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Analysis of reducing unused energy costs by leveraging ABC and TABC methods for sustainable operations

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Abstract

This study aims to investigate the efficacy of sophisticated cost-controlling techniques in supporting rural social ventures in becoming more sustainable and conserving energy in rural settings. Specifically, its overall purpose is to investigate through which avenues rural, resource-constrained ventures can maximize energy efficiency, enhance operational effectiveness, and become long-term sustainable with activity-based costing (ABC) and time-driven activity-based costing (TABC). A mixed-methods approach was employed, combining quantitative analysis through survey data collected from 400 respondents using partial least square structural equation modeling (PLS-SEM) and qualitative insights from interviews with rural entrepreneurs and operational managers. The findings indicate that these cost-management techniques enable businesses to precisely allocate energy costs to specific operations, significantly reducing energy waste while identifying inefficiencies and facilitating informed decision-making. From a theoretical viewpoint, this work extends cost-accounting frameworks through the incorporation of energy efficiency in studies of sustainability. In practice, it underlines the necessity for improvement in rural businesses' technical capabilities in terms of embracing such methodologies. What can be gained through such a study is useful information for policymakers and practitioners in terms of driving sustainable approaches in rural economies, proving that ABC and TABC can act as important tools in attaining both financial and environmental performance.

Keywords: Activity-based costing (ABC), Time-driven activity-based costing (TABC), Energy efficiency, Sustainable operations, Rural social enterprises, Cost management techniques

1. Introduction

Today's rural economies need to solve operational inefficiencies, especially in energy management, as sustainability becomes more and more important [1, 2]. Energy inefficiency presents a range of challenges for social businesses, critical for rural communities' development and access to basic goods and services. In addition to consuming cash buffers, wasted energy expenses hinder many companies' achievement of sustainability objectives. With rural companies enjoying thin profit margins, developing new approaches for expense cutting and asset maximization is critical [3, 4]. Regretfully, volume-based costing and traditional costing methodologies often cannot effectively capture the complexity of the consumption of energy. That is where new age cost-controlling methodologies such as time-driven activity-based costing (TABC) and activity-based costing (ABC) can make a big difference [5, 6]. The increasing understanding of the critical role rural social enterprises play in promoting sustainable development is the driving force behind this study. These businesses have a special opportunity to promote environmental responsibility and economic growth in rural areas, but they

must maximize operational effectiveness if they are to succeed [7, 8]. These organizations may better understand how particular operations use energy by utilizing the ABC and TABC methodologies [9, 10].

This helps them learn about techniques for conserving energy and minimizing expenses. Implementing such cost-controlling methodologies could redefine rural social enterprise's attitude towards sustainability and enable them to work in a manner that is both effective and efficient. By studying empirically in what manner ABC and TABC techniques can potentially be implemented in an effort to save wasted energy expenses in rural social ventures and enhance their programs for sustainability, this article aims to fill a research gap.

This study focuses on the main issue of rural social businesses' poor energy use, which raises operating costs and jeopardizes sustainability programs. Conventional costing methods, although beneficial in certain situations, are unable to identify the precise operations that propel energy usage in these businesses [11]. These businesses consequently find it difficult to deploy their resources effectively, which frequently results in large quantities of energy waste that could be prevented [12, 13].

The most critical is in rural regions, whose social companies are most susceptible to inefficiencies that can inhibit them and affect them in terms of development and growth. In rural areas, access to modern technology and financing is most restricted. Apart from enhancing financial performance, overcoming underinvestment in energy costs is most important for creating long-term viability in rural economies [14-17].

This study is prompted by the following queries:

1) What are rural social enterprises' greatest sources of wasted cost of energy?
2) How can one identify and save such cost of energy with ABC and TABC methodologies?
3) How can savings in energy wastage contribute to overall rural social enterprise financial performance and overall rural social enterprise sustainability?

