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Capacity Building of Green Accounting Consequences Based on the Explanation of Strategic Management Accounting Techniques

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Abstract

Strategic management accounting, including systems and processes in the modern era, is characterized by changes in the competitive environment that, Can be achieved through the participation of companies in the management accounting system, Assist financial managers to make decisions in the value chain and develop green accounting functions. Unfortunately, though, over time, strategic management accounting techniques are still unknown to corporate executives, especially in environmental processes, leading to a decline in corporate participation in strategic decision making. The Purpose of this research is Capacity Building Green Accounting Consequences Based on Explanation of Strategic Management Accounting Techniques by analysis of CARD and developed the theory of Rough (ERST). The methodology of this research is developmental, applied and hybrid and two groups of target

population participated in this research. In the first part of 15 experts in the field of accounting at the university level an In the second part, 35 executives participated matrix Tehran Stock Exchange through a questionnaire that both the target population, sampling was homogenous. In this research, in the qualitative part, the components and indices related to the research variables were selected based on content analysis and cross-analysis and then based on Delphi analysis and hierarchical analysis in order to achieve theoretical adequacy. Then, in the quantitative section, through the analysis of the Rough Complex analysis, the decision tree determined the most effective green accounting function/outcome and strategic management accounting technique, and finally, the product life cycle costing technique is the most effective strategic management accounting technique for enhancing green accounting functions. In fact, the results showed that product cycle costing technique is a factor for enhancing the cost savings of recycling and waste recycling costs and increasing the competitiveness of the company as a component of green accounting competitive Consequences.

Keywords: Strategic Management Accounting Techniques, Consequences of Green Accounting, Analysis CARD, Developed Theory of Rough

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Introduction

The application of management accounting practices has led to an increased focus on accountability, productivity, effectiveness, and improved corporate governance in various aspects such as financial policies, corporate strategies such as integration, diversification, etc., and environmental practices (Tanc & Gokoglan, 2015). Indeed, adopting strategic approaches in management accounting can play a role in expanding the company's infrastructure in a competitive market, leading to the formation of more responsible corporate practices in a competitive environment (Ebrahimi Kahrizsangi & Bekhradinasab 2019).

However, management accounting strategies can specifically enhance the corporate environmental functional processes by creating a systemic cycle. They can also help streamline the process with other enterprise management systems integrated into a competitive environment (Ioppolo et al., 2019). Verily, through accounting information systems as a component of the management information system, these processes can play a crucial role in facilitating environmental protection by "polluting" companies. In other words, green accounting in the form of strategic management accounting processes is associated with environmentally friendly accounting and auditing systems. It discloses environmental information and a vast array of practices for identifying, tracking, analyzing, and reporting materials and cost information related to the environmental aspects of an organization in the form of reporting (Poser et al., 2012). Nevertheless, the following question is always posed: why is it so important to consider green accounting practices? Its importance may be understood by exploring the standards developed over the last few years. As a matter of fact, given the increasing significance of environmental pollutants and waste, many supervisory bodies have adopted several laws and regulations to reduce environmental pollutants (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. The committee sought to develop several strategic approaches and to some extent monitor the practices of market-driven companies. Pollution and waste levels were not high due to low competition. The FASB issued its No. 8/90, "Capitalization of Environmental Pollution Costs" in 1990. Shareholders believe that there is no hope that Green Accounting Consequences will be considered serious for environmental management in the industry as long as corporate executives and

decision-makers do not find out about corporate environmental costs and the overwhelming significance of activities to fight against environmental pollution.

Hence, ISO 14000 was established in 1995 to stimulate companies to comply with environmental policies, later known as green policies. Nonetheless, since 2015, following the formulation of the "Paris Agreement" in cooperation with 196 countries in 2015, supervision has largely focused on transparent environmental practices in the capital market sector. This was due to the fact that the major source of environmental pollutants was those companies that were operating across the capital market, which plays a significant role in the development of environmental practices, especially green accounting (Qian et al., 2016).

Evidence suggests that multinational companies are under pressure by supervisory bodies to disclose information about activities linked to strategic green accounting practices (Hahn et al., 2015). It is also worth noting that the international standard ISO 14000, in the form of a strategic management accounting system, defines the company's environmental performance to meet the requirements of this standard. The ultimate goal is for the company to manage to perform its processes, communications, and activities without harming the environment. Furthermore, the International Federation of Accountants (IFAC) defines green accounting as "managing economic and environmental performance through the development and creation of a suitable environment for management accounting systems and activities." To achieve sustainable development, the UN emphasizes that management accounting systems should help green accounting produce the information required for internal decisions (managers and shareholders) by facilitating the information flow process. Such information can be focused on operational and strategic processes (Moorthy & Yacob, 2013). Furthermore, according to the United States Environment Protection Agency, the key function of green accounting under strategic management accounting processes is to inform stakeholders of environmental costs.

The reason is that they can be encouraged to identify ways to reduce and avoid these costs, which in turn can lead to an improvement in the quality of the environment and the community in which they are active (Hamidepour & Habibi Moheb Seraj, 2015). The analysis of these standards leads to the inference that green accounting Consequences are seen as a process influenced by strategic management accounting techniques. They improve financial performance such as profitability while also reducing environmental pollution,

thereby creating a more responsible social cycle in a competitive market environment. It is worth noting that capacity building in green accounting practices can help enhance the level of competitiveness of companies, the ones that can bring greater value to the customer and the competitive advantage for the company. By creating a competitive advantage, companies are primarily seeking to improve competitiveness and achieve a high-performance market position, such as environmental performance, relying on available resources and capabilities (Bodnaruk et al., 2016; Lin & Lin, 2019: Rajiv et al., 2014). The role played by strategic management accounting techniques in this area can be crucial because they help develop green accounting practices. By integrating financial/operational characteristics with management decisions, strategic management accounting can help strengthen the competitive position of the company in terms of reducing its waste and recycling.

It seeks to reduce costs in this area while also utilizing its full capacity to manage waste, a competitive solution in the market environment (Masanet-Llodra, 2006). Therefore, given the theoretical approaches and standards proposed in this field, this study aims to investigate the effectiveness of strategic management accounting techniques in capacity building on green accounting practices in capital markets firms through the developed theory of rough and decision-tree analyses.

Literature Review

Strategic Management Accounting

In the past, the role of traditional management accountants was limited to providing helpful information for decision-making. However, recent studies indicate that contemporary management accountants are an integral part of the strategic decision-making process (Bostjan & Cadez, 2009). The goal of management accounting contribution reflected in the development of business strategies in strategic management accounting is to overcome competitors in the field of competition so that it can lead to the maintenance and development of the business process of companies. In other words, strategic management accounting establishes a link between all firm activities and business strategy, leading to an increase in firm competitiveness (Manurung & KosasihElsje, 2013).

A review of management accounting practices has led to the development of various innovative techniques in the areas of costing, strategic decision-making, strategic performance management and control, competitor and customer assessment. The new term “Strategic Management Accounting” has

been introduced as the level of unique management accounting techniques has been developed (Ebrahimi Kahrizsangi & Bekhradinasab, 2019). Generally, strategic management accounting is the process of identifying, collecting, selecting, and analyzing accounting data to assist the management team in strategic decision-making and organizational effectiveness assessment (Hoque, 2001). Strategic management accounting systems are a series of practices and techniques recently introduced to overcome the limitations of traditional management accounting techniques in coping with strategic issues (Korravee & Phapruke, 2010). Indeed, strategic management accounting plays a pivotal role in the creation and implementation of corporate business strategies.

This can be significant on the path of corporate achievements. Although the literature on strategic management accounting has so far grown, there is still a limited consensus on the precise meaning of strategic management accounting (Ebrahimi Kahrizsangi & Bekhradinasab, 2019). Much of the literature is composed of conceptual papers, with a few being empirical research papers addressing strategic management accounting (Cadez & Guilding, 2007; Affes & Ayadi, 2014).

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, according 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, according 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 several 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).

