

Exploring Theoretical Foundations of Activity-Based Costing

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DOI: <https://dx.doi.org/10.47772/IJRISS.2024.803212S>

Received: 10 July 2024; Revised: 18 July 2024; Accepted: 23 July 2024; Published: 28 August 2024

ABSTRACT

This paper aims to explore the theoretical foundations of Activity-Based Costing (ABC) by examining its underlying assumptions, key concepts, methodology, applications and future directions. ABC emerged as an innovative approach to address limitations in traditional costing methods by assigning overhead costs based on activities and cost drivers. The paper at first discusses ABC's assumption that products consume activities, and activities consume resources. Key concepts of activities, cost drivers and cost pools are then defined. The methodology of how ABC traces costs from activities to cost objects is outlined. Applications across industries are reviewed and benefits of more accurate product costing is discussed. Challenges in implementation like extensive data requirements are acknowledged. Emerging trends integrating ABC with technologies like real-time costing, analytics and artificial intelligence are also examined. The paper argues that understanding ABC's theoretical foundations is essential for effective organizational adoption and optimization of its strategic decision-support capabilities. Continuous refinement will strengthen ABC's relevance in the evolving business landscape.

Keywords: Activity-Based Costing, Management accounting, Cost allocation, Product costing, Cost management

INTRODUCTION

Activity-Based Costing (ABC) emerged as a significant innovation in management accounting, aiming to address limitations with traditional costing paradigms. Traditional approaches often oversimplified the allocation of overhead costs, potentially resulting in distorted product costs and flawed managerial decisions (Adachi et al., 2022). These conventional techniques typically relied on aggregated averages and arbitrary allocation bases, failing to capture true resource consumption patterns (Alahmari, 2023). Activity-based costing is one of the prominent innovations in management accounting that appeared at the end of the 20th century. Activity-based costing is a costing method that classifies activities in an organization and allocates the cost of each activity to all products and services rendering to the real consumption by each. Thus, this model dispenses more indirect costs into direct costs compared to traditional costing. Perhaps, it was a response to the limitations of prevalent traditional simulations of costs and allocation of overheads to calculate proper product costs. The range of traditional techniques utilized in the early 20th century and before usually employed predetermined aggregate averages and averaged arbitrary threat ability estimation used to spawn costs and allocate overheads. Such system, apparently, could hardly represent the real resource usage.

In contrast, ABC provides a more nuanced approach by tracing costs to activities and then assigning them to cost objects based on consumption of those activities. This enhances the behavioural representation of costs, enabling more informed managerial decision-making (Williams, 2020). The present review seeks to delve into ABC's theoretical underpinnings, exploring its foundational principles, assumptions, and key constructs such as cost drivers, activity centres, and cost pools. Understanding these elements can help organizations implement ABC to achieve improved cost management, pricing strategies, and operational efficiency. By addressing limitations of traditional paradigms, ABC emerged as an important innovation with potential to complement management accounting practice. On the other hand, ABC goes a step further in ascertaining cost due to the nature of the relationship that exists between costs and the production of an activity. The costs are also ascertained with reference and the different activities and events contained in it. Costs are then charged to

be products or activities after being assigned to any pool and therefore, they enable not only more detailed cost allocation but also more cost drivers of activities which offers a better behavioural representation of the costs leading to potentially better managerial decisions. This paper is aimed at looking at the theoretical foundation of the ABC, the assumptions and other constructs such as activity centres, cost pools and the cost drivers that are used in the ABC system. This knowledge is to be used in explaining how ABC can be adopted in an organization for Cost Management, current Pricing practices and even increased efficiency. Thus by solving problems of traditional methodologies, the ABC system presents a major innovation that has great potential in complementing the practice of management accounting.

METHODOLOGY

The present paper aims at a critical review, whereby existing knowledge is integrated to generate a theoretical framework explaining the essence of ABC. Consequently, it should be hoped that scholars and practitioners are offered an updated and fresh view on the ideas and directions for future research in this significant area. Finally, the paper about application of ABC on various industries and future studies section which provides insights on new areas for research. This study is therefore concerned with seeking to identify the theoretical underpinning of the ABC system with reference to an audit of the available literature and mapping of conceptual developments over time. In a systematic sequence, this paper reviews previous arguments on the concepts of ABC activities, strategic cost drivers, and indirect costs dealing with ABC.

