



## Providing a Micmac Analysis to Strengthen Sustainable Green Accounting Values of Capital Market Companies: Polar Matrix Analysis

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### ABSTRACT

The Purpose of this research is providing a Micmac Analysis to Strengthen Sustainable Green Accounting Values of Capital Market Companies by Grounded Theory, Fuzzy Dematel and Polar Matrix Analysis. In this research, which is based on qualitative and quantitative methodology, first, 18 university experts in the field of accounting and finance participated in the analysis of Grounded Theory and Delphi, and then in the quantitative section, 23 managers of the top 50 companies of the Tehran Stock Exchange participated in two Fuzzy Dematel and polar matrix. The data collection method was based on qualitative methodology through field theory analysis (Grounded Theory), which collected the necessary data by conducting interviews, and after coding the research model, it was designed based on the theoretical framework. Then, in order to assess the level of reliability, Delphi analysis was used with the aim of achieving the theoretical adequacy of the main components of the research, finally, in the quantitative section, first by means of Fuzzy Dematel analysis and then pairwise and diagonal comparison between conceptual codes in several stages and accordingly, provide Micmac analysis chart. The results in the first phase of the research, which was conducted by the analysis of Grounded Theory, confirmed the existence of two categories of intra-organizational and extra-organizational values of green accounting based on the four main components of Information Advantage; Cost Advantage; Competitive Advantage and Ecological Advantage confirmed after conceptual coding. Then, based on Fuzzy Dematel analysis, the cost advantage is the most important consequence of the internal and external organizational values of green accounting.

**Keywords:** Sustainable Green Accounting Values, Grounded Theory, Polar Matrix Analysis

## 1. Introduction

Economic development and the upward trend of business activities and markets have occurred toward economic growth and human social welfare, pressure on the earth's natural systems and the use of non-renewable resources. The present age has witnessed some environmental limits, especially in global trade, as well as a restricted competition arena. To overcome these limits, reduce environmental damage, make extra money, or gain popularity and commercial success, some business entities have been forced to bear costs of environmental protection. Accordingly, "environmental audit" can be considered as a strategic issue for managers, community, and financial statement users (Maama & Appiah, 2019). Over the last few years, the lack of strategic approaches to "green audit" has led to an increase in a substantial level of environmentally hazardous waste consequently, inappropriate waste processing has resulted in the waste of resources and grave environmental and economic problems (Rajesh, 2011; Wath et al., 2010; Menikpura et al., 2014; Kumar & Dixit, 2018). Thus, many supervisory bodies have formulated a set of compulsory green audit laws and regulations to minimize environmental pollution due to the significance and increasing growth of environmental pollutants and waste (Bhutta et al., 2011). One of the numerous supervisory bodies considered in this study was the Financial Accounting Standards Board (FASB). A committee entitled "Monitoring the Adverse Effect of Companies to Study the Future of Environmental Protection" was established in 1976. It sought to develop strategic approaches and somehow monitor the practices of market companies. Pollution and waste levels were not so high due to limited competition. The FASB issued its No. 8/90 entitled "Capitalization of Environmental Pollution Costs" in 1990. Shareholders believe that there is no hope that green audits will be considered serious for environmental management in the industry as long as corporate executives and decision-makers fail to notice corporate environmental costs and the overwhelming significance of activities to fight against environmental pollution. Thus, ISO 14000 was established in 1995 to stimulate companies to comply with environmental policies, later known as green policies. However, following the drafting of the Paris Agreement (Accord de Paris in French) supported by 196 countries in 2015, supervision was mainly focused

on transparent environmental practices in the capital market. This was due to the fact that environmental pollutants mainly originated from capital market companies, which plays a significant role in the development of environmental practices, especially green audits (Qian et al., 2016). Evidence suggests that the pressure exerted by institutions supervising multinational corporations (MNCs) to disclose information on activities associated with sustainable green accounting practices (de Villiers & Alexander, 2014; Hahn et al., 2015). Companies are increasingly taking advantage of green accounting practices as a result of these supervisory pressures (Borghei et al., 2016; Welbeck, 2017). In Iran has long been involved with the issue of environmental pollution. Its economy experienced a 9% annual growth rate from 1961 to 1978, while it was 7.3% during the first post-revolutionary economic development program. Nevertheless, costs of environmental degradation and depleted perishable resources have not been subtracted from GDP in this measurement. From this perspective, the lack of green accounting as a strategic foundation for decision-making is quite evident. Hence, to protect the public interest, all executive bodies and NGOs were required to implement optimal basic and environmental resources consumption policies to reduce government spending credits, pursuant to Article 190 of the 5th Five-Year Development Plan (FYDP) Law. To implement the Green Accounting Plan, including the management of energy, water, raw materials, and equipment (e.g., paper), reducing and recycling solid waste (e.g., in buildings and vehicles), they were also tasked with cooperating in accordance with the regulations issued by The Environmental Protection Agency (EPA) and its deputy. These enactments are approved and ratified by the Council of Ministers and thus are binding (Seyed Javadian et al., 2016). Such guidelines and rules can be seen as tools for the strategic development of green accounting over the last few years, also they are certainly not sufficient. Compliance with international environmental standards can pave the way for growth and development in this sector. In light of the above, this study aims to provide a MICMAC analysis to strengthen the sustainable green accounting values of capital market companies based on the polar matrix analysis.

## 2. Literature Review

### Strategic Functions of Green Accounting

Environmental protection features prominently in Iranian laws and regulations. For example, Article 50 of the Constitution of the Islamic Republic of Iran enshrines environmental protection as a public duty. The Horizon 2025 in the 20-Year National Vision of the Islamic Republic of Iran has also emphasized the right of Iranian society to enjoy a favorable environment. Furthermore, providing all stakeholders with information on environmental practices can play a vital role in better enforcing existing environmental laws and regulations. According to Part C, Paragraph 13 of the Financial Accounting Standard, No. 1, companies would have to provide additional information optimally when presenting financial statements when users of financial statements need to do something more than complying with the requirements of Accounting Standards to understand the effects of transactions or other particular events on the financial status and financial performance of

business enterprises. Moreover, pursuant to Paragraph 19 of this Standard, management should apply a set of procedures that lead to the presentation of the most helpful information in the financial statements if there exists no specific accounting standard in this regard (Sepasi and Ismaili Kajani, 2015). Additionally, pursuant to Article 33 of Governance Principles Code for Companies Listed on the Stock Exchange, listed companies are required to provide general information on social and environmental obligations in their annual reports (Iranian National Accounting Standards Committee, 2006). On the other hand, according to its constitution and self-establishment regulation, the Supreme Accounting Court has addressed and put the development of a special and independent environmental Accounting on its agenda with a focus on three areas, namely the human, natural, and maritime environment (Environmental Accounting and Renewable Energy Board, 2013). Table 1 demonstrates the sub-domains for each of the domains mentioned above.

**Table 1: The domains examined by Iran's Environmental Accounting (Mirnajafi, 2012)**

Areas Highlighted	Job Description
Human Domain	Green Accountings of rivers across the country by adopting a pathological approach, Accountings of air pollution prevention by the relevant agencies, Accountings of environmental pollution and degradation self-reporting, and promoting technical specifications, environmental criteria and standards nationwide to ensure the environmental assessment in the implementation of projects, civil projects, environmental assessment of big projects, aerosol and dust management Accountings
Natural Domain	Environmental assessment Accountings of big projects, aerosol and dust management Accountings
Maritime Domain	Environmental Accountings of coastal management, wetland status Accountings, Accountings of the compliance of state environmental activities with international obligations (i.e., renewable energy)

Similar to other supreme Accounting courts in the world, this Accounting court also pursues a number of common goals from conducting environmental Accountings, including:

- Ensuring and promoting the compliance with environmental legal requirements verified by parliament and the government
- Ensuring environmental assessments in the implementation of projects and civil projects
- Evaluating the performance and effectiveness of environmental plans such as control of pollution, water, soil, air, waste management, natural resources conservation programs (e.g., trees, plants, and wildlife), etc.
- Accounting the alignment and compliance of state environmental policies and practices with international environmental obligations

(including 18 conventions and some environmental protocols ratified by the parliament, as a law). The evaluation of the deployment of environmental management systems by Accounting these systems in public institutions, organizations, and corporations

- Ensuring the adoption and implementation of appropriate and sufficient processes and policies to achieve sustainable development
- To fulfill the objectives of environmental Accounting, in conformity with the International Guidelines of the International Organization of Supreme Accounting Institutions (INTOSAI), this organization shall conduct its environmental Accountings as follows (Ali Asgharpour & Mirnajafi, 2014):
  - 1) Environmental Regulatory Compliance

- Accounting,
- 2) Environmental practices Accounting,
- 3) Environmental Accounting with a Joint Approach to Compliance Accounting and Performance Accounting,
- 4) Financial Accounting,
- 5) Environmental Accounting Based on a Pathological Approach (Considered by INTOSAI Working Group in Argentina as an innovative approach) (Azadi et al., 2015).

identify, record, and report the impact of environmental degradation and pollution. It can be applied at different scales in large and small enterprises and different industries, by adopting a systematic approach or based on the desired principles. The type of green Accounting selected by the companies explains their objectives and why they have used it. This can help develop the influence of the company across the market in terms of strategic characteristics (Feger & Mermet, 2017). The strategic applications of green Accounting need to be investigated, both from a microeconomic and a macroeconomic point of view, so that they can be expanded (Adams & Larrinaga, 2019), as follows:

**Strategic Applications of Green Accounting**

An environmental Accounting is a series of activities that enhance the ability of the accounting system to