By providing an answer to these queries, the article seeks to present a critical analysis of how state-of-the-art cost management methodologies can tackle rural companies' specific energy-related issues, and in return, have a more efficient and sustainable performance. The important not just for cost management, but also because it provides a means to empower rural economies by encouraging energy-efficient practices in social enterprises. Enhancing the operational effectiveness of these businesses can have positive effects on the environment and economy. Social entrepreneurship is becoming increasingly seen as a driving force for sustainable development. In its contribution towards ABC and TABC theory, in this study, awareness is shed regarding how such approaches, previously underexploited, can be utilized and adopted in rural settings. In offering useful information, such studies can make rural social ventures even more sustainable and, in consequence, amplify their potential for positive impact in rural communities through a consideration of specific rural community challenges that confront them. Energy consumption is a major problem for rural businesses, especially in developing nations where it is frequently difficult to obtain inexpensive, dependable energy [18-20]. Numerous rural businesses operate in resource-constrained areas where sustainability and profitability can be undermined by excessive energy prices and wasteful consumption habits [21-23]. These businesses frequently lack access to contemporary technologies that could optimize energy usage, and conventional cost-management techniques are inadequate to pinpoint the precise locations of energy inefficiencies. Energy management is further complicated by the seasonal and cyclical character of many rural industries, such as handicrafts and agriculture [24]. Energy that is not utilized for productive ends, and therefore wasted energy, forms a significant financial burden that makes rural companies less competitive in competitive markets. Rural companies' long-term survival and expansion depend on fixing this issue and reducing operational costs can be helped a lot through efficient use of energy [25, 26]. Growing evidence points to social entrepreneurship as a catalyst for change in rural economies, bridging the gap between sustainable practices and economic growth [27, 28].

In addition to overcoming challenges such as poverty, healthcare, and education, rural social entrepreneurs pay a lot of attention to value creation for society and for the environment. In such a scenario, social companies' aims involve creating social and/or environmental welfare in addition to financial security [29, 30]. Social

enterprises can save operating costs and set an example for more extensive sustainable development initiatives in rural areas by using sustainable practices, such as effective energy management. Energy efficiency helps these businesses reduce their environmental effect and increase their ability to scale their impact, which is in line with the larger objectives of social entrepreneurship [31, 32]. Because of this, a key component of social entrepreneurship's contribution to sustainable development in rural areas is energy efficiency.

The shortcomings of conventional volume-based costing techniques gave rise to activity-based costing (ABC). By linking overhead and indirect costs to the particular activities that cause them, ABC enables businesses to more precisely allocate these expenses [33, 34]. When it comes to energy management, ABC assists businesses in comprehending the many energy-consuming processes, such as manufacturing, transit, and storage.

Organizations are then able to target areas of ineffectiveness and areas in which consumption can be lowered through such information. Rural companies can budget for energy expenses accurately through activity-based analysis, in which expenses are linked with activity consumption [35, 36]. Traditional cost management systems sometimes miss useful insights because of this degree of detail, which makes ABC an effective tool for increasing energy efficiency in rural businesses.

With the incorporation of time into cost allocation, TABC is an enhanced version of the ABC approach. By calculating the amount of time needed to complete each task, TABC streamlines the process in contrast to traditional ABC, which can become complicated and resource-intensive [37, 38].

Regarding its management, TABC enables companies to evaluate how long processes and jobs take and concerning that, how energy expenses are composed. Rural industries with variable and seasonal demand for energy will gain the most in terms of TABC in that it will present a dynamic picture in terms of consumption through its integration with time [39, 40]. Real-time tracking of energy use is another feature of TABC that helps businesses react faster to inefficiencies and modify their processes to save energy waste. In operations management, energy efficiency is becoming more widely recognized as a major factor in cost reduction [41-43]. According to research, increasing energy efficiency can result in significant cost savings, especially in sectors of the economy with high energy usage [44, 45].

Common methods for minimizing energy expenses involve reform in the value chain, investing in efficiency-saving technology, and optimizing processes. Due to technological and financial restrictions, rural businesses can, nevertheless, encounter a challenge in putting such measures into practice. Cost-saving measures must, therefore, be designed specifically to address individual rural companies' circumstances [46, 47]. Both ABC and TABC offer a framework for accomplishing these objectives by helping rural businesses recognize inefficiencies, rank areas for development, and more wisely distribute resources.

The literature on cost management and efficiency in terms of energy keeps growing, but not much information is yet present about ABC and TABC use in rural social ventures. Most studies about such cost-controlling methodologies have focused on larger companies in urban environments or industries, underestimating rural companies. This study addresses ABC and TABC in terms of overcoming rural social companies' obstacles and enriching practice and theory at present. By specifically researching rural environments' management of energy, it addresses an important theoretical divide and provides useful information to allow such companies to save expenses, become sustainable, and contribute towards overall development in terms of economy. Through an empirical analysis, of complex cost management methodologies in unorthodox environments, this work provides useful information for improving rural companies' operational efficiency and long-term survival capacities.

