

Investigating the effectiveness in capturing environmental costs: The cause of small to medium enterprises in the Saudi manufacturing sector

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Abstract

This study investigates the current design of costing systems used by Saudi small and medium enterprises (SMEs) in the manufacturing industry. It investigates the ability of SMEs' costing systems (traditional or advanced) to capture environmental costs. The primary reason for this study is because there is a lack of research on Saudi SMEs and Environmental Management Accounting (EMA). This study adopts the contingency theory of business, which applies contingent variables to the issue being investigated. The contingent variables for this study are types of costing systems, the types of manufacturing, and their cost structures. The data was collected using an online, web-based questionnaire. Data was analyzed employing descriptive and multivariate analysis techniques. The study found that 65% of the targeted SMEs used traditional costing systems and 18.5% reported activity-based costing (ABC). Descriptive and multivariate analyses show that firms using ABC exhibited significantly greater ability to respond to environmental issues than firms using traditional systems; sector differences were not statistically significant. Cost-structure results provide partial support: several component-level correlations were significant and consistent with environmental costs being concentrated in overhead and indirect accounts, while direct materials and labor showed small positive links with the factors examined. This study recommends that SMEs in Saudi Arabia should change their costing approaches from a traditional system to a more advanced method, which will enable them to better identify and manage environmental costs and avoid wastage, penalties and fines from environmental and regulatory bodies.

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1. Introduction

In response to global warming and climate change, countries, organizations, and other stakeholders have collaborated to publicize and minimize the consequences of global warming and climate change by limiting the environmentally hazardous activities of businesses. The United Nations (UN), the International Organization

for Standardization (ISO) and the Global Reporting Initiative (GRI) have led well-known initiatives to promote a sustainable planet. They have targeted manufacturing sectors all over the world, developed several frameworks for environmental guidance of manufacturing processes and established accreditations and rankings. Their initiatives illustrate how manufacturing entities can comply with regulations and improve the environment [1]. In addition, governments have played a significant role by passing legislation that penalizes environmental and sustainability breaches by manufacturers [2], [3].

Management Accounting Systems (MASs), and costing systems in particular, play a vital role in any manufacturing business. Costing systems must be able to adequately classify and capture all relevant costs of the business. Most businesses have modified their costing systems so as to minimize costs in every part of their business. However, only large companies have moved towards adopting advanced costing systems, as they can justify this in terms of a cost-benefit analysis. Small and Medium Enterprises (SMEs), on the other hand, tend to be unable to adopt advanced costing systems since they do not have the capital to invest in these expensive systems; hence, they fall back on traditional costing systems [4], [5]. As a result, manufacturing SMEs in Saudi Arabia continue to rely on traditional costing systems that are not designed to adequately classify and capture all costs within the business. This inadequacy means that these traditional systems lack the capability to capture environmental costs [4], [6].

The objective of this research is to determine whether or not the current design of costing systems for SMEs in the Saudi manufacturing industry can be modified to capture environmental costs. The main question that this research will investigate is: Can SMEs in the Saudi manufacturing industry modify their costing systems to capture environmental costs? The study will explore the effect of different costing systems, the type of manufacturing and cost structures on the ability of SMEs to capture environmental costs.

This study is motivated by high demand for Environmental Management Accounting (EMA) research to address currently unresearched environmental issues [4], [5]. In particular, there is a need for research in the contemporary design of SMEs' costing systems and their ability to capture environmental costs and compare them to activities, products and profits [6], [7]. However, the design and application of SMEs' costing systems, from an environmental and sustainability standpoint, have been ignored in management accounting research, where the primary focus has been on large entities [8], [9]. The present research targets Saudi SMEs because they have a significant impact on the Saudi economy and individual income as they account for 36% of the country's workforce and 30% of listed companies [10], [11], while manufacturing SMEs account for 55% of Saudi Arabia's industrial workforce [12].

2. Literature review

There is a consensus that traditional accounting systems are unlikely to capture the environmental costs of organizational activities; there is therefore a need to adopt modern accounting systems that include innovations specifically designed to capture environmental costs. Management can use such systems as an environmental measurement scale to help with strategic decisions related to environmental responsibility [13].

EMA is a contemporary method of accounting that evolved from management accounting and can assess the environmental impacts of organizational activities by adopting sustainable management accounting systems and practices, such as environmental cost accounting and environmental performance measurements [4]. EMA applies a knowledge frame that addresses environmental costs, which is the dependent variable of the research question in this study. In the early 1990s, the US Environmental Protection Agency (EPA) promoted widespread adoption of EMA; as a result, organizations all over the globe in more than 30 countries apply EMA to several different categories of environment-related management initiatives [14]. Furthermore, the United Nations Division for Sustainable Development contributed to the development of EMA by establishing a working group in 2001 that specialized in EMA practices and principles [14]. The International Federation of Accountants

(IFAC) also developed an EMA guidance document, which is a primary source for EMA research and application [15], [16].

Since this study focuses on manufacturing settings, it is essential to apply EMA to production operations, which typically begin with acquiring raw materials that are processed into final products. On the one hand, waste and carbon emissions may result from the production process, and on the other hand, energy and natural resources will be consumed in the process [15]. Environmental costs are expenditures incurred to avoid environmental impacts or because a violation of environmental law has occurred [17]. Note that environmental costs are defined by the United Nations as: Those that comprise the costs of steps taken, or required to be taken, to manage the environmental impacts of an enterprise's activity in an environmentally responsible manner, as well as other costs driven by the environmental objectives and requirements of the enterprise [18]. IFAC examined environmental cost taxonomies all over the world, in a variety of organizations and sectors. It then defined six general environmental cost categories that can be applied to traditional accounting systems as well as advanced systems [15]. Table 1 shows IFAC's comprehensive environmental cost categories.

Table 1. IFAC's environmental cost categories [15]

1. Materials costs of product outputs: Includes the purchase costs of natural resources such as water and other materials that are converted into products, by-products and packaging.
2. Materials costs of non-product outputs: Includes the purchase (and sometimes processing) costs of energy, water and other materials that become Non-Product Output (Waste and Emissions).
3. Waste and emission control costs: Includes costs for: handling, treatment and disposal of Waste and Emissions; remediation and compensation costs related to environmental damage; and any control-related regulatory compliance costs.
4. Prevention and other environmental management costs: Includes the costs of preventive environmental management activities such as cleaner production projects. Also includes costs for other environmental management activities such as environmental planning and systems, environmental measurement, environmental communication, and any other relevant activities.
5. Research and development costs: Includes the costs for Research and Development projects related to environmental issues.
6. Less tangible costs: Includes both internal and external costs related to less tangible issues. Examples include liability, future regulations, productivity, company image, stakeholder relations and externalities.

As the central question of this study is to determine the ability of costing systems in Saudi SMEs to capture environment costs, this study implemented the above categories in a questionnaire. A similar questionnaire has been implemented by several other studies in the field of management accounting [18], [19]. Traditional accounting and costing systems generally place most environmental costs in the category of general overhead or indirect accounts. Such a system, however, may prevent management from realizing the size and impact of these particular costs [19], [20]. Therefore, this study examines the proportion of overhead costs in the cost structure of SMEs and measures the ability of their costing systems to identify environmental costs.

As defined by Langfield-Smith [4], a 'management accounting system (MAS) is the information system that produces the information required by managers to create values and manage resources' (p. 8). The MAS is one part of the overall management information system within an organization, and it regularly provides internal and external accounting information that assists decision makers with short-and long-term decisions [4], [21].

