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Leveraging activity-based costing and information technology strategic enhancements in decision-making, and competitive advantage in industrial projects

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A B S T R A C T

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This study examined the impact of activity-based Costing ABC and information technology IT on decision-making and competitive advantage in Sudanese industrial projects. The experimental results of this study were based on a questionnaire administered to accountants and administrators in 61 industrial projects in Sudan, and the data were analyzed using partial least squares. The study's results indicate that using activity-based costing and information technology methods in determining costs, evaluating company profits, and approximating product costs positively affects managerial decisions while improving the competitive advantage of industrial projects. The use of activity-based Costing and information technology affects decision-making and competitive advantage in industrial projects in Sudan. The study recommended that continuous training helps obtain the benefits of using activity-based Costing and information technology in industrial projects. The results show that the result gained from using activity-based Costing and information technology in determining costs, decision-making, and expanding competitive advantage has been affected by attending training programs, gradually, based on learning the capabilities of the activity-based costing system and the information technology system.

1. Introduction

Costs based on activities (ABC) emerged as a vital tool in industrial projects, particularly since companies seek more and more competitive advantages through the informed decision-making process. By thoroughly assigning costs to specific activities, ABC allows organizations to identify the true cost of products and services, leading to better price strategies and improved operational efficiencies. The effectiveness of ABC is, in particular, amplified if combined with information technology (IT), which simplifies data collection, processing, and dissemination. This synergy improves decision-making processes and provides companies with a robust picture to respond quickly to the dynamics of the market (Kocakulah et al., 2017; Al-Nuaimi et al., 2017; Martens et al., 2017). Organizations must know their cost structure in this aggressive and competitive business environment. The era of globalization has added extra pressure on management to improve their competitiveness, stay in, or achieve it. It is evident from the literature that the traditional method of cost formulation does not provide accurate product costs (Dubihlela & Rundora, 2013; Huang et al., 2012). Thus, management may be misled in the decision-making process. The drawbacks still carry on into those modern methods of cost formulation. Therefore, modern business enterprises need to adhere to those cost determination techniques that provide real insights into the 'true path' costs of products created, assisting management in making enlightened business decisions to some extent and ensuring a product's profitability. The decision-making models within the activity-based costing ABC promote a detailed understanding of the cost drivers, allowing organizations to make informed choices regarding the allocation of resources (Tsai et al., 2014). the integration of ABC within the life cycle assessments in ecological construction projects has proven advantageous for

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environmental sustainability while guaranteeing financial profitability (Tsai et al., 2015; Ghezzi et al., 2015); this approach helps companies make strategic decisions that align with economic and ecological objectives, improving their competitive advantage (Driscoll, 2022).

Activity-Based Costing (ABC) has gained wide acceptance in modern enterprises. It is seen as a 'costing methodology' that can be used to avert some of the drawbacks of traditional methods. Activity-Based Costing ABC gives companies a precise viewpoint on the costs of performing operations, handling customers, making and delivering commodities, and other routine activities in the business (Căpuşneanu et al., 2011). Activity-Based Costing ABC emphasizes that only some of the activities in an organization consume resources and recommends that costs are traced, as best as feasible, from overhead macro cost centers to those activities that carry out those resources. Past research studies have stated that most of the activities in an organization are basically 'routine activities' and suggest that special attention is given to those 'key activities' that the organization fares most. Although these perspectives have mainly been supplied to manufacturing enterprises recently, researchers have discovered that they are similar to those of the service sector. In addition, ABC has repercussions on other areas of internal accounting. Its implications are seen in budgeting, the operation of performance measurement systems, and the attainability of cost data for strategic advantage. On these grounds, this paper examines current methods of cost formulation and efforts to illustrate the concepts of Activity-Based Costing ABC, its evolution, and its implications for practice in today's context.

Increasing the value of these activities can increase the competitive advantage of a firm. There are several methods that have been developed for adding value to the core activities in the firm. One method that is gaining popularity among companies is activity-based cost management (ABCM). ABCM as a system can provide managers with a strategic view of the activities that are essential to the competitive nature of the enterprise (Beheshti, et al., 2004).

This study examines how activity-based costing and information technology affect decision-making and support competitive advantage in Sudanese industrial projects.