UNDERLYING PRINCIPLES AND ASSUMPTIONS OF ABC

Principle of Causality

The original concept that has been at the core of ABC, is the concept of cause, that is, the premising that the costs should be accrued based on the activities that prompted the costs (Blaschke et al., 2020). This especially goes against traditional costing approaches that of ten assigned overheads through non-resourceful measures such as direct labour hours or machine hours thus not depicting a cost behaviour.

The principle of causality is used in cost management in an attempt to offer accurate physical expressions of costs based on the systematic allocation process starting from omnibus costs, through activity costs, and finally these costs are distributed to individual products and services on some activity sale volume basis. The supporters state that this resembles actuality more accurately since referring costs to their source is more reasonable than allocating overheads (Alzly, 2024). The approach understands that various activities require different types and quantities of resources, and in return, these outputs necessitate different levels of such activities. Rather than superficially distributing overhead using broad averages, ABC disaggregates costs into discrete cost pools, identifies the activities generating each pool, and determines appropriate cost drivers to assign expenses based on demand for underlying activities (Borges et al., 2024). Thus, ABC aims at offering a better depiction of full product or service costs for decision making and performance evaluation.

Assumptions of Homogeneity

A core assumption underpinning ABC is activity homogeneity within defined activity centers (Cidav et al., 2020). This presumes activities grouped within the same centre consume resources in a comparable manner, which is integral for precise cost assignment across the model's stages. Heterogeneous resource demands within an activity centre could undermine accurate tracing and allocation of costs to individual activities and downstream cost objects. If some activities require significantly more or less resources than others in their pool, average cost driver rates may not appropriately reflect underlying consumption patterns (Erokhin et al., 2024). This could distort the behavioural cost representations that ABC aims to provide. Researchers remind that it is necessary to clearly define the boundaries of activity centres in a way that they cover only the operations that have substantially similar resource requirements. Combining different activities threatens the accuracy of potential consumption relationships, and hence the realism of costs allocations. Certain studies extend this by implying that further specific INTER-CENTER cost pools or cost drivers may be appropriate for other grouped activities which are highly diverse (Jalalabadi et al., 2018). Idea of activity centres and their

specific definition and composition is therefore a fine implementation consideration which if violated will negatively impact the homogeneity premise and therefore the precision and use-value of cost data as generated. It also means that the further empirical analysis of the practical applicability of this assumption's limitations may be useful to enhance the deployment of ABC applications. This seems crucial to fine-tune activity centres to potentialities suggested by the model's conceptualization of behaviour-based costing on a detailed level (Kudanga et al., 2023).

Cost Behaviour and Variability

Another postulate to the ABC is that costs are not the same as production volume, which means that more complex cost behaviour patterns should be taken into account. According to the extent of costs' variability in relation to the underlying activities, expenses can be classified as variable, fixed or mixed costs (Madwe et al., 2020). Unlike what previous paradigms have assumed, numerous overhead expenditures have stronger relations with non-volume elements such as setup frequencies, number of inspections or purchase order sizes under the ABC system. Thus, by taking into account that cost drivers can go beyond output measures, the approach's aim is to embrace various behavioural patterns and distribute costs more effectively. This brings to focus behaviourally profiling costs, towards enhancing the accuracy of the cost assignment process. Research evidence supports the approach to classify costs based on the cause rather than making a crude assumption and relating the costs directly to production volume. Possessing a behaviour-based perspective makes a number of differences in assessment of cost creation logics and, therefore, in managerial decision-making. This may also be helpful in cost control and in the overall pricing strategies in use (Pietrzak et al., 2020). In summary, cost behaviour analysis is one of the foundations of ABC because it eliminates volume-based assumptions and helps in refining the cost drivers.

Activity Hierarchy

A hierarchical conceptualization of activities is integral to the ABC framework. Activities are commonly classified into four interrelated levels to facilitate comprehension of cost generation and assignment dynamics. Unit-level activities are performed for each individual product unit, such as direct machine operation. Batch-level activities support groups of units manufactured concurrently, like product changeovers (Prasetyo et al., 2020). In this case, product-level activity refers to specific activities related to the entire line of products with reference to the company's structure composed of design and engineering functionalities (Williams, 2020). Last but not least, general activities managed at the facility level support maintenance of general buildings, utilities, and infrastructure. This structure is multi-tiered in order to acknowledge the fact that different activities incur costs on different scales. It also depicts hierarchies in activity which means that outputs of higher levels call for lower level activities (Robinson et al., 2023). For instance, a batch setup leads to other unit production setups. The hierarchy supports analysis of value chain to distinguish cost clusters and cost contributors. Further, it also helps in the tracing of cost from the final department to a specific item in facilities department costs such as broad facility level cost pools to narrow product level cost pools and actual product costs.