Strategic Applications of Green Accounting

Environmental Accounting is a series of activities that enhance the ability of the accounting system to 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:

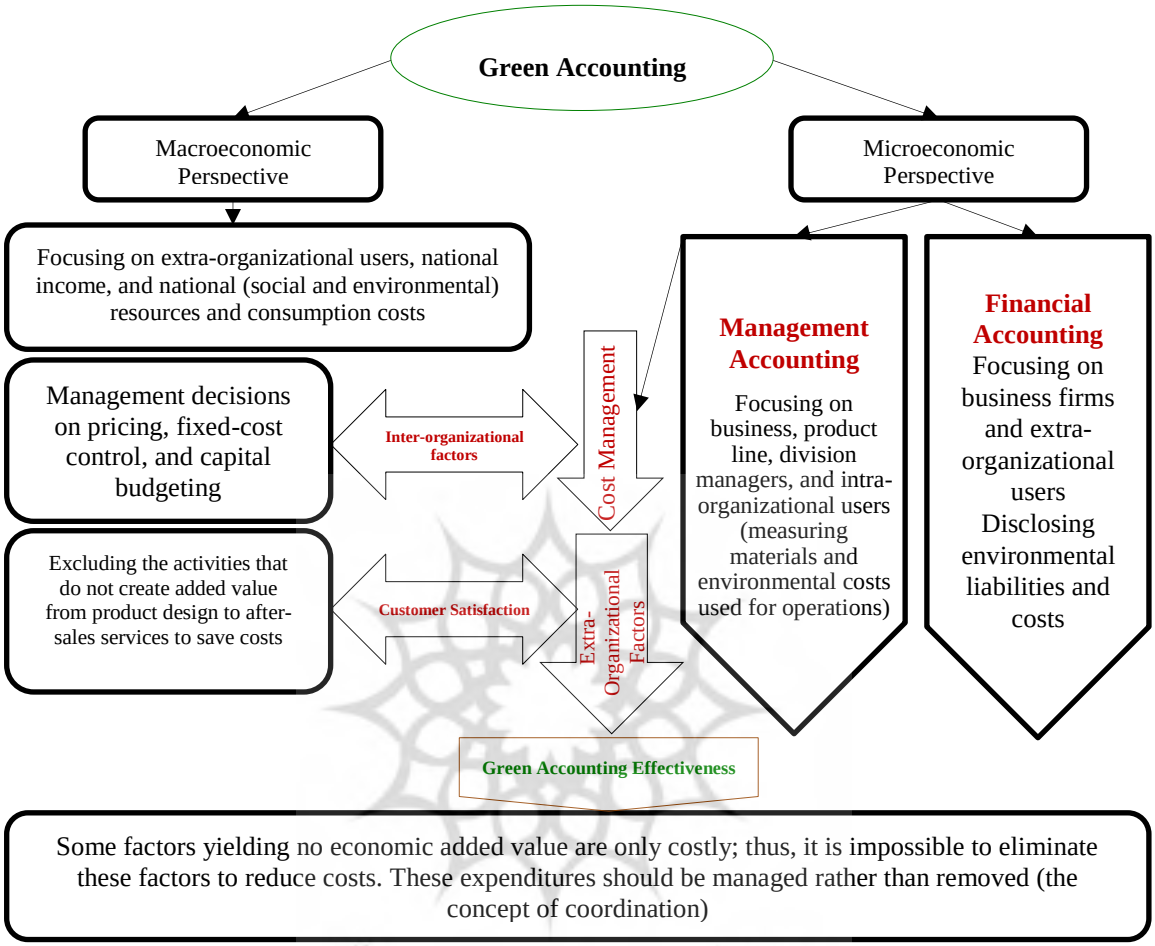

Figure 1. Strategic Applications of Green Accounting

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 Accountingors investigate and evaluate the issue from the standpoint of users of financial reporting to decide on and present general obligations (Solovida & 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 (Solovida & Latan, 2017). Simply put, this approach seeks to address larger economic aspects such as GDP by Accountingors, which could lead to reduced production costs, increased national income, and economic growth through the strategic effectiveness of the green Accounting.

Research Background

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 Consequences, existing research offers conflicting views on their implications (these Consequences), 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 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) 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 research titled The Firm Management Structure, Environmental Auditing and Financial Reporting Quality. In this research, 175 companies listed in Tehran Stock Exchange from 1999 through 2015 were investigated. To test the hypotheses, statistical analyzes using panel data were used using Eviews software and linear regression model. Research findings show that firm management structure has an impact on the relationship between environmental auditing and financial reporting quality.

Procedures of the Rough Set Theory

The Rough sets introduced by Pawlak (1982) for the first time, is a valuable mathematical instrument in uncertainty conditions (Pawlak, 1982). After the Rough Set Theory, Zhai et al. (2002) proposed the Rough numbers. A Rough number includes usually "Lower Limit", "Upper limit" and " Rough boundary interval" which depends only on the original data. So there is no need for supplementary data and this can get a better understanding of the experts' intended concepts and improve the decision making objectivity (Pawlak, 1982).

Suppose that "U" is a reference set including all members, "Y" is an arbitrary member of U and R sets belonging to "t class". R={G1, G2,…, Gt} which covers all members of U. If these classes are in order as G1< G2<...<Gt, then $\forall\, Y \in U. G_q \in R. 1 \leq q \leq t$.

The Lower Approximation (Apr (Gq)), the Upper Approximation (¯Apr(G_q)) and the Boundary Area (Bnd (Gq))3 belonging to class Gq are defined as follows:

$$\underline{\mathrm{Apr}}\left(G_q\right) = \cup\{Y \in U \middle| R(Y) \leq G_q\} \tag{1}$$

$$\overline{\mathrm{Apr}}\left(G_q\right) = \cup\{Y \in U \middle| R(Y) \geq G_q\} \tag{2}$$

$$\mathrm{Bnd}\left(G_q\right) = \cup\{Y \in U \middle| R(Y) \neq G_q\} \tag{3}$$

$$= \{Y \in U \middle| R(Y) > G_q\} \cup \{Y \in U \middle| R(Y) < G_q\}$$

Then Gq can be presented using a Rough number RN (Gq)4 in its corresponding lower and upper limits: (Equations 4-6).

$$\underline{\mathrm{Lim}}\left(G_q\right) = \frac{1}{M_L} \sum R(y) | Y \in \underline{\mathrm{Apr}}\left(G_q\right) \tag{4}$$

$$\overline{\mathrm{Lim}}\left(G_q\right) = \frac{1}{M_U} \sum R(y) | Y \in \overline{\mathrm{Apr}}(G_q) \tag{5}$$

$$RN(G_q) = \left[\underline{Lim}(G_q).\overline{Lim}(G_q)\right] \quad (6)$$

Where MU and ML are respectively the values of members $\underline{Apr}\,(G_q)$, $\overline{Apr}(G_q)$

It is clear that the lower and upper limits determined respectively the mean value of the elements related to upper and lower approximations and their difference are defined as "Rough Boundary Interval".

$$IRBnd(G_q) = \overline{Lim}(G_q) - \overline{Lim}(G_q) \quad (7)$$

The Rough Boundary Interval expresses the ambiguity of "Gq", so that its larger value means more ambiguity, while the smaller value has more accuracy. So the subjective data can be expressed by the Rough numbers (Ima et al., 2008: 34).

Gray Hierarchy Analysis Process

The gray hierarchy analysis process is one of the most famous and commonly used multiple decisions making which is able to measure the level of preferences' consistency and consider the tangible and intangible criteria. The gray relational analysis method is used to select the best choice based on the numbers of criteria. This method, like the Topsis technique and the Vikor technique, starts with a decision matrix but here in addition to the distinction between the positive and negative criteria, it also distinguishes between the most desirable values. In this research, because the experts' judgements were subjective and ambiguous, the gray hierarchy analysis process was used. In the following, the gray hierarchy analysis process is presented.

Step 1. Determine the goals, criteria and choices of the research and form the hierarchy structure.

Step 2. Prepare the pairwise comparison questionnaire and collect the experts' opinions.

Step 3. Using the concept of Rough theory to change the experts' preferences to interval numbers and form the interval pairwise comparison matrix like the Equation below:

$$M = \begin{bmatrix} [1.1] & [x_{12}^{L}.x_{12}^{U}] & \dots & [x_{1m}^{L}x_{1m}^{U}] \\ [x_{21}^{L}x_{21}^{U}] & [1.1] & \dots & [x_{2m}^{L}x_{2m}^{U}] \\ & & \vdots & \\ [x_{m1}^{L}x_{2m}^{U}] & [\dots & \dots & [1.1] \end{bmatrix} \quad (8)$$

Where, x_{ij}^{L}, Lower limit; x_{ij}^{U}, Upper limit. (p.11)

Before computing interval numbers, the inconsistency rate of the pairwise comparison questionnaires should be measured and if this rate is acceptable (below 0.1), we can compute the interval numbers.

