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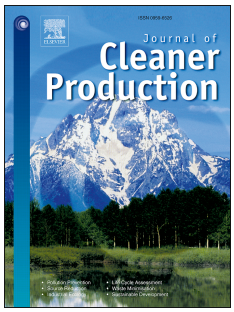

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Applying a Multiple Criteria Decision-Making Approach to Establishing Green Marketing Audit Criteria

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Abstract

Green marketing strategy has increasingly become a sustainable business operation goal, and Green Marketing Audit (GMA) is an effective measurement tool. In order to satisfy the green marketing quality assurance, the tight integration of green marketing missions, competition, stakeholders' requirements, and business activities are necessary. This study focuses on the establishment of green marketing audit criteria and priority sequence, using Multiple Criteria Decision Analysis (MCDA) to combine the Analytic hierarchy process (AHP) and Decision Making Trial and Evaluation Laboratory (DEMATEL) techniques. The major contributions of this study are as follows: (1) the proposed model provides a new practical architecture of GMA, which incorporates the experience and judgment of professional experts, and satisfies the needs of existing internal auditing operations; and (2) the GMA evaluation shows that linking the green marketing activities and firm performance contributes to the development of green marketing strategy management in Taiwan.

Keywords: Green marketing strategy; Green Marketing Audit (GMA); Analytic hierarchy process (AHP); Decision Making Trial and Evaluation Laboratory (DEMATEL); Multiple Criteria Decision Analysis (MCDA)

1. Introduction

Sustainable city development is an increasingly important focus of government policy, where the alignment of climate change and low-carbon strategy implementation are the key challenges (Mi et al., 2019). In the complex business world, traditional business operation strategies are insufficient to face increasingly strict environmental policies, stakeholder requirements, and the competition for innovation products/services. Implementing internal green practices and introducing monitoring mechanisms into firm operational processes can contribute to environment performance (Li et al., 2018). Regarding internal green marketing actions, Papadas et al. (2018) indicated that strategic green marketing and internal green marketing actions have positive influence on competitive advantage. The success of green marketing strategy depends on the effective implementation of green marketing activities. Although many approaches and checklists of marketing audit have been proposed (Herhausen, Egger and Oral, 2014; Morgan, Clark and Gooner, 2002), the main focus is limited to the audits of sales and collection (Taghian and Shaw, 2008). Given the impact of growing consumption on the environment, the number of companies developing green products has been rapidly increasing, and consumers have shown an increasing interest in these green products (Dangelico and Vocalelli, 2017). The successful development and manufacturing of green products and services requires communication with consumers regarding the benefits, and green marketing plays a key role in this process (Rex and Baumann, 2007). Green marketing consists of multiple activities designed to ensure the key aspects of marketing-product exchange have minimal negative environmental impacts (Lieskovska, 2010), present consumers with the importance of protecting the environment, build long-term relationships with customers and other stakeholders, and create the natural need to be environmentally responsible (Moravcikova,

Krizanova, Klierstikova and Rypakova, 2017). The adoption of green marketing is significantly facilitated by internal and external factors (D'Souza and Taghian, 2017). The former includes the mission and goals of a firm, green marketing strategies, and green marketing activities, while the latter consists of customer satisfaction of green products and services, global green competitions, and stakeholders' requirements for green business activities (Yadav, Dokania and Pathak, 2016; Cronin et al., 2011). Although numerous research has been conducted to formulate appropriate green marketing strategies/activities in various contexts (Wu and Lin, 2016; Davari and Strutton, 2014; Fraj, Martínez and Matute, 2011), managers still lack reliable tools to properly measure implementation efforts. In order to achieve efficient implementation of green marketing, firms must develop compelling criteria to audit green marketing strategies/activities' effective implementation. It is also necessary to determine the implementing priority and sequence of each GMA criterion to allocate marketing auditing resources. However, to the best of our knowledge, the GMA criteria for a specific industry have not been properly developed. Little academic research has also demonstrated the appropriate auditing criteria in assuring green marketing strategies/activities being properly implemented.

To assess the criteria relevant to the implementation of GMA and propose appropriate and effective GMA criteria for industry-specific practices, we adopted the multi-criteria decision analysis (MCDA), an approach based on combining the Analytical Hierarchy Process (AHP) and the Decision-Making Trial and Evaluation Laboratory (DEMATEL) to prioritize and analyze the interrelationships among the identified common accepted GMA criteria by incorporating the experience and judgments of industrial professional experts. This study appears to be one of the first papers to focus on the use and contribution of multiple criteria decision-making on the establishment of GMA criteria. In this study, we aimed to apply the MCDA to

integrate a multi-view discipline to assist internal auditors in implementing GMA with clear priorities and solid implementing sequences. This study extends the earlier work of Miles and Covin (2000), Rivera-Camino (2007), Cronin, Smith, Gleim, Ramirez and Martinez (2011), Fraj-Andre´s et al. (2009), and Mathiyazhagana, Govindan and Noorul Haq (2014), who developed the content of green marketing strategies/activities, and demonstrated the definite and practicable dimensions/ criteria to complement the GMA process, which could be embedded in existing enterprise resource planning (ERP) systems or internal auditing activities. This study is not meant to refine the content of GMA, but rather to apply the combined AHP and DEMATEL-based approach to specify the weights and priorities of efficient GMA criteria for green marketing implementation.

The paper is arranged as follows. First, we examined the green marketing strategies/activities that could be used as the critical auditing criteria for implementing green marketing activities, and also examined the characteristics of the focal industry through a literature review and expert interviews. Second, we adopted the techniques of analytic hierarchy process (AHP) and decision-making trial and evaluation laboratory (DEMATEL), to propose the framework of GMA for the focal industries. We formed two groups of experts for implementing these two techniques, respectively. Finally, we discuss theoretical and practical contributions, limitations and future directions of GMA research.

2. Literature Review

2.1 Green Marketing and Related Auditing Requirements

Green has clearly been an area of increased concern for organizations worldwide for decades (Montabon, Sroufe and Narasimhan, 2007). The term “green marketing” is presently still one of the most discussed topics in the area of academic research (Vadav, et al., 2016; Hartmann, et al., 2005). The green marketing concept can be

traced to the late 1980s (Peattie and Crane, 2005). Many scholars have proposed various definitions of green marketing, such as: (1) the holistic management process to deal with customers' and society's environmental requirements in a sustainable and profitable way (Peattie, 1992), (2) an organization's efforts to design, promote, price and distribute products in an environmentally friendly way (Pride and Ferrell, 1993), and (3) the process of marketing green products and services (Shil, 2012). In a broader sense, green marketing can be considered to be an outward extension of a firm's environment management systems and procedures, which try to avoid environmental harm and help to safeguard the environment. With environmental issues becoming a significant issue of concern for society, the number of firms relying on environment management systems, standards and audits to achieve sustainable development has increased exponentially (Li, Ngniatedema and Chen, 2017).