This nuanced perspective aims to capture cost interrelationships and assign expenses to cost objects dependent on complete activity consumption profiles (SAEDON et al., 2023). Overall, the activity hierarchy forms a conceptual backbone facilitating implementation and interpretation of ABC models.

KEY CONCEPTS

Cost Drivers

A critical element of the ABC framework is the identification of appropriate cost drivers that reflect the causal relationship between activities and resource usage. Cost drivers refer to the factors that influence fluctuations in activity costs, and their selection is integral to the precision of the cost assignment process. Examples of such driver types include transactional, where some of the most used factors are order volumes, and duration which targets time-based usage (Saeed et al., 2023). However, the selection of drivers should match the aspect

that activities require various quantities of resources. For instance, activity such as labour, may be more relevant with time-based drivers as compared to, transactional-based measures. Researchers stress on identifying the cost drivers that should be based on the actual observed consumption data instead of using some convenient but not real variable. Another problem caused by a mismatched driver is the distortion of behavioural cost representations that ABC intended to offer (Myca et al., 2023). Moreover, given that the activities and their cost characteristics could change with time, it is feasible to regularly assess and rebalance the associated drivers to maintain the model's reliability. Finally, it is essential to discern some cost drivers, and thus capture relationships of certain activities to costs that are representative of the actual cause-and-effect relationships with resource consumption basically from which the ABC system gets its essential fidelity and applicability. It has to therefore constitute a failure for any theory that is offered to this discourse that it has not achieved careful empirical examination and validation of proposed drivers.

Activity Centres

One of the key concepts of ABC is activity centres, also known as cost centres that is the parts of the organization where definite activities occur. The proposed segmentation means grouping customers into centres to enable the achievement of a more efficient manner of carrying the cost tracing exercise (Zamrud et al., 2020). Especially important for achieving accuracy is the assumption that each centre contains activities with similar characteristics that use resources in the same way. Heterogeneity could compromise the objectivity of the cost driver spreads that were assigned leading to a distortion of the behavioural costs. Examples of typical centres defined within the manufacturing context are machining, assembly and inspection that tend to demonstrate significant process continuity. Exploration of required resources offers direction to the makeup of the centre, although some research showed that internal centre pools may be necessary under specific circumstances. Definition is, therefore, a critical implementation consideration. Even though the creation of arbitrary cost pool segmentation may be administratively convenient, staying true to the homogeneity premise becomes a fundamental element of the ABC method's objective of accurately tracking cost behaviours (Susilowati et al., 2023). Further strengthening of the predictive abilities might be achieved if such assessment and corrections of centre configurations are performed on a continuous basis.

Cost Pools

Cost pools represent accumulated expenses associated with specific activities within defined centres. Pooling aims to streamline cost allocation while preserving the logical linkage between activities and generating costs. When there are multiple drivers or arbitrary bases, there is a threat of altering behavioural relationships that ABC aims to clear (Pietrzak et al., 2020). Therefore, the validation that chosen drivers significantly affect pooled costs enhances the validity of allocations derived therefrom. Some research goes further by suggesting that it is possible to implement intra-pool granularity especially where there is large driver heterogeneity (Prasetyo et al., 2020). In general, the cost pool construct is equally derived from such theoretical goals and pragmatic concerns that include simplification. Satisfactory design and validation of the pool-driver relationships remain essential in healthy ABC deployments. Future evaluation and updating may also enhance the system performance even more in the future.

EXPLORATION OF ABC CONCEPTS

Identifying and Mapping Activities

One of the essential primary strategies of operationalizing the ABC framework is the systematic documentation of all VA and NVA activities within the focal organization (Madwe et al., 2020). This critical step requires an understanding of each and every process to identify all activities and tasks which require the consumption of resources. In its essence, documenting the text comprises all possible kinds of activities from unit level like equipment setups to multifaceted support functions such as customer service as foundational work for subsequent model construction. The only time it is possible to have adequate visibility of each component in the value chain is when the value chain elements are fully recognized. As researchers pointed out, it remains essential to undertake a thorough empirical analysis to capture each activity's technical

specification, inputs, outputs and interactions. The measures of cost allocation are the cost pools whereby an incomplete or a limited approach can merely overlook such volumes which might have some influence hence reducing precision and usefulness. Challenging, the mapping work also produces diagnosis benefits such as revealing optimization opportunities (Khoruzhy et al., 2022). In general, the elaboration of the identification and documentation of the entire activities across the organization enables the creation of a strong base in which to develop the efficient application of ABC.