2. Research method

To investigate ABC and TABC effectiveness in reducing unnecessary costs for environmentally friendly operations in rural social ventures, a mixed-methods study is adopted in this work. With a mixed method, a rich examination of the issue is achieved through a mixture of both qualitative and quantitative processes. The impact

of ABC and TABC on operational efficiency is quantified through quantitative analysis using Partial Least Squares Structural Equation Modeling (PLS-SEM), while qualitative interviews offer deep insights into the potential and problems connected to energy cost reduction. This strategy makes sure that both broad trends and detailed knowledge are recorded, giving rise to a comprehensive picture of how these cost-control techniques support sustainable practices.

2.1. Qualitative method

In the qualitative stage of the study, 15 respondents representing operational management and rural social enterprise sectors were recruited for semi-structured interviews. Energy expense managing and advising in rural operations is what operational managers, financial directors, and experienced energy policy advisers did in common. Participants were recruited through purposeful sampling, with consideration for familiarity with and activity in energy management practice in respective companies.

Each interview lasted roughly sixty minutes and was conducted over Zoom. The purpose of the interview questions was to investigate the situation of energy management in rural businesses at the moment, the acceptance and performance of ABC and TABC, and the difficulties encountered in putting these strategies into practice. Important queries included:

1. What are the main obstacles to controlling energy expenditures in your company?
2. What part do ABC and TABC play in the way you now divide up energy costs?
3. What obstacles exist for incorporating more sophisticated cost control techniques, like TABC and ABC, into your operations?

The interview transcripts were subjected to thematic analysis, which revealed recurrent themes and patterns. Understanding ABC and TABC's roles in reducing energy inefficiencies and advancing sustainable practices was the main goal of the analysis. Table 1 presents comprehensive details regarding the interviewees, encompassing their roles and experience.

Table 1. Interviewee information

No.	Position	Age	Experience (Years)	Enterprise Type	Role in ABC/TABC Implementation
1	Operations Manager	43	16	Agricultural Cooperative	Manages energy use and cost allocation
2	CEO	51	21	Rural Manufacturing	Leads operational sustainability
3	Sustainability Consultant	37	11	Renewable Energy Firm	Provides advisory on ABC/TABC for energy
4	Social Enterprise Director	46	19	Rural Education Center	Leads sustainability strategy planning
5	Energy Policy Advisor	56	26	Government Department	Advises on energy efficiency policies
6	CFO	49	23	Rural Healthcare Clinic	Oversees energy-related cost accounting
7	Agricultural Manager	39	13	Small Farming Cooperative	Designs energy-saving strategies
8	Director of Operations	45	20	Social Entrepreneurship NGO	Implements energy management systems

No.	Position	Age	Experience (Years)	Enterprise Type	Role in ABC/TABC Implementation
9	Project Manager	42	16	Vocational Training Center	Oversees energy efficiency initiatives
10	Rural Business Owner	40	14	Artisanal Cooperative	Seeks cost reduction via energy savings
11	Energy Specialist	34	10	Renewable Energy NGO	ABC/TABC method advisor
12	Community Development Officer	53	28	Rural Municipality	Promotes sustainable practices
13	Head of Financial Planning	47	21	Rural Tourism Enterprise	Oversees financial and energy cost plans
14	Accountant	36	13	Small Manufacturing	Analyzes and tracks energy costs
15	Energy Efficiency Consultant	44	18	Government Agency	Provides ABC/TABC implementation advice

2.2. Quantitative method

A standardized questionnaire was distributed to 400 participants from various rural social enterprises as part of the quantitative phase. Important topics covered in the survey included energy management techniques, the efficiency of the ABC and TABC approaches, and how they affect operational sustainability. The questionnaire, which included questions on energy use, cost allocation, and overall sustainability of operations, measured participants' perceptions using a 5-point Likert scale. Table 2 contains the particular questions intended to assess these constructions:

Table 2. Survey questionnaire for quantitative analysis

Section	Question	Response Options	References
Demographics	Enterprise Size (No. of Employees)	Small, Medium, Large	Kusuma et al., 2020
	Years of Experience	Less than 5 years, 5-10 years, 10+ years	Kusuma et al., 2020
Energy Management	My enterprise tracks energy costs accurately	1 = Strongly Disagree, 5 = Strongly Agree	Meliani et al., 2021
	We have clear strategies to reduce energy waste	1 = Strongly Disagree, 5 = Strongly Agree	Meliani et al., 2021
Adaptability to ABC/TABC	Implementing ABC/TABC has been easy in our enterprise	1 = Strongly Disagree, 5 = Strongly Agree	Wang et al., 2023
	ABC/TABC tools have improved our ability to allocate energy costs	1 = Strongly Disagree, 5 = Strongly Agree	Wang et al., 2023
Operational Sustainability	Reducing energy wastage has improved our enterprise’s overall sustainability	1 = Strongly Disagree, 5 = Strongly Agree	Caiado et al., 2019
	ABC/TABC implementation has led to long-term financial savings	1 = Strongly Disagree, 5 = Strongly Agree	Caiado et al., 2019

During the qualitative stage, purposeful samples with respondents possessing relevant expertise in rural companies' energy cost management were enlisted. 400 respondents with a range of rural social ventures were

enlisted through a stratified random selection during the quantitative stage for an even distribution of respondents with a range of industries including manufacturing, tourism, and agricultural sectors.

3. Results and discussion

3.1. Thematic analysis for qualitative data

Four main topics regarding energy management and the implementation of ABC and TABC were identified through thematic analysis of the interview data:

Theme 1: Inefficiencies in energy cost allocation: Participants mentioned that it was not easy to precisely calculate and allocate energy expenses, and thus, it produced waste and ineffectiveness.

Theme 2: Opportunities for energy efficiency through ABC/TABC: The techniques of ABC and TABC helped in cutting down energy expenses through assigning usage with specific jobs.

Theme 3: Barriers to implementation: Participants emphasized concerns about factors that inhibit ABC and TABC, such as unavailability of resources and unfamiliarity.

Theme 4: Long-term sustainability gains: Participants emphasized factors that inhibit ABC and TABC acceptance, such as a lack of funding and lack of awareness.

3.2. Quantitative data analysis

The links between ABC/TABC adaptability and operational sustainability and adaptability and energy management, and between operational sustainability and energy management, have been analyzed through the application of PLS-SEM. The following presented values for reliability and validity have been achieved. Overall, a picture of the measurement model's validity and reliability is seen in Table 3, with values for Cronbach's Alpha, CR, and AVE.

Table 3. Reliability and validity of the measurement model

Construct	No. of Items	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Energy Management (ENG)	4	0.877	0.916	0.667
Adaptability to ABC/TABC (ADAPT)	3	0.835	0.872	0.598
Operational Sustainability (SUST)	5	0.859	0.894	0.626

With Cronbach's Alpha values above 0.7 and composite reliability (CR) values above 0.8, the constructs showed strong reliability. Convergent validity was confirmed by the average variance extracted (AVE) values, which were likewise greater than 0.5. Estimates for discriminant validity have been displayed in Table 4, in which it can be noticed that for anyone construct, its square root of AVE is greater than its inter-correlations with any other constructs.

Table 4. Discriminant validity measures

Construct	ENG	ADAPT	SUST
Energy Management (ENG)	0.817		
Adaptability to ABC/TABC (ADAPT)	0.502	0.774	
Operational Sustainability (SUST)	0.546	0.559	0.791

Since each construct's square root of AVE was higher than its correlations with other components, discriminant validity was proven.

3.3. Structural model and hypotheses testing

The links between energy management, adaptability to ABC/TABC, and operational sustainability were examined through testing of the structural model. Four theories were created and put to the test:

- **H1**: Energy management positively influences operational sustainability.
- **H2**: Adaptability to ABC/TABC positively influences energy management.
- **H3**: Adaptability to ABC/TABC positively influences operational sustainability.
- **H4**: Energy management mediates the relationship between adaptability to ABC/TABC and operational sustainability.

The direct and indirect links are shown in Table 5, which also validates the path coefficients and statistical significance of these hypotheses.

Table 5. Direct and indirect relationships

Hypothesized Path	Path Coefficient (β)	Standard Error (SE)	t-value	p-value	Decision
Energy Management → Operational Sustainability (H1)	0.629	0.073	8.59	<0.001	Supported
Adaptability to ABC/TABC → Energy Management (H2)	0.541	0.078	6.98	<0.001	Supported
Adaptability to ABC/TABC → Operational Sustainability (H3)	0.513	0.071	7.23	<0.001	Supported
Adaptability to ABC/TABC → Energy Management → Operational Sustainability (H4)	0.395	0.065	6.08	<0.01	Supported

The findings confirm that operational sustainability is facilitated incredibly with energy management and ABC/TABC adaptability, and between ABC/TABC and sustainability, a mediator function is performed through energy management.