However, beyond these technical aspects of environmental management systems or processes, green marketing is not limited to internal operations, such as green products manufacturing and services supplying, but also responds to customers' and society's environmental requirements, and efforts to implement marketing activities in an environmentally friendly way. In other words, green marketing tends to be outward bound efforts to satisfy pro-environment consumers since consumers have become more responsible toward the environment, are willing to purchase eco-friendly products and services, and consider socially responsible purchase behavior as more apt (Haanpää, 2007; Saad, 2006). Even though there is still the need for efficient marketing effort to close the value-action gap (Park and Ha, 2012), the central topics for firms with green marketing initiatives are not just effective green marketing strategies, but also their efficient implementation.

Based on the perspective of auditing, in order to achieve efficient implementation of green marketing, firms must not only develop compelling criteria to properly measure green marketing implementation efforts, but also incorporate the appropriate professionals to ensure the quality of green marketing implementation efforts. However, green marketing research that evaluates such strategic initiatives is still lacking in comparison to other disciplines, especially in the attention to the efficacy of green marketing strategies and activities (Cronin, et al., 2011). In addition, little academic research has demonstrated the appropriate approaches or criteria in assuring the proper implementation of green marketing strategies/activities. To develop appropriate auditing criteria for green marketing implementation, the scope of green marketing strategies/activities has to be defined. The scope of green marketing strategies/activities must cover a firm's internal and external pro-environmental policies and practices, including operational, tactical and strategic. For example, Mathur and Mathur (2000) argue that green marketing-related activities can be classified into four categories covering all activities of a firm: (1) green products; (2) recycling; (3) green promotions; and (4) the appointment of environmental policy managers. Green marketing also serves as an important business strategy (Ginsberg and Bloom, 2004) and philosophy (Chamorro and Banegil, 2006). Thus, the scope and related auditing criteria must be developed at operational, functional, managerial and strategic levels to satisfy different stakeholders' requirements. Given that there are no accepted auditing criteria depicting which green marketing strategies/activities should be audited regularly, this study aims to develop and validate a group of appropriate auditing criteria according to existing internal auditing practices and professionals, including environmental audits and marketing audits.

An environmental audit is “a systematic, documented, periodic and objective review by regulated entities of facility operations and practices related to meeting environmental requirements” (Evans, Liu and Stafford, 2015). Firms that utilize environmental audits may be in a better position to respond to stakeholder concerns for stronger environmental management (Darnall, Seol and Sarkis, 2009). For most firms, environmental auditing is a voluntary activity. However, in complying with gradually strict environmental regulations, environmental audits may provide firms better protection of their investment in environmental protection systems and improve management activities (de Moor and de Beelde, 2005). Recently, scholars have urged that a careful analysis is needed about the extent to which the scope must be considered, especially when environmental issues are at stake, since the interfaces become more numerous than in single financial monitoring or auditing, and social and environmental disclosure are targeted in wide auditing with sustainability purposes (Viegas, Bond, Ribeiro and Selig, 2013). Obviously, an outward bound and broadened audit that may be beyond the environment management systems audit, such as a marketing audit, is needed.

Similarly, the marketing audit is defined as a systematic, critical, and impartial review of the total marketing operations, including marketing objectives, strategies, objectives, activities, and target market environments (Shuchman, Sessions, Oxenfeldt and Crisp, 1959). The purpose of marketing audits is to reveal problems and opportunities, and to propose suggestions that would improve the organization's marketing performance (Kotler, Gregor and Rodgers, 1977), especially in relation to the corporate image, i.e. consumer perceived reputation and satisfaction. In addition, the marketing audit has an organization-wide scope and plays multiple roles, such as strategy innovation detection, an action framework to audit marketing activities, an instrument for intervention, or changing way of implementing marketing activities

(Mokwa, 1986). The use of marketing audits can be highly related to marketing performance (e.g., sales, market shares, profitability, and customer satisfaction) (Taghian and Shaw, 2008; Wu, Chen and Huang, 2015).

It is necessary to revive three main professions, i.e., internal auditing, environment auditing and marketing auditing, to constitute GMA in an integrative way. These professions have been developed simultaneously and have brought remarkable influence on how firms' environmental and marketing audits are understood and implemented. Their common base, the term audit, has been transferred from the language of finance to environmental science (Tomlinson and Atkinson, 1987). Logically, it could be further applied in the examination and assessment of marketing performance with the same rationale and portrayals (Griffiths, 2006; Berry, Conant & Parasuraman, 1991). Therefore, we suggest that these professions should be brought together and evolve into a plurality of contexts in which the GMA has been assumed to be an integrative tool.

2.2 The Involvement of Internal Auditors, Environmental System Managers and Marketing Managers for GMA Establishment

However, due to the lack of formal recognition of environmental management or green marketing skills and standards of competence as goals to aim for, several issues have confronted firms seeking assistance with environmental and marketing management expertise, including the identification of appropriate auditors and determining which professions are required to conduct an effective GMA, since the ISO 14012 was published (Power, 1996). According to the present ISO 19011:2011 Guidelines for auditing management systems, an auditor still needs the specific knowledge and skills of environmental management system auditors, to establish the auditor evaluation criteria and to select the appropriated auditor evaluation method.

These requirements are similar to those for GMA and the commodities between the principles of financial and environmental audit and GMA, and allow internal auditors' expertise to be applied to the conduct of GMA (Lightbody, 2000).

GMA needs the involvement of internal auditors from different professions. First, owing to the internal auditors' expertise in "audit procedures, processes and techniques" that must be applied to many types of assessment of audits, such as GMA, the green marketing auditors must be qualified as they are required to play a significant role in the provision of GMA services. Besides, the guidelines of ISO 19011:2011 also stress the multidisciplinary nature of internal auditing management systems. The expertise of internal audit can help to enhance the accountability of green marketing implementation through the reviews and reports regarding the effectiveness and efficiency of green marketing activities. The role of internal audit encompasses the policies and procedures established to ensure the achievement of organizational objectives, including green marketing's objectives (Griffiths, 2006).

Second, the green marketing auditors should also include those environmental system managers who have appropriate work experience, enough training in environmental science and technology, as well as relevant knowledge/experience of environmental laws, regulations and related documents. The emerging view and call for the development of auditing systems as learning and strategically oriented implies that environmental auditing is still far from addressed processes, lessons learned and best practices pursued (Viegas, et al., 2013). Therefore, through the involvement of environmental system managers, they can contribute their knowledge expertise and ensure effective accomplishment of GMA. Third, the marketing managers are familiar with green marketing strategies/activities implementation, and are able to provide practical step-by-step guidance of auditing and measuring to determine whether any related actions are needed to enhance green marketing performance. These marketing

experts' involvement determines the effectiveness of green marketing impact assessment (Morgan, Clark and Gooner, 2002).

