A Proposed Costing System for Intelligent/Resilient Automated Systems, using the Activity based System and Continuous Enhancement

Abstract

The development of automated firms and global firms has necessitated a shift in principles and measurement accuracy. The principles and concepts have been modified based on economic theory, moving from stable continuous improvement to continuous enhancement, or Kaizen enhancement. The accuracy of the proposed costing system has been improved by using modified activity-based costing. The current research has focused on multi-variation in explanatory variables, including the costing system and the degree of enhancement. The suggested costing system should include the modified version of activity-based costing and the new form of continuous enhancement system (Ranjain and Jae, 2022). The concept of intelligent supply chain has led to the idea of a cooperative game between all parties in the firm/chain. Intelligent automated systems are closed loop systems where all members are partners, aiming to maximize global benefits (Khatun et al., 2023). Resilient considerations indicate different attempts to measure and estimate the multi-effects of externalities and other external effects. This work has closed-to-open excess quantitative models, achieving the cooperative state between different partners.

Keywords: Activity based Costing; Hierarchal Costing System; Enhancement Systems; Intelligent Systems; Resilient Firms; Externalities

Introduction and Research Objective

Modern production systems and technology have integrated industrial systems using Computer Integrated Manufacturing (CIM), allowing for logical steps in the production cycle organized through computer programs. This has led to cost management issues, particularly in allocating costs to production units. Traditional costing systems often relied on direct labor hours, affecting the allocation rate and benefiting different production units. This has led to a shift in production processes and the organization of resources (Dhavale, 1989, Sontanan et al., 2014).

In recent years, objectives have been expanded and analyzed, including life cycle costing, target costing, and enhanced Kaizen systems. The study of the firm has also expanded to the value creation chain and intelligent supply chain, which raises questions about the competitive or cooperative relations between supply chain partners (Thyssen et al., 2006). The supply chain may play a double-advanced role, including the intelligent supply chain and the resilient supply chain (Lee et al., 2016). The intelligent supply chain focuses on organizing cooperative games between partners and managing uncertainty through measurement of internal affecting variables. The resilient supply chain, on the other hand, is inclusive and advanced, focusing on externalities that consume a part of the chain's capacity but are necessary for chain continuity. This type of chain has recently focused on environmental safety through the use of green energy to combat climate change. Further research will address these concerns in the coming pages.

Plausibility and Research Limitations

The credibility and plausibility of the current work can be seen through the use of ABC and continuous enhancement systems to modify and measure costs and profitability of an intelligent supply chain, recognizing the effects of endogenous and exogenous factors (Revilla and Saenz, 2010). Sharp deterioration is a special case of failure that requires timely repair (Shacheendran, 2020).

The industrial development has led to a multiplicity of products relying on standard parts, with a low impact on labor. This has led to a trend towards continuous enhancement to strengthen competitiveness and improve product performance. This has encouraged a shift away from traditional cost systems that are affected by changes in production volume. Studies by Holzer et al. (1991), Askarany et al. (2010) and Kumar and Mahts (2013) have called for allocating resources first to activities and then to products.

Activity-based costing emerged in the mid-eighties and has since been applied by numerous projects. A field study by Drury (1992) and Homburg (2005) found that it reached 12% of sample projects, indicating an upward trend. The scientific imperative behind this approach is its validity in long-term cost allocation and addressing traditional allocation problems. However, the challenge lies in balancing continuous enhancement as a short-term operational goal for technologically advanced firms with activity-based costing as a long strategic entry term (Pierce, 2004).

The research's evaluation of the activity-based costing system's practical efficiency is limited due to its newness and lack of projects for testing its feasibility. This limits the theoretical consolidation of the system, which is crucial for transitioning projects to production technology systems and technologically advanced firms, and is particularly important in the practical field.

Research Plan

The research is divided into three parts: the impact of production technology development on costing system structure, the development of activity-based costing to replace traditional cost systems, and the structure of activity-based costing for continuous enhancement. The first part discusses the factors leading to research towards traditional costing systems, the second part addresses the developmental aspects needed to replace activity-based costing with activity-based systems, and the third part discusses the structure of activity-based costing systems for continuous enhancement.