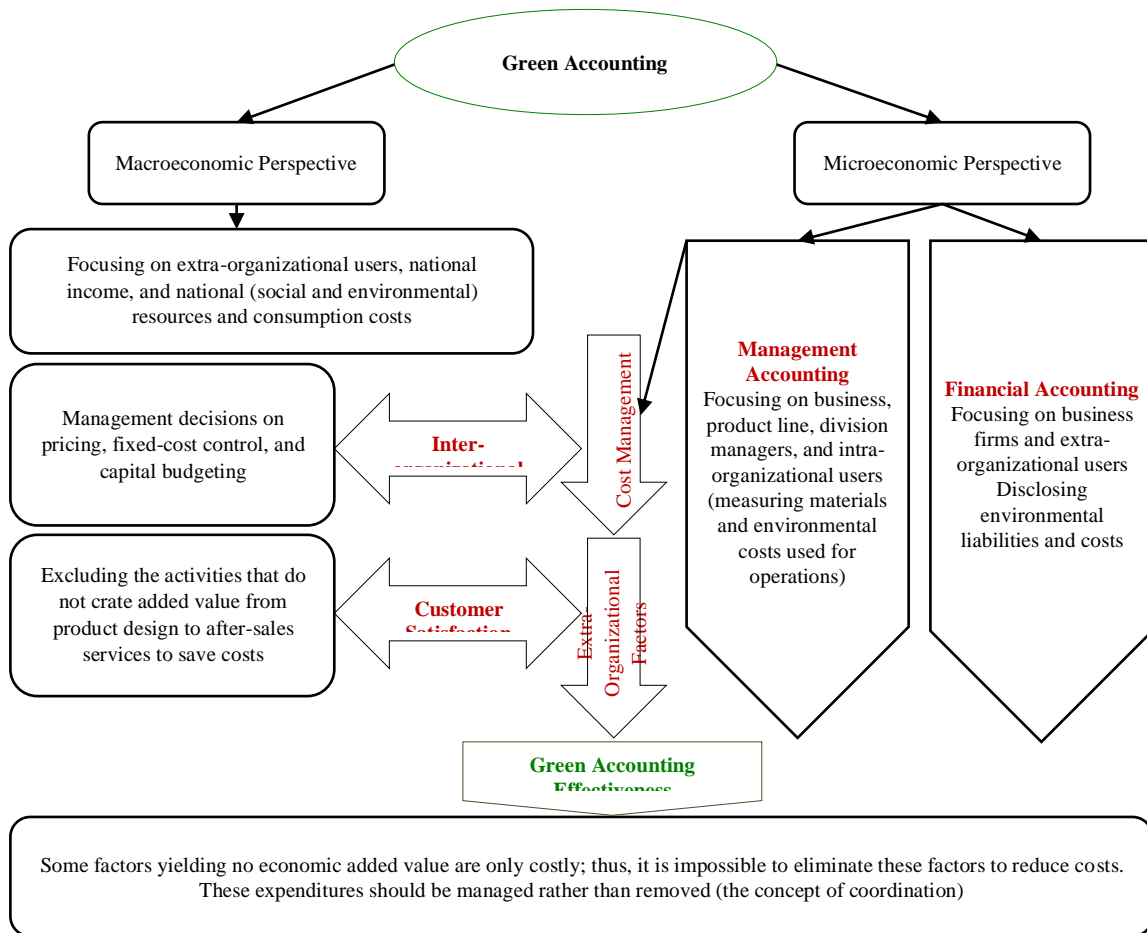


Figure 1: Strategic Applications of Green Accounting

The “microeconomic” approach is used in the strategic applications of green Accounting (e.g., business enterprise) based on financial and management Accountings. Several requirements have been imposed regarding the disclosure of environmental liabilities and costs via financial Accounting through which the business enterprise reports the accounting information associated with its economic activities to extra-organizational users. Financial Accounting investigate and evaluate the issue from the standpoint of users of financial reporting to decide on and present general obligations (Soloivida & Latan, 2017). The strategic applications of green Accounting across a competitive marketplace allow corporate executives to deliver the highest productivity to the company in product design and production process, performance evaluation and cost control, depreciation management, investments in “tangible fixed assets,” and waste management (Boyd, 1998). Nonetheless, the purpose of adopting a “macroeconomic” approach in strategic applications of the green Accounting is to calculate the costs of mineral resources and their resultant flows to increase the levels of competitive power (Soloivida & Latan, 2017). Simply put, this approach seeks to address larger economic aspects such as GDP by Accountings, which could lead to reduced production costs, increased national income, and economic growth through the strategic effectiveness of the green Accounting.

Based on theoretical foundations presented and the analytical approaches adopted in this research, the research questions are as follows:

- ❖ **Question 1:** What are the green accounting values throughout the capital market? (Grounded theory analysis)
- ❖ **Question 2:** What is the most important component of green accounting values throughout the capital market? (fuzzy DEMATEL analysis)
- ❖ **Question 3:** What is the most important conceptual code of green accounting values throughout the capital market? (Polar matrix analysis)

## Research Background

Zhu et al (2020) in our research conducted Green financial behavior and green development strategy of Chinese power companies in the context of carbon tax. Power sector is the main source of carbon emissions,

whether the carbon tax levy promotes the emergence of green financial behavior of China’s power companies. From the perspective of financial management, this paper analyzes the possible influence of carbon tax policy on green financial performance, green financial activities, green financial accounting and financial information disclosure of micro-economic entity power companies based on specific cases. And in terms of the green financial strategy, green financial management and green financial evaluation, this paper proposes countermeasures for the green development of China’s power companies. The study suggests that under the construction of China’s green tax system, the financial behavior of power companies is gradually moving towards green. This not only conforms to China’s green tax policy, but also is an inevitable strategic choice for China’s power companies to achieve green development. Shen et al (2020) in our research conducted Sustainability accounting, management and policy in China: recent developments and future avenues. This paper articulates the current status of researching sustainability accounting, management and policy in China that is instigated by the country’s regulatory initiatives under its political economy. It highlights the papers accepted for the special issue, their areas of focus and the underlying characteristics. It points out that the accepted research papers concentrate on issues related to corporate social responsibility disclosures, sustainability reporting and environmental management in China from the perspectives of the domestic stakeholders. Herold et al (2018) in their research, investigated interaction between institutional and stakeholder pressures: Advancing a framework for categorizing carbon disclosure strategies. Although the researchers attribute the prevalence of competitive institutions to different Consequencess, existing research offers conflicting views on their implications (these Consequencess), and the study said. In this study, an attempt was made to address this issue by presenting two frameworks: in the first framework (a), the institutional and stakeholder effects on carbon disclosure are clarified, and in the second framework (b), a picture of four carbon disclosure strategies. Various were presented at the company to assess the “real” carbon status of the company. Identified the various concepts influencing disclosure, including institutional areas, organizations, and stakeholders.

Guesalaga et al (2018) Research conducted under the title of determining the most effective tactics of strategic management accounting to improve the level of capabilities and resources of companies in a competitive market. In this study, which used fuzzy analysis methods, 22 experts participated both at the academic level and at the level of each industry. The results showed that target costing techniques, given capabilities and capacities such as human resource capacity, marketing, production and sales, are the most effective tactics for growing companies and start-ups. Oboh & Ajibolade (2016) they conducted a study entitled Strategic Management Accounting and Decision Making in Commercial Banks in Nigeria. The research instrument was a questionnaire and 255 commercial bank managers in the form of 16 banks in Nigeria participated in this study, which used partial analysis of partial squares (PLS) to analyze and test the model. The results showed that there is a significant relationship between benchmarking of operating methods (sampling), integrated performance evaluation and quality costing with competitive market decisions at the market level compared to other competitors. Akbari & Pourzamini (2018) conducted a research titled The Firm Management Structure, Environmental Auditing and Financial Reporting Quality. In this research, 175 companies listed in Tehran Stock Exchange during the period of 1999-2015 were investigated. In order to test the hypotheses, statistical analyzes using panel data were used using eviews software's and linear regression model. Research findings show that, firm management structure has an impact on relationship between environmental auditing and financial reporting quality.

### 3. Methodology

The study was based on exploratory study and matrix analysis based on grounded theory and Micmac analysis. This is because coherent research has not been conducted in the field of inertia in the Green Accounting or Environmental Accounting Values. This concept can make a significant Expanding sustainable development approaches of companies active in the competitive field of capital markets. This research, in its first step, seeks to theoretically expand and develop the concept of Environmental Accounting Values through grounded analysis. In the second step, it seeks to formulate a Micmac analysis diagram and model based on polar matrix analysis to determine the

positive (+ve) or negative (-ve) causal relationship in two ways, i.e., pairwise comparison and symmetry between components and Target. Accordingly, this research has used an exploratory-interpretive research method. That is, this method allows the researcher to formulate a new theory instead of using pre-defined theories in cases where it is not possible to formulate a hypothesis or a theoretical coherence on the subject under study. This research uses an inductive-deductive research approach in terms of data collection logic because it examines a phenomenon for which there is no comprehensive theory in the areas of in the capital market or whether there is no consensus. In other words, the effort is to design a suitable model using an inductive approach. To do so, Glaser (1992) used grounded theory and an emerging or emerging approach to identify and categorize issues related Green Accounting or Environmental Accounting Values through interviews with experts in the field. This approach allows the researcher to ask open-ended questions from the interviewees, in the first step, based on the first step of coding, i.e., open coding, through interviews with experts. In the second step, based on axial coding, it provides the ground for the researcher to summarize the innumerable concepts created and guide them in the path of research. In the final step, the researcher can provide a research model for the theory of selection based on Theoretical codes.

### Statistical Population and Sample

The qualitative section of this study used purposive theoretical sampling to "maximize the chances of comparing events, occurrences, or happenings" based on Strauss and Corbin's (1998) beliefs to comply with the principles of grounded theory. Accordingly, the researcher first tried to select several knowledgeable individuals to prevent deviations and waste of time during interviews by listing several criteria:

- 1) Having sustainable approaches in accounting, both academically and experimentally
- 2) Mastering qualitative research and familiarity with its interviewing process.