2.3 The AHP-DEMATEL application of GMA criteria

As previously mentioned, the GMA criteria have to be developed to satisfy specific industrial requirements, especially for the small and medium-sized enterprises (SMEs) with limited human resources in Taiwan. It is also necessary to determine the scope and importance of GMA criteria to allocate marketing resources. We adopted the MCDA, a combined AHP-DEMATEL approach to propose effective criteria of GMA, which are appropriate and effective for industry-specific practices through the existing ERP system.

The AHP technique was developed by Saaty (1996). It is a powerful tool for solving complex decision problems regarding hierarchical levels where each level represents a set of criteria relative to each sub-problem. The AHP technique is able to integrate feelings, intuition, and logic in a structured approach for decision-making, and is beneficial when incorporating mutually interacting elements (Sambasivan & Fei, 2008). The AHP technique consists of the following four steps: (1) Structure the problem and model building; (2) Collect data through pair-wise comparisons and measurements; (3) Calculate normalized importance weights of individual factors. The higher the weight, the more important the corresponding criterion! (4) Analyze the importance weights and derive solutions to the problem. A wide recognition of the applicability of AHP is reported in the literature (Gandhi, Mangla, Kumar and Kumar, 2016). For example, Chinda (2016) utilized AHP to investigate key factors influencing construction waste recycling decisions. Mathiyazhagan, Diabat, AI-Refaie and Xu (2015) applied AHP on evaluating pressure to implement green supply chain management. Luthra, Govindan, Kannan, Mangla and Garg (2017)

combined the AHP and ViseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) techniques to evaluate sustainable supplier selection criteria.

Given that the GMA criteria are a combination of composite and intertwined criteria, the DEMATEL methodology was also employed to examine interrelationships among these auditing criteria. Since the end of 1971, the DEMATEL technique has been adopted by researchers to solve complex in scientific, political, economic and business problems by considering experts' attitudes (Gabus and Fontela, 1972; Gabus and Fontela, 1973) due to its effectiveness on examining the interdependence among correlated features and its capability to identify practical solutions (Elham, Zulkiflle and Shahryar, 2012) and cause-effect chain components of a complex system (Si, You, Liu and Zhang, 2018). Recently, many scholars have been utilizing DEMATEL to clarify complex decision-making related or influential factors on green management issues. For example, Gandhi et al. (2016) used DEMATEL to evaluate the success factors associated with the implementation of green supply chain management. Li and Mathiyazhagan (2018) applied DEMATEL to identify the influential indicators towards sustainable supply chain adoption. Kaur, Sidhu, Awasthi, Chauhan and Goyal (2018) investigated barriers in green supply chain management. The DEMATEL technique consists of six main steps: (1) Establish the influence dimensions and determine the relationships among the dimensions; (2) Make the direct-influenced matrix and calculate the direct-influenced matrix normalization; (3) Achieve the total-influence matrix; (4) Produce a causal diagram; (5) Key GMA dimensions/criteria analysis.

As mentioned above, green marketing implementing auditing professionals is a proactive management strategy, simultaneously considering multi-views of expertise to explore the priority and interrelationships among criteria. More importantly, AHP-DEMATEL combines the advantages of MCDA for accurate estimation of

criteria weight in the GMA infrastructure, providing sustainable business operation decision information.

3. Methodology

This study uses a two-phase methodology. In Phase 1, we examined the GMA-related literature and identified the common GMA criteria that could be used to ensure a firm's implementation of environmental commitment, green marketing strategies and pro-environmental practices (Miles and Covin, 2000; Fraj-Andrés et al., 2009; Rivera-Camino, 2007; Mathiyazhagana, Govindan and Noorul Haq, 2014). The finalized 16 common GMA criteria were then categorized into six main dimensions: (1) Mission/Goals; (2) Green Marketing Strategies; (3) Customer Satisfaction; (4) Global Green Competition; (5) Stakeholders' Requirements; and (6) Green Marketing Activities. Each category has several sub-criteria.

As shown in Figure 1, a structure decision hierarchy was formed with three levels. The goal of research (i.e., the effectiveness of GMA criteria) is shown at Level 1, criteria (six main dimensions) are shown at Level 2 and sub-criteria (sub-dimensions) are shown at Level 3. For example, the mission/goals dimension incorporates six sub-criteria: "Environmental issues are very relevant to the major function of our firm", "We do our best to make every employee understand the importance of green business", "Environmental preservation is our major goal across all departments", "We have a clear statement urging environmental awareness in every area of operations", "Environmental preservation or green management is a high priority in our firm", and "Green is a central corporate value in our firm".

[Insert Figure 1 here]

3.1 AHP technique

In Phase 2, we adopted the AHP technique to evaluate the listed six dimensions of GMA criteria according to different professions, and utilized the DEMATEL technique to overcome the complexity of GMA criteria and analyze the causal relations among GMA criteria. The goal of AHP technique is to evaluate the factors related to the implementation of GMA. To form the pairwise assessments among factors, a judgment matrix (represented as 'A') was formulated to compute the factors priorities. A1~An are considered as the set of stimuli. The computed judgments on a pair of stimuli Ai and Aj are represented as follows:

$A = [a, ij]\ where\ i, j = 1,2,3, \ldots \ldots, n$

We formed a select group of ten experts (3 internal auditors, 3 environmental safety managers, 2 marketing managers, 1 professor in an Accounting Department and 1 professor in Business Administration) and asked these experts to judge the importance rating of each criterion over another, using a nine-point Saaty's scale (1=Equal importance of both factors, 9=Extreme importance of one factor over another). The scale helps to quantify the values of aij transformed from verbal judgments. The value of aij are given as follows:

$aij > 0\ ;\ aij = 1/aij\ ;\ aij = 1\ for\ all\ i$

Then, w**e** computed the importance weights of the factors according to the framed pairwise assessment matrices. The consistency ratio (CR) was also calculated to ensure the consistency of the pairwise assessment.

$CR = CI/RI$

$\mathrm{CI} = (\lambda_{max} - n)/(n-1)\ ;\ \lambda_{max}$ is the maximum average value.

RI indicates the value of a random consistency index and depends on the value of (n). The CR value should be less than 0.10 for the results obtained to be considered as consistent (Madaan and Mangla, 2015). To simplify and retrieve the critical GMA

criteria, we adopt Lawshe's (1975) approach and select the criterion in which the value of content validity ratio (CVR) is greater than 0.62.