An Analytical Study of the Impact of Development in Production Technology upon the Modified Structure of Activity-based Costing

The rapid development and flexible production changes in the intelligent supply chain necessitate a swift change in the costing system to accommodate this change. The chain's closed loop model suggests a new cooperative relationship between partners, enabling faster production, high quality, and accurate estimations of exogenous and endogenous variables. This shift from a competitive attitude to a cooperative state will improve the accuracy of estimations, despite the uncertainty state(Malik et al., 2019). .

Industrial development and advanced technology, particularly flexible manufacturing systems like Agile/JIT systems, have led to a need to shift from traditional costing systems based on product-based units to cost management themes, as per Horngren et al. (2016) and Cotton et al. (2003).
The transition to flexible production systems in industrial facilities necessitates the conversion of flexible production cells into production centers. These cells are human/automated groups that perform specific, homogeneous production, while flexible production systems integrate production and service functions to produce specific products (Shacheendran, 2020; Kalpakjian, 1989; AQslam et al., 2018, Wegman, 2019).

Three alternative production strategies have emerged due to advancements in production technology, including:

1. Material Requirement and Manufacturing Resources Planning (MRP)

Systems control commodity inventory, determining demand based on final product demand from industrial processes. This basis for production and purchase scheduling is influenced by computer-based methods. Inventory planning systems also consider resources needed for manufacturing, such as machine power and productive labor. These systems help determine the production needs of raw materials and procurement processes.

2. Methods of Agile/Just-In-Time Production

This system aims to achieve timely and quality production with the required quantity and quality to meet the required objectives:

- Excluding activities that do not add value to the productive activity.
- Elimination of faults.
- Cancellation of downtime.
- Delivery on request.
- Large production with specific specifications and reduced downtime.
- Disposing of inventory and linking the production cycle so that it is from the supplier to the production cells to the consumer.

The previous system requires analysis at the activity level to reduce costs by identifying activities that don't add value for production or consumers, indicating the role of the ABC in profit analysis and maximization (Comolli, 2008; Qian & Arign, 2008).

3. Production Optimization Techniques

The goal of systems is to achieve optimal use of productive resources by controlling production flow, reducing inventory, and reducing operating expenses. To achieve these goals, it is essential to address limitations of the production process, such as controlling scarce resources, bottlenecks, and excess. The optimal exploitation of resources should be within the limits of the full utilization rate of controlling scarce resources, rather than reaching full exploitation of available resources.
The researcher found that the development of production systems can be adapted to traditional methods, such as intermittent production (production orders and batch systems), patch production, or continuous production (flow production system). **This could result in a mix between the two systems.**

- The two methods of resource planning and production maximization are compatible with production orders. Accordingly, it is possible to link between the needs of raw materials and the various elements of costs on the one hand and between the quality, size, and timing of the completion of production.
- In the case of continuous flow of production and characterized by repetition, the simultaneous production system Agile/Just-in-Time becomes the appropriate alternative method for the production stages system, and this system aims to reduce the number of component parts of the production unit, (El-Gibaly, 2024).

The resource planning and ideal production systems track cost elements at each production order level, aiming to be near-direct. The instant production system aims to reach the average cost, similar to the production stage costing system, affecting cost systems.

This work will analyze activity-based costing, highlighting its feasibility and the need to address shortcomings in traditional cost systems, which are considered advanced by many cost accounting writers (Jensen, 1990; Kaplan & Cooper, 1987; Whicker et al., 2006; Zboyrak et al., 2004).

The application of cost deviations should be linked to the causes of cost occurrence, or cost drivers, rather than production units. This prompts a study of cost allocation based on long-term causes, which will be the subject of analytical analysis in the next part of the research.

Historically, cost components were primarily materials and labor, with a small portion allocated to indirect costs. However, with advancements in production systems and technology, most cost elements are now concentrated in direct materials and indirect elements. Rayburn (1989) suggests that modern industrial projects have become mostly sunk costs, while Malik et al. (2019) highlight the main defects of traditional costing systems.