Based on the above two criteria, in the first step, a list of researchers in the Areas of social and environmental accounting is available, by searching on reputable domestic and international scientific research sites. Then, according to the research related to the objectives of the research, several emails were sent to

at least 26 people and they were asked to be interviewed if they wished. Of the emails sent, 16 emails were answered, with 14 eventually selected as interviewers. Attempts were made to conduct the interviews face-to-face (in person) as much as possible. In a small part of this study, 23 people were selected as the target population using convenience sampling, following the design of the model by selecting the target population from the CEO according to work experience and technical/specialized knowledge. Shortly after the model was designed, executives from the top 50 companies in the capital market, which are announced each year by reputable publications such as the Industrial Management Organization based on statistics and information from the Securities Exchange, were used to explain the model at the capital market level. At this stage, the target community was selected using the available sampling method, based on which 23 managers in different layers of the mentioned companies were selected as the target community in the quantitative section according to experience and knowledge level.

### **Data Collection and Analysis**

The Qualitative Analysis section used first open-ended interviews conducted by semi-structured interviews with an average time of one hour to collect data from the interviews. The interview questions encompassed several real situations faced by participants in terms of their experience or education. Some of these interview questions were:

- ❖ How do competitive practices-based green accounting values result in reduced environmental pollution?
- ❖ Can increased effective supervision lead to increased convergence of capital market companies in their commitment to reducing the environmental waste of their operating activities?
- ❖ Can social dimensions help make green accounting values as dynamic as possible?
- ❖ Can technology and its development in the industry help waste recycling processes reduce environmental pollution?
- ❖ How much is the significance level of the role played by governance practices in improving green accounting values?

At the beginning of the qualitative analysis process,

non-structured interviews were generally conducted because it helped researchers create different perspectives on the research topic. Nonetheless, in the later stages of the research process, semi-constructed interviews were gradually conducted due to the implications for creating a purposeful theoretical framework for producing more effective content. This can significantly help to make an effective reduction in the orientation or orientation resulting from research literature-based theories in data collection. Completing interviews is considered one of the most important parts of grounded analysis, with “reaching the saturation point” as a vital process and strategy in this analysis. Following each interview, the researchers began to perform open coding and, to some extent, selective coding to determine their concepts and commonalities. Accordingly, at each stage, the codes generated in the selective coding stage were compared with each other because continuous comparison helps to sequentially control new concepts, expand, develop, and compare classifications and make decisions about the adequacy or inadequacy of existing classifications (Wastell, 2001). In the axial coding stage, the researcher records all emerging ideas, codes, and possible classifications and the relationships between the main and sub-classifications based on similarity. In the selective coding stage, sub-main and main classifications are created based on the theoretical framework. The interviews were conducted such that the model was almost formed between the first interview and the eighth interview because the researchers started to analyze the interviews based on open and axial coding after each interview. From the ninth interview to the fourteenth interview, the interviews continued to ensure that the saturation point and codes were frequently repeated in the interviews. Accordingly, after the fourteenth interview, it was announced that the interview process is over.

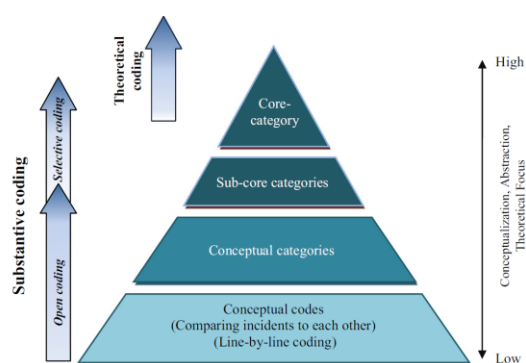


Figure 3: Analysis steps in Grounded Theory

Then, in the quantitative section, according to determining the value dimensions of green accounting, a matrix analysis questionnaire was designed. The model was developed in several stages to provide an analytical chart, which contributes to greater perceptual coherence to explain the model in the target community. In this regard, an attempt was made to send the questionnaire to the participants of the target community in a small section with previous coordination. However, in order to comply with the instructions for filling out the matrix questionnaire, an attempt has been made to explain how to fill it out in person.

### Research Validity

In qualitative research, the concept of validity has been used from different perspectives. It was not a single concept, but a complex and comprehensive one. In interviews using a qualitative approach, the mind plays a prominent role. Therefore, the reproducibility and generalizability of the results of these interviews are questionable, and researchers should use the techniques used in qualitative research to demonstrate the reliability and validity of the findings. This research has used the method of "triangulation or multilateralism" to validate the research. In this study, for a multidisciplinary study, different approaches to interviewing were examined from the following four aspects. More valid data is provided in addition to strengthening the results.

- 1) **Certification or review by interviewees:** This method examines the validity of the research by the interviewees to determine whether this research properly covers their views on the subject matter or not. In this method, 10 of the 14 participants were questioned and debated,

after the interview and data analysis, to see if their views matched those of the interviewees. Fortunately, in all cases, the researcher had a correct understanding of the interviewees' statements, which could be due to the favorable interaction between and the theoretical understanding of the interviewees and the interviewer on the subject matter.

- 2) **Peer Review:** Using this strategy, the researcher is assisted by other researchers during the research to critique the methods used and to examine their results and accuracy. He asks them to review the notes, the classification made using the list of categories, and the computer analyzes performed during the research. It was impossible to get help from other researchers in this field due to the existing limitations. Nevertheless, to apply this method, the interview data were re-analyzed after two weeks, without significant differences in understanding the concepts of "interview" in these two periods.
- 3) **Explaining the note-taking method and conducting research:** At this stage, ten interviewees were provided with a protocol/interview process to confirm whether the analysis process was correct or not. Reviews of the notes indicated that the research and analysis of the codes had been carried out correctly.
- 4) **Preparing a detailed report of the results:** In the interpretive analysis, according to the principle of "meanings derived from situations", each of the results should be regarded fully together with the situation and the reader should show special attention. To position. Therefore, a report should explain the details of the research position. Accordingly, interviews, notes, and regular reporting of results led to the collection of valid data, which was confirmed.

Nonetheless, in quantitative terms, Delphi analysis has been used for validation according to two criteria, namely mean and contingency variables. A Delphi analysis is performed to achieve theoretical adequacy in the target population regarding the identified aspects and components to examine the degree to which these concepts have been used in the target population. In this section, the results are presented in Table 3 in the



second part of the "Analysis of Research Findings".

**Findings**

**Findings of Grounded Theory Analysis**

There is no definite list of Green Accounting Value Features and Components, nor is there any definite possibility of identifying and limiting all the features associated with Developmental approaches and consequences of waste control in a specific set of

characteristics with clear and distinct boundaries. Notwithstanding, the findings of this study suggest that interviewees were familiar with the concept of The value of green accounting and used it mainly from a more or less applied perspective. Theoretical domains of this approach in the audit profession. It can be used as a foundation for developing behavioral strategies in the audit profession based on the findings of this study. Table 1 shows the three-step process of coding:

**Table 1: Conceptual and classified codes of interviews**

Principal Coding				Theoretical Coding
Open Coding	Axial Coding	Selective Coding		
Conceptual Codes	Major Components	Categories	Main Categorization	
Creating and maintaining the environmental information system (ENVIS)	<b>Information Advantage</b>	<b>Intra-organizational green accounting values</b>	<b>Green accounting values across the capital market</b>	
Identifying, collecting, and analyzing information				
Full control and strengthening of environmental decisions				
Strengthening operations management practices in green product design				
Improving the effectiveness of strategic management accounting techniques (SMATs)				
Periodic evaluation of financial and accounting strategies in the environment				
Strengthening ENVISs in carbon reporting disclosure	<b>The cost advantage</b>			
Estimating and calculating environmental operating costs				
Reducing resource and waste recycling costs				
Reducing product prime cost				
Reducing the environmental waste cost				
Reducing overhead and other relevant costs such as warehousing				
Social cost reduction	<b>Competitive Advantage</b>	<b>Extra-organizational green accounting values</b>		
Reducing legal costs of environmental pollution				
Activity-based costing dynamics				
Determining environmental opportunities and threats				
Receiving tax benefits and incentives				
The dynamization of the life cycle for the competition				
Creating environmentally pluralistic values	<b>Ecological Advantage</b>			
Providing the opportunity to compare the benefits acquired and the effective competitive progression				
Gaining a greater market share thanks to enhanced social trust				
Optimizing economic value added in using natural resources				
Sustainable supervision for environmental protection				
Value chain sustainability				
Improving flexibility (resilience) levels against environmental standard changes				
Increasing the biodiversity of animal species				
Increasing the effectiveness of the equilibrium between the man-made environment and ecosystem				
Strengthening accounting and social audit standards via getting feedback				
Consistent and integrated compliance with the environmental culture				

Below is a description of research findings, especially concepts and subcategories based on research on green accounting values in accordance with information disclosure guidelines and requirements, as well as the constituent components of each conceptual category. According to Table 1, there are two subcategories:

intra-organizational green accounting values and extra-organizational green accounting values. Table 2 defines each of these subcategories. There is an internal relationship between the variables of the constituent components of green accounting values

**Table 2: Definitions of subcategories**

Subcategories	Definition
<b>Intra-organizational green accounting values</b>	They are operating/information and cost processes within organizational structures that enable a company to analyze the prime cost and enterprise cost-effectiveness to reduce waste. They also contribute to guiding financial reporting systems to become more dynamic in increasing transparency for internal and external stakeholders based on these mechanisms.
<b>Extra-organizational green accounting values</b>	They are competitive and ecological processes outside organizational boundaries to enhance the effectiveness of corporate competitive practices and develop sustainable accounting based on identifying environmental opportunities and threats and raising social trust levels based on greater accountability of companies toward the environment.

It should be noted that this section only summarizes the results due to the limited number of article pages.