The MAS includes but is not limited to the following managerial accounting tools: costing systems, budgeting systems, performance measurement systems, and management control systems [4], [22]. This study, however,

will only address costing systems, which are the systems that estimate the cost of goods, services, and other operational costs [4], [23]. Costing systems range from simple, traditional forms to sophisticated and advanced systems: the more sophisticated a costing system is, the greater the likelihood that it will capture all relevant costs [8], [24]. However, implementing an advanced costing system can itself be costly, and a lack of resources may make it difficult for SMEs to adopt advanced costing systems [9], [25].

Most of the previous literature reviews and textbooks have classified costing systems into two types. The first, variously described as ‘traditional’, ‘simple’, ‘simplistic’ or ‘absorption’ or ‘full’ costing systems, only assign direct and indirect manufacturing costs to products; the issue is that they do not allocate other period and non-manufacturing expenses to particular products, even though some of those expenses are product-specific [23], [26]. This first type of costing system can be divided into three sub-categories: job order costing, process costing, and hybrid costing [4], [27].

The second type comprises advanced costing systems, referred to as ‘modern’, ‘advanced,’ or ‘sophisticated’ systems, solve the issue presented in the first type; they assign all expenses, including period and non-manufacturing expenses to specific products. This category includes, among others, activity-based costing (ABC), target costing (TC), just-in-time costing (JITC), and Life Cycle Costing (LCC) [4], [6]. The key to identifying which costing system has the ability to capture environmental costs is to know the place of those costs in that particular costing system. Traditional accounting usually places most environmental costs in the ‘general overhead’ or ‘indirect’ accounts. Therefore, traditional costing systems are expected to have less ability to capture environmental costs because they are hidden under less specific headings [4], [20].

However, advanced costing systems are deemed to be able to capture environmental costs because they have different criteria by which to allocate them. For example, ABC allocates all of the costs of a product, including manufacturing overhead expenses and direct non-manufacturing expenses (where environmental costs are placed) to that exact product by using several appropriate cost drivers (one cost driver for each activity) [4], [28]. In addition, LCC has been labelled an environmental costing system because it considers all the costs of a product ‘from cradle to grave,’ from the collection of raw materials to product disposal and recycling. This makes LCC useful for examining the environmental impact and sustainability of a product over its entire lifetime [29]. There are three challenges to the adoption of sustainable practices in manufacturing SMEs. First, there is a lack of knowledge about the impact of sustainability [30], [31]. Second, there is a lack of expertise on and strategies for sustainable development [32], [33]. Third, sustainable development can be expensive and uses costly resources [34], [35]. Although many SMEs leaders view the implementation of sustainable procedures as costly, several studies have argued that that sustainable practices lead to long-term savings in the form of waste reduction, tax exemptions, energy savings, and avoidance of environmental penalization [36], [37]. Furthermore, there are also many non-financial benefits to sustainable development, such as improvements in workforce attitudes, since sustainability practices eliminate hazardous jobs: it also promotes a positive public image [4] and customer appreciation for the refined production lines that produce sustainable products [38].

3. Theoretical framework

Organizational theory, also as known as institutional theory, refers to the practices within external organizations that can be adopted by a company in a way that legitimately influences its own design and structure [4]. Moreover, organizational theory has expanded to introduce the contingency theory, which makes associations between two factors or variables and then measures their effective responses, which may or may not be favorable to the company [39], [40] this underlying theory helps explain why various designs of management accounting systems are effective in different organizational settings. Contingency theory suggests that management accounting practices will only be effective if there is a good match between the organizational context and the management accounting system. It suggests that no single best way of accounting will suit all situations: system design must fit with the organizational structure and the environment in which the business operates [26], [40]. In this view, management accounting systems must be tailored to suit the circumstances of a particular business

if they are to provide the support necessary for effective decision-making and desired organizational performance.

The study considers as its performance measure the capability of SMEs' costing systems to capture environmental costs. This is measured along two criteria: the firm's ability to incorporate environmental management considerations into its costing systems and the success it achieves in managing its environmental costs in the accounting period. In this study the independent variables looked at were: the nature of the manufacturing industry, the type of costing method used, and the business's expense structure. These variables have been explicitly identified in prior management accounting research as key contingencies influencing accounting system design and effectiveness [4], [8]. Given the heterogeneous conditions under which Saudi manufacturing SMEs operate, including production processes, regulatory exposure, environmental intensity and resource constraints, contingency theory offers a suitable framework for this research. In particular, SMEs have less financial and operational resources available than larger organizations [5]. As a result, they have limited ability to invest in sophisticated accounting systems [9], [25]. The theory thus provides a coherent framework to explain why some SMEs are more capable than others of classifying, identifying and managing environmental costs through their costing systems.

3.1. Costing system type and the ability to capture environmental costs

Organizations make key decisions as to how costs are identified, classified and allocated when they select the type of costing system, which the contingency theory views as a critical organizational design variable. Research in the field suggests that conventional costing systems have the tendency to group environmental costs together with general overhead and indirect costs, which consequently conceals their actual impact and prevents management from being aware of their true extent [4], [19]. When environmental costs are put into overhead accounts, managers may not properly assess their importance in terms of money and operations, which ultimately reduces the firm's ability to respond effectively to environmental issues and tends to obscure much of the detailed cost information generated within an organization. In traditional costing systems, costs are usually traced to production departments, such as production, sales or administration, but aggregating costs at these levels gives management little information about costs associated with the products themselves.

In contrast, advanced costing systems, such as ABC and LLC, are designed to increase cost visibility by tracing costs to the various products or stages in a product's life cycle through the use of appropriate cost drivers [23], [28]. This approach is particularly associated with ABC, which distributes overhead expenses, including indirect costs and costs not associated with manufacturing, such as the cost of pollution, by factors (i.e. cost drivers) that are the actual causes rather than by a general average cost. The life cycle assessment methodology used by LCC adopts an all-encompassing approach that includes environmental impacts from product development through to the end of the product life cycle [29]. Studies in academic literature, [25], [41], have shown that companies that employ more advanced cost accounting systems demonstrate a greater ability to identify and manage costs associated with environmental problems. However, SMEs are often unable to afford the costs of implementing an advanced costing system [9], [25]. The contingency theory suggests that this divergence between costing systems and management's needs to respond to the environment will lead to the firm not being able to effectively account for its environmental costs. Accordingly, this research introduces the following hypothesis:

H1: There is an association between the main types of costing systems and their ability to capture environmental costs.

3.2. The type of manufacturing and the ability to capture environmental costs

According to contingency theory, environmental factors, which include the industry's overall nature, influence what management accounting systems are required [4], [40]. Industrial sectors exhibit considerable variation in terms of their production methods, their consumption of resources, their waste output and their exposure to environmental legislation. Both the amount of environmental costs and the pressures to consider these costs, are

affected [5]. For example, chemicals, metals and industries requiring a lot of resources face greater environmental scrutiny and have thus more of a motive to use environmental management accounting techniques. In recent years there has been substantial growth in the use of EMA [5], [25]. Companies operating in industries where the company's impact on the environment is immediately apparent, or where environmental factors consume a lot of a company's resources, are often very careful about the damage they do to the environment and tend to incorporate advanced costing systems into their accounting procedures. Studies indicate varying degrees of difference between sectors, especially with regards to SMEs, which often face limitations in resources. From a contingency viewpoint, the nature of the manufacturing industry continues to be a crucial contextual factor which may impact the effectiveness of cost systems in incorporating environmental costs. Based on such theoretical reasoning, the study introduces the second hypothesis as follows:

H2: There is an association between the nature of the manufacturing sector and the ability to capture environmental costs.