Step 4. Calculate the weight of each of the research's criteria using the Equations (9) and (10)

$$w_i = \left[\sqrt[m]{\prod_{j=1}^{m} x_{ij}^{L}} \cdot \sqrt[m]{\prod_{j=1}^{m} x_{ij}^{U}}\right] \quad (9)$$

$$w_i' = w_i / \max(w_i^{u}) \quad (10)$$

Where we have: W1' is a normalized form. Finally, the weight of the research criteria is obtained (Zhu et al., 2015: 413).

Gray Vikor method:

Step 1: In the Vikor method, the decision matrix is formed. Since in this research we have used the Gray Vikor method, the Vikor questionnaire completed by the experts must be first changed into the interval numbers using the Rough theory concept, and then performs calculations using the Gray Vikor method. In the following the Gray Vikor method is presented:

Step 1: form the interval decision matrix obtained from the Rough theory,

$$D = \begin{bmatrix} [f_{11}^{L} f_{11}^{U}] & [f_{12}^{L} f_{12}^{U}] & \dots & [f_{1m}^{L} f_{1m}^{U}] \\ [f_{21}^{L} f_{21}^{U}] & [f_{22}^{L} f_{22}^{L}] & \dots & [f_{2m}^{L} f_{2m}^{U}] \\ [f_{n1}^{L} f_{n2}^{U}] & [f_{n2}^{L} f_{n2}^{U}] & \dots & [f_{nm}^{L} f_{nm}^{U}] \end{bmatrix} \quad (11)$$

Step 2: determine the best (the most desirable) value fj* and the worst value fj- in each criterion of matrix D

For positive criterion (with the profit nature), the largest number shows the best value and the smallest value shows the worst value:

$$f_j^{*} = \mathrm{Max}_i f_{ij}^{U} . f_{ij}^{-} = \mathrm{Min}_i f_{ij}^{L} \quad (12)$$

It is vice versa for the negative criterion (with the expense nature):

$$f_j^{*} = \mathrm{Min}_i f_{ij}^{U} . f_{ij}^{-} = \mathrm{Max}_i f_{ij}^{L} \quad (13)$$

In general, the best and worst values are obtained as follows:

$$f_j^{*} = \{(\mathrm{Max}_i f_{ij}^{U} | j \in B) \mathrm{or} (\mathrm{Min}_i f_{ij}^{L} | j \in C)\} \quad (14)$$

$$f_j^{-} = \{(\mathrm{Min}_i f_{ij}^{L} | j \in B) \mathrm{or} (\mathrm{Max}_i f_{ij}^{U} | j \in C)\} \quad (15)$$

B is a set of positive criteria and C is a set of negative criteria.

Step 3: Calculate values of $\left[S_i^L S_i^U\right]$ و $\left[R_i^L R_i^U\right]$

$$S_i^L = \sum_{j\in B} W_j^L \left(\frac{f_j^* - f_{ij}^U}{f_j^* - f_j^-}\right) + \sum_{j\in B} W_j^L \left(\frac{f_{ij}^L - f_j^*}{f_j^- - f_j^*}\right) \tag{16}$$

$$S_i^U = \sum_{j\in B} W_j^U \left(\frac{f_j^* - f_{ij}^L}{f_j^* - f_j^-}\right) + \sum_{j\in B} W_j^U \left(\frac{f_{ij}^U - f_j^*}{f_j^- - f_j^*}\right) \tag{17}$$

$$R_i^L = \max_j \begin{cases} W_j^L \frac{f_j^* - f_{ij}^U}{f_j^* - f_j^-} \Big| j \in B \\ W_j^L \frac{f_{ij}^L - f_j^*}{f_j^- - f_j^*} \Big| j \in C \end{cases} \tag{18}$$

$$R_i^U = max_j \begin{cases} W_j^U \frac{f_j^* - f_{ij}^L}{f_j^* - f_j^-} \Big| j \in B \\ W_j^U \frac{f_{ij}^U - f_j^*}{f_j^- - f_j^*} \Big| j \in C \end{cases} \tag{19}$$

Where WjL is lower limit and WjU is the upper limit of each criterion's weight.

Step 4: Calculate values of $\left[Q_i^L Q_i^U\right]$

$$Q_i^L = \nu\left(\frac{S_i^L - S^*}{S^- - S^*}\right) + (1-\nu)\left(\frac{R_i^L - R^*}{R^- - R^*}\right) \tag{20}$$

$$Q_i^U = \nu\left(\frac{S_i^U - S^*}{S^- - S^*}\right) + (1-\nu)\left(\frac{R_i^U - R^*}{R^- - R^*}\right) \tag{21}$$

$S^* = \mathrm{Min}_i S_i^L$ ،$S^- = \mathrm{Max} S_i^U$ ، $R^* = \mathrm{Min}_i R_i^L$ ، $R^* = \mathrm{Max}_i R_i^U$

Q is a cumulative index. in addition, ν indicates the weight of the maximum criterion policy and is shown a

Shown as $\nu \in [0.1]$: usually $\nu = \frac{0}{5}$

Step 5: Ranking choices according to S, R and Q.

Since the Gray Vikor method suggests the interval weights for the choices of the research, the weight of the choices, similar to Vikor method, cannot be easily ranked according to Q index. In order to rank the interval weights, several ways are described below.

$$A = [a_1 . a_2]; B[b_1 . b_2] \tag{22}$$

$$C = [c_1 . c_2] = A - B = [a_1 - b_2 . a_2 - b_1] \tag{23}$$

$$\text{IF}\frac{|c_1|}{c_2-c_1} < \frac{|c_2|}{c_2-c_1} \rightarrow \text{Then A} > \text{B} \quad (24)$$

$$\text{IF}\frac{|c_1|}{c_2-c_1} < \frac{|c_2|}{c_2-c_1} \rightarrow \text{Then A} \leq \text{B} \quad (25)$$

Research Questions

1. What are the green accounting Consequences for companies?

2. What are the Strategic Management Accounting Techniques?

3. What are the most important strategic management accountings techniques for capacity building of corporate green accounting Consequences based on the decision-tree analysis and developed theory of rough?

Methodology

From a methodological point of view, research is divided into three sections: outcome, purpose, and data type. Accordingly, this is developmental research in terms of outcome. This is because this study seeks to develop strategic management accounting techniques to enhance the effects of green accounting through the Developed Theory of Rough (ERST) analysis. This has been less addressed before. This study seeks to provide greater theoretical coherence on this topic. It is also intended as a descriptive-applied study in terms of purpose and a qualitative-quantitative or so-called two-phase in terms of the data type. According to the qualitative research method, the criteria of the research variables were first identified by referring to the text of various researches through meta-synthesis. Then, the developed theory of Rough set analysis was performed and the decision tree was plotted.

Furthermore, it should be stated that the research approach used in this study is inductive-deductive in terms of data collection logic. Thus, in the first step, strategic management accounting techniques were identified by examining the research theoretical foundations. In the second step, the components of green accounting Consequences of companies operating in the capital market were developed in the form of a checklist. Based on the deductive approach, it was attempted to examine the views of the managers of firms active in the capital market on the most effective strategic management accounting technique for capacity building on green accounting Consequences of firms active in the capital market.

Statistical Population and Sampling Method

The statistical population is comprised of two parts, i.e., qualitative and

quantitative. In the qualitative section, the target population is comprised of research on the subject matter and 15 accounting and financial management specialists across the university. They are involved in the analysis and recognition of content propositions based on a meta-analysis, critical assessment, and Delphi analysis. The "homogeneous qualitative sampling" method has been used by panel members to select these individuals. In this sampling technique, the researcher selects his/her samples to gain in-depth, centralized, and detailed knowledge from among those who have experienced this phenomenon and can provide him/her with a wealth of information (Sadeghi Fassaei and Naseri Rad, 2012).

However, in the quantitative section, the target population is comprised of 35 Capital market managers. This statistical population is acceptable due to the requirements of comprehensive Rough analysis because they participate in the study to explain the results of the qualitative section in the companies listed on the Tehran Stock Exchange (TSE). The comprehensive interpretive-structuralist approach is an analysis based on the analysis of complex systems at specific levels. It should be done by participants founded on specific criteria such as experience or specialized knowledge. Here, the cross-matrix questionnaires participated by 15-30 individuals are used to avoid a multitude of ambiguous responses. Researchers such as Singh & Kant (2011), Malone (2014), Ramesh et al. (2008), and Attri et al. (2013) have predicted the optimal sample size selected within the range of 15-25 individuals. They have used a convenience sampling method by considering filters that suit the nature of the study.

Determination of Management Accounting Techniques and Development of Green Accounting Consequences

To determine the criteria and decision-making components, create the decision tree model, and determine the optimal point for adopting the best strategic management accounting techniques to enhance green accounting Consequences, the research data must first be extracted from theoretical foundations using an adapted rational approach.