#### 1) **Intra-Organizational Green Accounting Values**

Green accounting was discussed and argued more seriously in communities at the onset of the 21st century aiming at sustainable development, leading to numerous studies in this sphere as a result of its broadness and influential areas. Following the adoption of these approaches, environmental protection, and its strategies soon got out of the scope of purely climatic and environmental research and entered other scientific fields such as management and finance. Nowadays, green accounting is seen as a vital functional strategy in competitive arenas. Nonetheless, the majority of studies have failed to address the absence of green accounting values within organizational frameworks. Competitive advantage and sustainability values resulting from green accounting are significantly highlighted. Notwithstanding, the necessity of addressing intra-organizational green accounting practices for reducing costs and increasing the effectiveness of information systems can facilitate the dynamism of companies, especially capital market companies, owing to the high volume of environmental pollution. Hence, this section examines the two identified dimensions of intra-organizational green accounting values.

#### **A) Information Advantage**

One of the major components dealt with in this section, is the information advantage. It is a kind of

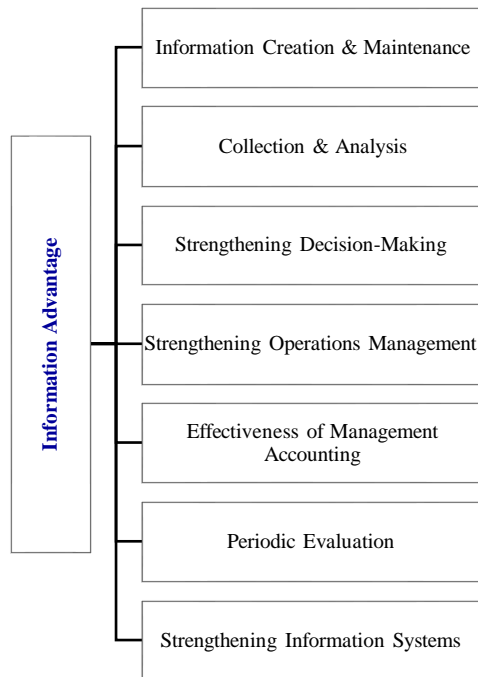
intra-organizational value-based Consequences leading to the strengthening of decision-making practices regarding the supervision and evaluation of intra-organizational environmental practices, thereby reducing environmental decision-making risk levels. Data collection processes and applying necessary processes for its analysis and creation in the form of a report form a range of systematic financial reporting procedures as green accounting information systems, which can help create information values. One of the interviewees stated:

“Every capital market company needs to review management information systems, either at a technical or an operational level, or at a high level, again due to increased environmental pollution. Similar to other functional areas, such as finance and accounting, construction and manufacturing, etc., they must promote environmental practices to a separate section to maximize the effectiveness of decision-making systems, from initial processing of functional processes at the lowest level (i.e., technical level) to preparing environmental pollution forecast reports at the highest level (i.e., high level).”

Another interviewee stated:

“The application of information technology systems, as one of the functional dimensions of green/environmental accounting, helps control risk and develop the process of designing and converting data into green products. This cycle leads to the continuous construction and production of practices such as environmental practices, as well as making appropriate

decisions on investment in green manufacturing infrastructure by assessing internal manufacturing capabilities. Upon reviewing these interviews, the following seven conceptual codes were developed based on the concepts defined as the information advantage component, as shown in Figure 3.



**Figure 3: Conceptual codes associated with the information advantage**

For matching this dimension with other research, notably, only a few studies have addressed the information practices in terms of green accounting. However, research conducted by Taleb Nia et al. (2012); Lynch (2010), and Ebimobwei (2011) on the role of information in green accounting stated that information capabilities can facilitate the development of waste reduction and environmental pollution infrastructure and provide an information base for stakeholders, especially internal stakeholders.

### **B) The cost advantage**

Various costs have always been regarded as one of the major reasons and incentives for accounting theorists to consider environmental areas. Companies can have a more successful performance in a competitive environment in conformity with

requirements and rules ratified by supervisory bodies for environmental protection if they have exploited costs as “a threat that has turned into an opportunity.” Thus, they can plan to boost their profitability by reducing costs such as overhead and waste costs. In this context, costs are sometimes quantitative and sometimes qualitative. In other words, the qualitative costs of environmental accounting include costs such as the reduction of agency gaps with stakeholders like governments, supervisory bodies, and shareholders with social concerns along with financial concerns and benefit maximization. Accordingly, identifying the values arising from the effectiveness of environmental cost control can help improve the competitiveness of companies and lead to significant benefits to the company thanks to focusing on responsible social goals. One of the interviewees stated:

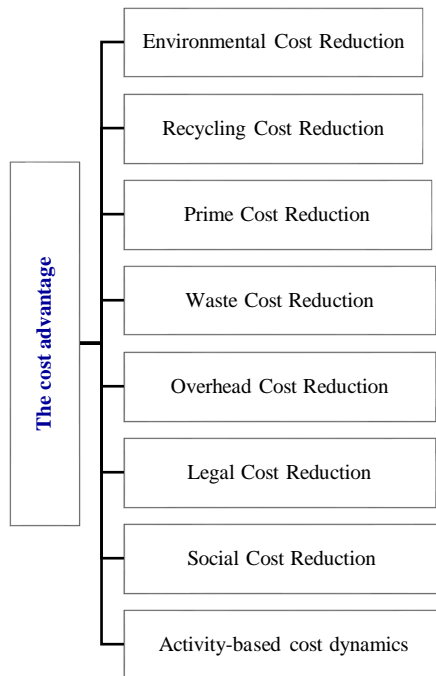
“In green accounting, when it comes to value, the most important principle is certainly cost reduction dimension. Proper costing in line with the corporate macro perspectives (e.g., the corporate environmental perspective) can facilitate the promotion of corporate profitability practices. Cost control can lead to a reduction in the company's product cost through green strategies (as its most important role) and many other dimensions, such as other indirect costs including warehousing and so on.”

#### **Another interviewee commented:**

“By investing in environmental pollution-reducing and waste recycling technologies, production line costs are expected to decline in the short run, leading to the company's devalued net profit by substantial amounts of money before such strategies were developed. However, companies have managed to gain a competitive advantage through appropriate investments and the application of up-to-date recycling technologies. Other companies have been deprived of such an advantage due to a failure to invest in or develop the required strategies.”

As mentioned in the interviews, one of the major aspects of the cost advantage of environmental accounting is the increased probability of the company's success regarding the pros and cons within its structural boundaries. Here, increased effectiveness can pave the way for the company to adopt green accounting strategies and provide a reliable output to stakeholders such as transparent reporting. Upon examining these interviews, the following 7 conceptual codes were developed based on the

concepts defined in the form of the cost advantage component, as shown in Figure 4.



**Figure 4: Conceptual codes associated with the cost advantage**

According to research by Jahangard (2000), Alamshah (2014), Herbohn (2005), and Tu & Huang (2015), the greatest achievement of green accounting, especially in a competitive environment, is the reduced costs in various dimensions, and the adoption of green accounting, at least in terms of cost, is described as a factor for greater sustainability. There is a big difference between companies with a green accounting strategy and those without a green accounting strategy in terms of costs in the long run.

## 2) Extra-Organizational Values

In green accounting, extra-organizational values allow us to compare the advantages obtained and an effective and efficient progression mediated by environmental protection activities to identify and make appropriate decisions by external users and stakeholders via disclosing the results of quantitative measurements of environmental protection activities, holding managers accountable while building trust. By increasing the value of their external stakeholders, companies help create competitive advantages in the

first place and protect the living environment of future generations through ecological practices in the second place. These values can help intensify sustainability throughout the capital market and lead to disclosure practices based on innovative standards and procedures to reduce environmental pollution. Thus, this section examines the two identified dimensions of extra-organizational green accounting values.

### A) Competitive Advantage

The adoption of green accounting strategies in a company will generally pull it ahead of its competitors who have not adopted any green accounting strategy. This is because environmental protection is regarded as a sensitive issue in the eyes of society and external stakeholders. Keeping that in mind, the company can gain a competitive advantage in a competitive market. Advantages are categorized, usually varied depending on capital market requirements. This advantage is sometimes simply interpreted as detecting opportunities to control environmental threats by the company in conformity with the requirements and standards governing companies and sometimes to the company's dynamic competitive life-cycle thanks to the adoption of green production and disclosure mechanisms. The interviewees provided appropriate insights into this dimension. For example, one of the interviewees stated:

“To explain the supervisory practices regarding green accounting development, it would be better to first define the role played by green accounting in an environment where companies compete. First of all, it should be noted that environmental practices disclosure laws are not sufficiently strong; thus, we should not seek incentives in the laws or requirements for minimum disclosure in our national capital market. The stage will be set for competition in green accounting, generally when the company's social and interpretive approaches are inclined toward environmentalism (environmentally friendly). Using this approach, the company first identifies potential threats and then opportunities to take advantage of this strategy in a competitive market environment. Accordingly, it can reach significant accomplishments compared to other competitors by timely disclosure of its environmental practices. This is exactly where effective supervision enhancing the competitive advantage of green accounting acts as a regulator that harmonizes and aligns the path of strategies developed for implementation with goals. These values can bring

with them pluralistic values for the company if they are institutionalized.”

Focusing on a few conceptual codes in this interview and other interviews facilitated the creation of a component known as a competitive advantage. For example, “environmental pluralistic values” was a concept considered in several interviews as a foundation for creating a competitive advantage through green accounting. In creating a competitive advantage, pluralistic values refer to the content and nature of the company’s environmental reporting disclosure processes, which will lead to better understanding and commitment of the company to stakeholders. For example, one of the interviewees stated:

“The most important Consequences of green accounting processes is the pluralistic values created for stakeholders. This is because stakeholders today are sensitive to climate change, environmental pollution, social responsibility toward future generations for environmental protection, etc. This leads the market to promote the companies that can develop these values into a higher competitive position.”