2. Literature review and hypothesis development

2.1 ABC, Decision-Making and Competitive Advantage in Industrial Projects

Costs based on activities (ABC) is a managerial accounting method that aims to understand better the costs associated with specific organizational activities. Unlike traditional cost methods that allocate general costs based on a single measure, such as working hours or hours of the machine, ABC assigns costs to activities based on their actual resource consumption. This refinement allows organizations to dissect their cost structure more granularly, allowing decision-makers to identify the areas for reducing costs, improving efficiency, and creating value (Pinto, 2020). The Conceptual Foundation of Activity-Based Costing ABC emerged in the 80s as a response to the increasingly complex needs of production and supply of services. The companies were struggling with global competition and the need to understand profitability more deeply.

Historically, the introduction of ABC has significantly transformed project management paintings by aligning financial analysis with strategic objectives. Pinto (2020) maintains that the ABC's ability to provide the decision-makers with insights on the behavior of costs and the use of resources plays a fundamental role in improving the project's decision-making process. This is particularly salient in the sectors characterized by projects based on the project, such as the construction, production, and development of the software, in which an effective allocation of resources can determine the feasibility of the project and the adhesion to the temporal sequence. The method not only supports financial transparency but also promotes a culture of responsibility between the teams involved in the execution of the project.

The relevance of the ABC extends beyond simple cost monitoring; it substantially removes how organizations allocate resources. The application of ABC allows companies to identify high-cost activities that may not produce high corresponding yields. These intuitions facilitate the strategic reallocation of resources towards more profitable projects, promoting a culture of informed decision-making based on empirical data (Thompson et al., 2013). Using ABC, organizations can prioritize projects that align with their long-term strategic objectives, thus simplifying operations and improving efficiency. An efficient allocation of resources becomes critical in sectors with thin margins or significant competition, such as health care and retail sales. By using ABC, organizations can refine the drivers of actual costs of the projects, allowing them to optimize expenses and reduce unnecessary general expenses. In addition, using ABC plays a strategic role in achieving a competitive advantage in various sectors. The information provided by ABC not only helps in the internal management of costs but also improves external strategic positioning. Companies can use ABC data to improve price strategies, mix product decisions, and assess customer profitability. This deepening granular level promotes the ability of an organization to respond to market fluctuations and consumer needs in a more skilled way, thus improving its competitive position in a crowded market (Thompson et al., 2013). This literature revision explores the multifaceted implications of costs based on activities in different sectors, with particular emphasis on how its strategic implementation influences the project's decision-making processes, the efforts to allocate resources, and the research of the competitive edge. The factory environments, the service sectors, and non-profit

organizations can benefit from ABC's structured approach, which transforms raw data into what can be used. By examining ABC's intersections with various project management paradigms, the revision tries to outline the essential role of this cost method in facilitating the organizations' informed and strategic decision-making process. Costs based on activities (ABC) significantly influence the project's decision-making processes, allowing an estimate and provision of the most accurate project costs. Traditional cost methods often cannot capture the complexities of the consumption of resources, leading to insufficient information that can distort the decision-making process. On the other hand, ABC assigns costs to specific activities based on their adequate consumption of resources, providing a more transparent link between the underlying costs and activities that involve them. This granularity allows the project manager to make informed decisions by offering insights on what activities are the driving costs and where it is possible to reach efficiency (Cooper, 2017a).

The basis of accurate estimate and forecasting of the costs lies in the report between calculated costs and strategic objectives of the project. Cooper (2017b) highlights how target costs can serve as a precious picture if combined with ABC. In this process, the organizations aim to determine the allowed cost of a project by subtracting the desired profit margin from the competitive market price of the product or service. This approach requires significant precision in costs on costs, as it establishes a point of reference to which the team members must join in their efforts to allocate resources during the execution of the project. Therefore, the accurate data of the costs derived by ABC inform the project costs and the entry staff to improve performance and reduce waste, namely the principles of value engineering core.