3.2 DEMATEL technique

Using the DEMATEL method, we aimed to determine the influence relations between GMA dimensions/criteria by contrasting the reason degree and the core degree, and providing a scientific reference for the GMA implementation sequences, which incorporates the interdependences among the GMA dimensions and criteria, on the basis of the perception of another group of six experts (2 internal auditors, 2 environmental safety managers, and 2 marketing managers). First, we used the DEMATEL technique on GMA dimensions. The process is described below (Tsai, Lee & Guo, 2014; Tsai, Xue & Zhang, 2016; Yang, Lee & Chen, 2016):

(1) Establish the influence dimensions and determine the relationships among dimensions.

Based on the GMA dimensions within Figure 1, each of the six experts analyzed the influence relation of various dimensions and rated the dimension based on the scale (0=No influence, 1=Little influence, 2=High influence, 3=Very high influence). If k is the number of experts and n is the number of dimensions, for each expert, (n×n) non-negative matrices are formulated as X^k=[x_{ij}^k]. The entry x_{ij} indicates the degree to which the expert conceives that dimension i affects dimension j. To integrate all the opinions from the six experts, the average direct-influenced matrix M=[a_{ij}] was constructed as follows:

m_{ij}=$\frac{1}{H}\sum_{K=1}^{H} x_{ij}^k$, where H represents the number of experts.

(2) Make the direct-influenced matrix and calculate the direct-influenced matrix normalization. The normalized direct-influenced matrix (D) is obtained as follows:

D=M×S, where S= min $\left[\frac{1}{\max\sum_{j=1}^{n}|m_{ij}|}, \frac{1}{\max\sum_{i=1}^{n}|m_{ij}|}\right]$

(3) Achieve the total-influence matrix.

To analyze the direct and indirect relationships among influence dimensions, we needed to build a total-relation matrix (T) by referring to the DEMATEL formula. $T=D\ (I - D)^{-1}$, I represents the identity matrix.

According to the total-relation matrix structure for GMA dimensions, the sum of elements in rows (R) and the sum of elements in columns (D), the sum of D+R and the value of D-R have to be calculated for the specific GMA dimensions. The sum of D+R can determine the amount of influence and effect of a criterion in the system. In other words, D+R shows the degree of the central role (namely core degree) that the audit dimension plays in the criteria system. The final value of each dimension's influence on the other dimensions in the system can be obtained from D-R (namely reason degree). If D-R is positive, then that audit dimension is affecting other audit dimensions; if D-R is negative, then that audit dimension is being influenced by other auditing dimensions.

(4) Produce a causal diagram.

Based on the value of D+R and D-R, we generated a reason degree and the core degree effect graph (Figure 3) to reflect how one dimension or factor influences other dimensions or factors.

(5) Key GMA dimensions analysis.

According to the effect graph, we analyzed the influences of one dimension or factor over another dimension or factor of GMA criteria and proposed the practical insights of GMA criteria.

The corresponding research flow is summarized, as shown in figure 2.

[Insert Figure 2 here]

4. Results and Discussions

4.1 AHP application: determining the relative importance of the GMA criteria

Figure 1 reveals the proposed AHP model and importance ranking of GMA criteria based on the results of comparison between criterions by experts; each criterion has a specific importance weight and ranking.

The proposed AHP model indicates that the top four criteria of GMA belong to the "Stakeholders' Requirements" dimension. The 5th criterion is related to the "Global Green Competence" dimension. Apparently, the "Stakeholders' Requirements" and "Global Green Competence" dimensions are perceived as highly important GMA implementation dimensions by the experts, and these two dimensions are based on the outward-bound initiatives of responding to the stakeholders' green requirements and providing competitive green products/services in global markets.

The 6th, 7th and 8th criteria appertain to the "Green Marketing Activities" dimension, indicating that the "Green Marketing Activities" dimension is regarded as the third dimension in importance ranking. The "Mission/Goals" dimension was ranked as the fourth and last in importance ranking. Through the AHP technique and experts' comparisons, we found that the effectiveness of GMA criteria depends heavily on ensuring that the stakeholders' requirements are suitable, the globally competitive green products/services are provided and green marketing activities are completely implemented. Obviously, the GMA has been considered as an outward and responsive tool to emerging green requirements by firms, as well as an implementation-oriented tool. The importance ranking of GMA dimensions/criteria reveals the experts' pragmatism and instrumentalism toward GMA. The "mission/goals" dimension and related criteria surprisingly have the lowest importance in implementing GMA, also indicating that the ideology, philosophy and pro-environmental mindset have not been the premise of effective GMA

implementation; instead, meeting the stakeholders' requirements and implementing effective green marketing activities should be the most important GMA dimensions.

4.2 DEMATEL application: determining priorities among the GMA criteria

Table 1 illustrates the total-relation matrix structure for GMA dimensions and that only the reason degree of "Green Marketing Activities" dimension is lower than zero, indicating that this dimension is being influenced by other auditing dimensions.

[Insert Table 1 here]

Based on the calculated results from Table 1, we generated a reason degree and the core degree effect graph (Figure 3). The distribution of two degrees reveals that the "mission/goals", "Stakeholders Requirements" and "Global Green Competition" dimensions seem to be close to each other compared to the "Green Marketing Activities" dimension since their reason degrees are all greater than zero and the core degrees are all greater than 19.

[Insert Figure 3 here]

Figure 3 also indicates that the "Green Marketing Activities" dimension appears to be influenced by the other GMA dimensions. While implementing the GMA, the "mission/goals", "Stakeholders Requirements" and "Global Green Competition" dimensions ought to be implemented in advance so that the effectiveness of the GMA could be improved. We also found that "mission/goals", "Stakeholders Requirements" and "Global Green Competition" dimensions are perceived as core GMA dimensions by the experts.

Following the same procedure, we also performed the DEMATEL method on sub-GMA criteria that were the result of previous AHP processes (see Figure 1). Table 2 depicts the total direct and indirect effects between sub-GMA criteria. As shown in Figure 4, the distribution of two degrees is chaotic and there is no clear pattern among

these sub-GMA criteria. However, most reason degrees of criteria belonging to "Green Marketing Activities" and "Stakeholders' Requirements" dimensions are lower than zero, indicating that these sub-GMA criteria are deeply influenced by other criteria (i.e., "Mission/Goals" and "Global Green Competence" dimensions' criteria). On the other hand, the ranking of core degree depicts that criteria 3.5 and 3.2 in the "Stakeholders' Requirements" dimensions have the highest core degrees, followed by criteria 1.5, 1.4 and 1.1 in the "Mission/Goals" dimension. Apparently, most criteria in the "Mission/Goals" and "Stakeholders' Requirements" dimensions have greater core degrees than the criteria in the "Green Marketing Activities" and "Global Green Competence" dimensions. At the GMA dimension level, the core degree of "Green Marketing Activities" dimension is the lowest. However, at the sub-GMA criteria level, the criteria in the "Global Green Competence" dimension have the lowest core degrees.