One useful approach in this regard is the meta-synthesis method, a method based on content analysis of similar research. In this method, keywords and metrics related to the research variable were initially determined through note-taking from each source. Its validity was fitted using the Delphi method, due to the presence of the elite, based on the CVR indicator. Then, its reliability was determined using Delphi analysis and hierarchical analysis to determine the desirability of each component. Thereafter, strategic

management accounting techniques (x) and capacity building criteria of green accounting Consequences (y) are identified in Tables 1 and 2.

A) Identification of Strategic Management Accounting Techniques (x)

Over the past few years, numerous books and papers have repeatedly referred to the word “accountant” in management accounting. According to Kaplan & Johnson (1987), management accounting did not undergo any change until the early 20th century and neglected its major objective, i.e., the preparation of financial and non-financial reports for managers' decisions. However, in some industries, some of the most complex management accounting techniques has been introduced, perhaps in response to these criticisms. According to Johnson and Kaplan, even though 1825-1925 marked the beginning of a flourishing period for management accounting, novel techniques and methods had not emerged during this period. The Financial and Management Accounting Committee (FMAC), a subsidiary of IFAC, issued the revised International Management Accounting Practice Statement in 1998, which defines all the concepts of management accounting. The issuance of this statement led to the application of "generalized" accounting management to all management process activities in all business organizations, rendering it an integral part of the management process to provide the necessary information for planning, evaluation, control, and decision-making. Hence, accounting management is the process of identifying, measuring, collecting (both financial and non-financial) and analyzing information to give a hand to the organization's management in performing the tasks of evaluation, planning, and control of the organization.

Table 1. Determination of strategic management accounting techniques based on content analysis

Accounting Techniques	References
Quality Costing	Berg (2015)
Product Lifecycle Costing	Juras (2014); Cadez & Guilding (2008)
Value Chain Costing	Collins & Ajibolade (2017); Cadez & Guilding (2008)
Target Costing	Samuel (2018); Kee & Matherly (2013)
Benchmarking	Sayyadi Souma et al (2018)
Product Attribute costing	Cadez & Guilding (2008); Lachmann et al (2013)
Integrated Performance Measurement	Cinquini & Tenucci (2010); Vatanparast et al (2018)
Strategic Pricing	Cadez & Guilding (2008); Vatanparast et al. (2018)
Competitor Cost Assessment	Kee & Matherly (2013); Cadez & Guilding (2008); Sayyadi Soumar et al. (2018)
Brand Evaluation	Martin et al (2015); Vatanparast et al (2018)

The following table summarizes the definitions of identified strategic management accounting techniques:

Table 2. Definitions of identified strategic management accounting techniques

Management Accounting Techniques	Description
Benchmarking of working methods	This technique focuses on finding the best performance, including a continuous comparative (adaptive) process applicable to all areas of an organization's operations, including strategic development, operations, and customer service (Brownlie, 1999).
Integrated Performance Measurement	This technique includes both financial and non-financial scales, encompassing all aspects of the organization. When combined, these scales provide the basis for translating strategy into a coherent set of scales (Chenhall, 2005).
Quality Costing	Quality costing consists of the costs of providing the desired quality as well as those due to the lack of quality (Aksoylu & Aykan, 2013).
Strategic Pricing	According to Simmonds (1982), the data used to make pricing decisions must be supplemented with those about competitors' potential reactions to proposed changes in pricing policy.
Target Costing	Target costing is a systematic approach to achieving product cost goals based on market-oriented factors. In this method, the product selling price is initially determined, followed by the target price. Target costs emphasize reducing costs in the R&D, design, and production stages of a product (Namazi et al., 2019).
Product Lifecycle Costing	The product lifecycle costs include all the costs of creating, designing, developing, manufacturing, using, maintaining, and disposing of a product. The initial cost of purchasing a product may sometimes be lower than that of other products, though its lifecycle costs may be higher than those of other products (Chenhall, 2005).
Competitor Cost Assessment	This technique is used regularly and daily to estimate the cost of each competing unit (Kee & Matherly, 2013).
Product Attribute costing	Product-specific attribute costing is requested by customers. This costing may include the following features: Enhanced decorations, reliable supply chain, warranty arrangements, and after-sales service (Cadez & Guilding, 2008).
Value Chain Costing	It is an activity-based costing model including all the activities in the value chain (R&D, design, manufacturing, marketing, distribution, and customer service) (Vatanparast et al., 2018).

B) Identification of the Criteria for Capacity Building of Green Accounting Consequences (y)

Meta-synthesis is used to identify the criteria for capacity building of green accounting Consequences. To perform meta-synthesis, databases and research authorities were initially used. To this end, relying on the meta-synthesis process and Delphi, this section of the research seeks to analyze the components and indicators associated with the strategic Consequences of green accounting. Accordingly, similar research on the subject of the present study is

extracted by referring to the following databases and research authorities.

Table 1. Databases and Official Research Authorities

English Databases	Persian Databases
Sciencedirect	MAGIRXN
Emeraldinsight	NOORSOFR
online library	SID
Aaajournals	All of Iranian Research Systems

Several authentic and reliable studies have been identified in the 2015-2020 and 2014-2019 ranges based on the protocol and the meta-synthesis assessment process. Put differently, research related to the research purpose was identified to obtain similar papers and studies by referring to the above databases and research authorities.

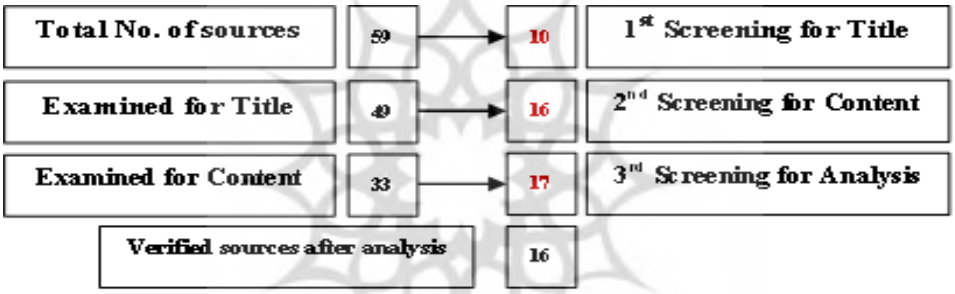

Figure 1. Screening analysis process of research tailored to the research purpose to identify the components and propositions

Regarding the screening of the research studies for title, content, and analysis, it was found that 16 research studies can be utilized as the foundation for evaluation to determine the components and propositional themes of the Green Accounting Consequences. In the next step, the themes are categorized and separated using Stirling's (2001) approach (Stirling's approximation or formula) in the form of components and propositional themes of the Green Accounting Consequences. To arrive at a more coherent understanding of the nature of the research, this method first fits 16 verified studies through 10 criteria used by the critical assessment method including research objectives, research methodology rationale, research design, sampling, data collection, reflexibility, the accuracy of the analysis, the theoretical and transparent expression of the findings, and the significance of the study, assisted by 15 research experts.

Table 2. Evaluation process of verified studies to determine the components and propositional themes of the research

No.	International Research													Iranian Research		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Critical Assessment Criteria / Research	Maama & Appiah (2019)	Adams and Larrinaga (2019)	Herold et al (2019)	Mata et al (2018)	Kumar & Dixit (2018)	Welbeck (2017)	Feger & Mermet (2017)	Solovida and Latan (2017)	Qian et al (2016)	Borghei et al (2016)	Roberts & Wallace (2015)	Menikpura et al (2014)	Bhutta et al (2011)	Dehghani Soltani et al (2019)	Akbari & Poorzamani (2018)	Valiyan et al (2018)
Research Objective	2	2	2	3	3	3	3	3	4	2	3	2	2	3	4	4
Methodology Rationale	2	3	3	4	3	4	4	4	3	2	3	2	3	4	4	4
Research Design	2	3	3	4	4	3	4	3	3	3	3	3	3	4	4	3
Sampling Method	3	2	2	3	4	4	4	4	4	2	3	2	3	4	4	4
Data Collection Method	3	2	3	4	3	4	5	4	3	2	4	2	2	4	3	4
Generalization of Findings	2	2	2	3	4	4	4	3	4	2	3	2	3	4	4	3
Ethical	2	2	3	4	4	3	5	4	4	3	4	2	2	4	3	4
Statistical Analysis Method	2	2	3	3	5	4	5	4	3	2	3	3	2	4	3	4
Theoretical Capability	2	2	3	4	3	4	4	4	4	2	3	2	2	4	5	4
Significance of the Study	3	3	2	4	4	4	4	4	4	2	4	3	3	4	4	4
Total	**23**	**24**	**26**	**36**	**37**	**37**	**39**	**37**	**36**	**24**	**33**	**23**	**25**	**39**	**38**	**38**

According to the results of this analysis, six of the studies did not obtain the required score and were therefore excluded from the study. These included Maama & Appiah (2019), Adams and Larrinaga (2019); Harold et al (2019), Borghei et al (2016), Menikpura et al (2014), and Bhutta et al (2011). Afterward, the research topics are extracted using the method presented by

Sterling (2001). As a result, the following scoring method is used to determine the indicators of the strategic Consequences of green accounting across the capital market. According to this method, all sub-criteria extracted from the text of verified papers are written in the columns of the table. Then, the names of the researchers of the verified studies are written in each row of the table. A checkmark (☑) is inserted in the column of the table for the sub-criteria used by each researcher. Thereafter, the obtained scores are summed by each ☑ in the sub-criteria column. Finally, scores above the average of the research conducted are selected as the research components.