On the other hand, these processes can help companies optimize economic value added (EVA) in using natural resources. For example, an interviewee stated:

“Green processes-based product design and manufacturing practices play a role in reducing the company’s direct production costs, with value-added created as its important Consequences, which plays a decisive role in governments’ economic dimensions, at the macro level, and in competition between companies, at the micro-level. Put differently, the contribution of the managed resources as scarce in manufacturing products based on green mechanisms is accompanied by economic and more cost-effective added value that can facilitate the development of a competitive position.”

Based on these interviews and the concepts derived from them, the competitive advantage was created as one of the major components of the extra-organizational green accounting values. In a competitive advantage, all of these dimensions are serially interconnected contributing to the continuity and sustainability of the company in competitive arenas. Based on the conceptual codes created, the following figure can be drawn for the competitive

advantage of the extra-organizational green accounting values.

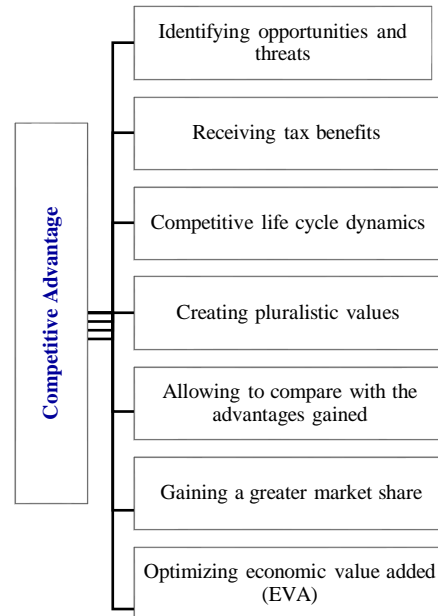


Figure 5: Conceptual codes associated with a competitive advantage

The conceptual codes identified for this component, i.e., the competitive advantage, are conceptually consistent with the research conducted by Solovida & Latan (2017) and Chang (2013), which emphasized the competitive Consequenceness of green accounting in capital market companies.

**B) Ecological Advantage**

Ecology is the study of the knowledge of interactions between ecological species and the human environment. The growth and development in industrialized countries have largely led to the degradation of environmental ecosystems and changes in social lifestyle throughout the world, including industrial and capital market companies as one of the most important ones. They have inflicted irreparable damage on the environment to maximize the interests of themselves and their stakeholders. Nevertheless, the term green has been institutionalized in corporate operational processes (e.g., green accounting) as a control mechanism in line with international standards over time following an increase in environmental

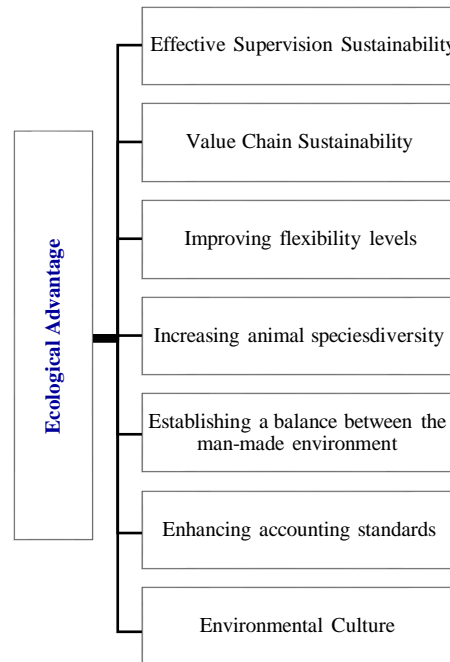
concerns. In this section, many interviewees underscored the link between corporate practices and the surrounding ecological environment. For example, one of the interviewees stated:

“I believe that value chain sustainability was one of the most important extra-organizational accomplishments of companies in green accounting. This is because upon searching for a sequence (continuum, concatenation), from the need for a resource to its supply and production, is all on the agenda today of many of the world’s creditable companies, by adopting an approach based on environmental sustainability. A large number of automotive industries manufacture environmentally-friendly cars while protecting the environmental ecology against environmental pollutants as its most important achievement.”

Another interviewee stated:

“By being flexible in their structural layers, as one of the management goals, companies seek to maintain environmental sustainability based on their social responsibilities toward future generations. By creating R&D teams and providing a range of programs to maintain institutional standards, they are trying to facilitate an equilibrium between a man-made environment, namely primary resources utilization processes, and the ecosystem by presenting a range of ideas.”

Obviously, today, the ecological advantage as an extra-organizational value is considered as an important strategy because it can lead to effective supervision of environmental pollution practices and protection of various animal and plant species in the region and climate. This social responsibility, as a cultural function, can result in the creation of consistent and integrated green accounting values along with a higher level of stakeholder satisfaction. In light of the above explanation, the conceptual codes associated with ecological advantage are presented in the following order:



**Figure 6: Conceptual codes associated with a competitive advantage**

This dimension is consistent with research by Herbohn (2005), Tu & Huang (2015), and Solovida & Latan (2017) that highlight the role of ecology in green accounting.

**Theoretical Framework**

Following an overview of interviews associated with codes generated in this section, a grounded theory analysis-based model will be presented. In other words, upon identifying and describing the components of the conceptual categories, subcategories, and main categories, the interviewees were asked open-ended questions based on codes generated by analyzing the interviews in three coding sections: open, selective, and axial. Then, based on axial coding, the many concepts generated were shortened and guided along the research path. This section introduces the research model for theorization based on selective coding. The theoretical framework of sustainable green accounting values of capital market companies is presented as follows:

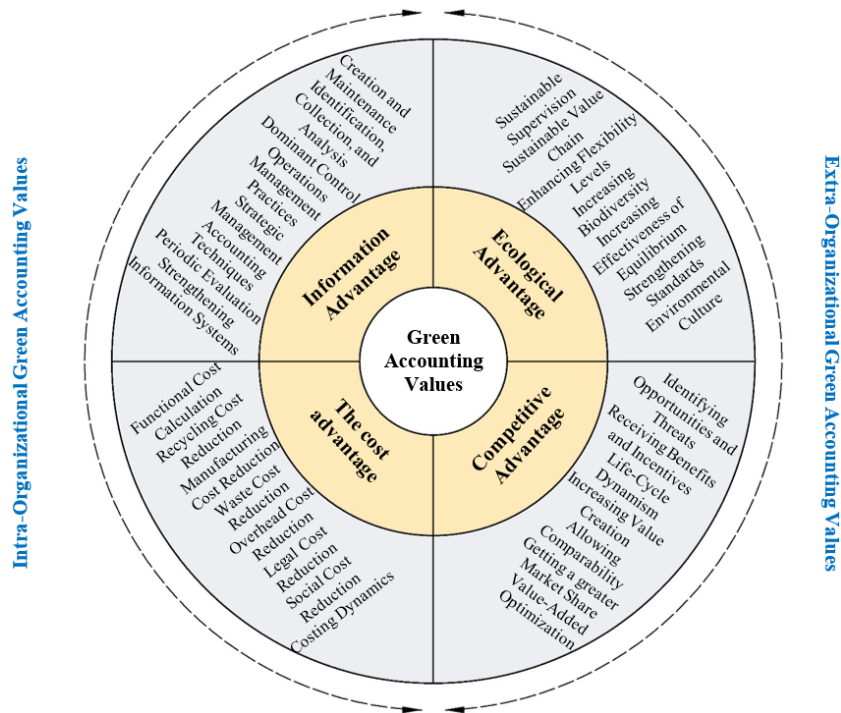


Figure 7: Theoretical framework of green accounting values

**Delphi Analysis Findings**

This section uses Delphi analysis to determine theoretical adequacy to evaluate the reliability of the major components of the proposed model, as a confirmation of the polar matrix analysis for MICMAC analysis. Table 3 shows the results of Delphi analysis based on two criteria, namely “mean” and “contingency variable.”

According to the results, the mean (the optimum level in a 7-point Likert scale) and the contingency variable (the optimum level is 0.5) of all sub-components were verified based on checklists filled by the participants. To perform Delphi analysis, sub-

components were developed in the form of a 7-item questionnaire to create greater distances between the more standard responses of panelists. The mean was accepted if it was 5 or higher. Likewise, according to the standard contingency variable set equal to 0.5, the sub-components with a coefficient greater than 0.5 were approved. Based on the results above, it can be stated that all sub-components have theoretical adequacy and contingency for polar matrix analysis. Now, this section utilizes fuzzy DEMATEL analysis to select the most effective major component identified for intra- and extra-organizational green accounting values.

Table 3: Delphi analysis of the major components

Categories	Major Components	Mean	Contingency Variable	Result
Intra-organizational green accounting values	Information Advantage	6	0.80	Confirmed
	The cost advantage	5.30	0.75	Confirmed
Extra-organizational green accounting values	Competitive Advantage	5	0.60	Confirmed
	Ecological Advantage	5.20	0.70	Confirmed

**Fuzzy DEMATEL Analysis**

Decision Making Trial and Evaluation Laboratory (DEMATEL) is one of the decision-making methods based on pairwise comparisons. Thanks to the judgment of experts in extracting the elements of a system and structuring them systematically, it provides the effective and impressionable reciprocal relationships among these elements by applying a hierarchical structure of system element. It determines the severity of the effect and the importance of the relationship as a numerical score. Accordingly, the identified major categories and components must first be coded.

**Table 4: Coded components and indicators for analysis**

Categories	Major Components	Code
Intra-organizational green accounting values (C1)	Information Advantage	C11
	The cost advantage	C12
Extra-organizational green accounting values (C2)	Competitive Advantage	C21
	Ecological Advantage	C22

Then, to compare the criteria, five verbal expressions were employed, with their equivalent fuzzy names and values presented in the table below.