Assigning Costs to Activities

A subsequent critical step following comprehensive activity identification is appropriately assigning costs to each established segment. This involves directly tracing direct expenditures like material to causative activities along with allocating indirect expenses in accordance with consumption patterns. For example, electricity supporting manufacturing may represent an indirect cost that demands allocation to pertinent operations (Jalalabadi et al., 2018). Merely proportional distribution risks obscuring behavioural insights, conflicting with ABC's objective of accuracy. Emerging techniques may facilitate cost assignment. Sensor-based systems promisingly enable activity-level cost tracking at a granular level. Standard cost models also supplement ABC when actual data proves unavailable. Overall, properly assigning costs constitutes a pivotal ABC implementation step, with validity and transparency central to delivering actionable cost representations (Gold et al., 2022).

Determining Cost Drivers

An important part of ABC implementation is the functional selection of cost drivers that accurately symbolise the causal relationship between activities and underlying resource demands. Cost drivers refer to the factors influencing fluctuations in activity costs, and their empirical identification is integral to model precision (Cidav et al., 2020). For a cost to be meaningfully assigned, its generating activity must correlate to a valid cost driver.

If setup frequency causally impacts labour expenses for a production operation, for example, the number of setups emerges as the right driver variable. Scholars emphasize the importance of drivers emerging from observed consumption patterns rather than arbitrary proxies to avoid distorting the behavioural insights ABC aims to provide. Retrospective analysis of cost behaviours helps substantiate proposed driver-activity linkages. Periodic re-examination also ensures continuing relevance as processes and cost structures evolve over time (Borges et al., 2024). While demanding analytical work, identifying well-matched drivers forms a linchpin of the framework's ability to faithfully represent cost causation. Overall, properly ascertaining cost drivers grounded in empirical evidence represents a pivotal success factor underpinning robust ABC implementations.

Assigning Costs to Cost Objects

An attested stage of any ABC implementation is taking a systematic decision over the frequencies with which activity costs get apportioned to the appropriate cost objects making use of identified cost driver details. Hence, cost objects are usually value-generator products, services, project or customers whose costs the system aims at revealing. This objective is attained through tracing an accumulation of activity costs to objects abiding by consumption trends (Zamrud & Abu, 2020). Thus, given that a specific product requires proportionally more setups and inspections compared to other potential choices, for example, a greater share of activities' costs reasonably would be linked to this product. Prompted by the formulated cost drivers, quantitative consumption measures make it possible to derive accurate allocations. Scholars note the importance of allocation rationales anchored in empirical analysis rather than arbitrary attribution. Only behaviours-based assignments maintain consistency with ABC's objective to illuminate cost causation.

CHALLENGES AND LIMITATIONS OF ABC

Complexity and Implementation Costs

While ABC implementations undoubtedly demand substantial investments of time, personnel and technology resources that dissuade some organizations, emerging techniques promise to optimize the framework's benefits relative to costs. Traditional ABC methodologies requiring exhaustive activity identification and cost tracing present formidable analytical challenges (Myca et al., 2023).

However, the integration of process mining along with machine learning and data capture methods can enhance implementation activities. Other lesser approaches such as the traditional cost modelling or even the activity level specificity in calculating productivity also assist in countering the dilemma related to availability of data that has in the past posed a big challenge to the ABC as known to Tsai et al., 2024. Web-based solutions on the other hand reduce the costs of ongoing maintenance due to consolidation of data in one location, and use of analytics. That is nonetheless true, ABC still implies non-trivial resource mobilisation which calls for proper attention to strategic goals and cash availabilities. On the other hand, due to the ability of generating value by providing better decision making, it may be explained that costs of ABC are reasonable for many organizations. Altogether, one can state that in the case of pure ABC implementations some barriers are observed, however, new hybrid approaches, tailored to better reveal strategies for working in the digital environment, seem to reveal the maximum of advantages in terms of the amount of resources needed. It is still sensible to strike a balance of costs against the potential organisational benefits at every level.