Table 5. Analysis of the main components of the strategic Consequences of green accounting across the capital market

Researcher	Competitive Consequences	Control Consequences	Social Consequences	Value Consequences	Cultural Consequences	Legal Consequences
Mata et al (2018)	☑	-	☑	-	-	☑
Kumar & Dixit (2018)	☑	-	-	☑	-	-
Welbeck (2017)	☑	☑	-	☑	☑	☑
Feger & Mermet (2017)	-	-	☑	-	-	☑
Solovida and Latan (2017)	☑	-	☑	☑	-	☑
Qian et al (2016)	-	-	☑	☑	☑	☑
Roberts & Wallace (2015)	☑	☑	-	☑	-	☑
Dehghani Soltani et al (2019)	☑	-	-	☑	-	☑
Akbari & Poorzamani (2018)	-	☑	☑	-	☑	-
Valiyan et al (2018)	☑	☑	-	☑	-	-
Total						

The results of this analysis indicated that the three components, namely competitive Consequences, value Consequences and legal Consequences had the highest frequency, among a total of 10 verified studies. Consequently, they are explored in this study as the main criteria for determining the indicators of the strategic Consequences of green accounting. This section analyzes the theoretical foundations of verified research, followed by the determination of indicators according to Table 6.

Table 6. Components and indicators of strategic Consequences of green accounting

Principal Component	Indicator	7	6	5	4	3	2	1
Competitive green accounting Consequences	Received tax benefits and incentives							
	Reduced resource and waste recycling costs							
	Gaining a greater market share							
	Enhanced level of social responsibility culture							
	Increased corporate competitive lifecycle							
Value Consequences of Green Accounting	Social Responsibility							
	Adherence to pluralistic values (value pluralism)							
	Lack of information symmetry and reduced agency costs							
	Information feedback given to shareholders							
Legal Consequences of Green Accounting	Enhanced sustainable development accounting standards							
	Enhanced social accounting and auditing standards							
	Corporate standards aligned with social norms							
	Compliance with environmental regulations							
	Increased standard level in waste control							

Findings

As previously mentioned, first, strategic management accounting techniques were identified by examining the theoretical foundations of the research. Then, the components of green accounting Consequences of companies operating across the capital market were developed in the form of a scoring checklist. Now, using a deductive approach, this section will seek to investigate the opinions of experts on the most effective strategic management accounting technique for capacity building of green accounting Consequences in companies operating in the capital market. Nevertheless, before performing this analysis, the optimal theoretical adequacy of the identified components must be determined by Delphi analysis to verify the reliability of the research.

Delphi Analysis

In this section, to determine the research components in the model, first, the identified research components were distributed among 17 selected elites through a homogeneous sampling method as a scoring checklist according to Table 7. This is aimed at determining whether or not their opinions on the identified features of accounting techniques and the criteria for competition

among companies will obtain the required score. To perform this analysis, the identified indicators of both criteria, namely Strategic Management Accounting Technique and Green Accounting Consequences, must be analyzed with the participation of 15-panel members to achieve theoretical adequacy.

Table 7. Delphi Analysis

Criteria	Indicators	Importance Coefficient of Indicators				
		First-Round Average	First-Round Kappa Statistic	Second-Round Average	Second-Round Kappa Statistic	Verified / Rejected
Strategic Management Accounting Techniques	Quality Costing	5	0.70	5.20	0.80	Verified
	Product Lifecycle Costing	5.30	0.85	6	0.90	Verified
	Value Chain Costing	5.10	0.75	5.50	0.88	Verified
	Target Costing	5.10	0.75	5.30	0.85	Verified
	Benchmarking	4	0.40	Rejected		
	Product Attribute costing	3	0.28	Rejected		
	Integrated Performance Measurement	5	0.70	5.15	0.78	Verified
	Strategic Pricing	4	0.40	Rejected		
	Competitor Cost Assessment	2.50	0.20	Rejected		
	Brand Evaluation	3	0.25	Rejected		
Competitive green accounting Consequences	Received tax benefits and incentives	5.10	0.75	5.30	0.85	Verified
	Reduced resource and waste recycling costs	5	0.70	5.30	0.85	Verified
	Gaining a greater market share	4	0.40	Rejected		
	Enhanced level of social responsibility culture	4.50	0.45	Rejected		
	Increased corporate competitive lifecycle	5.50	0.88	6	0.90	Verified
Value Consequences of Green Accounting	Social Responsibility	5.10	0.75	5.50	0.88	Verified
	Adherence to pluralistic values	3	0.25	Rejected		

	(value pluralism)					
	Lack of information symmetry and reduced agency costs	5.20	0.80	5.50	0.88	Verified
	Information feedback given to shareholders	5.10	0.75	5.50	0.88	Verified
Legal Consequences of Green Accounting	Sustainable Development Accounting Standards	5	0.70	5.20	0.80	Verified
	Enhanced social accounting and auditing standards	3	0.25	Rejected		
	Corporate standards aligned with social norms	2	0.15	Rejected		
	Compliance with environmental regulations	5.20	0.80	6	0.90	Verified
	Increased standard level in waste control	4.50	0.45	Rejected		

After determining both the mean and the contingency coefficient during the two steps in this section, five techniques were eliminated from the indicators of strategic management accounting techniques, namely modeling, product attribute costing, strategic pricing, competitor cost assessment, and brand valuation, for obtaining an average below 5 and contingency coefficient below 0.5. Moreover, out of the 14 indicators of Green Accounting Outcome, five indicators were eliminated, namely gaining a greater market share, enhanced social responsibility culture, adherence to pluralistic values (value pluralism), enhanced social accounting/auditing standards, and standards aligning with social norms.

Extended Rough Set-Based Analysis and Decision Tree

A series of process analyses have been employed in the extended rough set-based analysis. The first analysis used in this section is the hierarchical analysis. In this analysis, the criteria for both variables, namely strategic management accounting techniques and green accounting Consequences will be identified. Then, the weight of the research criteria is calculated using the gray hierarchical analysis process. Therefore, expert opinions were collected

following the formation of the pairwise comparison matrix of the problem. Afterwards, the inconsistency of each pairwise comparison matrix was determined. If the inconsistency of the pairwise comparison questionnaires is at a standard level (< 0.1), the next step may be initiated; otherwise, the pairwise comparison questionnaires will be returned to the experts for review. Table 8 displays the results obtained from the gray hierarchical analysis process calculations.

Table 8. Results of the gray hierarchical analysis process

Components	Items	Code	Weight of items		Final weight	
			Upper limit	Lower limit	Upper limit	Lower limit
Strategic Consequences of Green Accounting	Received tax benefits and incentives	(Y1)	0.303	0.347	0.205	0.347
	Reduced resource and waste recycling costs	(Y2)	0.315	0.377	0.240	0.377
	Increased corporate competitive lifecycle	(Y3)	0.219	0.256	0.197	0.256
	Social Responsibility	(Y4)	0.188	0.204	0.163	0.204
	Lack of information symmetry and reduced agency costs	(Y5)	0.526	0.593	0.510	0.593
	Information feedback given to shareholders	(Y6)	0.422	0.490	0.401	0.490
	Sustainable Development Accounting Standards	(Y7)	0.319	0.412	0.302	0.412
	Compliance with environmental regulations	(Y8)	0.678	0.725	0.623	0.725
Management Accounting Techniques	Quality Costing	(X1)	0.327	0.392	0.311	0.392
	Product Lifecycle Costing	(X2)	0.425	0.516	0.396	0.516
	Value Chain Costing	(X3)	0.664	0.719	0.593	0.719
	Target Costing	(X4)	0.490	0.548	0.432	0.548
	Integrated Performance Measurement	(X5)	0.511	0.631	0.438	0.631

As shown, the highest indicator weight in the “Green Accounting Consequences” component equals to 0.725, which corresponds to the high level of compliance with environmental regulations. Additionally, the lowest indicator weight corresponds to controlling stakeholder pressures to meet the demands. Following the data preparation steps and reducing their dispersion, the extended rough set theory model is examined and analyzed. Testing Accuracy and Testing Coverage are performed as shown below.