3.3. Cost structure and the ability to capture environmental costs

The cost structure of the firm is another factor which affects how successfully a company's costing system will operate. Research into the practices of organizations in various sectors, such as the work of Jasch [19] and Langfield-Smith et al. [4], indicates that environmental costs are often found in the 'indirect costs' accounts rather than directly attributed to production processes (i.e. direct materials or labor accounts). When overhead costs and indirect costs comprise a substantial part of total costs, conventional accounting systems are more likely to obscure environmental costs, reducing their visibility and manageability. In such cases, advanced cost systems are necessary to achieve accurate costing of the costs to the environment [8], [25]. In SMEs, where conventional accounting systems predominate, the cost structure of an organization with a considerable overhead and indirect component will hinder the company's ability to identify and manage environmental costs. From the contingency theory point of view, a lack of harmony between the enterprise's cost structure and the design of its costing systems undermines the usefulness of the accounting system in providing management with useful information. Therefore, a third hypothesis is proposed:

H3: There is an association between the cost structure and its ability to capture environmental costs.

4. Research design

4.1. Research methodology

This study adopts a quantitative methodology, which can be relied on to satisfy the contextual factors of the study on the one hand, and to deliver an acceptable degree of validity on the other. As Ron [42] noted, 'excellent researchers simply choose a research method that fits their purposes and get on with the business of doing their research' (p.9).

Contextual factors, also known as independent factors, have power over a particular research question, so they affect the selection of a research method and indicate whether it is valid or even suitable for a research issue [43]. To specify the methods and strategies of a research plan, a researcher must fully identify the source of his or her information, the scheduled timeframe for the project, sampling procedures and the relevant costs [44]. Therefore, several contextual factors apply in the case of this study, including a limited timeframe, the descriptive nature of the research questions and the size of the representative sample to be examined. Concerning the validity of quantitative methods in management accounting, such as using closed-ended questionnaires and gathering a stream set of secondary data to put into statistical models, validity depends on the configuration of the right set of questions with the suitable quantitative model, and this may be seen as a limitation. This accords with Ryan [45], who stated that quantitative 'research can answer questions and indicate causes (problem solving), but equally, research can be about problem setting—coming up with the right questions' (p.19). If applied correctly, the quantitative results gleaned from this study will highlight an adequate degree of validity.

4.2. Research methods

This study used a web-based questionnaire which targeted practitioner accountants, officials and financial auditors working with Saudi SMEs in the manufacturing industry as the primary respondents. The questionnaire was limited to five pages and was designed to take no more than 15 minutes to complete, using a survey construct of Likert scales (See Appendix A). The data from the questionnaires were transferred through descriptive and multivariate analyses through the statistical software application IBM SPSS Statistics 22. The use of an online questionnaire complies with the contextual factors mentioned in the section on research methodology, which are the nature of the descriptive research questions and the nature of the representative sample accompanied with a limited timeframe. An article by Christ and Burritt inspired the chosen method. Burritt has an extensive body of research and is a pioneer in the area of environmental management accounting [25].

The web-based questionnaire includes four sections: profile information, cost structures, costing systems and response to environmental issues. The first section emphasizes respondents' biographical information, such as their years of experience, manufacturing activity and current position. It also highlights the Saudi SMEs' details, such as the number of employees and annual sales turnover. However, because this study is labelled ethically as low-risk, it does not ask for personal information, such as a respondent's name, email address or phone number. The questions appear in yes/no and multiple-choice formats, both of which were applied in a previous study [39]. The second section addresses the SMEs' cost structures. It asks participants to report on direct costs and indirect costs, and then to specify overhead expenses for both direct and indirect costs. A similar approach was used in previous studies [8], [46]. The third section offers a different set of questions that address traditional and advanced costing systems. It includes yes/no questions, multiple-choice questions, five-point Likert scale questions and open-ended questions. Each of these questions was modified from previous study [39]. The fourth section examines the ability of costing systems to capture environmental costs via the implementation of the IFAC comprehensive environmental cost categories. It considers two factors: the Management's Ability to Respond to Environmental Management Issues in Respect of Costing Systems; and Success of the Company in Managing Environmental Costs in the Recent Accounting Period. This section is framed as four-point Likert scale questions. Similar question sets have been implemented by many other studies in the field of management accounting [18], [19].

The initial assessment of the model's reliability involved a determination of the consistency of its constituent elements through the application of Cronbach's alpha. The alpha reliability value for the overall survey was 89.6% and the value for each individual scale ranged from 80.7% to 93.7%. The results of the reliability analysis show that all scale values exceeded the recommended Cronbach Alpha threshold of 0.70, showing a high degree of consistency among the survey questions. This demonstrates that the instrument exhibits excellent reliability [47], [48].

4.3. Research sampling

The sampling process began by obtaining ethical approval from the Human Research Ethics Committee at King Khalid University. This was obtained to ensure that all aspects of integrity and ethics for dealing with humans were met during the data collection process. The sampling frame began with identification of the targeted participants: accountants, auditors, officials and design makers employed by Saudi SMEs. The single-cluster sampling method, also known as one-stage cluster sampling, was the sampling method of choice [49]. The rationale behind the use of cluster sampling is that it has the ability to target populations and to split them into mutually exclusive and comprehensive sectors, or 'clusters'. For this study, the manufacturing industry was split into several manufacturing sectors.

In this study, manufacturing sectors are clustered according to their national percentage in the greater manufacturing industry, as illustrated in Table 2, after which minor sectors were discarded as not representing the Saudi manufacturing industry. Had these minor clusters, such as printing and recorded media, been included,

they could have caused an issue with data analysis. Next, each sector was categorized according to the SMEs' classifications, based on the number of full-time employees and the volume of total revenues (sales). If there were any exceptions, the higher rating between the two criteria was considered: annual sales of less than 200 million Saudi Riyal (SR), and fewer than 249 full time employees. Lastly, all SMEs were included in each sector, as one-stage sampling requires selection of all elements in each cluster [49].

The Saudi Arabian Standard Industrial Classification has 23 Classifications, of which this study combined 9 into 'other manufacturing' due to their marginal contribution to the manufacturing industry, as illustrated Table 2; consequently, to draw conclusions about the entire manufacturing industry, this study acquired a representative sample from dominant sectors. The LSEG Workspace was able to narrow the search according to the SME classifications mentioned earlier using the number of employees [50]. A search of the LSEG Workspace database resulted in 724 items of contact data, including phone numbers and email addresses, for targeted SMEs that matched the sampling criteria: these could be used to direct the online survey. A total of 1423 emails were sent after filtering.

The survey was designed using Microsoft forms web-based survey tool, as recommended and supported by King Khalid University. For a preliminary evaluation, the survey accompanied and survey link were sent to six faculty staff in the College of Business at King Khalid University, and some feedback was collected and maintained. Data collection was conducted over a period of five months, spanning early February of 2025 through to the end of June in the same year. To ensure there was no non-response bias, an independent samples test was performed to determine if there were any significant differences in the early and late respondents' equal variance estimators. The majority of items showed no significant variation in the estimated variance between early and late respondents to the survey; consequently, it was unlikely that non-response in this survey would pose a problem. The survey excluded 37 responses that were returned in fewer than five minutes. An additional 13 complete responses were excluded due to the 'junk' or unreasonable nature of the answers. The survey yielded a net of 216 valid responses, a 15.1% response rate. This allowed for the use of descriptive and multivariate statistics. This response rate is considered reasonable in environmental management accounting research according to previous literature [25], [51]. To increase the response rate, the survey email was sent several times; a filter was applied after each sending to exclude all unsubscribed participants and to add emails for additional contacts referred by participants. Random phone calls to participants were also made to increase the response rate.