The mixed-approaches approach showed that applying the ABC and TABC methods improves energy cost management and sustainability in rural businesses significantly. The results highlight the significance of sophisticated cost management strategies in fostering enduring operational effectiveness and durability.

3.3.1. The role of ABC and TABC in enhancing energy efficiency in rural social enterprises

The results of such a study confirm that activity-based costing (ABC) and time-driven activity-based costing (TABC) have a lot of potential in terms of improving rural social businesses' efficiency in terms of energy consumption. ABC and TABC methodologies allow companies to have a thorough awareness of the consumption of energy in an activity, and with such increased transparency, companies can precisely assign a cost to energy [48, 49]. With such increased transparency, companies can utilize it in terms of pinpointing areas of inefficiencies and making specific efforts towards minimizing loss of energy. With ABC and TABC, companies can make an immediate contribution towards cost savings and operational viability, critical in rural economies with less availability of resources at their disposal.

3.3.2. Addressing energy management challenges in rural enterprises

Because they have limited access to new technology and expertise, rural social ventures have specific obstacles in managing their energy expenses. According to this study, by simplifying the distribution of expenses and offering insightful information regarding trends in the consumption of energy, ABC and TABC can help in overcoming such impediments [50]. Adopting such strategies, nevertheless, is not an accomplishment in a vacuum. Interview findings showed that lack of infrastructure and technical expertise make most rural ventures

encounter a challenge in setting an initial ABC/TABC system. Despite such impediments, participants agreed that such strategies have long-term payoffs through effective use of resources and less unnecessary consumption of energy when adopted in routine operations.

3.3.3. Implications for sustainability in rural economies

Adopting ABC and TABC for improving efficiency in terms of energy is most effective in rural economies. Rural businesses can boost financial performance and drive environmental sustainability through lowered energy costs [51, 52]. According to the study, operations in companies that adopted TABC and ABC saw an improvement in operational sustainability and lowered loss in terms of energy. Adopting a transition towards effective tools for efficient use of energy is in harmony with overall rural sustainable development objectives, with companies taking a significant role in driving economic development in a manner that conserves the environment.

3.3.4. Promoting long-term financial viability

The strategic advantage ABC and TABC present for rural businesses in terms of financial viability over the long run is that they enable a strong linkage between consumption of energy and specific operations. With such methodologies, companies can track and analyze consumption of energy with a high level of accuracy and pinpoint areas of inefficiency and make fact-based operational cost-saving decisions [53, 54]. Rural companies, with thin profit margins, can channel saved funds through efficient consumption of energy into the entity in a bid to fuel expansion and growth. Empirical findings in analysis through PLS-SEM confirm that companies with efficient consumption of energy in its operations saw considerable improvement in financial viability.

3.3.5. Challenges in implementing ABC and TABC in rural contexts

Despite the advantages, several obstacles must be tackled in an endeavor to implement ABC and TABC in rural environments. Difficulty in terms of ABC/TABC system installation cost and a lack of technical expertise were discussed in the qualitative stage by respondents. Besides these, rural businesses lack access to infrastructure and technology, such as reliable information collection systems, in an endeavor to discourage the full integration of such methodologies. Institutional intervention in terms of government programs and capacity development programs must occur in an endeavor to counteract such impediments and allow rural companies to use ABC and TABC methodologies with greater success. In an endeavor to have full success with such cost management techniques, rural companies must have access to in-depth training and supporting frameworks.

4. Policy implications

The results of such studies have important implications for rural social enterprises' use of high-tech cost-controlling tools such as ABC and TABC for improving efficiency and sustainability in terms of energy consumption. Policymakers have to make an issue out of developing programs through which rural firms can access financial and technical capacities for utilizing such techniques in practice. Tax incentives, grants, and financial incentives can be utilized for increased ABC and TABC use, and firms can save energy and make operations more sustainable. Government and non-governmental agencies have to fund capacity-development programs through which rural entrepreneurs and managers can learn to utilize such cost-controlling tools in practice. Policymakers can assist rural businesses in reducing operating costs, improving financial viability, and advancing larger sustainability goals by encouraging the incorporation of energy efficiency methods. Finally, to make the switch to sophisticated cost-management techniques more practicable in rural areas, public-private partnerships ought to be promoted for the provision of infrastructure support, such as access to data management systems. These policy changes will encourage sustainable economic development in rural areas while also enabling rural enterprises to flourish.