**Table 5: Linguistic options and fuzzy numbers to measure the severity of effects (Jeng & Tzeng, 2012)**

Linguistic options	Absolute Values	Triangular Numbers	Fuzzy
Very high effect	4	(0.75, 1, 1)	
High effect	3	(0.5, 0.75, 1)	
Low effect	2	(0.25, 0.5, 0.75)	
Very little effect	1	(0, 0.25, 0.5)	
No effect	0	(0, 0, 0.25)	

The opinions of six experts have been used to evaluate the criteria. In these matrices,  $\tilde{x}_{ij} = (l_{ij}, m_{ij}, u_{ij})$  are triangular fuzzy numbers and  $\tilde{x}_{ii} = (i = 1, 2, 3, \dots, n)$  are considered as a fuzzy number (0.0.0). To examine the opinions of all experts, their arithmetic mean is calculated according to Equation (1).

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the opinions of all experts, their arithmetic mean is calculated according to Equation (1).

$$\tilde{z} = \frac{\tilde{x}^1 \oplus \tilde{x}^2 \oplus \tilde{x}^3 \oplus \dots \oplus \tilde{x}^p}{p} \tag{1}$$

where p is the number of experts and  $\tilde{x}^1, \tilde{x}^2, \tilde{x}^p$  are the pairwise comparison matrices for Experts 1, 2, and P, respectively, and  $\tilde{z}$  is a triangular fuzzy number as  $\tilde{z}_{ij} = (l'_{ij}, m'_{ij}, u'_{ij})$ . Tables 6 and 7 provide the average pairwise comparison value for the main and sub-factors, respectively:

**Table 6: Direct fuzzy matrix between dimensions**

C	C1			C2		
	L	M	U	L	M	U
C1	0	0	0	0.63	0.88	0.94
C2	0.63	0.88	0.94	0	0	0

**Table 7: Direct fuzzy matrix between criteria**

C	C11			C12		
	L	M	U	L	M	U
C11	0	0	0	0.563	0.81	0.88
C12	0.375	0.5	0.625	0	0	0
C21	0.688	0.938	1	0.313	0.5	0.75
C22	0.688	0.938	1	0.375	0.63	0.88

Equations (2) and (3) are used to normalize the resulting matrix.

$$\tilde{H}_{ij} = \frac{\tilde{z}_{ij}}{r} = \left( \frac{l'_{ij}}{r}, \frac{m'_{ij}}{r}, \frac{u'_{ij}}{r} \right) = (l''_{ij}, m''_{ij}, u''_{ij}) \tag{2}$$

where r is obtained from the following equation:

$$r = \max_{1 \leq i \leq n} (\sum_{j=1}^n u_{ij}) \tag{3}$$

Tables 8 and 9 show the normalized matrix for dimensions and criteria, respectively.

**Table 8: Normalized relation matrix between dimensions**

C	C1			C2		
	L	M	U	L	M	U
C1	0	0	0	0.093	0.13	0.139
C2	0.093	0.13	0.139	0	0	0

**Table 9: Normalized relation matrix between criteria**

C	C11			C12		
	L	M	U	L	M	U
C11	0	0	0	0.019	0.027	0.029
C12	0.013	0.017	0.021	0	0	0
C21	0.023	0.032	0.034	0.011	0.017	0.025
C22	0.023	0.032	0.034	0.013	0.021	0.029



Following the calculation of the above matrices, the fuzzy GRM is obtained according to Equations (4)-(7).

$$T = \lim_{k \rightarrow +\infty} (\tilde{H}^1 \oplus \tilde{H}^2 \oplus \dots \oplus \tilde{H}^k) \quad (4)$$

with each entry equivalent to a fuzzy number like  $\tilde{t}_{ij} = (l_{ij}^t, m_{ij}^t, u_{ij}^t)$  which is calculated as follows:

$$[l_{ij}^t] = H_l \times (I - H_l)^{-1} \quad (5)$$

$$[m_{ij}^t] = H_m \times (I - H_m)^{-1} \quad (6)$$

$$[u_{ij}^t] = H_u \times (I - H_u)^{-1} \quad (7)$$

In the equations above, I is a unit matrix and  $H_l$ ,  $H_m$ , and  $H_u$  are  $n \times n$  matrices whose entries consist of a low number, a middle number, and a high number of triangular fuzzy numbers of matrix H, respectively. Tables 10 and 11 show matrix T for dimensions and criteria, respectively.

**Table 10: The matrix of fuzzy general relations between dimensions**

C	C <sub>11</sub>			C <sub>12</sub>		
	L	M	U	L	M	U
C11	0	0	0	0.019	0.027	0.029
C12	0.013	0.017	0.021	0	0	0
C21	0.023	0.032	0.034	0.011	0.017	0.025
C22	0.023	0.032	0.034	0.013	0.021	0.029

**Table 11: The matrix of fuzzy general relations between criteria**

C	C <sub>11</sub>			C <sub>12</sub>		
	L	M	U	L	M	U
C11	0.027	0.094	0.302	0.037	0.099	0.309
C12	0.026	0.076	0.253	0.009	0.046	0.216
C21	0.048	0.123	0.333	0.028	0.087	0.303
C22	0.044	0.111	0.308	0.027	0.082	0.284

**Table 12: Importance and effectiveness of dimensions**

Dimensions	$\bar{D}$	$\bar{R}$	$\bar{D} + \bar{R}$	$\bar{D} - \bar{R}$	Result
Intra-organizational green accounting values	6.048	6.734	12.78	-0.686	Effect
Extra-organizational green accounting values	6.437	6.734	13.17	-0.297	Effect

**Table 13: Importance and effectiveness of criteria**

Categories	Major Components	$\bar{D}$	$\bar{R}$	$\bar{D} + \bar{R}$	$\bar{D} - \bar{R}$	Result
Intra-organizational green accounting values	Information Advantage	0.499	0.468	0.967	0.0311	Cause
	The cost advantage	0.356	0.405	0.761	-0.048	Effect
Intra-organizational green accounting values	Competitive Advantage	0.45	0.366	0.815	0.0841	Cause
	Ecological Advantage	0.402	0.446	0.848	-0.044	Effect

In the next step, the sum of the rows and columns of the matrix  $\tilde{T}$  is obtained according to Equations (8) and (9):

$$\bar{D} = (\bar{D}_i)_{n \times 1} = [\sum_{j=1}^n \tilde{T}_{ij}]_{n \times 1} \quad (8)$$

$$\bar{R} = (\bar{R}_i)_{1 \times n} = [\sum_{i=1}^n \tilde{T}_{ij}]_{1 \times n} \quad (9)$$

where  $\bar{D}$  and  $\bar{R}$  are an  $n \times 1$  matrix and a  $1 \times n$  matrix, respectively.

In the next step, the significance level of the indices,  $\bar{D}_i + \bar{R}_i$ , and the relationship between the criteria,  $\bar{D}_i - \bar{R}_i$ , is determined. If  $\bar{D}_i - \bar{R}_i > 0$ , the relevant criterion is effective, and if  $\bar{D}_i - \bar{R}_i < 0$ , it is impressionable. Table 12 shows  $\bar{D}_i + \bar{R}_i$  and  $\bar{D}_i - \bar{R}_i$ . In the next step, the fuzzy numbers  $\bar{D}_i + \bar{R}_i$  and  $\bar{D}_i - \bar{R}_i$  obtained in the previous step are defuzzified according to Equation (10):

$$B = \frac{(a_1 + (a_2 * 4) + a_3)}{6} \quad (10)$$

B is a defuzzified version of  $\tilde{A} = (a_1, a_2, a_3)$ . Tables 12 and 13 show the defuzzified numbers of effectiveness ( $\bar{D}$ ), impressionability ( $\bar{R}$ ), importance ( $\bar{D} + \bar{R}$ ), and net effectiveness and impressionability ( $\bar{D} - \bar{R}$ ) values for dimensions and criteria, respectively.

In column ( $\bar{D} - \bar{R}$ ), the positive elements indicate the causal relationship, and the negative elements indicate the effect relationship of each element. Here, based on the results, it was found that both categories, intra- and extra-organizational green accounting values, are the result of the functional processes of green accounting. That is, green accounting and its associated processes have created a range of values. Furthermore, Table 13 shows the value of ( $\bar{D} - \bar{R}$ ) for the sub-factors.

Based on the results, it turned out that the information advantage in green accounting is considered one of the intra-organizational values that create cost advantages in intra-organizational green accounting values. Furthermore, it appeared that competitive advantage in extra-organizational values is considered a cause for environmental ecological development. That is to say, companies can develop ecological advantages based on competitive approaches they adopt in green accounting. Now, the analytic network process (ANP) should be employed to determine the most effective major component. This section determines the degree of effectiveness and

impressionability of major components based on GRM. Thus, the GRM is initially normalized to obtain a fuzzy weighted supermatrix (Table 14). It is worth noting that the unweighted matrix is the same as GRM.

Following normalization, the weighted supermatrix is converged using the equation  $\lim_{K \rightarrow \infty} (W^\alpha)^K$  to form the limit supermatrix. In this study, the supermatrix converged and a limit matrix was formed (Table 15).

Finally, after the limit supermatrix is obtained, the weight of the specific categories and components is determined, presented in Table 16.

**Table 14: Fuzzy Weighted Supermatrix**

C	C <sub>11</sub>			C <sub>12</sub>		
	L	M	U	L	M	U
C11	0.0162	0.0264	0.0303	0.0224	0.0277	0.031
C12	0.0249	0.0317	0.0327	0.009	0.0191	0.0279
C21	0.045	0.0398	0.0345	0.0261	0.0282	0.0314
C22	0.05	0.0411	0.0346	0.0309	0.0304	0.0319

**Table 15: Limit Weighted Supermatrix**

C	C11	C12	C21	C22
C11	0.0385	0.0298	0.0313	0.0375
C12	0.0385	0.0298	0.0313	0.0375
C21	0.0385	0.0298	0.0313	0.0375
C22	0.0385	0.0298	0.0313	0.0375

**Table 16: Weight and rank of categories and components**

Category Weight & Rank		Major Components	Code	Category Relative Weight & Rank		Category Final Weight & Rank	
Intra-organizational green accounting values	0.141	Information Advantage	C11	0.221	12	0.0298	4
		The cost advantage	C12	0.286	1	0.0385	1
Extra-organizational green accounting values	0.147	Competitive Advantage	C21	0.232	10	0.0313	3
		Ecological Advantage	C22	0.278	3	0.0375	2

According to Table 16, the most important Consequences of green accounting throughout the capital market is extra-organizational values because it weighs 0.147, above intra-organizational green accounting values. It was also found out that the cost advantage obtained the highest effectiveness among other major components based on the final weight of major components, i.e., 0.038. Since the cost advantage is the most significant factor in value creation in green accounting, a matrix analysis is performed on its conceptual codes to gain a better understanding.