5. Results

5.1. Descriptive statistics of participants and profile of companies

A web-based survey was sent out to a sample of 1423 participants who are accountants, auditors, officials and design makers employed by the Saudi SMEs in the manufacturing industry. However, Table 3 illustrates that only 216 valid and complete responses were received (N=216), which account for a response rate of 15.1%. Table 3 also shows that just below half of the companies have been operating for over 10 years (n=104, 48.1%). The other major group was companies, which have been operating between 4-10 years (n=80, 37%). Companies from targeted manufacturing sectors are represented in the sample and there is no skew towards any one sector as indicated in Table 4. Then, Table 5 shows that the two largest groups of companies had between 50-150 employees (n=92, 42.6%) and 6-49 employees (n=80, 37%). Table 6 illustrates a small proportion of companies had an annual sales turnover of less than SR 1 million. Companies with revenue between SR 1 million to SR 3 million, SR 3 million to SR 40 million, and between SR 40 million and SR 200 million were almost equally represented. Table 7 shows the first largest group of participants indicated that they were either working in the position of a Chief Executive Officer (CEO), Chief Information Office (CIO), Executive Director, or Executive (n=88, 40.7%). Also, table 7 shows the second largest group of participants were working in positions in Management, Cost, Financial, Product, Environmental, or Chartered Accountancy (n=52, 24.1%). Table 7 represents a range of other professions. Table 8 illustrates that the participants indicated that their companies were not listed on the Saudi Stock Exchange (TASI) (n=160, 74.1%).

Table 2. Manufacturing subdivision as illustrated by General Authority for Statistics

Enterprises	%	Total	Medium	Small	Micro
Operating Revenues by Economic Activity and Size 2023					
1. Manufacture of chemicals and chemical products	26.3	83,390,665	79,931,644	2,556,273	902,747
2. Manufacture of food products	12.1	38,170,786	20,128,194	10,567,233	7,475,359
3. Manufacture of other non-metallic mineral products	11.1	35,074,690	29,607,088	3,352,423	2,115,179
4. Manufacture of fabricated metal products	9.8	30,930,067	10,989,453	11,083,839	8,856,775
5. Manufacture of electrical equipment	5.6	17,673,264	16,606,149	870,669	196,445
6. Manufacture of rubber and plastics products	5.3	16,736,671	15,644,621	608,220	483,830
7. Manufacture of furniture	3.9	12,433,241	5,469,661	4,140,109	2,823,472
8. Repair and installation of machinery and equipment	3.7	11,595,685	5,542,695	2,930,311	3,122,679
9. Manufacture of wearing apparel	3.5	11,135,900	1,254,892	2,025,649	7,855,359
10. Manufacture of basic metals	2.8	8,965,989	7,484,759	1,028,783	452,447
11. Manufacture of textiles	2.6	8,177,835	4,630,466	2,190,463	1,356,905
12. Printing and reproduction of recorded media	2.0	6,355,449	2,368,594	3,218,497	768,358
13. Manufacture of paper and paper products	2.0	6,276,732	5,403,296	784,578	88,857
14. Manufacture of machinery and equipment	1.9	6,137,672	5,601,007	341,795	194,871
15. Other manufacturing	7.4	23,582,695	14,106,552	6,048,228	3,427,915
Total Manufacturing	100	316,637,340	224,769,073	51,747,069	40,121,198

Source: General Authority for Statistics

Table 3. Years of operation/business

	Frequency	Percent
1-3 years	32	14.8
4-10 years	80	37.0
More than 10 years	104	48.1
Total	216	100.0

Table 4. Manufacturing activities (sectors)

	Frequency	Percent
Manufacture of chemicals and chemical products	40	18.5
Manufacture of food products	40	18.5
Manufacture of other non-metallic mineral products	20	9.3
Manufacture of fabricated metal products	24	11.1
Manufacture of electrical equipment	32	14.8
Manufacture of rubber and plastics products	24	11.1
Repair and installation of machinery and equipment	24	11.1
Others (Please specify)	12	5.6
Total	216	100.0

Table 5. Number of employees

	Frequency	Percent
0 to 5	36	16.7
6 to 49	80	37.0
50 to 150	92	42.6
151 to 249	8	3.7
Total	216	100.0

Table 6. Annual sales turnover (SR)

	Frequency	Percent
Zero to less than SR 1m	20	9.3
SR 1m to less than SR 3m	56	25.9
SR 3m to less than SR 40m	72	33.3
SR 40m to less than SR 200m	68	31.5
Total	216	100.0

Table 7. Your current position

	Frequency	Percent
CEO, CIO, Executive Director, Executive Assistant	88	40.7
Management, Cost, Financial, Product, Environmental, CA	52	24.1
Factory Manager, Facilities Manager, Manufacturing Director, BDM	32	14.8
Finance manager, Financial Controller	16	7.4
Environmental Manager/Administrator/Risk Manager/Planner/Auditor	20	9.3
Others (Please specify)	8	3.7
Total	216	100.0

Table 8. Is your company listed on the Saudi Stock Exchange (TASI)?

	Frequency	Percent
Yes	56	25.9
No	160	74.1
Total	216	100.0

5.2. Descriptive statistics of cost structure of the companies

Table 9 below shows the cost structure of the company as a percentage. It is noteworthy that the two largest costs for companies were the material costs (M=30.99%, SD=12.55%) and labor costs (M=28.27%, SD=11.99%).

Table 9. Cost structure of the company (%)

	Minimum	Maximum	Mean	Std. Deviation
Direct material costs	8.70%	60.00%	30.99%	12.55%
Direct labor costs	10.00%	75.00%	28.27%	11.99%
Other direct non-manufacturing overhead expenses (i.e. direct selling and administrative costs associated with a particular product)	0.00%	40.00%	15.94%	9.02%
Indirect manufacturing overhead expenses (i.e. indirect material and indirect labor)	0.00%	40.00%	13.02%	8.71%
Other indirect non-manufacturing costs (i.e. known as period costs, which are indirect selling and administrative costs that are not associated with a particular product)	0.00%	45.00%	11.77%	9.12%

Tables 10 and 11 highlight that a vast majority of the participants indicated that their companies used a costing system (n=180, 83.35). Out of these, a majority (n=140, 77.8%) indicated that they used traditional costing, while the remainder indicated that they used Activity Based Costing.

Table 10. Does your company use a costing system?

	Frequency	Percent
Yes	180	83.3
No	36	16.7
Total	216	100.0

Table 11. Which of the following costing systems are being used in your company?

		Frequency	Percent
Valid	Traditional costing	140	64.8
	Activity based costing (ABC)	40	18.5
	Other	36	16.7
Total		216	100.0

Figure 1 reveals the level of use by participants of the three types of traditional costing systems: job costing system, process costing system, and hybrid costing system. It indicates that the process costing system and job-costing system were dominant and used much more frequently than the hybrid costing system.