Data Accuracy and Reliability

As a strategic resource, accuracy and validity of data is an important determinant for any organisation's implementation of ABC, which is in pursuit of enhanced performance (Saeed et al., 2023). Inaccuracies in source data are debilitating to the validity of the costs assigned to activity and product which distort strategic analysis of decisions. However, obtaining detailed real-time costs throughout the uncertain operation is not without its obstacles. Paper data collection is prone to mistakes and missing values that contaminate the cost model. However, application of disparate legacy systems involves implementing data quality risks that must be managed.

Emerging technologies like sensors, IoT and automated workflow capture promise more robust audit trails and completeness. Nevertheless, associated investments and change management must suit organizational contexts (Robinson & Umo 2023). While imperfect data remains inevitable, periodic validation and refinement help sustain reliability over time. Hybrid techniques leveraging predictive modelling also show promise for addressing gaps. In summary, while data quality presents an ongoing priority, a balanced assessment of benefits against resource requirements guides optimal solutions. Continuous improvement likewise strengthens ABC system robustness.

Resistance to Change

All change requires careful management when introducing a new paradigm to support the most beneficial results. ABC introductions might face resistance from stakeholders who are used to traditional strategies and techniques (Prasetyo et al., 2020). Training makes the personnel understand why ABC is done and how it supports strategic goals and objectives. The organize approach emphasizes value by responding to the concerns. Pilot implementations also assist with management of the communication that comes with benefits where they afford society the ability to familiarize itself with such programs before mass release. Organizational priority is built when leadership commitment is declared towards ABC. Early wins contribute to the strategic advancement of outcomes, which empowers buy-in (Madwe et al., 2020). Leaders promoting the advantages of ABC undoubtedly turn out to be priceless. Resistance naturally arises from uncertainty but well-designed change management mitigates its impacts. Recurring feedback also improves the degree of ABC and deals with new arising problems (Jalalabadi et al., 2018). All in all, while change requires work, proper utilization of approaches that increase participation and clarity over advantages guaranteed a favourable outcome. Sustaining improvement also forges value realization over time this is because with time the implementation of strategies brings about improvements in operations and increases customer values. Thus,

careful management of the situation, ABC's proven ability to improve the quality of decision-making and focus on strategy, can compensate for the initial lack of desire.

Overhead Allocation

As for ABC, it offers more detailed cost information in relation to conventional methods, though, some considerations concerning limitations should be taken into account to enhance the use of implementations (Cidav et al., 2020). For instance, the allocation of certain indirect expenses requiring various resources for a distinct activity involves analytical difficulties. Such circumstances are covered by other recent methods such as the predictive modelling and the standard cost estimation. Also, qualitative judgments are used in identifying the cost drivers and in assigning the activities thus can have bias if not validated quantitatively. Effects such as these are reduced through periodic review and refinement. Workarounds in the form of hybrid techniques that incorporate process mining seem quite feasible, given that it is possible to program the analysis of these extensive workflows and their costs. They also estimate the sensitivity analysis that introduces the cost model's vulnerability to subjective factors (Alzly, 2024). Every framework that exists in the world does not show any indication of being totally objective. However, with proper data and periodical revision, ABC's strengths in identifying cost behaviours have sufficient reasons to offset its weaknesses. A balanced perspective acknowledges that there is still improvement than can be made while also acknowledging the strategy's importance.

APPLICATIONS OF ABC IN VARIOUS INDUSTRIES

Manufacturing

Accordingly, the manufacturing industry has come out as one of the major proving grounds that have established the role of and the need for ABC as a decisions enabler. Due to the ability to explain the detailed cost behaviours on the manufacturing process, ABC makes it possible for manufacturers to gain knowledge in terms of the workflow, the technologies as well as the distribution of resources. For instance, ABC may report activities that require more spending to offer small enhancements in quality that have to be re-engineered (Alahmari, 2023). Similarly, ABC provides organisations with the actual product costs to help with such strategic decisions as pulling out a poor performing product line or adding value-enhancing variants. Pricing strategies may also be communicated or influenced to enhance the competitive drives and the margins. The new form of more integrated ABC application, which enters digital technologies, strengthens such a decision more firmly (Al-Mekhlafi & Eddin Othman, 2023). As the implementation requires resources, strategic and competitive benefits obtained are frequently mentioned by manufacturers as justifying their investments. On balance, manufacturing has proved to become a success story that portrays ABC's ability to improve cost management and, therefore, create value by using fine, causally related cost allocations. Constant improvement enhances these advantages in the long run, hence the aspect of refinement.