Study cases further illustrate the effectiveness of the Activity-Based Costing ABC in real-world project scenarios. Kerzner (2013) indicates examples in the construction sector where companies employed ABC to simplify their project management processes. In a remarkable study, a construction company that implemented Activity-Based Costing ABC reported that the project managers could identify the hidden costs associated with specific activities that had previously been neglected. This new clarity has allowed the organization to regulate workflows and allocate resources more effectively, ultimately improving the fulfillment of the budget and the project deadlines. In another case, a production company used ABC to perfect its product development cycle, identifying which design elements were at a high intensity of costs and, therefore, ripe for re-enlargement. This allowed the optimization of resources and a reallocation of time and effort towards elements that offered a more excellent value to the customer, ensuring a critical competitive advantage.

In addition, integrating Activity-Based Costing ABC with predictive analysis is becoming increasingly widespread in the project's decision-making process. By exploiting the historical data derived from the ABC framework, organizations may provide for future project costs more precisely, allowing proactive adjustments rather than reactive measures. The potential of this synergy creates significant opportunities for organizations in various sectors to improve their strategic project results while safeguarding their investments in resources. Through the lenses provided by Cooper (2017a) and the empirical tests documented by Kerzner (2013), it becomes evident that the costs based on the activities act as a transformative tool in optimization not only of the estimate of the costs and processes of the landscape., Costs based on activity (ABC) provide organizations with a robust framework to understand cost engines and the use of resources, thus improving the strategic allocation of resources. According to Dale and Plunkett (2017), adopting quality cost practices in the ABC model considerably strengthens resource management capacities. By determining how resources contribute to specific activities and processes, ABC offers organizations the analytical tools to identify the sub-performative areas that can siphon precious resources without giving corresponding yields. This level of clarity allows managers to allocate resources more strategically, ensuring that capital and human resources are directed to areas that offer the potential of a maximum generation of value, as Nagle et al. (2023).

ABC's implications extend beyond the individual project's delimitation, significantly impacting broader organizational strategies, including supply chain management. Cooper (2017b) underlines the importance of the ABC in the alignment of resource allocation decisions in various functional fields within an organization. By offering a detailed overview of the costs associated with specific activities through the supply chain, ABC facilitates an inter-functional approach to resource effectiveness, often lacking traditional cost methods. This is particularly relevant in scenarios where the interdependencies of resources are complex, and decisions in a field can considerably affect others.

With an integrated vision of costs, organizations can make informed decisions on suppliers or the processes to be prioritized depending on their contributions to value creation. For example, the ideas obtained by ABC could reveal that some suppliers contribute to cost reductions in several downstream processes, which prompted an organization to promote these strategically. ABC's accuracy in identifying activities that disproportionately consume resources allows companies to rationalize their supplier base and renegotiate contracts according to analyses based on the activity of cost and value contributions. Thus, deploying resources via ABC not only preserves capital but also improves the agility and responsiveness of the supply chain, which stimulates competitive advantages in the constantly evolving markets (Almeida et al., 2017).

In addition, ABC's ability to provide detailed information on operational ineffectiveness allows organizations to reconfigure resource allocation dynamically and more efficiently while adapting to changes in customer demand or market conditions. An effective allocation of resources supported by the results of the ABC not only leads to a reduction in waste and increased profitability but also strengthens the organization's position by collecting opportunities sensitive to time that require responses

to agile resources. While organizations are sailing in the complexity of their resource environment, ABC's clarity is essential in allocating resources that align with tactical objectives and strategic visions. By prioritizing where resources can be deployed most effectively, companies can make a user effect that considerably improves their global competitive advantage in various industries. The role of costs based on activities (ABC) in guaranteeing a competitive advantage in various sectors is increasingly recognized in contemporary literature, particularly dynamic skills (Ferreira et al., 2020). ABC allows organizations to obtain refined insights into their cost structures and the consumption of resources associated with specific activities and processes. This granularity of the information can be fundamental for the decision-making process, as it allows organizations to understand where their resources are used more efficiently and highlight mature areas for innovation. The integration of ABC in the project's decision-making processes provides companies with the analytical bases necessary to align their strategic initiatives with current market demands, thus promoting an environment in which adaptation and innovation thrive (Conforto et al., 2014).