**Findings of Polar Matrix Analysis**

The "polarization polarity matrix" method is considered as one of the evaluation-based analyzes in the research on operations with very significant flexibility and attention to the characteristics of the analyzed subject (Sharma et al., 2018). According to Trueck and Rachev (2009), flexibility in this analysis is considered as its strength compared to other methods of analysis. In this method, the criteria of the research subject, The value of green accounting, must be determined first to rank the matrix according to its diameter. According to this method, categories, major components, and conceptual codes were initially

identified through grounded theory analysis as well as by coding analyses in the qualitative section. At this stage, conceptual codes associated with the cost advantage should first be defined using acronyms. CA – abbreviated form for The cost advantage – is used according to conceptual codes. Accordingly, eight conceptual codes associated with the cost advantage include estimating and calculating environmental operating costs (CA1), reducing resource and waste recycling costs (CA2), reducing the final production cost (CA3), reducing environmental waste cost (CA4), reducing overhead and other relevant costs such as warehousing (CA5), reducing legal costs of

environmental pollution (CA6), and activity-based costing dynamics (CA7). Pairwise and symmetric comparison between them is explained based on polar matrix analysis to determine symmetric relations between research components based on “+ ve” (positive) or “-ve” (negative). For this comparison, pairwise comparison is conducted between the *i*-th pair of the component and all elements from (*i* + 1)-th to *n*-th. The answer Yes (Y) or No (N) is given to any relationship. If the answer is yes, the reason is stated. Otherwise, if the answer is no, they must express their opinion on the pair of components considered by the participants.

**Table 17: Pairwise comparison between components based on matrix form**

Pairwise Comparisons	i leads to j (i-j)	j leads to i (j-i)	Mutual relation between i and j (i = j)	No valid relation between i and j (0)	Symmetric relations between components	
CA1 . CA2	1-2	2-1	1=2	0	+ve	-ve
CA2 . CA3	2-3	3-2	2=3	0	+ve	-ve
CA1 . CA3	Is the relation between CA1 and CA3 transferable?			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
	1-3	3-1	3=1	0	+ve	-ve
CA3 . CA4	3-4	4-3	3=4	0	+ve	-ve
CA2 . CA4	Is the relation between CA2 and CA4 transferable?			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
	2-4	4-2	2=4	0	+ve	-ve
CA1 . CA4	Is the relation between CA1 and CA4 transferable?			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
	1-4	4-1	1=4	0	+ve	-ve
CA4 . CA5	4-5	5-4	4=5	0	+ve	-ve
CA3 . CA5	Is the relation between CA3 and CA5 transferable?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		
	3-5	5-3	3=5	0	+ve	-ve
CA2 . CA5	Is the relation between CA2 and CA5 transferable?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		
	2-5	5-2	2=5	0	+ve	-ve
CA1 . CA5	Is the relation between CA1 and CA5 transferable?			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
	1-5	5-1	1=5	0	+ve	-ve
CA5 . CA6	5-6	6-5	5=6	0	+ve	-ve
CA4 . CA6	Is the relation between CA4 and CA6 transferable?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		
	4-6	6-4	4=6	0	+ve	-ve
CA3 . CA6	Is the relation between CA3 and CA6 transferable?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		
	3-6	6-3	3=6	0	+ve	-ve
CA2 . CA6	Is the relation between CA2 and CA6 transferable?			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
	2-6	6-2	2=6	0	+ve	-ve
CA1 . CA6	Is the relation between CA1 and CA6 transferable?			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
	1-6	6-1	1=6	0	+ve	-ve
CA6 . CA7	6-7	7-6	6=7	0	+ve	-ve
CA5 . CA7	Is the relation between CA5 and CA7 transferable?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		
	5-7	7-5	5=7	0	+ve	-ve

Pairwise Comparisons	i leads to j (i-j)	j leads to i (j-i)	Mutual relation between i and j (i = j)	No valid relation between i and j (0)	Symmetric relations between components	
CA4. CA7	Is the relation between CA4 and CA7 transferable?			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
	4-7	7-4	4=7	0	+ve	-ve
CA3. CA7	Is the relation between CA3 and CA7 transferable?			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
	3-7	7-3	3=7	0	+ve	-ve
CA2. CA7	Is the relation between CA2 and CA7 transferable?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		
	2-7	7-2	2=7	0	+ve	-ve
CA1. CA7	Is the relation between CA1 and CA7 transferable?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		
	1-7	7-1	1=7	0	+ve	-ve
CA7. CA8	7-8	8-7	7=8	0	+ve	-ve
CA6. CA8	Is the relation between CA6 and CA8 transferable?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		
	6-8	8-6	6=8	0	+ve	-ve
CA5. CA8	Is the relation between CA5 and CA8 transferable?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		
	5-8	8-5	5=8	0	+ve	-ve
CA4. CA8	Is the relation between CA4 and CA8 transferable?			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
	4-8	8-4	4=8	0	+ve	-ve
CA3. CA8	Is the relation between CA3 and CA8 transferable?			Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		
	3-8	8-3	3=8	0	+ve	-ve
CA2. CA8	Is the relation between CA2 and CA8 transferable?			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
	2-8	8-2	2=8	0	+ve	-ve
CA1. CA8	Is the relation between CA1 and CA8 transferable?			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
	8-1	1-8	1=8	0	+ve	-ve
<b>Describing analytical situations</b>						
Definitions	Direct relation +ve					
	Direct relation -ve					
	Directly transferable relation +ve					
	Directly transferable relation -ve					
	No relation					

According to the table above, driving and dependence power of each component in the polar matrix must be

determined so that the relations can be expanded in the form of a MICMAC analysis.

**Table 18: Determining driving and dependence power**

Components	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	Driving Power
CA1	1	1	0	0	0	0	0	0	2
CA2	1	1	0	0	0	0	0	0	2
CA3	1*	1	1	0	1	0	1*	1	6
CA4	1*	1*	1	1	1	0	1*	1*	7
CA5	1*	1*	0	0	1	0	1	0	4
CA6	1*	1*	1	0	1	1	1	1	7
CA7	1*	1*	0	0	0	0	1	0	3
CA8	1*	1*	1	0	1	0	1	1	6
Dependence Power	8	8	4	1	5	1	6	4	---

\* A transferable relation between components

The nodes and links of each conceptual code associated with the cost advantage are analyzed in the form of a MICMAC diagram based on driving/dependence power. In other words, the following analytical table is utilized to analyze the

nodes associated with conceptual codes of the cost advantage. This table interprets the nodes and links associated with conceptual codes above along with the symmetric combination of relations.

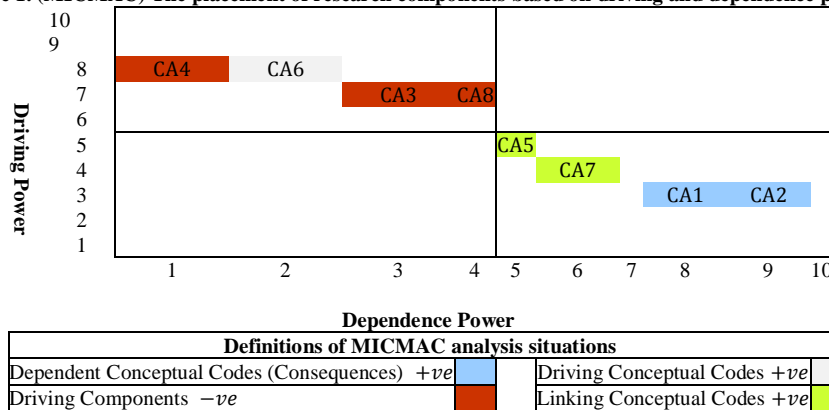
**Table 19: Analysis of nodes and links associated with the relation between conceptual codes**

Components	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8
CA1	-	+1	0	0	0	0	0	0
CA2	+1	-	0	0	0	0	0	0
CA3	0	0	-	0	-1	0	0	+1
CA4	0	0	+1	-	-1	0	0	+1
CA5	0	0	0	0	-	0	+1	.
CA6	0	+1	-1	0	+1	-	0	-1
CA7	+1	+1	0	0	0	0	-	0
CA8	0	0	+1	0	-1	0	0	-

As shown, there is a positive correlation between CA1 (i.e., estimating and calculating environmental costs) and CA2 (i.e., reducing resource and waste recycling costs). There is also an indirect link between CA7 (i.e., reducing the legal costs of environmental pollution) and CA1 (i.e., estimating and calculating the environmental operating costs). Furthermore, there is a positive correlation between CA7 (i.e., reducing legal costs of environmental pollution) and CA2 (i.e., reducing resource and waste recycling costs). The other relations between conceptual codes are provided in Table 19 and Figure 1 as follows. In this research, conceptual codes associated with the cost advantage

are analyzed based on a MICMAC analysis diagram. It consists of a horizontal axis including dependence power and a vertical axis including driving power. The degree of the dependence or driving of conceptual codes associated with the cost advantage value is determined by whether they are included in the MICMAC diagram as compared to the reachability matrix. Thus, the criteria are classified into three categories: driving criteria (high driving power - low dependence power), association criteria (average driving power - average dependence power), and dependent criteria (low driving power - high dependence power), as shown in Figure 1.

