. Res*. **2019**, *57*, 3748–3765.
10. Fahimnia, B.; Tang, C.S.; Davarzani, H.; Sarkis, J. Quantitative models for managing supply chain risks: A review. *Eur. J. Oper. Res*. **2015**, *247*, 1–15.
11. Ikram, M.; Zhang, Q.; Sroufe, R.; Ferasso, M. The Social Dimensions of Corporate Sustainability: An Integrative Framework Including COVID-19 Insights. *Sustainability* **2020**, *12*, 8747.
12. Hakovirta, M.; Denuwara, N. How COVID-19 Redefines the Concept of Sustainability. *Sustainability* **2020**, *12*, 3727.
13. Chang, S.C.; Lu, M.T.; Pan, T.H.; Chen, C.S. Evaluating the E-Health Cloud Computing Systems Adoption in Taiwan's Healthcare Industry. *Life* **2021**, *11*, 310.
14. Chen, H.L.; Hu, Y.C.; Lee, M.Y.; Yen, G.F. Importance of Employee Care in Corporate Social Responsibility: An AHP-Based Study from the Perspective of Corporate Commitment. *Sustainability* **2020**, *12*, 5885.
15. Li, Y.; Pinto, M.C.B.; Diabat, A. Analyzing the critical success factor of CSR for the Chinese textile industry. *J. Clean. Prod.* **2020**, *260*, 120878.
16. Tran, N. Applying 2-stage DEA model to evaluate the corporate social responsibility implementing efficiency of FDI firms. *Manag. Sci. Lett.* **2020**, *10*, 2491.
17. Lu, M.T.; Lin, S.W.; Tzeng, G.H. Improving RFID adoption in Taiwan's healthcare industry based on a DEMATEL technique with a hybrid MCDM model. *Decis. Support Syst*. **2013**, *56*, 259–269.
18. Lu, M.T.; Tsai, J.F.; Shen, S.P.; Lin, M.H.; Hu, Y.C. Estimating sustainable development performance in the electrical wire and cable industry: Applying the integrated fuzzy MADM approach. *J. Clean. Prod*. **2020**, *277*, 122440.
19. Chang, S.C.; Chang, H.H.; Lu, M.T. Evaluating Industry 4.0 Technology Application in SMEs: Using a Hybrid MCDM Approach. *Mathematics* **2021**, *9*, 414.
20. Bae, K.H.; Ghoul, E.S.; Gong, Z.J.; Guedhami, O. Does CSR matter in times of crisis? Evidence from the COVID-19 pandemic. *J. Corp. Financ.* **2021**, *67*, 101876.
21. Gray, R.; Kouhy, R. Lavers, S. Corporate social and environmental reporting. *Account. Audit. Account. J*. **1995**, *8*, 47–77.
22. Deegan, C. The legitimising effect of social and environmental disclosures—A theoretical foundation. *Account. Audit. Account. J*. **2002**, *15*, 282–311.
23. Frynas, J.G.; Yamahaki, C. Corporate social responsibility: Review and roadmap of theoretical perspectives. *Bus. Ethics Eur. Rev*. **2016**, 25 258–285.
24. Huang, C.L.; Kung, F.H. Drivers of environmental disclosure and stakeholder expectation: Evidence from Taiwan. *J. Bus. Ethics* **2010**, *96*, 435–451.
25. Chen, F.; Tebourbi, I. The relationship between business performance, corporate social responsibility, and innovation capital: A case study of Taiwan. *Manag. Decis. Econ*. **2021**, *42*, 360–368.
26. Becker-Olsen, K.L.; Cudmore, B.A.; Hill, R.P. The impact of perceived corporate social responsibility on consumer behavior. *J. Bus. Res.* **2006**, *59*, 46–53.
27. Franco, S.; Caroli, M.G.; Cappa, F.; Del Chiappa, G. Are you good enough? CSR, quality management and corporate financial performance in the hospitality industry. *Int. J. Hosp. Manag.* **2020**, *88*, 102395.