Investigating the intersection between ABC and dynamic abilities reveals how companies exploit accurate cost methods to improve their innovative capacities. According to Ferreira et al. (2020), companies implementing ABC are better positioned to identify opportunities for improving processes, simplifying operations, and facilitating a faster response to market changes. This is essential in industries characterized by rapidly evolving consumer preferences or technological progress. Organizations that use ABC can spin their resources towards projects that promise higher yields on investments, thus optimizing the allocation of resources and strengthening their competitive position. However, the benefits of Activity-Based Costing ABC depend on the external and internal dynamics of the operational environment, underlining the contingent value of ABC as laid by Schilke (2014). A practical implementation of ABC requires companies to have the methodology and the ability to adapt their strategic approaches in response to the floating market conditions. Organizations in dynamic environments exploit ABC to align their costs more strategically, with an eye to efficiency and agility. This interaction supports an adaptive business model; Companies that use ABC can recalibrate their project wallets in response to market feedback or emerging trends more quickly than those based on traditional cost methods.

Research claims that organizations that apply ABC methodologies are better equipped to guarantee and maintain a competitive advantage under various levels of market dynamism. Wamba-Taaguimdje et al. (2020) note that Activity-Based Costing ABC companies can improve their reactivity by analyzing and reporting data in real-time, facilitating informed decision-making. In the sectors in which customer preferences are unpredictable, the shaded ideas provided by ABC allow for planning the most reactive project and allocating resources that align with the customer's demand, thus supporting the competitive edge.

In summary, the literature indicates that ABC's adoption is not simply an accounting innovation; It is basically intertwined with the conceptual picture of dynamic skills. By facilitating a clearer understanding of the costs of activities, ABC allows organizations to cultivate a culture-oriented culture that embraces change and encourages innovation. The convergence of ABC with strategic management underlines a critical paradigm in which organizations can navigate more skilled than their competitive landscapes, affirming the need to integrate sophisticated cost methodologies within the wider strategic framework. This alignment positions organizations to react to challenges and anticipate and model market opportunities, thus improving their competitive advantage between the divergent sectors. The examination examined illustrates a convincing case for the significant impact of activity based on activity (ABC) on the project's decision-making, the allocation of resources, and the competitive advantage in various industries. ABC's ability to provide a nuanced understanding of cost engines facilitates the improvement of decision-making processes by allowing managers to make informed assessments of the viability and profitability of the project. Numerous studies indicate that organizations that exploit ABC are better placed to identify activities with high-cost intensity and eliminate ineffectiveness, thus refining their project selection and project prioritization. This finally improves the project results and maximizes the return on investment (Fuchs et al., 2021; Lee & Swe, 2022).

The allocation of resources is another area deeply influenced by ABC. By offering a clear map of the use of resources and the costs incurred in producing goods and services, ABC allows organizations to adopt a more strategic approach to consider traditional financial measures and qualitative information on deploying resources. As evidenced by the results of Kumar et al. (2023), organizations that effectively exploit ABC can align their resources more closely with organizational objectives, thus guaranteeing optimal performance and adaptability in resource-limited scenarios. The increased visibility of cost behavior allows managers to distribute resources strategically, generating better financial results and aligning them with organizational objectives (Dixit et al., 2021).

The competitive advantage appears to be a central theme of ABC's integration into organizational processes. The literature says that ABC offers organizations distinct information contributing to their market strategic positioning. By understanding costs and profitability at a granular level, companies can be differentiated by improved customer service, pricing strategies, and targeted investments in high-value projects. A study conducted by Ramirez & Garcia (2023) underlines that companies employing ABC not only carry out cost savings but also undergo innovation in product development, thus strengthening their competitive advantage over rivals that may not take advantage of detailed analysis of costs. However, despite the noted advantages, several areas justify a more in-depth exploration. As digitization increasingly reshapes traditional commercial models and market dynamics, the implications of ABC integration into digital tools and data analysis present unique

opportunities and challenges. Future research could study how organizations can optimize the use of ABC in parallel with the progress of artificial intelligence and automatic learning to increase decision-making capacities during large data sets (Parviainen et al., 2017). In addition, examining ABC's adaptability in agile methodologies and project-focused environments could give a significant overview of how organizations in industries at a rapid pace can maintain their competitive position. In addition, it is increasingly necessary to assess the relevance of the ABC in emerging markets and entrepreneurial companies where traditional cost structures may not apply. The exploration of the implementation of startups and small and medium-sized enterprises (SMEs) could provide precious case studies demonstrating flexibility and the applicability of this cost method in various contexts (Grant, 2024). In the end, the literature synthesis establishes that the cost based on activity remains a vital tool for organizations that strive to improve the project's decision-making, optimize the allocation of resources, and benefit from competitive advantages. While the commercial landscape continues to evolve, particularly in digitization and change in consumer expectations, ABC's relevance and applicability as an integral component of contemporary management practices deserve university attention and Practical exploration (Beheshti, 2004).