[Insert Figure 4 here]

5. Conclusions

This study aimed to apply the AHP and DEMATEL-based techniques on the appropriate GMA dimensions and criteria for green marketing practices based on two groups of professional expertise. The results differ from previous studies, which typically only adopt questionnaire survey methods or propose the concept framework based on literature without considering the weight of importance for each GMA dimension/criterion and the relations of influence (implementation sequences) among GMA dimensions/criteria. Our study fits the gap of theory and practice in the GMA field.

Theoretically, green marketing strategies/activities implementation success is multidimensional since it results from both successful implementation efforts and favorable environmental conditions (Herhausen, Egger and Oral, 2014). Through a

literature review, we found the complexity of green marketing strategies/activities and the need for an approach to propose the industry-specific GMA criteria, including the critical auditing criteria and implementation sequences. Our study yields four dimensions reflecting the cornerstones of effective GMA implementation: (1) Mission/Goals, (2) Global Green Competence, (3) Stakeholders' Requirements and (4) Green Marketing Activities. All the dimensions consist of sub-GMA criteria reflecting the measurement of achievement of green marketing efforts within each dimension in detail.

Previous research did not incorporate and examine experts' judgments on GMA criteria with different professional/practical background, such as environmental management, marketing management, and internal audit expertise. This study fills this gap in the literature and lays the foundation for future research by applying the AHP and DEMATEL-based technique to integrate the various experts' professionalism and to reveal the importance weights and sequence of GMA implementation criteria. There is sparse research using decision-making approaches (i.e., AHP and DEMATEL) to combine experts' judgments. The current research contributes to the close match of auditing criteria and industry-specific practices. This study demonstrates the value of using the MCDA on GMA criteria planning. The proposed practical architecture of GMA, which incorporates the experience and judgment of professional experts and satisfies the needs of existing internal auditing operations and requirements, should ensure effective GMA implementation. These criteria not only reveal the steps of GMA implementation, but also indicate the important or critical criteria for internal auditors to follow. The results justify the application of MCDA and reveal the key predictors of successful GMA.

Third, the application of MCDA also indicates that the stakeholders' requirements appear to be of the topmost importance while implementing GMA.

Global green competence, green marketing activities and mission/goals determine whether the audits on green marketing satisfy the stakeholders' requirements and are competitive in the global market; they are perceived as highly important GMA implementation dimensions by the experts.

To sum up, we found that applying MCDA to establishing GMA criteria can lead marketing managers and internal auditors to identify contemporary green marketing implementation priorities and detect emerging green marketing issues in satisfying existing and potential green opportunities, while confronting the threats in the global market. This study proposed a solid framework and steps of GMA implementation in multiple disciplines, i.e., academic literature review, and practical experts, while also revealing the priorities of implementing an effective GMA. For example, the results of DEMATEL are revealed while implementing GMA; the mission/goal, stakeholders' requirements and global green competence audits ought to be implemented in advance so that the effectiveness of green marketing activities will be improved. In other words, the external and strategic green marketing perspective-related audit criteria are perceived as the most important ones to be implemented in advance. After that, the auditing of green marketing activities is implemented.

The primary managerial implication of these results is that the results generate a new architecture of GMA based on multiple knowledge, expertise and experience, such as internal audits, environmental safety and marketing management, that could be integrated into the existing operation in a firm, especially the operation of the ERP system. For decades, an increasing number of firms depend on ERP to address operational transactions (Madani, 2009). The introduction of GMA in a firm may generate new risks, such as business interruption, process interdependency, management system security, and overall internal controls (Chang, Yen, Chang and Jan, 2014). In the comprehensive application of the IT environment, the application of

the MCDA on GMA criteria establishment can help internal auditors enhance their efficiency of implementing GMA during the introduction or operation of the ERP system (I-hang, Myung-gun and Park, 2013; Kanellou and Spathis, 2011), since these techniques help internal audit managers focus on critical GMAs; in particular, these critical GMAs reveal industry-specific practices and requirements due to the involvement of professional experts.

Besides, the importance weights and implementing sequences of GMA dimensions/criteria could be the bases of comparison and analysis between firms' green marketing activities and market performances. The results respond to Cronin et al.'s (2011) call for investigating the links between green marketing strategies and firm performance. Our MCDA techniques can bridge the proper implementation of green marketing activities and firm performance through the efficient and effective GMA criteria establishment and implementation according to firms' green initiatives and industry-specific needs. The results are beneficial in helping internal audit managers save time and human resources in implementing GMA.

Finally, our findings suggest that the global and stakeholders' perspectives-related audits are emphasized; they are helpful to providing insights into how the green marketing activities proceed as planned, and whether the green marketing mixes match stakeholders' and global requirements (Sadovnikova and Pujari, 2017). It is also worth noting that GMAs alone are not enough; the failure to study green consumers' needs and ensure that they and stakeholders' interests have been comprehensively satisfied might lead to misunderstanding of the market situation and downfall of green marketing performance. Moreover, the results suggest that the marketing and internal audit managers have to pay more attention to implementing audits for global green competence and compliance with external stakeholders' requirements (Leonidou, Katsikeas and Morgan, 2013). For firms that are already

confronted with a global competitive market environment, it is highly advisable to conduct GMA periodically, not only to ensure that green marketing activities perform well and high green marketing productivity is achieved, but also to ensure the global green marketing strategies/ activities proceed completely and consistently with both pro-environmental consumer needs and organizational goals of green marketing.

6. Limitations and Future Research

As with any study, there are limitations in the present work that need to be identified. First, although the AHP and DEMATEL were conducted among experts, the limitation of generalization still exists. As stated previously, experts who were chosen as informants were from the electronic manufacturing industry in Taiwan. The experts involved in this study reveal the specific criteria for this industry. In general, future studies should use more experts who are from alternative industries. However, given the capacities of AHP and DEMATEL algorithm, all experts' judgments from most industries are difficult to obtain and choosing specific industries should be a logical choice for data gathering and analysis.

Second, the study employed experts' judgments and applied multiple criteria decision-making approach to propose GMA dimensions and criteria; empirical investigation still needs to be examined to verify if these can bridge green marketing strategies/activities and firm performance or green marketing performance. Future studies should use real detailed marketing performance data to confirm their reliability and validity for practical implementation.

Third, the lack of standards for green marketing performance must be recognized as a limitation. Though many studies examine green marketing-related strategies and activities (Song-Turner and Polonsky, 2016; Wu and Lin, 2016), there is no standard definition or way to define green marketing performance that GMA could refer to.