Table 9. Cross-validation test results to evaluate management accounting criteria

Management Accounting Techniques	X	Best Rule Pruning	Testing Accuracy	Validation Test	Model Aggregation
Quality Costing	(X1)	Pruning (restricting) rules with values less than 1	0.617	0.55	1.016
Product Lifecycle Costing	(X2)	Pruning (restricting) rules with values less than 1	0.953	0.91	1.712*
Value Chain Costing	(X3)	Pruning (restricting) rules with values less than 1	0.883	0.81	1.604**
Target Costing	(X4)	Pruning (restricting) rules with values less than 1	0.711	0.63	1.105
Integrated Performance Measurement	(X5)	Pruning (restricting) rules with values less than 1	0.553	0.48	1.002

According to the results of the model aggregation in Table 9, the sum of Testing Accuracy and Testing Coverage referred to as the model aggregation (STAC), is 1.712 for the product lifecycle costing technique. This suggests that cross-validation has the greatest impact on the capacity building of green accounting, among the five strategic management accounting techniques followed by value chain costing. This method avoids the potential problem of similarity between options (known as over-fitting), as one of its advantages. Now, the decision tree, which refers to data reduced by decision tree analysis, is investigated to select the most effective feature of capacity building of green accounting Consequences, determined according to the command codes provided in Table 8. Accordingly, based on verified strategic management accounting techniques, the opinion of each panel member on the characteristics of green accounting Consequences should be determined, according to Table 10. As previously explained, 15 experts participated in this study; however, only part of these results are presented due to the limited number of pages allowed:

Table 10. Experts' opinions on competition-level characteristics based on management accounting

Y8	Y7	Y6	Y5	Y4	Y3	Y2	Y1		Y8	Y7	Y6	Y5	Y4	Y3	Y2	Y1	
No. Person 2									No. Person 1								
3	4	3	6	5	4	3	3		3	3	2	4	5	6	4	3	(X1)
4	4	4	3	5	6	5	4		6	5	3	4	5	4	7	2	(X2)
3	4	3	2	5	5	4	3		3	5	4	7	3	3	4	2	(X3)
4	2	6	4	4	4	4	5		4	3	3	5	5	3	4	2	(X4)
5	4	4	3	3	3	3	4		4	3	4	4	6	3	7	5	(X5)

Experts' opinions on the status of each strategic management accounting techniques (i.e., quality costing, product lifecycle costing, value chain costing, and target costing) were distributed and analyzed. Then, a decision-making matrix was formed to analyze the problem, namely to identify the greatest capacity-building green accounting indicator of companies operating across the market, for each of green accounting Consequences (Y1-Y8). First, the analyses performed on the opinions of these 15 experts in this study should be transformed into distance numbers (intervals) to form a problem decision table. According to Equation (10) and Table 11, the summing results are determined from the scores presented in Figure 1.

Table 11. Significance of each competition-level criterion

Strategic Consequences of Green Accounting	Y	Degree of importance	Degree of explanation
Received tax benefits and incentives	(Y1)	0.165	3.12
Reduced resource and waste recycling costs	(Y2)	0.322	7.11
Increased corporate competitive lifecycle	(Y3)	0.292	6.62
Social Responsibility	(Y4)	0.272	6.09
Lack of information symmetry and reduced agency costs	(Y5)	0.216	5.20
Information feedback given to shareholders	(Y6)	0.188	3.75
Sustainable Development Accounting Standards	(Y7)	0.095	1.61
Compliance with environmental regulations	(Y8)	0.110	2.18

It is worth noting that the most effective green accounting outcome under strategic management accounting techniques based on the decision tree is “reduced resources and waste recycling costs,” followed by an “increased competitive lifecycle.” Importantly, the strategic management accounting techniques exert an impact on the competitive green accounting Consequences in companies operating across the capital market.

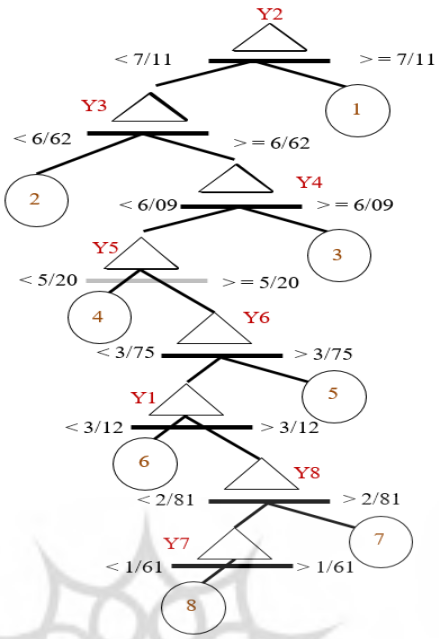

Figure 1. Feature selection using decision tree analysis

In other words, according to Figure 1, the most important capacity building due to strategic management accounting techniques in green accounting Consequences is related to "reduced resources and waste recycling costs," followed by "increased competitive lifecycle," selected as indicators of the component "competitive green accounting outcome." In the remainder, an extended rough set analysis is used to determine the most important strategic management accounting technique for capacity building of green accounting Consequences. In this analysis, five-part cross-validation was used, leading to the formation of decision-making rules for the extended rough set analysis model. The power of each rule is used as the threshold of pure decision-making rules. A law-based model has been developed following the pruning process. Then, the accuracy and coverage of the extended rough set analysis model were calculated. According to this model, the number of decision-making rules in the pruning process is reduced, taking into account accuracy and coverage. The sum of accuracy and coverage is used as a criterion for pruning rules (Pie et al, 2010). The amount of model aggregation is equal to the sum of testing accuracy and testing coverage. According to Table 9 in this study, the "product lifecycle costing technique" was selected as the best way to prune the number of rules, based on testing coverage and the amount of model aggregation. Put differently, this technique ranked highest both in terms of testing accuracy and

testing coverage. The amount of model aggregation obtained the highest value in comparison with the four strategic management accounting techniques in identifying the greatest capacity-building Consequences of green accounting. Now, the contingency percentage is determined based on the extended rough set derivation analysis developed according to Table 12.

Table 12. X2-derived decision rules in the extended rough set model

Decision-Making Rules	Contingency Percentage
The significance level of Y2 (reduced costs of resource and waste recycling) is 0.322%. Accordingly, it is the first-greatest capacity-building factor in green accounting.	0.82
The significance level of Y3 (increased corporate competitive lifecycle) is 0.292%. Accordingly, it is the second-greatest capacity-building factor in green accounting.	0.79
The significance level of Y4 (social responsibility) is 0.272%. Accordingly, it is the third-greatest capacity-building factor in green accounting.	0.63
The significance level of Y5 (information asymmetry and reduced agency cost) is 0.216%. Accordingly, it is the fourth-greatest capacity-building factor in green accounting.	0.61
The significance level of Y6 (information feedback given to shareholders) is 0.188%. Accordingly, it is the fifth-greatest capacity-building factor in green accounting.	0.49
The significance level of Y1 (received tax benefits and incentives) is 0.165%. Accordingly, it is the sixth-greatest capacity-building factor in green accounting.	0.41
The significance level of Y8 (compliance with environmental regulations) is 0.110%. Accordingly, it is the seventh-greatest capacity-building factor in green accounting.	0.32
The significance level of Y7 (enhanced sustainable development accounting standards) is 0.095%. Accordingly, it is the eighth-greatest capacity-building factor in green accounting.	0.18

Note: X2 (Product Lifecycle Costing Technique), as the most important strategic management accounting technique for capacity building of green accounting Consequences, has obtained the highest value among other strategic management accounting techniques. Hence, other decision-making rules are derived from the value of X2. Then, the upper and lower bounds in the hierarchical analysis process are determined by the distance between the effectiveness of the competitive criteria. Thus, the created function, including the integration of upper and lower bounds, is derived. For this purpose, the following rule is used, which directly gives the formula for calculating the derivative of the integral. The derivative of the integral $\int_{n(x)}^{m(x)} h(t)dt$ is equal to: $\left(\int_{n(x)}^{m(x)} h(t)dt\right)' = m'(x).h(m(x)) - n'(x).h(n(x))$

The derivative of a function, including an integral and a univariate function such as $h(t)$ and bounds in terms of x such as $m(x)$ (upper bound) and $n(x)$ (lower bound), is calculated as follows. It is equal to the derivative of the upper bound, multiplied by the function inside the integral, whose variable is replaced by the upper bound, minus the derivative of the lower bound, multiplied by the function inside the integral, whose variable is replaced by the lower bound.