Through the above studies, we formulated the following hypotheses:

H_1: *ABC affects decision-making in industrial projects.*

H_2: *ABC affects competitive advantage in industrial projects.*

2.2 IT, Decision -Making and Competitive Advantage in Industrial Projects

In summary, integrating costs based on information technology represents a formidable approach to improve decision-making processes and guarantee competitive advantages in industrial projects. Although challenged by several factors, successful implementation can lead to a better study in cost structures, aerodynamic operations, and potential innovation. The organizations that navigate these challenges, seen through various examples of the real world, can obtain substantial benefits, positioning themselves favorably in a competitive panorama; through the strategic alignment of ABC with it, companies cannot only improve their internal processes but also cultivate a far-sighted culture about future challenges and opportunities (Nkeobuna & Ugoani, 2019). Data analysis is essential to transform unprocessed information into processable ideas. It has been shown that integrating business intelligence (BI) tools improves the quality of decision-making processes, acting as a mediator that improves data interpretation and strategic results (Wieder & Ossimitz, 2015). This capacity allows organizations to analyze market trends, customer preferences, and operational performance, thus facilitating a data-based strategy formulation. Gunasekaran et al. (2017) emphasize that it enables logistics and supply chain management, allowing companies to obtain a competitive advantage through a better prognosis, reduced operating costs, and a greater capacity to respond to market demands. The role of Big Data management in increasing decision-making capacity has become increasingly evident, particularly within Chinese companies that adopt dynamic capacity frames (Shamim et al., 2019). In addition, incorporating knowledge management practices is essential to promote a culture of innovation and strategic thinking, which are critical to maintaining a competitive advantage (Meihami & Meihami, 2014). Knowledge management initiatives allow organizations to use their internal data and experience, facilitating informed decision-making aligned with general commercial objectives. This is corroborated by Abubakar et al. (2019), who claim that an approach arranged in decision-making styles can substantially influence organizational performance results.

Communication, as a central component of it, significantly improves collaboration efforts within industrial projects. Effective communication ensures that relevant information flows perfectly between interested parties, thus speeding up processes and promoting a cohesive project environment (Silvus et al., 2017). The ability to communicate efficiently through digital platforms not only accelerates the dissemination of information but also encourages transparency, which is crucial for the participation of interested parties and the success of the project; in this regard, improved communication platforms can lead to a better alignment of project objectives and improve interested parties (Kaiser et al., 2015). In addition, e-government in project management is essential to address the implementation risks associated with communication breakdown, ensuring that projects adhere to regulatory standards while improving operational transparency (Khatib et al., 2020).

IT solutions in project management allow monitoring and real-time reports, directly influencing productivity levels (Kerzner, 2022). Organizations can obtain immediate information on project performance by establishing key performance indicators (KPIs) and using panels, allowing rapid corrective actions (Kerzner, 2018, 2022). This integration leads to a reduction in the bad allocation of the waste of time and resources, which ultimately increases operational efficiency (Olanipekun et al., 2015). In addition, technologies such as artificial intelligence can improve decision-making processes, which allows companies to perform rational analyses that promote effective marketing and operations strategies (BAG et al., 2021). IT investments also allow companies to innovate and adapt more quickly to changes in the market, a study on agility and innovation of the supply chain shows that taking advantage of it can lead to significant improvements in competitive advantage by promoting a rapid adaptation culture to changing market conditions (Chen, 2018). The surrounding environment is often uncertain, and organizations that use it to assess risks and develop strategic responses are better positioned to mitigate adverse impacts (Saeidi et al., 2019).