**Figure 1. (MICMAC) The placement of research components based on driving and dependence power**



The results showed that none of the conceptual codes associated with the cost advantage has fallen into the fourth quarter, i.e., the “autonomy” category. That is, none of these conceptual codes exist in terms of low driving and dependence power. Based on

positive/negative driver/dependence power in the reachability matrix table, based on which the above diagram is drawn. Accordingly, CA6 (i.e., social cost reduction) has more positive driver power (4 positive drivers) compared to negative driver power (2 negative

drivers); thus, it is considered as a positive driver criterion. This means that reduced social costs play a role as the most important factor and the component of the cost advantage of green accounting values. However, CA3 (i.e., reducing the final production cost), CA4 (i.e., reducing environmental waste cost), and CA8 (i.e., activity-based costing dynamics) have more negative driver power (4 negative drivers for each) as compared to positive driver power (CA3 (i.e., reducing total production cost), CA4 (i.e., reducing environmental waste cost), and CA8 (i.e., activity-based costing dynamics), respectively, regarded as negative drivers. In other words, reducing total production costs, reducing environmental waste cost, and activity-based costing dynamics are among the important factors in the cost advantage of green accounting values. Nevertheless, they affect the cost advantage as neutral drivers influenced by CA6 (i.e., social cost reduction). Association criteria, on the other hand, have more positive driver power, regarded as positive association criteria. CA1 (i.e., estimating and calculating environmental operating costs) and CA2 (i.e., reducing resource and waste recycling costs) have more positive dependence power (each with 4 positive drivers) compared to negative dependence power (each with 3 negative drivers), regarded as positive results. In other words, two conceptual codes can be estimated and the calculated environmental operating costs and reduced resource and waste recycling costs are taken into account as concepts affiliated to other conceptual codes associated with the cost advantage, determined as the least effective conceptual codes in this research. According to the diagram above, it can be deduced that CA6 (i.e., social cost reduction) is the only positive driver and three other driving conceptual codes, namely CA3 (i.e., reduction of total production cost), CA4 (i.e., reduction of environmental waste cost), and CA8 (i.e., activity-based costing dynamics) have a negative orientation. This result suggests that CA6 (i.e., social cost reduction), with positive driver and high driving power, is considered as one of the important factors contributing to the creation of the cost advantage of intra-organizational green accounting values. Notwithstanding, CA3 (i.e., reduction of total production cost), CA4 (i.e., reduction of environmental waste cost), and CA8 (i.e., dynamic activity-based costing) have high driving power but are considered as negative drivers. That is, these three conceptual codes

strengthen cost advantages in the long run, though they do not have a positive driver and require other factors such as social cost reduction. Nevertheless, CA6 (i.e., social cost reduction) is both highly effective and considered a driving factor with respect to other conceptual codes. It directly affects CA5 (i.e., reducing overhead and other relevant costs such as warehousing) and CA2 (i.e., reducing resource and waste recycling costs). As it turned out, there are seven negative and three positive pathways for conceptual codes associated with the cost advantage. The only positive driver is CA6 (i.e., social cost reduction) which has a positive effect on the enhanced cost advantages of intra-organizational green accounting values through CA3 (i.e., reduction of total production cost), CA4 (i.e., reducing environmental waste cost), and CA8 (i.e., activity-based costing dynamics). The only positive driver, CA6 (i.e., social cost reduction) should be increased because it is regarded as the most important factor in improving the level of cost advantages. Negative drivers should also be controlled to facilitate increased the cost advantage according to formulated policies and strategies, as well as the completion of reduced social costs. The following table summarizes the results showing the path of communication between conceptual codes associated with the cost advantage:

According to the results, CA6 (i.e., social cost reduction) is a positive driver in increasing cost advantages of green accounting values. Environmental accounting practices have a positive effect on stakeholders through CA3 (i.e., reducing total production cost), CA8 (i.e., activity-based costing dynamics), and CA5 (i.e., reducing overhead and other relevant costs such as warehousing). Furthermore, CA3 (i.e., reduction of total production cost), CA8 (i.e., activity-based costing dynamics), and CA5 (i.e., reducing overhead and other relevant costs such as warehousing) play a significant role in increasing cost advantages. Nonetheless, they are not considered to be strengthened, negative effectiveness drivers. Companies can surround these three conceptual codes through social contexts.

Table 20: The path of communication between the components

Major Components	Waste Cost Reduction	Prime Cost Reduction	Costing Dynamics	Social Cost Reduction
Proprietary Codes	CA4	CA3	CA8	CA6
Polar Symmetry Path	Prime Cost Reduction CA3 Costing Dynamics CA8 Overhead Cost Reduction CA5	Costing Dynamics CA8 Overhead Cost Reduction CA5	Prime Cost Reduction CA3 Overhead Cost Reduction CA5	Prime Cost Reduction CA3 Costing Dynamics CA8 Overhead Cost Reduction CA5
Positive/Negative Symmetries	-ve, -ve, -ve	-ve, -ve, -ve	-ve, -ve, -ve	+ve, +ve, +ve

## Conclusion

Based on the research process, in the first phase, four major components including information advantage, the cost advantage, competitive advantage, and ecological advantage were identified after conceptual coding by grounded theory analysis in the form of two categories, i.e., intra-organizational/extra-organizational green accounting values. They then entered the second phase of analysis, namely the fuzzy DEMATEL analysis, in the form of a theoretical framework. In line with the second research question, the purpose of this analysis was to determine the most important major component among the four advantages mentioned above. According to the results, cost advantage is the most important Consequences of intra-organizational/extra-organizational green accounting values. In answer to the first question of the research should be stated, The green accounting deals with accounting and management issues relating to environmental and social impacts, regulations and restrictions, safety, environmentally sound, and economically viable energy production and supply. The foremost role of green accounting is to tackle the social environmental problems and may have impact on attaining sustainable development and environment in any country and influences the company's behavior in confronting social and environmental responsibility issues. In summary, it is known that businesses are formed to deliver services or produce products in order to earn a profit. With the growing green consumer awareness, companies are more than ever expected to align its business strategies with environmental initiatives. Environmentally conscious companies have already discovered that they can generate business strategies to help them reduce their carbon footprint, minimize their environmental impact, make the best use of natural resources, become more energy efficient, reduce costs, and exhibit social responsibility

all at the same time. Then, the research entered the third step of the analysis to determine the most effective conceptual code of the cost advantage through polar matrix analysis and MICMAC diagram. According to the results, reduced social costs are regarded as the most important green accounting value. Based on statistical analyses, it was found out that reduced social costs are the most important driver to help enhance cost advantages of intra-organizational green accounting values. Properly contrived, it can facilitate the promotion of cost advantages of green accounting. In other words, disclosing financial reports to stakeholders in a transparent, timely, and reliable manner can help shape their positive perceptions and society's perceptions of corporate social responsibility toward the environment. Thus, trust in functional practices of corporate green accounting increases; as a consequence, the company can increase its net profits based on advantages gained from reduced stakeholder social pressure. Hence, it is inferred that corporate social practices with regard to environmental activities play a significant role in reducing corporate costs. In this manner, it creates effective channels of communication with the company and at the same time helps to form two-way interactions to formulate corporate future policies and strategies in environmental areas. On the other hand, it transpired that the cost strategies used to reduce total production cost through green accounting processes, activity-based costing dynamics to identify potential future environmental costs and reduce overhead costs based on green accounting processes can strengthen cost advantages based on social contextualization. In other words, these three conceptual codes do not play a negative driver role in other conceptual codes, although the necessary planning can be conducted to strengthen them by strengthening the environmental performance policies. The results of this study are consistent with those of the following studies.

**Table 21: The results of this study and their comparison with those of other studies**

Categories	Major Components	Taleb Nia et al. (2012)	Alamshah (2014)	Chang (2013)	Tu & Huang (2015)	Solovida & Latan (2017)	Herbohn (2005)	Lynch (2010)	Ebimobowei (2011)
		Intra-organizational green accounting values	Information Advantage	✓	✓	✓	-	×	-
	The cost advantage	×	✓	✓	-	✓	✓	-	-
Extra-organizational green accounting values	Competitive Advantage	-	-	✓	✓	×	-	×	-
	Ecological Advantage	-	-	-	✓	✓	✓	-	-

As can be seen, ✓ indicates that the major component has been verified in this study, while × indicates that it is criticized based on the approaches of the category in question. For example, Solovida & Latan (2017) criticized the competitive advantage of green accounting values simply as extra-organizational values and considered a competitive advantage as a macro-value at both intra- and extra-organizational levels. Nevertheless, Chang (2013) and Tu & Huang (2015) interpreted the existence of a competitive advantage as an external driver to strengthen other green accounting values. The other major components were also compared with those of the research in question, which can be adapted according to theoretical explanations provided in the Qualitative Analysis section.

Based on the results obtained and the fuzzy DEMATEL analysis, it is recommended to strengthen green accounting information systems based on a system flow from inputs to outputs to strengthen intra-organizational green accounting values on the one hand. Accordingly, the company's environmental decision-making power can be identified and strengthened, and green accounting periodic evaluations can be performed by creating integrated and consistent databases. The implications of creating such information systems can facilitate the promotion of cost advantages and effective formation. On the other side, competitive advantages must be created throughout the capital market in terms of environmental accounting, such as detecting opportunities and controlling threats to strengthen the extra-organizational green accounting values. They can best serve the community and their surroundings by gaining ecological advantages through optimizing the EVA of natural resource utilization. Competitive

planning in green accounting can help enhance ecological advantages. Furthermore, based on matrix analysis results, reduced social costs were the most driving conceptual code to improve cost advantages as the most important Consequences of green accounting values. Accordingly, companies are encouraged to attempt to expand stakeholder social trust levels by developing interactive activities with stakeholders to disclose realistic environmental practices, thereby laying the groundwork for other advantages of green accounting costs. They can be more successful by promoting the level of cost advantages since it has a direct impact on the economic profitability of companies.

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