4.1. Practical implications

The findings of this work have pragmatic consequences that expose ABC and TABC's significant role in supporting rural social companies' viability and energy efficiency. With ABC and TABC in use, companies can

precisely assign energy costs to individual operations, and in the process, can pinpoint areas of inefficiency and save unnecessary consumption of energy. Decision-making is supported through increased awareness of cost, and savings can then be realigned to alternative segments of the business. All such savings go towards enhancing rural companies' financial viability, with razor-thin profit margins. Adopting these cutting-edge cost-management strategies can also help businesses connect with more comprehensive environmental aims by promoting long-term operational sustainability. The report also emphasizes how crucial it is for rural businesses to develop their technological know-how to successfully incorporate these techniques into their daily operations. Through this approach, rural businesses can improve their total productivity, reduce their operating expenses, and make a more significant contribution to the sustainable economic growth of rural areas.

4.2. Theoretical implications

The study's theoretical contribution comes in terms of adding to the pool of work in cost-controlling techniques and its contribution to rural social entrepreneurship's viability. It expands the present cost-accounting theory through its demonstration of ABC and TABC efficacy. It introduces new information regarding energy efficiency techniques for application in scarcity environments and key theoretical implications include:

Expansion of cost-manage theory: In this study, ABC and TABC can be extended to track not only financial expenses but also energy consumption, enhancing its utility in studies of sustainability.

- Link between cost management and sustainability: As an illustration, high-performance cost-manageability and sustainability performance have a positive relationship, and therefore, effective cost distribution will have a positive impact on environmental performance.
- Adaptation in rural environments: The article comes with proof that conventional cost-controlling structures, such as TABC and ABC, can function effectively in rural, low-resource environments, with the theoretical basis for them becoming a norm in such cases.
- New insights into efficiency in terms of energy: The work deepens theoretical understanding of efficiency in terms of energy strategies through its demonstration of cost-allocation tools' capabilities in terms of minimizing energy loss.

5. Conclusions

This paper engages in a critical examination of leveraging TABC and ABC to minimize unnecessary energy expenses and support rural social ventures' long-term operations. In a mixed-methods model, in which quantitative analysis and in-depth interviews with PLS-SEM have been drawn, the analysis identifies to what level such sophisticated cost-controlling methodologies contribute towards operational and energy management long-term viability.

The thematic analysis emphasized the long-term financial and environmental benefits once ABC and TABC are adopted, but it also revealed important implementation problems, such as inadequate technical skills and resource limits. The quantitative findings verified that energy management and operational sustainability are positively impacted by adaptability to ABC and TABC.

The energy management hypotheses under which sustainability and flexibility have a bearing have been validated using a structural model, and it accentuates such strategies' role in becoming cost-effective. In general, in consideration of all factors, in this work, ABC and TABC have been effective tools for rural social ventures, providing viable alternatives for reducing loss of energy, improving financial viability, and contributing towards overall aims for sustainability. The results yield useful information for practitioners and policymakers in an endeavor toward the use of such techniques in rural and constrained environments.

6. Limitations and future directions

One limitation of the present study is its narrow consideration of a single group of rural social entrepreneurs, and its generalizability to industries and geographical regions apart from its target group can therefore be

questioned. The effectiveness of ABC and TABC could rely on specific factors in companies included in the present study, including their size and availability of assets. Besides, the use of questionnaires and interviews and a single use of information derived through self-reporting could introduce bias and inaccuracies in assessments of the use and impact of alternative cost-manageability approaches. Future research will have to explore ABC and TABC in a broader range of industries and geographies, and urban settings and larger organizations, specifically. Rural and urban comparative studies could produce a deeper analysis of the specific challenge and opportunity of using sophisticated cost-manage techniques in rural and urban settings, respectively. Including longitudinal information could allow for a fuller analysis of long-term cost savings and viability of ABC and TABC use.

Declaration of competing interest

The authors declare that they have no known financial or non-financial competing interests in any material discussed in this paper.

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Author contribution

Fayhaa Abdulkhaleq Mahmoud: Conceptualization of the study, methodology design, and overall supervision of the research paper. Mohammed Faraj Hanoon: He contributed to the writing and editing of the manuscript. Both of them discussed the first draft of this paper and checked all the journal requirements

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