Ramifications of these advances in information technology also extend to sustainability considerations. Shrivastava (2018) postulates that adopting environmental technologies contributes to a competitive advantage and encourages companies to integrate sustainability in their strategic planning processes. This is aligned with the feelings resonated in the research of Mavi and Standing (2018), which identifies critical successful factors for the management of sustainable projects in construction. Addressing sustainability mitigates risks and improves a company's reputation, thus creating a robust competitive differentiation. Additionally, a well-rounded decision-making framework integrating Industry 4.0 technologies showcases the transformative power of digital advancements in industrial environments (Soni et al., 2022). This method encourages companies to investigate different technological options by adopting effective strategies, which helps ensure their operations stay efficient and competitive. Through the correct application of IT tools and strategies, organizations refine their decision-making processes and improve their competitive positioning in the market. Continuous investment in data analysis, effective communication, and operational efficiency through you leads to measurable improvements in performance, adaptability, and sustainability; ultimately, these dimensions of information technology are intertwined, forming a solid base on which industrial projects can prosper in the middle of a constantly evolving commercial panorama (Galliers, 1993). The influence of information technology (IT) on decision-making processes in industrial projects is profound, improving various aspects such as efficiency, collaboration, and overall project results. Key tools such as Building Information Modeling (BIM) have revolutionized the financial decision-making process in construction projects by providing a framework for better evaluating the project's profitability (Lu, Won & Cheng, 2016). In addition, there is a flourishing focus on multi-crown decision-making methods (MCDM) that exploit data to optimize maintenance in the era of Industry 4.0 (Bousdekis et al., 2021; Mardani et al., 2017).

Strategically, adopting Agile Project Management has extended beyond software development in other industrial sectors, facilitating faster adaptation to changes in project requirements (Confort et al., 2014). In addition, the paintings for sustainability are increasingly integrated into the decision-making process of project management, revealing a growing consciousness of long-term impacts (Silvius et al., 2017; Marcelino-Sádaba, González-Jaen and Pérez-Ezcuria, 2015). This integration aligns with the growing need for metrics and key performance (KPI) to evaluate the project's success (Kerzner, 2022). The collaboration tools enabled by it, as discussed by Hazır (2015) and Radujković and Sjekavica (2017), improve the interaction of the interested parties, leading to more informed decisions. The comparative analysis between management methodologies of the Agile and Waterfall project highlights the importance of the context in selecting methods, suggesting that the right approach can significantly influence the efficiency of the project (Thesing, Feldingn, & Burchardt, 2021). Decision support systems that use Fuzzy logic and other advanced techniques offer complete solutions to complex decision-making scenarios, simplifying the essential processes for the project's success (Mardani et al., 2015; Yazdani et al., 2019). As the industrial landscape evolves, the attention to a robust decision-making framework will continue to model the project's results, underlining its critical role in rationalization and encouraging collaboration (Driscitl, Parnell, and Henderson, 2022; Merrow, 2024).

Through the above studies, we formulated the following hypotheses:

H_3: *Information technology affects decision-making in industrial projects.*

H_4: *Information technology affects competitive advantage in industrial projects.*

3. Methods

In this study, industrial projects are considered the community to which the analysis was applied. The study sample includes all accountants and administrators in Sudanese industrial projects. An electronic questionnaire was designed and arbitrated by academics specialized in accounting. A survey sample of (35) individuals was taken from the study community via the LinkedIn platform. The reliability of the questionnaire was calculated from the survey sample using Cronbach's alpha equation, where the reliability coefficient reached 90%. The results of the split-half method are shown in Table 1. After that, 230 questionnaires were distributed to study sample on the LinkedIn platform, where 140 accountants and 90 administrators were collected. SPSS and the Partial Loop Squares (PLS-SEM) test were used to analyze the questionnaire and test the hypotheses.

4. Result and Discussion

4.1 Evaluating the measurement model

Convergent Validity: Convergent validity evaluates the variance of latent variable loadings. It is assessed using Average Variance Extracted (AVE) (Legate et al., 2023) and indicator loadings (Hair Jr., Joseph F., et al., 2014; Fornell & Larcker, 1981; Chin, 2009). The factor loading should be at least 70%, and the AVE should be at least 50% (Hair Jr., Joe, et al., 2023).

Table 2 and Figure 1 demonstrate that the AVE is greater than 50%, and the factor loading exceeds 70%, confirming high convergent validity.