Healthcare

A strategic strength that ABC provides the organization relates to its ability to support the strategic management of costs through the linking of cost representations and the goals of the organization. By segmenting activities into cost components, ABC provides executives with the numeric data on resource consumption, which enables making management decisions according to the firm's strategies and goals (Adachi et al., 2022). For example, at ABC it is possible to support the adjustment of the product portfolio or the implementation of processes aimed at strengthening the value proposition. Others may also include the pricing strategies that are likely to be influenced by the ABC derived product cost. Resource allocation receives better guidance since activity-based costing brings out the degree of alignment between what is performed at the activity level and the strategic objectives. Scholars note ABC promotes strategic focus by tracing costs to value-adding activities and revealing opportunities to redirect spending elsewhere (Alahmari, 2023). Hybrid applications combining ABC and advanced analytics further reinforce such strategic alignment. Overall, ABC's emphasis on causality-based cost assignment establishes it as an indispensable tool for

strategic cost management by ensuring costing systems synchronize with organizational objectives. Continuous refinement strengthens this strategic decision-support over time.

Service Industry

The service sector has emerged as a key proving ground demonstrating ABC's decision-enabling capabilities. By illuminating granular cost behaviors at the project/engagement level, ABC equips service providers with intelligence to streamline workflows, optimize resource allocation, and enhance value delivery (Myca & Ióparim, 2023). For instance, ABC may reveal disproportionately costly activities that can be redesigned or automated.

Likewise, ABC-derived service cost transparency enables strategic portfolio management and pricing calibration to bolster margins. Emerging hybrid applications combining ABC with digital tools further strengthen such decision support (Susilowati, 2023). While implementation demands analytical rigor, service firms routinely report competitive advantages realized through optimized cost management and value-based pricing. Ongoing refinement also optimizes benefits over the long term. In summary, the service sector has emerged as an exemplar demonstrating ABC's capacity to drive value through granular, causality-based cost representations and strategic decision-making.

Public Sector

The public sector has increasingly embraced ABC as a means to bolster accountability and value-conscious stewardship of public funds. By illuminating cost behaviors at the program-level, ABC equips agencies and non-profits quantitative insights to streamline workflows while upholding service standards (SAEDON et al., 2023). For example, analysing service delivery pathways via ABC may reveal inefficiencies that can be addressed through technology upgrades or policy reforms. Likewise, ABC-derived service cost transparency supports strategic portfolio decisions and budget negotiations ensuring optimal resource allocation. Outcomes-focused initiatives to enhance value for taxpayers may also be informed. Emerging hybrid applications combining ABC with advanced analytics and automated data capture promise even more robust cost visibility and decision support (Doe, 2022). While implementation demands investments, the potential to strengthen value-based governance justifies related commitments (Susilowati, 2023). In summary, the public sector has emerged as a proving ground demonstrating ABC's capacity to enhance value delivery through granular, causality-based cost management. Ongoing refinement optimizes these benefits over the long term.

FUTURE TRENDS AND INNOVATIONS IN ABC

Time-Driven ABC

Scholars note emerging innovations aim to optimize traditional ABC's implementation practicality. Time-Driven Activity-Based Costing (TDABC) constitutes one such promising development, employing time as the primary cost driver to streamline complexity (Cidav et al., 2020). Rather than identifying numerous cost drivers, TDABC allocates resource costs per time unit for each activity. Firstly, it reduces analytical burdens associated with exhaustive cost driver identification and tracking. Automating time-based cost assignment through digital workflows likewise eases implementation. The literature further indicates TDABC supports more timely cost insights through its emphasis on periodic cost assignments (Zamrud & Abu, 2020). Outdated data proves less detrimental to reliability. Sensitivity analysis remains prudent to validate assumptions. In summary, TDABC presents an innovative means to maximize ABC benefits through streamlined implementation, which scholars posit will broaden adoption. Ongoing evaluation strengthens the approach over time.