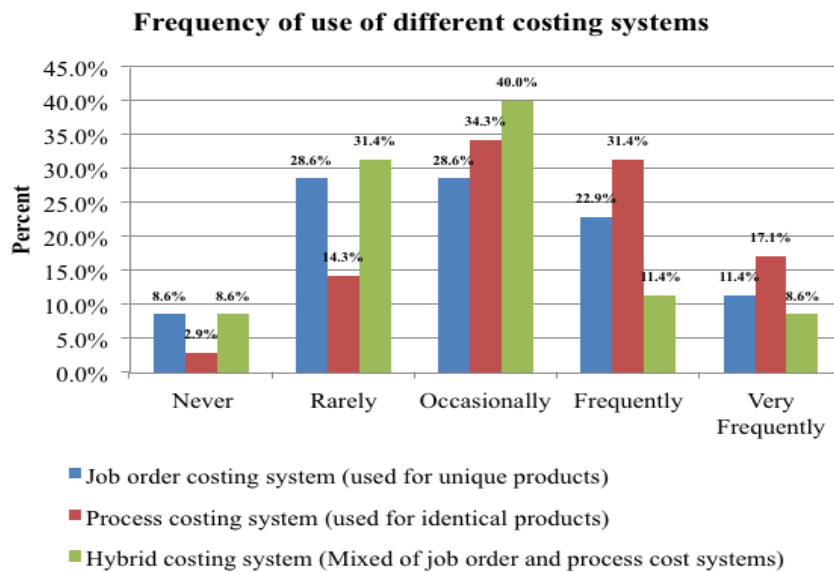


Figure 1. Please indicate the extents to which each of the following traditional costing systems is used in your firm

Figure 2 gives an indication of the variety of production methods used by the SMEs surveyed. This fact about manufacturing activities in the Saudi context is consistent with the prevalence of repetitive production and job-based and process-based manufacturing techniques. The study's findings support the descriptive data that was previously collected, showing that most companies used traditional costing systems. These systems are generally used in businesses that manufacture the same product over and over. Many companies make use of traditional cost accounting systems because these are viewed as simpler to use and fit in with existing working methods, even though they do not offer a detailed breakdown of environmental costs.

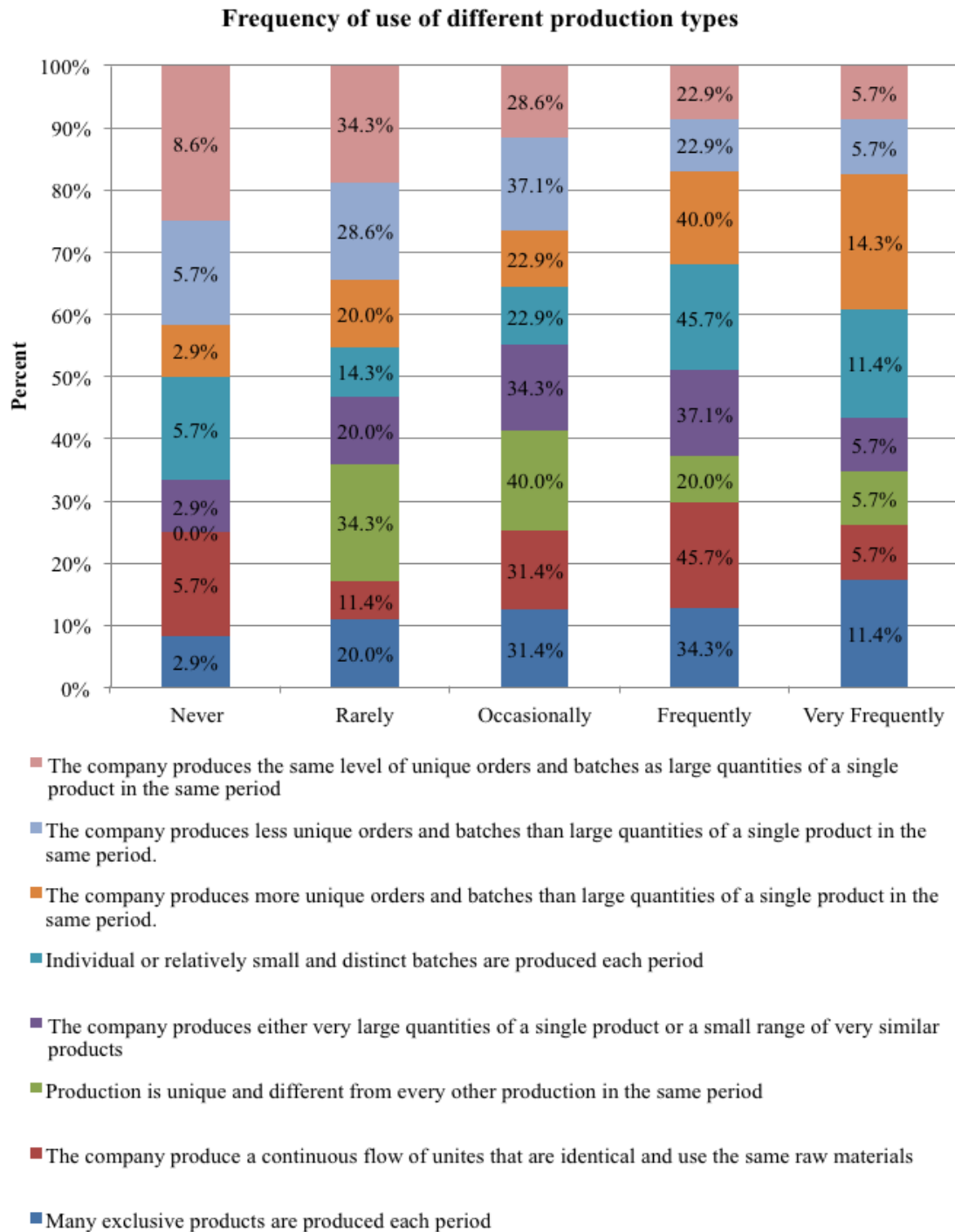


Figure 2. Please indicate the extent to which of the following best describe the production types that are used in your firm

Figure 3 ranks the factors contributing to the non-adoption of ABC in the respondents' views. The main reasons for not adopting ABC systems were the lack of trained staff, management preference for a simple method and happiness with their current system, as well as the complexity and costly nature of adopting the ABC system. The structural and financial limitations imposed on SMEs are in line with the arguments put forward by contingency theory, as research has shown. The findings in Figures 2 and 3 indicate that the production profiles of the Saudi manufacturing SMEs do not require an advanced costing system; moreover, institutional and resource constraints are crucial for the continued use of the traditional costing practices. These factors hinder the SMEs adoption of advanced costing systems, such as ABC.



Figure 3. Because the company has not yet implemented ABC, please rank the influence of the following factors

5.3. Exploratory factor analysis

To identify the underlying components of the management’s ability to deal with environmental management issues in respect of costing systems, and the success of the company in managing environmental costs in the recent accounting period, an exploratory factor analysis was conducted on the 25 items relating to the management’s ability to deal with environmental management issues in respect of costing systems, and 20 items relating to the success of the company in managing environmental costs in the recent accounting period.

For the questions relating to the management’s ability to deal with environmental management issues in respect of costing systems, a one-factor solution was obtained using principal components analysis with an eigenvalue greater than one. The component has been named ‘Management’s Ability to Respond to Environmental Management Issues in respect of Costing Systems. This component explains 33.19% of the variance. The results for the Bartlett test of sphericity indicate that the overall correlation matrix is significant at $p = 0.001$ [52]. The

Kaiser-Meyer-Olkin (KMO) test showed a value of 0.7, which is acceptable since it is close to 0.8 [53]. The KMO result reveals that the factor analysis is useful when analyzing these variables.

For the questions relating to the success of the company in managing environmental costs in the recent accounting period, a one-factor solution was obtained using principal components analysis with an eigenvalue greater than one. The component has been named ‘Success of the Company in Managing Environmental Costs’. This component explains 52.09% of the variance. The results for the Bartlett test of sphericity indicates that the overall correlation matrix is significant at $p = 0.001$ [52]. The KMO test showed a value of 0.841, which is acceptable as it is more than 0.8 [53]. The KMO result reveals that the factor analysis is useful when analyzing these variables.