Consistency Reliability: Consistency reliability measures the uniformity of results across items within the same test (Hair Jr., Joseph F., et al., 2010). Internal consistency validity is evaluated through Composite Reliability (CR) and Cronbach's Alpha (CA). The CA must be at least 70% (Cronbach, 1951), while the CR should also be a minimum of 70% (F. Hair Jr. et al., 2014). Table 2 and Figure 1 show that the CA and CR values for all latent variables (ABC, IT, Decision, and Competitive Advantage) exceed 70%, confirming high internal consistency reliability. Once validity and reliability have been established, discriminant validity must be verified. Table 3 illustrates the structural model's discriminant validity, revealing that each latent variable's correlation with itself is higher than its correlation with other variables, as explained by Bagozzi & Yi (1988) and Bagozzi et al. (1981). Thus, discriminant validity has been confirmed.

Table 1
Loading Matrix

	ABC	Competitive Advantage	Decision-Making	IT
ABC1	0.828			
ABC2	0.863			
ABC3	0.819			
ABC4	0.853			
CA1		0.840		
CA2		0.921		
CA3		0.893		
CA4		0.878		
DM1			0.809	
DM2			0.855	
DM3			0.926	
DM4			0.863	
DM5			0.869	
IT1				0.848
IT2				0.901
IT3				0.868
IT4				0.843
IT5				0.892

Table 2
Result of Measurement Model

Variables	Cronbach's	Composite	Average Variance
ABC	0.862	0.906	0.707
IT	0.920	0.940	0.758
Competitive	0.906	0.934	0.781
Decision-	0.915	0.937	0.748

Table 3
Discriminant validity

Discriminant	AB	Competitive	Decision-	IT
ABC	0.8			
Competitive	0.5	0.884		
Decision-	0.5	0.761	0.865	
IT	0.6	0.733	0.839	0.8

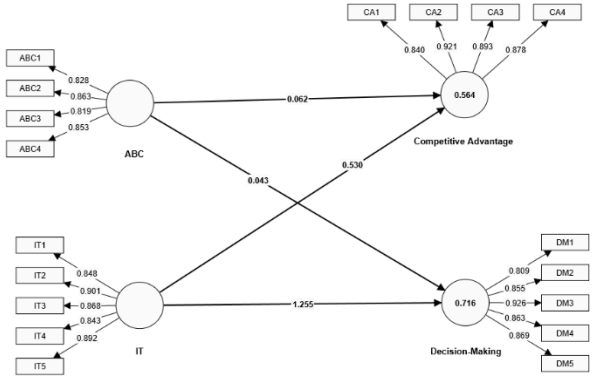

Fig. 1. loading, R-square, and F-square

4.1 Structural model assessment

Structural model assessment involves evaluating the coefficient of determination (R^2) and effect size (F^2) as outlined by Hair et al. (2019). The coefficient of determination (R^2) measures the variance in the dependent variables that the independent variable can explain. Its value ranges from zero to one. Specifically, an R^2 value is considered strong if it is 0.67 or higher, moderate if it falls between 0.33 and 0.67, and weak if it ranges from 0.19 to 0.33 (Lin et al., 2020). As shown in Table 4 and

Figure 1, our findings indicate a strong R^2 value of 0.716 for the Decision-Making variable and a strong value of 0.564 for the Competitive Advantage variable. This suggests that Decision-Making explains 72% of the variance in ABC and IT, and competitive advantage explains 57% of the variance in ABC and IT, highlighting the strength of the linear relationship between the independent and dependent variables.

Table 4
R-square

Dependent Variable	R-square	R-square adjusted
Decision-Making	0.716	0.711
Competitive Advantage	0.564	0.556

The effect size (F^2) measures the strength of an independent variable's impact on a dependent variable. An F^2 value is categorized as large if it is greater than or equal to 0.35, medium if it falls between 0.35 and 0.15, small if it ranges from 0.15 to 0.02, and indicates no effect if it is less than or equal to 0.02. According to the data presented in Table 5 and Figure 1, the effect size of ABC on Decision-Making is 0.043, which is classified as small. Similarly, ABC's effect size on Competitive Advantage is also small at 0.062. In contrast, the effect size of IT on Decision-Making is significantly large at 1.255. Moreover, IT's effect size on Competitive Advantage is also classified as large, with a value of 0.530.