Integration with Technology

Consequently, these apply in optimizing ABC's strategic value proposition through advancement in technologies. Today's ERP solutions are capable of enabling the capture of various financial and operative data that supports the enhancement of ABC implementation's processes (Zamrud & Abu, 2020). Transfers of

data into ABC modules are automatic; this reduces the possibility of manual data entry mistakes and oversight. Other technologies also enhance the analytical engines. Applying AI/ML, potential cost modelling is reached and all the gaps related to data are covered. Consequently, activity cost assignments become even stronger through process mining backed by the digital traces. Technological advances perform the process with density and bring resources to higher-value analysis. When used in conjunction with other functions such as predictive analytics, the level of insight into cost behaviour gets deeper with the aid of hybrid applications. Technical integration, however, requires some input, and scholars observe that the optimisations called by such integrations pay for the related sacrifices (Khoruzhy et al., 2022). Sustaining innovation will provide the greatest gain in the long term, which is the ultimate goal. In conclusion, it can be stated that technological application advancements represent a clear avenue for strengthening the strategic relevance of ABC on the basis of the underlying ideas that relates to processes' automation to adequately implement DSS solutions, augment decision-making support.

Sustainability and Environmental Costing

Researchers observe the increase in the use of ABC to support sustainability through a detailed environmental costing (Naderi et al., 2024). Known as Activity-Based Environmental Management (ABEM), this relatively new use of the ABC system integrates environmental costs to the agendas of the organization. Expenses related to the usage of resources, emissions and wastes can be identified and tracked back to value-relevant processes. This provides operations with a set of specific metrics, which outline an organisation's environmental footprint and establishes areas that can be redesigned. Chances for meeting goals to minimize costs and emissions at the same period can be further spotted. ABEM also assists with strategic portfolio decisions because it measures sustainability performance at the activity level (Tsai et al., 2024). More profound cost-environmental synergies are created by event-wave hybrid applications consisting of ABC, LCA and predictive modelling. While implementation remains complex, ABEM's potential to strengthen sustainability through causality-based cost representations has generated substantial interest. Ongoing refinement is optimizing its strategic decision support capabilities.

Global Adoption and Adaptation

Experts observe that ABC's increasing global adoption seems to highlight its adaptability irrespective of prevailing market circumstances (Abeysekera & Sharma, 2023). With the increasing interconnectivity of organizations globally, localized improvements in the techniques utilized in the ABC analysis have been established in consideration to cultural and legal differences. For example, growth strategies entail the centrality of social benefits that accompany activities, thus the need for additional cost factors. There are also others that refer to specific regulatory compliance demands which have led to Industry specific queries' adaptations. The same holds true for processes that address the cultural differences between countries so that they may develop the activity frameworks that are pertinent to their regions (Alzly, 2024). Although causality-based cost assignment's strategic advantage is retained, these adaptations enhance its application's relevance within specific geographic locations. Technology has helped in sharing of knowledge around the world and hence this has enhanced refinements. International case studies further validate ABC across industrial spectra. Continuous cross-cultural evaluation strengthens generalizability. In summary, ABC's global proliferation underscores its flexibility amid diverse market conditions. This adaptive applicability will broaden adoption and maximize strategic benefits over the long run.

Real-Time ABC

Innovation trends that are being developed as of the current year are likely to help ABC increase the firm's strategic value proposition by providing instantaneous cost visibility. Linking of the ABC frameworks with the automated operational data feeds provides real-time activity costing. Blessed as Real-Time ABC, this development suggests providing detailed and timely cost representations (Blaschke et al., 2020). Due to the digital recording of transactions, Real-Time ABC enables instantaneous pricing responses and the right inventory resupply. The following are the said cost control techniques: Out of the cost variances that may emerge as the activity progresses, some may be estimated in advance. Scientists state that Real-Time ABC

provided the possibilities of more flexible decisions due to the instant understanding of cost behaviours. Responses are supported by other applications that are developed by integrating ABC with advanced predictive analytics. The aspects of the technical difficulties that remain, there are reasonable strategic benefits presented by Real-Time ABC gaining a lot of attention. Such benefits will be optimised in the long run by the continuous innovation of the various factors of production. Thus, Real-Time ABC offers a creative approach to enhancing ABC's benefit model in terms of flexibility and expansiveness. Maintenance of this type of evaluation also arms this approach.

Enhanced Decision Support Systems

Scholars note emerging technologies promise to augment ABC's strategic decision-support capabilities (Susilowati, 2023). Integration with advanced decision support systems (DSS) and business intelligence (BI) tools furnishes sophisticated visualization and predictive analytics functionality.