- The costing system in intermittent production requires tracking cost elements based on task and order type.
- Indirect costing rates are general and gross, causing unrealistic allocation due to the distribution of cost elements not affected by production volume changes.
- The cost elements that are not affected by the change in the volume of production are also distributed according to the bases affected by the change in the volume of production, which leads to the allocation process being unrealistic.
- The allocation process assumes all resources are of the same quality, benefit production equally and fully utilized.
- Other cost elements like marketing, subsidizing production activities, and research and development costs are charged directly to the production units that benefit from them.

The transformation of production systems requires a shift towards activity-based costing, considering the consumption of various cost elements while achieving mixed administrative objectives. Previous studies estimated that direct materials contribute 40-50% of total industrial costs, while labor participation ranges from 10-30%, and the rest is allocated to the indirect cost component. This shift is necessary to address previous shortcomings and achieve mixed administrative objectives (Scheer, 1991; Hicks, 1992; Cohan et al., 2005; Kee, 2008).

Activity-based costing involves allocating production inputs as the basis for allocation, rather than outputs. This involves identifying necessary productive activities, analyzing them, and classifying them into productive cells. The cost of each cell is then allocated to production units based on the causes of cost drivers, as illustrated in Figure 1.

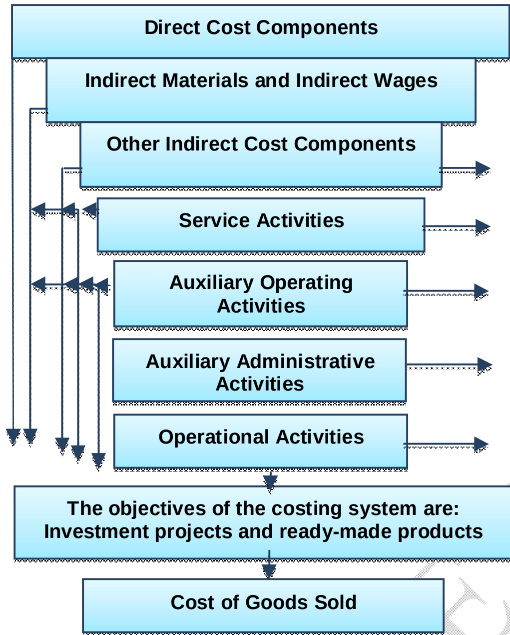

Figure (1) The Hieratical Cost Accumulation Model

Activity-based costing involves understanding and defining indirect cost elements, identifying their causes (cost drivers), and linking them to beneficiary production units. It requires identifying factors causing activities and establishing a relationship between activities and production units.

Activity-based costing is a systematic framework that focuses on the processes and activities of accessing products, rather than direct allocation (Statubus, 1990). It focuses on the economic concept of cost, considering the cost of using resources. The accounting approach analyzes cost qualitatively, considering cost drivers and recurring activities. Cost allocation stages are illustrated in Figure 2, illustrating the stages of cost allocation.

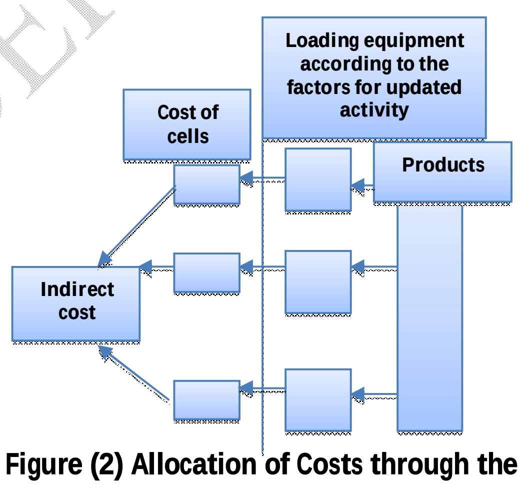

Figure (2) Allocation of Costs through the ABC

Activity-based costing is now widely used due to licenses and the widespread use of computers. This method allows for subsidiary activity accumulation and allocation between production units based on their actual benefit. It takes into account the causal relationship between cost occurrence, activities that create it, and units of benefit (Thomas, 1971). The degree of benefit and subsequent allocation emphasize endurance capacity for satisfactory cost element allocation. Traditional methods of downloading costs did not consider the fulfillment of previous requirements, possibly due to the short-term and long-term aspects of causation. The appropriate allocation process must consider the relevant cost concept (Askary, 2020).