Future research could attempt to develop green marketing performance standards revealing specific industrial requirements and characteristics.

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Table 1 Total influence matrix structure for GMA dimensions

	(1)	(2)	(3)	(4)	D	D + R	D - R
(1)	*2.446*	*2.663*	*2.739*	*2.636*	10.485	20.231	0.738
(2)	*2.622*	*2.303*	*2.623*	*2.497*	10.046	19.613	0.478
(3)	*2.643*	*2.587*	2.437	*2.600*	10.267	19.834	0.344
(4)	*2.035*	*2.014*	2.124	1.833	8.006	17.574	(1.561)
R	9.746	9.567	9.923	9.567			

Note: (1) Mission/Goal, (2) Global Green Competition, (3) Stakeholders' Requirements, (4) Green Marketing Activities

Table 2: Total influence matrix structure for sub-GMA criteria (0.372)

criteria	1. 1	1. 2	1. 3	1. 4	1. 5	2. 1	2. 2	3. 1	3. 2	3. 3	3. 4	3. 5	3. 6	4. 1	4. 2	4. 3	D	D + R	D - R
1. 1	0.329	*0.397*	*0.415*	*0.428*	*0.426*	*0.396*	*0.400*	*0.445*	*0.458*	*0.465*	*0.459*	*0.475*	*0.408*	*0.461*	*0.456*	*0.460*	6.879	12.148	1.610
1. 2	0.343	0.301	*0.374*	*0.379*	*0.382*	0.356	0.352	*0.397*	*0.409*	*0.415*	*0.410*	*0.428*	0.365	*0.408*	*0.404*	*0.407*	6.128	11.536	0.721
1. 3	0.342	0.346	0.310	*0.381*	*0.388*	0.351	0.357	*0.392*	*0.408*	*0.414*	*0.408*	*0.426*	0.367	*0.407*	*0.402*	*0.405*	6.103	11.695	0.511
1. 4	0.354	0.369	*0.373*	0.335	*0.409*	0.368	0.367	*0.407*	*0.426*	*0.432*	*0.423*	*0.445*	*0.391*	*0.425*	*0.421*	*0.424*	6.369	12.166	0.572
1. 5	0.355	0.360	0.367	*0.378*	0.336	0.355	0.361	*0.400*	*0.419*	*0.425*	*0.420*	*0.438*	*0.384*	*0.418*	*0.414*	*0.417*	6.246	12.168	0.324
2. 1	0.326	0.336	0.346	0.357	*0.374*	0.289	0.348	*0.385*	*0.400*	*0.399*	*0.394*	*0.411*	0.360	*0.399*	*0.395*	*0.394*	5.915	11.307	0.523
2. 2	0.319	0.330	0.343	0.353	0.360	0.329	0.288	0.364	*0.379*	*0.384*	*0.379*	*0.396*	0.353	*0.381*	*0.373*	*0.379*	5.711	11.261	0.161
3. 1	0.334	0.345	0.359	0.370	*0.377*	0.341	0.360	0.332	*0.403*	*0.416*	*0.404*	*0.418*	*0.376*	*0.399*	*0.394*	*0.397*	6.025	12.092	(0.043)
3. 2	0.339	0.343	0.357	0.371	*0.375*	0.342	0.358	*0.386*	0.345	*0.417*	*0.402*	*0.420*	*0.374*	*0.410*	*0.406*	*0.409*	6.057	12.339	(0.224)
3. 3	0.314	0.321	0.334	0.344	0.354	0.320	0.339	0.365	*0.373*	0.329	*0.383*	*0.397*	0.358	*0.381*	*0.378*	*0.380*	5.669	12.060	(0.721)
3. 4	0.326	0.333	0.343	0.361	0.367	0.332	0.345	*0.382*	*0.393*	*0.392*	0.334	*0.408*	0.364	*0.392*	*0.388*	*0.391*	5.852	12.143	(0.440)
3. 5	0.337	0.348	0.358	*0.372*	*0.379*	0.340	0.356	*0.387*	*0.399*	*0.408*	*0.403*	0.357	0.372	*0.401*	*0.394*	*0.396*	6.007	12.562	(0.548)
3. 6	0.338	0.345	0.359	*0.373*	*0.380*	0.348	0.357	*0.385*	*0.400*	*0.406*	*0.401*	*0.418*	0.317	*0.402*	*0.398*	*0.401*	6.028	11.811	0.244
4. 1	0.304	0.307	0.316	0.333	0.335	0.309	0.321	0.342	0.356	0.362	0.357	*0.373*	0.332	0.309	0.361	0.364	5.381	11.702	(0.940)
4. 2	0.308	0.315	0.324	0.338	0.344	0.311	0.326	0.355	0.362	0.367	0.363	*0.379*	0.337	0.371	0.311	0.370	5.481	11.727	(0.764)
4. 3	0.300	0.310	0.316	0.322	0.335	0.303	0.317	0.342	0.352	0.358	0.353	0.366	0.325	0.358	0.351	0.304	5.312	11.610	(0.985)
R	5.269	5.408	5.592	5.797	5.922	5.392	5.550	6.067	6.281	6.390	6.291	6.555	5.783	6.321	6.246	6.298			