Cost behaviour patterns and strategic alternatives can be modelled under varied scenarios through an intuitive interface. This furnishes executives quantitative, visual insights hitherto unfeasible with manual ABC systems. Emerging hybrid applications combining ABC with prescriptive analytics further optimize recommendations. As technologies assume more complex tasks, focus redirects to value-added strategic analysis and planning (Doe, 2022). Scholars posit resultant optimizations will maximize ABC's competitive leverage. While technical integration remains non-trivial, the strategic advantages of DSS/BI-augmented ABC have generated interest. Continuous innovation will strengthen these synergies long term. In summary, emerging technologies promise to reinforce ABC's strategic decision-support through enhanced visualization and predictive capabilities. Ongoing refinement optimizes these benefits.

Education and Training

As ABC grows in strategic significance, scholars emphasize complementary skills development through expanded curricula (Borges et al, 2024). Academic institutions and professional associations recognize ABC proficiency constitutes a core managerial competency. Coursework and certifications have proliferated factoring principles, methodologies and emerging applications. Specialized programs cultivate skills like activity identification, driver analysis, and technology-augmented implementation. Different cases teach strategic skills in decision-making. Hence, as such techniques are incorporated in the ABC, there is need to undertake continuous education. That is why we can also speak about the need for curriculum flexibility in connection with technology-driven innovations. Despite the fact that these resources are intensive at first, scholars point out that the skills investments achieve the highest value of ABC's organizational effectiveness in the long run. Such activities also enhance the aspect of generalizability if sustained in the process of improvement. Consequential skill duplication achieved by the broadened curricula can be recognized as a wise way of enhancing the communicative skills and other abilities which would in turn intensify the impact of the ABC approach for the specified organization.

RECOMMENDATIONS AND CONCLUSION

Here are some recommendations for how organizations can maximize the benefits of activity-based costing (ABC) systems through proactive application of insights and data:

ABC analysis can be used to prioritize and define valuable and non-valuable activities to decide on the improvement of the production process and increase efficiency. Hence, the process of decision-making to eliminate certain activities that can appear unimportant may result in a noteworthy reduction of costs.

The cost drivers that are highlighted from the ABC implementation are very useful for subsequent continuous improvement programs. This way the firm can see very clearly where discretionary costs are being incurred or accumulating so that proper effort can be made to try and bring them down.

ABC also translates into backing strategic plans as it involves detailed cost and activity information used during planning. Organizations report activity costs in the summary, which becomes a fact base for make-or-buy and outsourcing considerations to improve supply chain and sourcing management.

Likewise, ABC cost assignments may also be used as the allocation bases of overhead for the customer, product and channel profitability evaluations. This in turn results in better information that can be used in strategic pricing and positioning of products and services.

It also reveals that the rich cost pools and driver structures running through ABC also create opportunities in the application of predictive analytics. Simulation modelling enables a number of operation schemes to be tested with a view of predicting and controlling expenses.

It can be seen that measurement of organizational performance and incentive systems can be developed based on the activity hierarchies and cost driver metrics. This creates awareness of costs within the various organizational departments and across organizational hierarchy.

The validation and improvement temporarily guarantee that the ABC model always remains flexible and efficient as the business processes change. An embracing living system focuses on the attainment of more gains from steady sharing.

In this manner, all the potential of the usage of the ABC tool in the functions of the strategic decision support is maximally revealed for the organization when it is used proactively in these manners.

Activity-Based Costing (ABC) is considered to be a major improvement from the traditional ways of handling management accounting cost assignment since it offers an improved method of allocating costs and tracing costs to activities and cost objects. This way, based on the key principles of cost causality and by dint of using driving forces, activity centres, and cost pools as the major conceptual blocks, ABC provides a sound tangle for managing cost behaviours and boosting the quality of managerial decisions. However, implementation difficulties remain intact, namely, increases in the level of work complexity, increased resource demand, and dependence on input data. Nevertheless, such key issues are being tackled by other upcoming improvements in the methodological call for proposals. Time-Driven ABC simplifies the processes of cost assignment, for instance integration with new trends in digital technologies is also believed to lower costs and increase system reactivity. As cost control becomes of utmost importance for organizations, resource allocation and strategic objectives realization, ABC remains relevant as it offers detailed cost information and contributes to the ongoing company's improvement. It also remains effective across industries in that aspect. Thus, the further development of ABC is realized through the application of new and promising approaches and technologies in support of continued emphasis on accuracy, easy access to information and the enhancement of relevance to the various critical needs of ABC's audience.

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