High factor scores can be interpreted to have lower values for the phenomenon being measured (because the two factors have reversed scores). However, lower factor scores for this analysis are shown in Table 12, which interprets to have high values for the phenomenon being measured. In other words, higher factor scores correspond to lower levels of the underlying construct, while lower (more negative) factor scores correspond to higher level of the construct.

Table 12. Descriptive statistics for factor scores

	Minimum	Maximum	Mean	Std. Deviation
Management’s Ability to Respond to Environmental Management Issues in respect of Costing Systems	-2.34	2.12	0.00	1.00
Success of the Company in Managing Environmental Costs	-2.26	2.18	0.00	1.00

The two factor scores computed using the Exploratory Factor Analysis were used in testing the three hypotheses. In testing the first two hypotheses, the factor scores were computed by the costing system in use, and by manufacturing activity, respectively. In testing the third hypothesis, the two factor scores were correlated with cost structure variables.

5.4. Hypothesis testing

H1: There is an association between the types of costing systems and the ability to capture environmental costs.

The association between the main types of costing systems and the ability to capture environmental costs as measured by the two factors was tested using an independent sample assuming equal variances. Tables 13 and 14 present the descriptive and inferential results respectively. The t-test found a statistically significant difference ($p=0.001$) between the type of costing system and the factor “Management’s Ability to Respond to Environmental Management Issues in respect of Costing Systems”. Companies using an Activity Based Costing (ABC) system were able to respond better to environmental issues. This is evident from the mean values for Traditional Costing and ABC by Management’s Ability to Respond to Environmental Management Issues in respect of Costing Systems, as shown in Table 13. The mean value for ABC is lower than the mean for Traditional Costing (since the coding of Likert scale was reversed), meaning that ABC is more effective in this respect. However, there was no statistical difference between the Success of the Company in Managing Environmental Costs in the Recent Accounting Period and type of costing system.

Table 13. Summary statistics for the two factors by costing methods

Factor		N	Mean	SD	SE
Management's Ability to Respond to Environmental Management Issues in respect of Costing Systems	Traditional costing	140	0.18	0.94	0.08
	Activity based costing (ABC)	40	-0.57	1.01	0.16
Success of the Company in Managing Environmental Costs	Traditional costing	140	-0.01	1.05	0.09
	Activity based costing (ABC)	40	-0.25	0.82	0.13

Table 14. Independent sample t-test

T-test for Equality of Means								
	t	df	Sig. (2-tailed)	Mean Difference	SE Diff.	CI for the Diff.		
						L	U	
Management's Ability to Respond to Environmental Management Issues in respect of Costing Systems	4.377	178	.001	0.75	0.17	0.41	1.09	
Success of the Company in Managing Environmental Costs	1.333	178	.184	0.24	0.18	-0.12	0.60	

H2: There is an association between the type of manufacturing and the ability to capture environmental costs.

Table 15. Summary statistics for environmental cost factors by type of manufacturing

		N	Mean	SD	SE	95% CI for Mean	
						LB	UB
Management's Ability to Respond to Environmental Management Issues in respect of Costing Systems	Manufacture of chemicals and chemical products	40	-0.43	0.89	0.28	-1.07	0.20
	Manufacture of food products	40	0.15	0.82	0.26	-0.44	0.74
	Manufacture of other non-metallic mineral products	20	0.37	1.49	0.67	-1.48	2.22
	Manufacture of fabricated metal products	24	-0.60	0.94	0.39	-1.59	0.39
	Manufacture of electrical equipment	32	0.31	0.87	0.31	-0.42	1.03
	Manufacture of rubber and plastics products	24	-0.34	1.16	0.47	-1.55	0.88
	Repair and installation of machinery and equipment	24	0.20	0.77	0.31	-0.60	1.01
	Other (Please specify)	12	0.99	0.99	0.57	-1.48	3.45
Total		216	0.00	1.00	0.14	-0.27	0.27
Success of the Company in Managing Environmental Costs	Manufacture of chemicals and chemical products	40	0.11	0.96	0.30	-0.58	0.79
	Manufacture of food products	40	-0.03	0.72	0.23	-0.54	0.49
	Manufacture of other non-metallic mineral products	20	0.15	1.01	0.45	-1.11	1.41

	N	Mean	SD	SE	95% CI for Mean	
					LB	UB
Manufacture of fabricated metal products	24	-0.27	0.97	0.40	-1.29	0.75
Manufacture of electrical equipment	32	0.26	0.82	0.29	-0.43	0.94
Manufacture of rubber and plastics products	24	-0.33	0.86	0.35	-1.24	0.58
Repair and installation of machinery and equipment	24	-0.07	1.47	0.60	-1.61	1.46
Other (Please specify)	12	0.16	2.24	1.30	-5.42	5.73
Total	216	0.00	1.00	0.14	-0.27	0.27

Table 16 presents the association between the type of manufacturing sector and the ability to capture environmental costs as measured by the two factors was tested using a one-way ANOVA. For the first factor, the p -value is 0.001, which means the result is statistically significant that the nature manufacturing activity influences how well managers respond to environmental management issues through the use of their costing systems. In contrast for the second factor, the p -value is 0.337, which is not statistically significant. This suggests that there is no meaningful difference among manufacturing sectors in terms of their success in managing environmental costs.

Table 16. Result of ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Management's Ability to Respond to Environmental Management Issues in respect of Costing Systems	Between Groups	9.574	7	1.368	6.551	.001
	Within Groups	43.426	208	.209		
	Total	53.000	215			
Success of the Company in Managing Environmental Costs	Between Groups	1.965	7	.281	1.144	.337
	Within Groups	51.035	208	.245		
	Total	53.000	215			

H3: There is an association between the cost structure and the ability to capture environmental costs.

The association between cost structure and the ability to capture environmental costs as measured by the two factors was assessed using a correlation analysis (Table 17). The correlation analysis did not find a significant association between cost structure and the ability to capture environmental costs as measured by the two factors. However, the analysis found that the "Other direct non-manufacturing overhead expenses", "Indirect manufacturing overhead expenses", and "Other indirect non-manufacturing costs" were negatively correlated with the two factors. Since the two factors showed reversed scores (i.e. a low score indicates that environmental costs are hidden in general overhead and indirect accounts), this finding is consistent with the literature reviewed previously. Perhaps a larger sample size would have yielded statistically significant results.

The association between cost structure and the two factor scores was examined using Pearson correlations (Table 17). Several specific associations are statistically significant. Direct material costs show small positive correlations with both factors ($p < .05$). Direct labor costs correlate positively with Management's Ability to Respond ($p < .01$). Among overhead-type components, Other direct non-manufacturing overhead is negatively associated with Management's Ability ($p < .01$), while Other indirect non-manufacturing costs is likewise negatively associated with Management's Ability ($p < .01$). Indirect manufacturing overhead shows negative but non-significant correlations with both factors. Because the factors are reverse-scored (i.e. a low score indicates that environmental costs are hidden in general overhead and indirect accounts), this finding is consistent with

the literature reviewed previously. Overall, H3 receives partial support: cost structure is related to the factors in a targeted way rather than uniformly across all components.