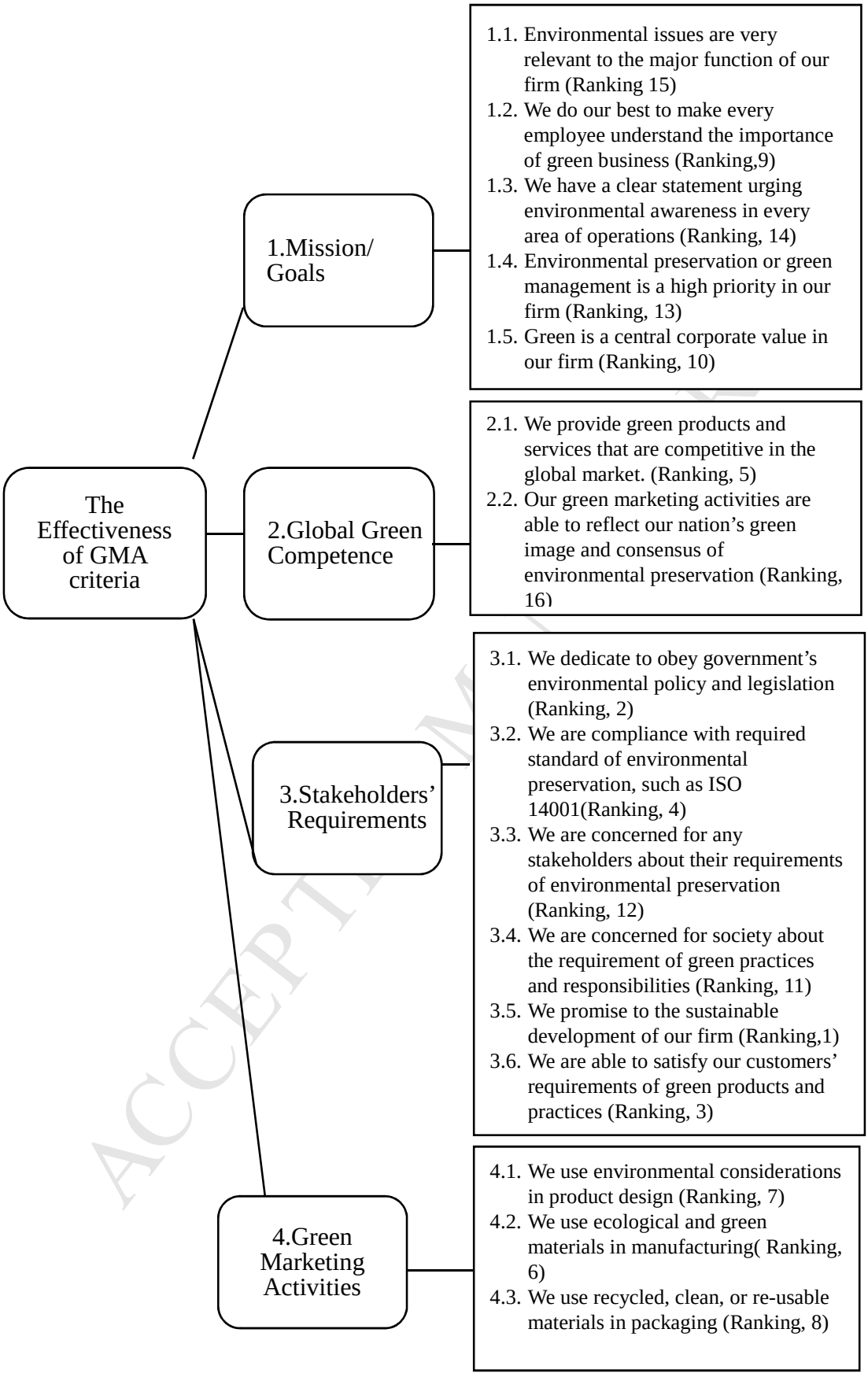

Figure 1: The proposed AHP model for GMA implementation

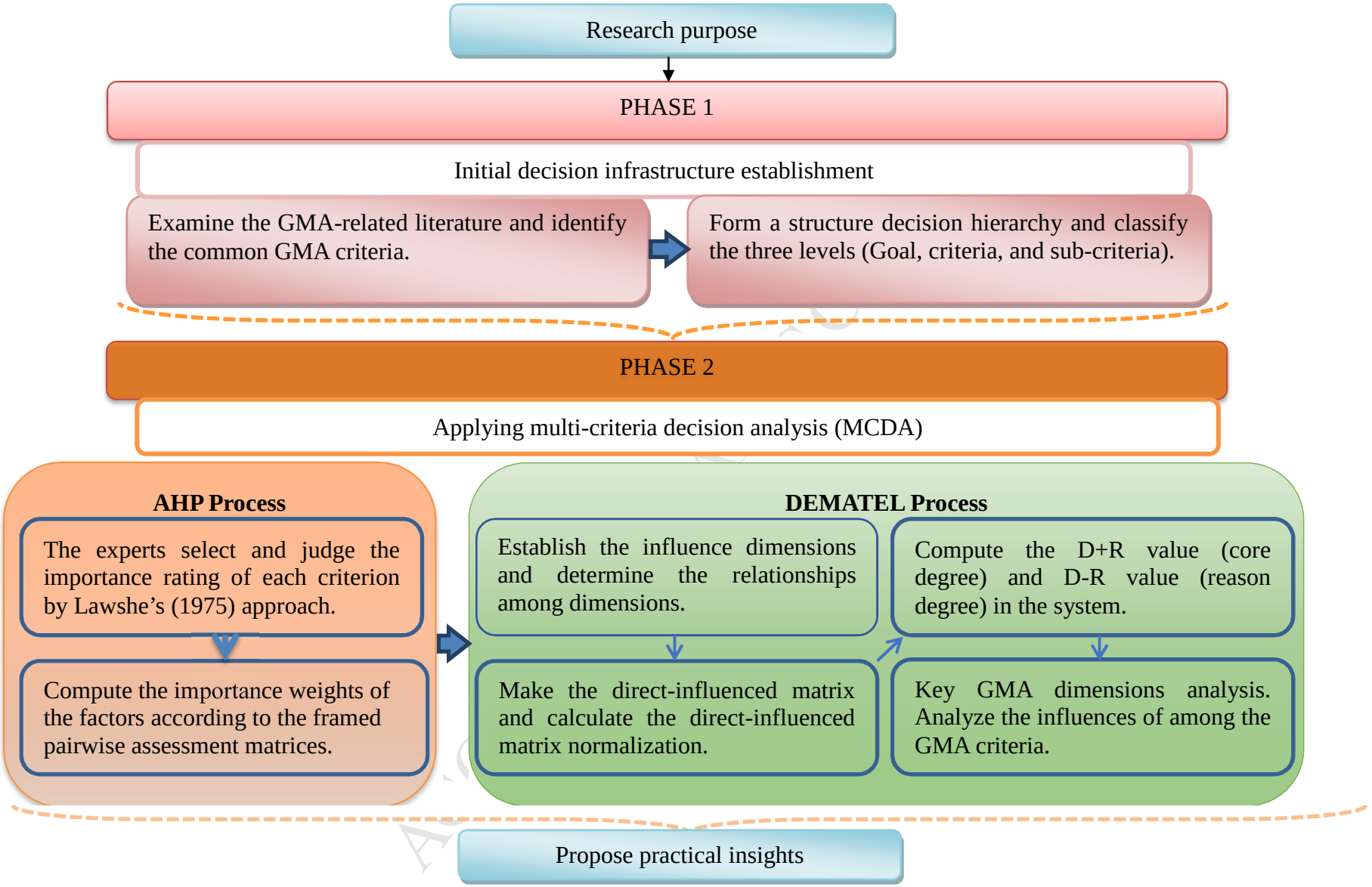

Figure 2. A flow chart of the combined AHP-DEMATEL process to identify the influence relations between GMA