28. Bocquet, R.; Le Bas, C.; Mothe, C.; Poussing, N. CSR, innovation, and firm performance in sluggish growth contexts: A firm-level empirical analysis. *J. Bus. Ethics* **2017**, *146*, 241–254.
29. Guerrero-Villegas, J.; Sierra-García, L.; Palacios-Florencio, B. The role of sustainable development and innovation on firm performance. *Corp. Soc. Responsib. Environ. Manag*. **2018**, *25*, 1350–1362.
30. Mishra, D.R. Post-innovation CSR performance and firm value. *J. Bus. Ethics* **2017**, *140*, 285–306.
31. Garcia, A.S.; Mendes-Da-Silva, W.; Orsato, R.J. Sensitive Industries Produce Better ESG Performance: Evidence from Emerging Markets. *J. Clean. Prod.* **2017**, *150*, 135–147.
32. Escrig-Olmedo, E.; Rivera-Lirio, J.M.; Muñoz-Torres, M.J.; Fernández-Izquierdo, M.A. Integrating Multiple ESG Investors' Preferences into Sustainable Investment: A Fuzzy Multicriteria Methodological Approach. *J. Clean. Prod.* **2017**, *162*, 1334–1345.
33. Martí-Ballester, C.P. Can Socially Responsible Investment for Cleaner Production Improve the Financial Performance of Spanish Pension Plans? *J. Clean. Prod*. **2015**, *106*, 466–477.
34. Tseng, M.L.; Tan, P.A.; Jeng, S.Y.; Negash, Y.T.; Darsono, S.N. Sustainable investment: Interrelated among corporate governance, economic performance and market risks using investor preference approach. *Sustainability* **2019**, *11*, 2108.
35. Karlsson, N.P.E. Business models and business cases for financial sustainability: Insights on corporate sustainability in the Swedish farm-based biogas industry. *Sustain. Prod. Consum*. **2019**, *18*, 115–129.

36. Guo, L.; Qu, Y.; Tseng, M.L. The interaction effects of environmental regulation and technological innovation on regional green growth performance. *J. Clean. Prod*. **2017**, *162*, 894–902.
37. Wu, W.-W.; Lee, Y.-T.; Tseng, M.-L.; Chiang, Y.-H. Data mining for exploring hidden patterns between KM and its performance. *Knowl. Based Syst.* **2010**, *23*, 397–401.
38. Nesticò, A.; He, S.; De Mare, G.; Benintendi, R.; Maselli, G. The ALARP Principle in the Cost-Benefit Analysis for the Acceptability of Investment Risk. *Sustainability* **2018**, *10*, 4668.
39. Prakash, C.; Barua, M.K. A combined MCDM approach for evaluation and selection of third-party reverse logistics partner for Indian electronics industry. *Sustain. Prod. Consum*. **2016**, *7*, 66–78.
40. Khedrigharibvand, H.; Azadi, H.; Teklemariam, D.; Houshyar, E.; De Maeyer, P.; Witlox, F. Livelihood alternatives model for sustainable rangeland management: A review of multi-criteria decision-making techniques. *Environ. Dev. Sustain*. **2017**, *21*, 11–36.
41. Garg, C.P.; Sharma, A. Sustainable outsourcing partner selection and evaluation using an integrated BWM–VIKOR framework. *Environ. Dev. Sustain*. **2020**, *22*, 1529–1557.
42. Rezaei, J. Best-worst multi-criteria decision-making method. *Omega* **2015**, *53*, 49–57.
43. Rezaei, J. Best-worst multi-criteria decision-making method: Some properties and a linear model. *Omega* **2016**, *64*, 126–130.
44. Gupta, H. Evaluating service quality of airline industry using hybrid best worst method and VIKOR. *J. Air Transp. Manag*. **2018**, *68*, 35–47.