Table 5
F-square

F-square	Decision-Making	Competitive Advantage
ABC	0.043	0.062
IT	1.255	0.530

4.2 Path Analysis

The final step of Partial Least Squares Structural Equation Modeling (PLS-SEM) involves path analysis through linear regression, which is used to test the study's hypotheses and assess the direct and indirect effects of independent variables on dependent variables (Lin et al., 2023). As illustrated in Table 6 and Fig. 2, the analysis revealed a direct negative effect of the ABC on Decision-Making at a significance level of 0.05. The beta coefficient (β) was 0.140, the t-statistic was 1.775, and the p-value was 0.076. Therefore, the first hypothesis (H1) was rejected. Additionally, the ABC had a direct positive effect on competitive advantage at a significance level of 0.001. Here, the beta coefficient (β) was 0.207, the t-statistic was 2.397, and the p-value was 0.017, supporting the second hypothesis (H2). Furthermore, a direct positive effect of IT on Decision-Making was found at a significance level of 0.001. The beta coefficient (β) reached 0.754, the t-statistic was 10.900, and the p-value was 0.000, thus supporting the third hypothesis (H3). Lastly, IT directly affected competitive advantage, which was also at a significance level of 0.001. The beta coefficient (β) was 0.606, the t-statistic was 6.613, and the p-value was 0.000, confirming support for the fourth hypothesis (H4).

Table 6
Path Analysis

Hypotheses	**Path**	β	**T statistics**	**P values**	**Decision**
H1	ABC → Decision-Making	0.140	1.775	0.076	Rejected
H2	ABC → Competitive Advantage	0.207	2.397	0.017	Supported
H3	IT → Decision-Making	0.754	10.900	0.000	Supported
H4	IT → Competitive Advantage	0.606	6.613	0.000	Supported

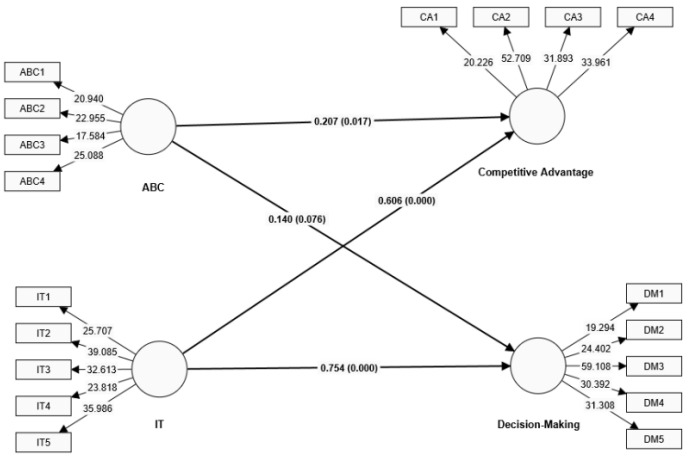

Fig. 2. Path Analysis

5. Conclusion

This research investigates the application of new decision-making models, with a specific focus on Sudanese industries. Despite their potential, Sudanese industries are often underrated and overlooked by global economies and industry participants. The expected outcome of this research is to demonstrate a practical implementation of Activity-Based Costing (ABC) and Information Technology (IT) specifically in the area of budgeting decision-making within these industries. This approach aims to enhance their performance in comparison to global competitors. The synergy generated in the production system emphasizes the need to optimize all parameters and utilize resources wisely. In this context, effective decision-making processes are essential for achieving the desired performance. The findings provide valuable insights for industrial decision-makers, enabling them to make efficient decisions. The paper illustrates the positive impact of implementing Activity-Based Costing and Information Technology on optimizing decisions within the production systems of industries. To broaden the applicability of these findings, the study proposes a practical model and potential sustainable solutions that can enhance production systems in Sudanese industries, with relevance to other industries as well. This model will help decision-makers concentrate on crucial factors in their specific decision-making contexts. Furthermore, the enhancement of Activity-Based Costing and Information Technology can help decouple regulations related to input factors, allowing for the normalization of information and completion of necessary data required for informed decision-making. On the other hand, the optimization model relies on the available normalized information, providing decision-makers with the advantage of reducing procurement. Ultimately, decisions within Sudanese industries can focus on critical levers that improve the sustainability of the industrial production system.

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