According to Table 10, given a higher contingency percentage, participants believe that the product lifecycle costing technique should be used to determine the greatest capacity-building green accounting outcome based on strategic management accounting techniques. Accordingly, two Consequences, i.e., “reduced resources and weight recycling costs” and “increased corporate competitive lifecycle,” will be greatly enhanced under this technique as components of competitive green accounting Consequences.

Conclusion

The purpose of this research is to measure the capacity building of green accounting Consequences based on the explanation of strategic management accounting techniques. By analyzing similar research in response to the first research question, this research initially tried to determine the strategic management accounting techniques, as well as green accounting Consequences in companies, function in the capital market. Then to answer the third research question, which attempted to identify the most important strategic management accounting technique for capacity building of corporate green accounting Consequences.

This research tried, to identify the most effective green accounting Consequences and strategic management accounting technique developed by rough set theory analysis and decision tree. Thus, it managed to identify the technique with the highest capability in capacity building of green accounting Consequences. The first section identified the rough set analysis results, the most important green accounting Consequences are "reduced resource and waste recycling costs" and the "increased corporate competitive lifecycle" as components of competitive green accounting Consequences.

The corporate competitiveness in using green accounting is promoted by using effective management accounting techniques, leading to a reduction in waste and recycling costs, as well as an increase in the corporate competitive lifecycle across the market. This indicates that companies can make the product recycling process more dynamic through the infrastructure that controls the manufacturing of their products. Thus, waste will be reused in the production process through enhanced production mechanisms, resulting in less damage to the environment. Environmental performance processes are regarded as a crucial competitive characteristic in today's competitive market environment. Thanks to these mechanisms, companies can postpone the saturation stage of their lifecycle, prolong the growth-to-maturity process, and gradually plan reconstruction processes to re-enter new competition arena at the saturation

point by the establishment of feedback mechanisms. Moreover, according to the results of the extended rough set analysis, the "product lifecycle costing technique" as the most effective strategic management accounting technique, can lead to an increase in the capacity building of green accounting Consequences, with the highest impact. Applying this technique will reduce the product lifecycle cost while making the product more valuable. The product lifecycle costing technique is considered to be a knowledge-boosting process with higher competitive capabilities, a higher value for customers compared to other products given initial purchase costs, and at the same time lower prices. The product lifecycle costing technique can play a significant role in production processes for pollution reduction/waste control and their recovery in the production process and give the company more competitive building capacity in terms of environmental or green accounting Consequences. This is because it reduces production costs by creating more value for customers in the long-run across a competitive market by making production processes more knowledge-based from R&D to product sales.

This result is conceptually consistent with those of research conducted by Moorthy & Yacob (2013), Jones (2010), and Dorweiler & Yakhou (2004), confirming the results of this study. Based on the results obtained, it is recommended to eliminate the complexities and innumerable nested (intervening) layers to save production costs and connect the supply chain to the pre-production and post-production process, i.e., the development of technological infrastructure for raw material recycling, based on the development of its infrastructure. Therefore, companies operating across the competitive market can strengthen the level of the "product lifecycle costing technique" of their structures by making R&D processes to production processes more agile. Consequently, they can reduce their costs while increasing the effectiveness of their competition and ultimately expand their competitive lifecycle.

Moreover, given the market conditions and the identification of environmental characteristics, companies are recommended to adopt accounting management strategies to gain a competitive advantage over other competitors in the capacity building of green accounting Consequences, leading to more significant strategic success. Indeed Environmental Recognition Techniques can help to companies that provide more remarkable responses to climate and environmental change to develop environmental protection, given their industrial capabilities. As a result, they can enhance shareholders' interests in maximizing their wealth and corporate competitive values, leading to a greater market share.

References

Adams, C. and Larrinaga, C. (2019). Progress: engaging with organizations in pursuit of improved sustainability accounting and performance, Accounting, Auditing & Accountability Journal, 32(8): 2367-2394. https://doi.org/10.1108/AAAJ-03-2018-3399

Affes, H., Ayadi, F. (2014). Contextual factors impact on the use of new management accounting practices: An empirical analysis in the Tunisian context. Journal of Research in International Business and Management, 4(12): 45-55.

Akbari, A., Pourzamani, Z. (2018). The Firm Management Structure, Environmental Auditing and Financial Reporting Quality. Journal of Management Accounting and Auditing Knowledge, 7(26), 133-144.

Aksoylu, S., Aykan, E. (2013). Effects of Strategic Management Accounting Techniques on Perceived Performance of Businesses, Journal of US-China Public Administration, Vol. 10, No. 10, 1004-1017

Aksoylu, S., Aykan, E. (2013). Effects of Strategic Management Accounting Techniques on Perceived Performance of Businesses, Journal of US-China Public Administration, Vol. 10, No. 10, 1004-1017

Attri, r., Dev, n., & Sharma, v. (2013). Interpretive Structural Modelling (ISM) approach: An Overview. Research Journal of Management Sciences, 2(2), 6.

Berg, T. (2015). A compass for teaching enterprise governance. Accounting Education, 24(6), 559–563. http://dx.doi.org/10.1080/09639284.2015.1108776.

Bhutta, M. K. S., Omar, A. Yang, X. (2011). Electronic waste: a growing concern in today's environment. Economics Research International, 2011.

Bodnaruk, A., O'brien, W., Simonov, A. (2016). Captive finance and firm's competitiveness, Journal of Corporate Finance, 37(3): 210-228

Borghei, Z., Leung, P., & Guthrie, J. (2016). The nature of voluntary greenhouse gas disclosure—An explanation of the changing rationale: Australian evidence. Meditari Accountancy Research, 24, 111–133. https://doi.org/10.1108/MEDAR 02 2015 0008

Bostjan, A., Cadez, S. (2009). "Management Accountant's Participation in Strategic Management Processes: a Cross-industry Comparison", Journal for East European Management Studies, Vol. 14, No. 3, pp. 310 – 322

Boyd, J. (1998). The Benefits of Improved Environmental Accounting: An Economic Framework to Identify Priorities, Resources for the Future, Available at www.rff.org. [Online] [05 February 2014].

Brownlie, D. (1999). Benchmarking your marketing process, Long Range

Planning, 31(3): 88-95.

Cadez, S., Guilding, C. (2008). An exploratory investigation of an integrated contingency model of strategic management accounting, Accounting, Organizations and Society, 33(7/8): 836-63.

Chenhall, R. H. (2005). Integrative strategic performance measurement systems, strategic alignment of manufacturing, learning and strategic Consequences: an exploratory study, Accounting, Organizations and Society, 30(11): 395-422

Cinquini, L., Tenucci, A. (2010). Strategic management accounting and business strategy: a loose coupling? Journal of Accounting & Organizational, 6(2): 228–25.

Collins, S, O., Ajibolade, S, O. (2017). Strategic management accounting and decision making: A survey of the Nigerian Banks, Future Business Journal, 3(2): 119-137

Dehghani Soltani, M., Shoul, A., Ramezani, S. (2019). Investigating Environmental Value and Green Image Supposed Effects on the Word of Mouth Advertising Tendency by Explaining Green Trust and Willingness to Pay Roles through the SOR Model Framework. Journal of Business Management, 11(4): 804-824.

Dorweiler V. P., Yakhou, M. (2004). Environmental Ac-counting: An Essential Component of Business Strategy, Asian Institute of Technology Thailand Online, 13(2): 65-77.

Ebrahimi Kahrizsangi, K., Bekhradi Nasab, V. (2019). The Role of Corporate Governance in Strategic Management Accounting. Management Accounting, 12(41), 69-89.

Feger, C. and Mermet, L. (2017). A blueprint towards accounting for the management of ecosystems, Accounting, Auditing & Accountability Journal, 30(7): 1511-1536. https://doi.org/10.1108/AAAJ-12-2015-2360

Guesalaga, R., Gabrielsson, M., Rogers, B., Ryals, L., Cuevas, J, M. (2018). Which resources and capabilities underpin strategic key account management? Industrial Marketing Management, 75(2):160-172.