45. Karaman, A.S.; Akman, E. Taking-off corporate social responsibility programs: An AHP application in airline industry. *J. Air Transp. Manag*. **2018**, *68*, 187–197.
46. Rezaei, J.; Nispeling, T.; Sarkis, J.; Tavasszy, L. A supplier selection life cycle approach integrating traditional and environmental criteria using the best worst method. *J. Clean. Prod*. **2016**, *135*, 577–588.
47. Rezaei, J.; Wang, J.; Tavasszy, L. Linking supplier development to supplier segmentation using Best Worst Method. *Expert Syst. Appl*. **2015**, *42*, 9152–9164.
48. Salimi, N.; Rezaei, J. Measuring efficiency of university-industry Ph.D. projects using best worst method. *Scientometrics* **2016**, *109*, 1911–1938.
49. Ren, J.; Liang, H.; Chan, F.T. Urban sewage sludge, sustainability, and transition for Eco-City: Multi-Criteria sustainability assessment of technologies based on best-worst method. *Technol. Forecast. Soc*. **2017**, *116*, 29–39.
50. Gupta, H.; Barua, M.K. Identifying enablers of technological innovation for Indian MSMEs using best–worst multi criteria decision making method. *Technol. Forecast. Soc*. **2016**, *107*, 69–79.
51. Ahmad, W.N.K.W.; Rezaei, J.; Sadaghiani, S.; Tavasszy, L.A. Evaluation of the external forces affecting the sustainability of oil and gas supply chain using Best Worst Method. *J. Clean. Prod*. **2017**, *153*, 242–252.
52. Pamučar, D.; Petrović, I.; Ćirović, G. Modification of the Best–Worst and MABAC methods: A novel approach based on interval-valued fuzzy-rough numbers. *Expert Syst. Appl*. **2018**, *91*, 89–106.
53. Kumar, A.; Aswin, A.; Gupta, H. Evaluating green performance of the airports using hybrid BWM and VIKOR methodology. *Tour. Manag*. **2020**, *76*, 103941.
54. Lu, M.T.; Tzeng, G.H.; Cheng, H.; Hsu, C.C. Exploring mobile banking services for user behavior in intention adoption: Using new hybrid MADM model. *Serv. Bus*. **2015**, *9*, 541–565.
55. Feng, Y.; Hong, Z.; Tian, G.; Li, Z.; Tan, J.; Hu, H. Environmentally friendly MCDM of reliability-based product optimisation combining DEMATEL-based ANP, interval uncertainty and Vlse Kriterijumska Optimizacija Kompromisno Resenje (VIKOR). *Inf. Sci*. **2018**, *442*, 128–144.
56. Wu, M.; Li, C.; Fan, J.; Wang, X.; Wu, Z. Assessing the global productive efficiency of Chinese banks using the cross-efficiency interval and VIKOR. *Emerg. Mark. Rev*. **2017**, *34*, 77–86.
57. Rajesh, R. Measuring the barriers to resilience in manufacturing supply chains using grey clustering and vikor approaches. *Measurement* **2018**, *126*, 259–273.
58. Wu, Y.; Zhang, B.; Xu, C.; Li, L. Site selection decision framework using fuzzy ANP-VIKOR for large commercial rooftop PV system based on sustainability perspective. *Sustain. Cities Soc*. **2018**, *40*, 454–470.
59. Opricovic, S.; Tzeng, G.H. Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS. *Eur. J. Oper. Res*. **2004**, *156*, 445–455.
60. Lu, M.T.; Hsu, C.C.; Liou, J.J.; Lo, H.W. A hybrid MCDM and sustainability balanced scorecard model to establish sustainable performance evaluation for international airports. *J. Air Transp. Manag*. **2018**, *71*, 9–19.
61. Lu, M.T.; Tzeng, G.H.; Tang, L.L. Environmental strategic orientations for improving green innovation performance in fuzzy environment-Using new fuzzy Hybrid MCDM model. *Int. J. Fuzzy Syst*. **2013**, *15*, 297–316.