Table 17. Correlation analysis

	Management's Ability to Respond to Environmental Management Issues in respect of Costing Systems	1.Direct material costs	2.Direct labor costs	3.Other direct non- manufacturing overhead expenses	4.Indirect manufacturing overhead expenses	5.Other indirect non- manufacturing costs
Success of the Company in Managing Environmental Costs	.617**					
1. Direct material costs	.134*	.135*				
2.Direct labor costs	.215**	.063	-.019			
3.Other direct non- manufacturing overhead expenses	-.176**	-.067	-.516**	-.288**		
4.Indirect manufacturing overhead expenses	-.123	-.131	-.365**	-.604**	.099	
5.Other indirect non- manufacturing costs	-.176**	-.077	-.492**	-.427**	.006	.244**

** . Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Overall, the main significant finding revealed by the data analysis was that companies with Activity Based Costing systems have more ability to respond to environmental issues. Other interesting but non-significant findings are discussed in the discussion section below.

6. Discussion

The first hypothesis aimed to test for the association between the type of costing systems used in manufacturing SMEs in Saudi Arabia and measures of environmental costs. Most companies indicated that they have some sort of costing system in place, with 65% stating that they use a traditional costing system and 18.5 % stating they use ABC. The former system is simplistic [8], [26], also called an absorption costing system, in which all manufacturing costs are absorbed by products. ABC is a more sophisticated costing system [8], [26]. These results indicate that the majority of companies in the sample might not have the appropriate costing systems to capture environmental costs.

The results of the hypothesis test found that the Management's Ability to Respond to Environmental Management issues with Respect to Costing Systems was significantly associated with the type of costing system used. The Success of the Company in Managing Environmental Costs in the Recent Accounting Period was not found to be significantly associated with the type of costing system used. Therefore, the acceptance of the hypothesis by the first factor revealed what was suspected: companies using more sophisticated costing systems like ABC respond better to environmental issues and are better able to identify and manage environmental costs, such as preventing wastage and avoiding penalties and fines to environmental and regulatory bodies [41], [54].

This finding provides a clear direction as far as the main research question is concerned. There is evidence that changing the costing system from a traditional system to a more advanced one will likely translate to better

management of environmental issues and better environmental sustainability [55]. ABC uses advanced technology that allows identification of activity-cost pools and the choice of allocation bases, known as cost drivers, that provide unique measures for activities [23]. Consequently, ABC can accurately recognize and trace environmental costs to each activity, unlike traditional costing systems that hide environmental costs in general overheads and indirect cost accounts [6].

The second hypothesis aimed to identify any association between the type of manufacturing and the ability to capture environmental costs. Previous literature mentioned that environmental accounting methods (such as EMA) usually benefit environmentally sensitive sectors [25], [5]. An understanding of this issue is important, because if there were differences between types of manufacturing and their ability to capture environmental costs, then this would mean different strategies would be required to modify the costing systems at these companies.

The multivariate analysis did not find any significant association between the type of manufacturing and the ability to capture environmental costs. However, the analysis did find that the Management's Ability to Deal with Environmental Issues with Respect to Costing Systems and the Success in Managing Environmental Costs in the Recent Accounting Period were better in the wood and furniture manufacturing domain compared to other domains like food, beverage, tobacco, machinery, and equipment. This may be because there is a more direct and visible link between the environment and companies in wood and furniture manufacturing compared to companies in other domains. For example, one of the main raw materials for companies in wood and furniture manufacturing is wood, which comes directly from natural resources (i.e. plantations), whereas there is often no direct, visible link between packaged food and the environment. This suggests that companies in certain manufacturing sectors need to be more proactive when it comes to managing environmental costs and issues, as there are expectations that different sectors will have variable levels of intensity with respect to environmental pressures [15].

The third hypothesis examined whether the cost structure of a company is associated with its ability to capture environmental costs. This hypothesis addresses directly the way Saudi manufacturing SMEs currently identify and record such environmental costs. Survey data covered five cost components (Table 17; Appendix A), which are consistent with prior work [4]. We expected environmental costs to be hidden in overhead and indirect costs because SMEs are more likely to use traditional systems, as statistically shown by this study (Table 11), which tend to accumulate these costs in general overhead, rather than under materials or labor. Overall, the evidence partially supports H3: cost structure is related to the factors in specific components, and the pattern is consistent with literature showing that environmental costs are often embedded in overhead and indirect accounts [4], [9]. This underscores the need within manufacturing SMEs for more advanced costing systems capable of tracing environmental costs out of overhead pools and into activity-level drivers [4].

Recommendations have emerged from the hypothesis testing. The testing of the first hypothesis indicated that activity-based costing was much more effective than traditional costing when it came to classifying environmental costs. However, the vast majority of the companies in the sample used traditional costing. Therefore, there is an opportunity for SMEs from the Saudi manufacturing industry to switch from traditional to more advanced costing systems, though the literature review cited previously indicated that this is not always practical or easy. Implementing an advanced costing system can be difficult due to lack of resources, especially for small to medium enterprises [9], [25]. Therefore, the first recommendation is to policymakers and regulators (e.g. state and federal government), suggesting they provide incentives to SMEs in the Saudi manufacturing industry to switch from traditional costing to a more advanced and sophisticated costing. This would allow the environmental costs to be appropriately classified, which in turn would allow for a transparent understanding of the size and impact of environmental issues and costs. The benefits derived from such an initiative would have a ripple effect and would be passed on to the community at large.

The testing of the second hypothesis did not discover any significant findings. However, it was observed that certain manufacturing activities, such as furniture manufacturing, had a better capability at the management level to deal with environmental issues. Further investigation is required to validate this assertion. Therefore, the second recommendation is to encourage the private, public, not-for-profit, and academic sectors to invest more into research in this space. Over time, this will translate to further insights, as clearly there is a dearth of research on this topic.

The testing of the third hypothesis yielded several significant associations that clarify how SMEs currently allocate environmental costs: overhead-type components are negatively related to the (reverse-scored) ability factor, while direct materials and labor show positive links with ability/success. These patterns reinforce the view that environmental costs are often embedded in overheads and indirect accounts. This provides a good starting point for policymakers, regulators, and bodies responsible for setting environmental guidelines/standards to encourage manufacturing SMEs to adopt advanced costing systems, such as ABC and LCC, which will allow more efficient capturing of environmental costs via appropriate drivers and to assess costs “from cradle to grave” [4], [23]. Therefore, the third recommendation based on this research is to use the findings of this study as the starting point to make necessary changes to encourage manufacturing SMEs to adopt advanced costing systems. Such empirical findings should give sufficient confidence to policymakers, regulators, and bodies responsible for setting environmental guidelines/standards in their initiatives, in terms of providing practical guidance for tracing environmental costs out of overhead pools and into activity-level cost drivers.

7. Conclusion

The increased awareness of global warming and climate change in recent years has highlighted the importance of these issues. Collaboration is required at different levels of government, industry, and academia in order to address the environmental sustainability issues associated with businesses. One way to do so is through better management accounting. Appropriate accounting practices provide transparency and enable an understanding of the size and impact of environmental issues and costs associated with doing business. A review of relevant literature shows that researchers have studied environmental sustainability issues and solutions relating to management accounting for the manufacturing industry. However, such studies have predominantly focused on large enterprises. Unfortunately, there is a lack of relevant literature which deals with small to medium enterprises (SMEs) in Saudi Arabia. SMEs in Saudi Arabia are critical components of the Saudi economy and contribute a substantial amount to Saudi employment [10], [12]. Therefore, it is important to have such research available about SMEs in Saudi Arabia. The main research question that the researcher wanted to address was to establish whether or not the current design of costing systems for SMEs in the Saudi manufacturing industry can be modified to capture environmental costs.