Hahn, R., Reimsbach, D., & Schiemann, F. (2015). Organizations, climate change, and transparency: Reviewing the literature on carbon disclosure. Organization and Environment, 28, 80–102. https://doi.org/10.1177/1086026615575542

Hamidehpoor, K., Habibimohebseraj, A. (2015). Green Accounting: Correct Measurement of Costs by Implementing Optimal Management Accounting System, Accountant Magazine, 31(11): 36-43.

Herold, D. M. (2019). Has carbon disclosure become more transparent in the global logistics industry? An investigation of corporate carbon disclosure strategies between 2010 and 2015. Logistics, 2(4): 13-39. https://doi.org/10.3390/logistics2030013

Hoque, Z. (2001). Strategic Management Accounting: Concepts, Processes and Issues, Spiro Press, London.

Ioppolo, G., Cucurachi, S., Salomone, R. et al. (2019). Integrating strategic environmental assessment and material flow accounting: a novel approach for moving towards sustainable urban futures, International Journal of Life Cycle Assess, 24(4): 1269–1284. https://doi.org/10.1007/s11367-018-1494-0

Jones, M. J. (2010). Accounting for the environment; towards a theoretical perspective for environment accounting and reporting, Accounting Forum, 34(3): 123-138.

Juras, A. (2014). Strategic management accounting – what is the current state of the concept? Economy Transdisciplinary Cognition, 17 (2): 76-83.

Kee, R., Matherly, M. (2013). Target Costing in the Presence of Product and Production Interdependencies, Advances in Management Accounting, 22(14): 135-158.

Korravee, Ch, A., Phapruke, U. (2010). Strategic management accounting and corporate performance of Thai-listed companies: a mediating effect of management. Process, International Journal of Strategic Management, 10(1): 1-29.

Kumar A., Dixit G. (2018). An analysis of barriers affecting the implementation of e-waste management practices in India: A novel ISM-DEMATEL approach. Sustainable Production and Consumption, https://doi.org/10.1016/j.spc.2018.01.002

Lachmann, M., Knauer, T., Trapp, R. (2013). Strategic management accounting practices in hospitals: Empirical evidence on their dissemination under competitive market environments, Journal of Accounting Organizational Change, 9(3): 336-369

Lachmann, M., Knauer, T., Trapp, R. (2013). Strategic management accounting practices in hospitals: Empirical evidence on their dissemination under competitive market environments, Journal of Accounting Organizational Change, 9(3): 336-369

Lin, H, Ch., Lin, P, Ch. (2019). The interplay between CEO-TMT exchange level and differentiation: Implications for firm competitive behaviors and performance, Journal of Business Research, 95(3):171-181

Maama, H., Appiah, K. (2019). Green accounting practices: lesson from an

emerging economy, Qualitative Research in Financial Markets, 11(4): 456-478. https://doi.org/10.1108/QRFM-02-2017-0013

Malone, D. W. (2014). An introduction to the application of interpretive structural modeling. Proceedings of the IEEE, 63(3), 397-404.

Manurung, E., KosasihElsje, T. (2013). The Implementation of SMEs Sector's Strategic Management Accounting to Win the Local Competition Relating to Facing Global Business Competition", IBEA, International Conference on Business, Economics, and Accounting, pp. 1-8.

Martin, R, W., Hiebl, M, R, W., Duller, C., Feldbauer-Durstmüller, B., Ulrich, P. (2015). Family influence and management accounting usage - findings from Germany and Austria Schmalenbach Business Review, 67(9): 368-404

Masanet-Llodra, M, J. (2006). Environmental Management Accounting: A Case Study Research on Innovative Strategy. Journal Business Ethics, 68(3): 393–408. https://doi.org/10.1007/s10551-006-9029-1

Mata, C., Fialho, A., Eugénio, T. (2018). A Decade of Environmental Accounting Reporting: What we know?, Journal of Cleaner Production, doi: 10.1016/j.jclepro.2018.07.087.

Menikpura, S, N, M., Santo, A. and Hotta, Y. (2014). Assessing the climate co-benefits from waste electrical and electronic equipment (WEEE) recycling in Japan. Journal of Cleaner Production, 74(2): 183-190.

Moorthy, K., Yacob, P. (2013). Green Accounting: Cost Measures: Open Journal of Accounting, 2(4/7): 111-138. http://dx.doi.org/ 10.4236/ ojacct.2013.21002.

Namazi, M., Hajiha, Z., Chenari, H. (2019). Conceptual Explanation of Target Costing Based on Critical Perspective. Management Accounting, 12(43), 129-152.

Nonahalnahr, A, A., Ghaemmaghami, K., Zamani, M. (2017). Accounting position in dealing with environmental and social crises, Accounting Journal, No. 303, July and August, 39-53.

Oboh, C, S., Ajibolade, S, O. (2017). Strategic management accounting and decision making: A survey of the Nigerian Banks, Future Business Journal, 3(2): 119-137

Pai, P, F., Hsu, M, .F., Wang, M, C. (2011). A support vector machine-based model for detecting top management fraud, Knowledge Based Systems, 24(2): 314–321. https://doi.org/10.1016/j.knosys.2010.10.003

Poser, C., Guenther, E. & Orlitzky, M. (2012). Shades of green: using computer-aided qualitative data analysis to explore different aspects of corporate environmental performance, Journal Management Control, 22(3): 413–450.

https://doi.org/10.1007/s00187-011-0147-2

Qian, W., Burritt, R., & Chen, J. (2016). The potential for environmental management accounting development in China. Journal of Accounting and Organizational Change, 11(1): 406–428. https://doi.org/10.1108/JAOC 11 2013 0092

Rajiv, D. B., and Raj, M., and Arindam. T. (2014). Does a Differentiation Strategy Lead to More Sustainable Financial Performance than a Cost Leadership Strategy? Management Decision, 52(5): 872 – 896

Ramesh, A., Banwet, D.K., Shankar, R. (2010). "Modeling the Barriers of Supply Chain Collaboration", Journal of Modelling in Management, 5(2): 176–193.

Roberts, R. W. Wallace, D, M. (2015). Sustaining Diversity in Social and Environmental Accounting Research, Critical Perspectives on Accounting, Vol. 32, pp. 78-87.

Rostami Mazouei, N., Rahnamay Roodposhti, F., Raeiszadeh, S., Poorzamani, Z. (2019). Examining and explaining the effects of technical and human actors on the functions of the management accounting information system using actor network theory. Management Accounting, 12(41): 91-110.

Sadeghi-Fasaei, S., Naseri-Rad, M. (2012). Fundamental Elements of Qualitative Research in Social Sciences (Ontology, Epistemology, Methodology and Methods). *Journal of Iranian Social Studies*, 5(2): 78-98.

Samuel, S. (2018). A conceptual framework for teaching management accounting, Journal of Accounting Education, https://doi.org/10.1016/j.jaccedu.2018.05.004

Sayadi Somar, A., sabzali poor, F., nazarbigi dehbalae, H., radmehr, R. (2018). Investigation Persistence Component Earning in Economic Foundations with Calculation Coefficient Sensitivity Each Industry and Comparison with Persistence Component Earnings in Accounting Fundamentals. Journal of Iranian Accounting Review, 5(19), 69-92.

Simmonds, K. (1982). Strategic management accounting for pricing: a case example, Accounting & Business Research, 46(2): 206-14

Singh, M. D., & Kant, R. (2011). Knowledge management barriers: An interpretive structural modeling approach. International Journal of Management Science and Engineering Management, 3(2), 10.

Solovida, G. and Latan, H. (2017). Linking environmental strategy to environmental performance: Mediation role of environmental management accounting, Sustainability Accounting, Management and Policy Journal, 8(5): 595-619. https://doi.org/10.1108/SAMPJ-08-2016-0046

Tanc, A., Gokoglan, K. (2015). The Impact of Environmental Accounting on Strategic Management Accounting: A Research on Manufacturing Companies, International Journal of Economics and Financial Issues, 5(2): 566-573.

Valiyan, H., Abdoli, M., Karimi, S. (2018). Designing a model of innovative environmental functions for the development of business functions with a fuzzy approach (Case Study: Tehran Stock Exchange pharmaceutical companies). Management Accounting, 11(37), 59-75.

Welbeck, E. E. (2017). The influence of institutional environment on corporate responsibility disclosures in Ghana. Meditari Accountancy Research, 25(3): 216–240. https://doi.org/10.1108/MEDAR 11 2016 0092

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