Figures-02

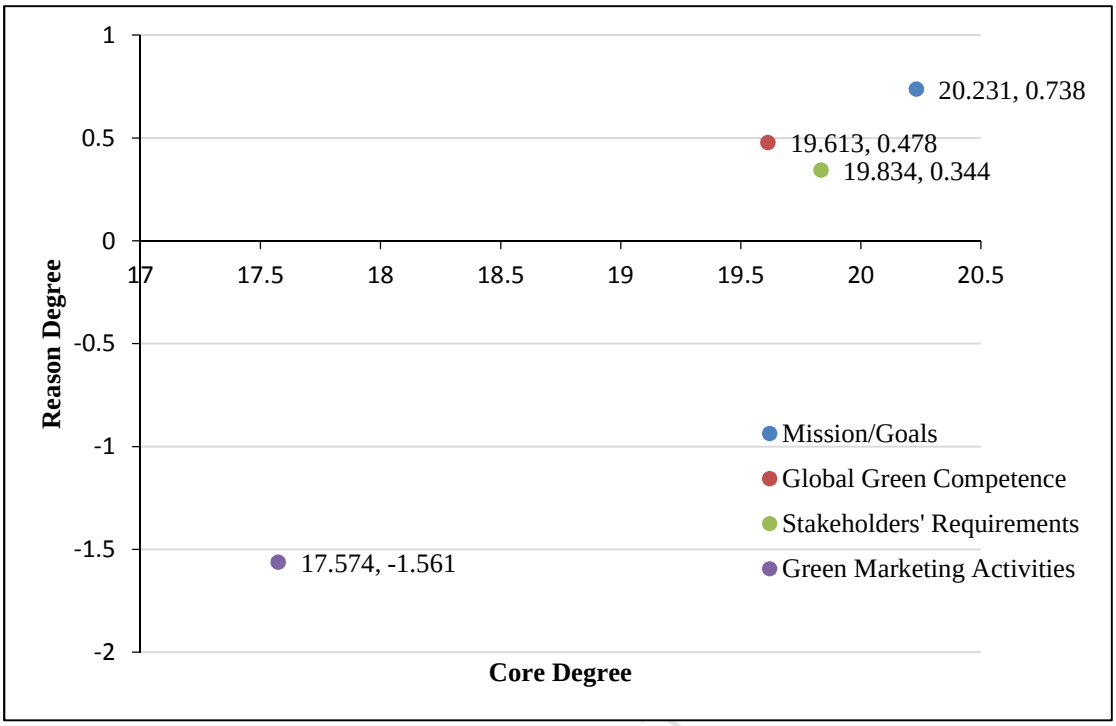

Figure 3: The relations between the GMA dimensions

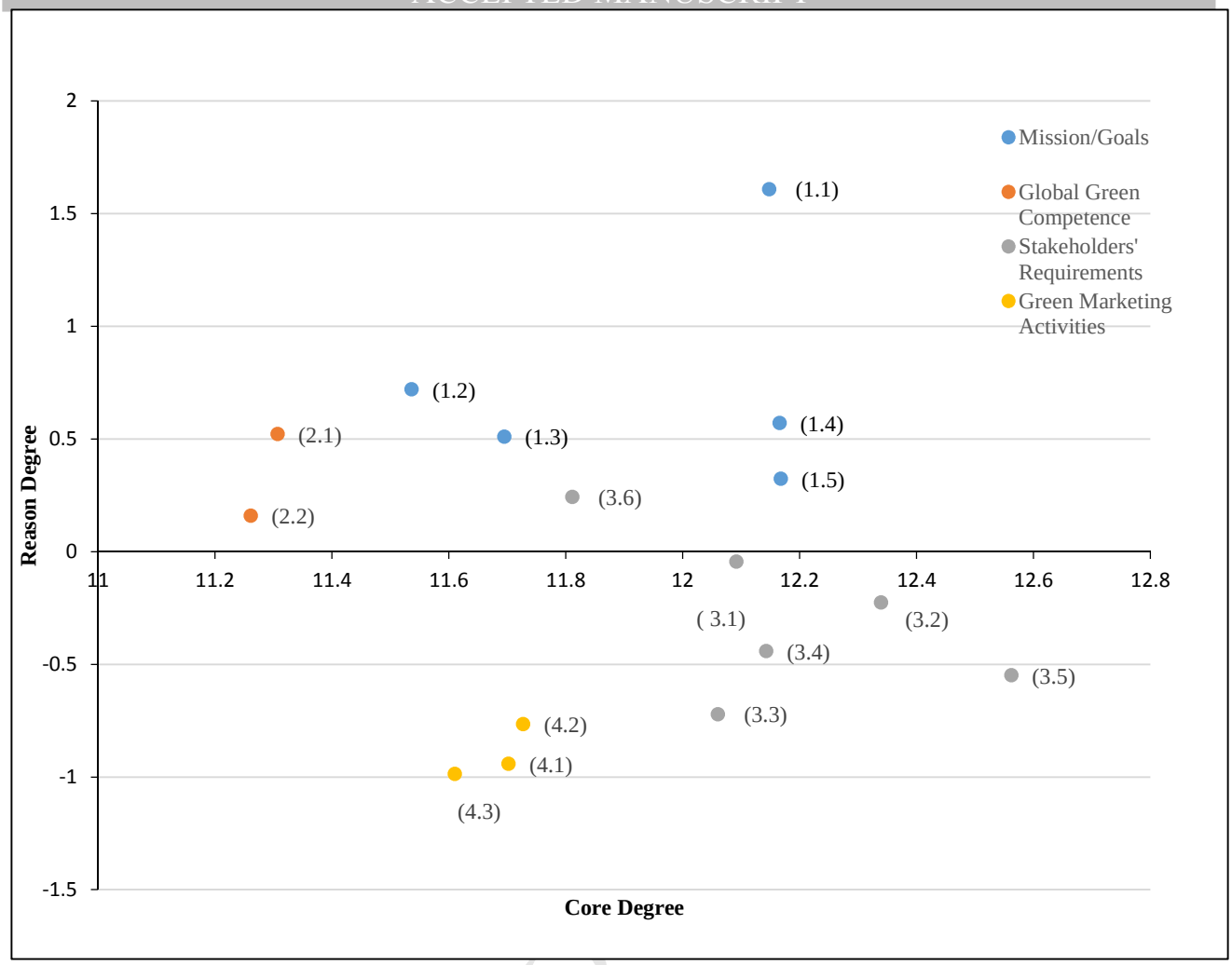

Figure 4: The relations between the GMA criteria

Applying a Multiple Criteria Decision-Making Approach to Establishing Green Marketing Audit Criteria

Research Highlights

- Presenting an effective mechanism for Green Marketing Audit (GMA) measurement.
- Employing the MCDA technique in evaluating the effectiveness of GMA criteria.
- Multi-dimensional to explore the relationship of GMA infrastructures.
- Stakeholder's requirements are the most significant factors for GMA implementation.