The study design for this research followed a web-based survey in the framework of contingency theory in business. This kind of design was found to be most suitable for research on a small scale as it can be conducted and analyzed relatively quickly compared to other qualitative research methods. A survey was designed with the aim of capturing Saudi manufacturing SME demographic information, the cost structures used at these companies, the costing systems used at these companies, and how these companies respond to environmental issues and deal with environmental costs. The survey also aimed to uncover findings that would be representative of the activities at the SMEs in the Saudi manufacturing industry. It was sent to senior management at SMEs in the manufacturing industry of Saudi Arabia, including accountants, chief information officers, and chief executive officers. Final completed and valid responses numbered 216, accounting for a 15.1% response rate from the targeted sample.

A mix of descriptive statistics and multivariate analysis techniques was utilized to address the hypotheses from this research. Two factors that measure the ability to capture environmental costs were derived from the survey data. These factors capture information about two important dimensions related to the ability to capture

environmental costs. These factors are the Management's Ability to Respond to Environmental Management Issues with regard to Costing Systems, and the Success of the Companies in Managing Environmental Costs in the Recent Accounting Period.

The three hypotheses tested associations with (i) costing system type, (ii) manufacturing sector, and (iii) cost structure. The only across-group (between-system) significant finding was that firms using ABC show a better ability to respond to environmental issues. For cost structure, results provided partial support: several statistically significant correlations linked specific cost components (materials, labor, overhead-type accounts) with the two factors, consistent with environmental costs being concentrated in overheads. We used these findings together with non-significant but suggestive patterns to motivate the recommendations.

Three main recommendations have been made using the findings from this research. The first recommendation is for policymakers and regulators to provide incentives to SMEs in the Saudi manufacturing industry to switch from traditional costing methods to more advanced costing methods. This will likely translate to better classification of environmental costs, which in turn will translate to a more transparent assessment of the size and impact of environmental issues. The second recommendation from this research is to encourage the private, public, not-for-profit, and academic sectors to invest more into research in this space, as an association between various manufacturing activities and management accounting of environmental issues and costs is not known. The third and final recommendation from this research is that the findings should be used by policymakers, regulators, and bodies responsible for setting accounting guidelines/standards to encourage manufacturing SMEs to adopt advanced costing systems, which will allow for better capturing of environmental costs. Implementation of these recommendations would benefit communities, as businesses are likely to become more environmentally sustainable. These benefits may be in the form of better employment opportunities and more prosperity.

Most research has limitations associated with it and therefore leads to routes for future research. One limitation to this study is that the research would have benefited from a complimentary qualitative analysis. If the time and budgetary constraints of this project had permitted such an analysis, it would have allowed for more validations of some of the assertions borne from hypothesis testing.

Hence, future research should include a qualitative survey in the form of an interview with selected SME representatives from the manufacturing sector in Saudi Arabia. This will allow for the validation of such assertions. Furthermore, several other contingent variables may influence management's ability to capture environmental costs beyond what has been addressed in this study. For instance, the pressure resulting from environmental laws, public image, and customer satisfaction may motivate companies to adopt advanced environmental accounting tools [4], [41]. Hence, these variables and aspects that come from stakeholders other than management should be included in future research. Future work in this space would benefit from also including qualitative analysis and non-manufacturing SMEs.

Declaration of competing interest

The author declares that he has no known financial or non-financial competing interests in any material discussed in this paper.

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Ethical approval statement

Research ethics approval was obtained from the Research Ethics Committee at King Khalid University (HAPO-06-B-001).

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Appendix [A] – Survey Construct

Costing systems.

Costing systems are the systems that are used by organizations to estimate the costs of operations, goods, services and any other incurred costs in a specific entity. Costing systems provide cost and profit information, which used in both external and internal reports.

Section A: Costing systems’ design and application.

Do you use a costing system in your company? (Please tick in the appropriate box)

Yes []
 No []

Please use the following scale for questions 13 and 14. Please circle your answer.				
Never	Rarely	Occasionally	Frequently	Very Frequently

Which of the following costing systems are used in your company? (Tick the right answer or fill the space).

Traditional costing (*i.e. absorption costing system*) [] Others (Please specify) []
 Activity based costing (ABC) []

- If you picked “Traditional costing” please continue to question number 13 and onwards.
- If you picked “Activity based costing (ABC)” please proceed to appendix [B]
- If you picked “Others” please proceed to appendix [C]

Please indicate the extent to which of the following traditional costing systems are used in your firm?					
Job order costing system (<i>used for unique products</i>)	1	2	3	4	5
Process costing system (<i>used for identical products</i>)	1	2	3	4	5
Hybrid costing system (<i>Mixed of job order and process cost systems</i>)	1	2	3	4	5

Please indicate the extent to which of the following best describe the production types that are used in your firm?					
Many exclusive products are produced each <u>period</u>	1	2	3	4	5
The company produce a continuous flow of unites that are identical and use the same raw <u>materials</u>	1	2	3	4	5
Production is unique and different from every other production in the same period	1	2	3	4	5
The company produces either very large quantities of a single product or a small range of very similar products	1	2	3	4	5
Individual or relatively small and distinct batches are produced each period	1	2	3	4	5
The company produces more unique orders and batches than large quantities of a single product in the same period.	1	2	3	4	5
The company produces less unique orders and batches than large quantities of a single product in the same period.	1	2	3	4	5
The company produces the same level of unique orders and batches as large quantities of a single product in the same period	1	2	3	4	5

Because the company has not yet implemented ABC, please rank the influence of the following factors using the scale given below:

<i>High</i>	<i>Moderate</i>	<i>Low</i>	<i>Unimportant</i>
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You may use the same number more than once

- a) ABC is more complex and costly than traditional cost systems ()
- b) Lack of resources ()
- c) Lack of trained staff ()
- d) Management prefer to apply simple methods ()
- e) Management is satisfied with existing costing system and decision making process ()
- f) Other (Please specify)..... ()

Section B: Costing systems and their response to environmental costs issues*You may use the same number more than once**Use the following scale to provide answers for following questions, as applicable to your company:*

With regard to costing systems adopted by your company, rate the ability of management to respond timeously to Environmental Management (EM) issues:

<i>Environmental-related cost categories outlined by the International Federation of Accountants – IFAC (2005) are as follows:</i>	<i>Identifying relevant cost items</i>	<i>Measuring associated costs/savings/earnings</i>	<i>Identifying EM activities</i>	<i>Planning activities with cost/revenue estimates</i>	<i>Taking actions & measuring costs/savings/earnings</i>
a) Material costs of product outputs: <i>(purchase costs of natural resources such as water and other material that are convert into products, by-products and packing).</i>					
b) Material costs of non- product outputs: <i>(costs of energy, water and other materials that become waste and emission).</i>					
c) Waste and emission control costs: <i>costs (cost of handling, treatment and disposal of waste and emissions; remediation and compensation costs related to environmental damage; and any control-related regulatory compliance costs).</i>					
d) Prevention and other EM costs: <i>(costs of preventive EM activities i.g. cleaner production projects, and other EM activity such as environmental planning and systems, environmental measurement, environmental communication, and other relevant activities).</i>					
e) Research and development costs: <i>(costs related to environmental issues).</i>					

Evaluate the success of your company in the recent accounting period in **managing environmental costs**, using the following scales:

<i>EM activates undertaken relating to:</i>	<i>Attainment of Planned activity level</i>	<i>Adhered to planned costs</i>	<i>Minimized waste & emissions</i>	<i>Maximized savings/ earning</i>	<i>Minimized non-value added activities.</i>
Purchase of natural resources (Materials)					
Use of materials that become waste & emission					
Waste and emission control					
Preventive EM activities					