To design activity-based costing, identify direct cost elements like materials and wages, and analyze the demand for indirect elements. This involves passing through stages such as identifying the needs of these elements and analyzing their demand (Cooper et al., 1989):

1. Focus on controlling and high-cost resources that significantly impact product total cost.
2. Identify those affected by product quality changes.
3. Consider resources not related to traditional cost systems like direct labor hours, as they have a significant marginal impact.

The first procedure favors traditional cost systems for tracking cost components directly to products. The second and third procedures highlight weaknesses in traditional cost systems and emphasize the need to focus on activities not directly resulting from cost-refreshing elements. To implement this, personalization should be shifted to activities and products, following the stages in figure (3).

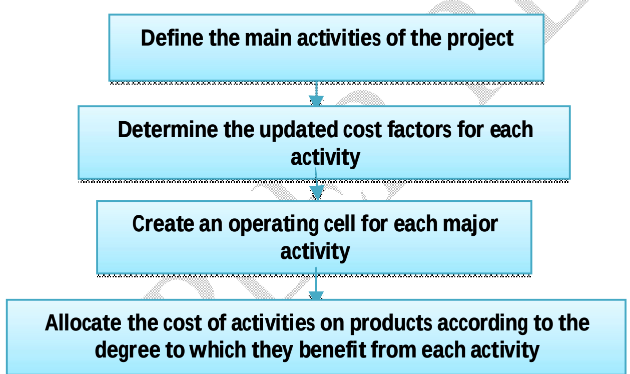

Figure (3) The sequential Flow Steps of Applying the ABC in Reality

The research has transitioned from extrapolating accounting writings to dividing industrial project activities into three main groups, as summarized by Jensen (1989), in the first stage.

1. Activities related to the operation of machinery.
2. Activities directly related to labor.
3. Activities that support the production process.

The second stage involves identifying cost-inducing factors, which involve selecting suitable bases for allocating indirect costs among production cells and products.
The third stage involves identifying controlling factors in activities, focusing on resource exploitation, to enhance efficiency and effectiveness of the firm.

The cost origin is primarily driven by demand or need, not final production. The activity-based cost model is more comprehensive than traditional models, considering necessary preparation activities. The second model, based on improvisational foundations, only in-

cludes cost components related to changes in production volumes, known as volume-related costs, primarily affected by production occurrence (Singer and Donoso, 2008).
An independent basis is established for each activity, ensuring that benefit units (production units) bear the actual benefit amount regardless of production volume. This approach ensures fairness in cost allocation and considers causality in cost creation, thereby reducing the impact of production volume changes.
The researcher suggests that traditional costing systems erred in linking allocation to activity volume, prompting Drury (1989) to analyze cost behavior towards long-term changes in activity volumes. This is due to the changeable nature of fixed costs in the long run, prompting the call for the replacement of traditional systems.
Activity-based costing focuses on measuring resources needed for a project to produce products, rather than just allocating costs to production units or forecasting short-term expenditures. It emphasizes resource consumption, which changes over time, leading to changes in expenditure. In the long run, activity-based costing predicts expenditure and cost elements by predicting the amount of resources consumed through firm activities, which represents the expected aspects of the activity to be performed by the firm (refer to the following case shown in Table 1).

Table (1) Degree of Consumption of Various Activities

(p), (I) and the necessary active for each, their cost and the appropriate loading bases for each activity	Product	Production quantity per year	The nature of the production of the product	Unit Hours Needs	Consumer quantity of raw materials in kg	Direct Working Hours	Machine Rotation Hours	Number of startups	Number of orders	Number of times material handling	Number of production personnel	Total
	(S)	20	Small size/small productive quantity	0.5	120	10	10	2	2	2	2	
	(AM)	200	Small size/large produced quantity	0.5	1200	100	100	6	6	6	2	
	(On)	20	Large volume/variable quantity produced	1.5	360	30	30	2	2	2	2	
	(for)	200	Large size/large produced quantity	1.5	3600	300	30	6	6	6	2	
		-	-	--	$528	4400	6600	1920	2000	400	400	19848

The study examines the volumes produced from four previous products using the same machines and equipment, consuming seven customary cost elements, and assuming production in one cost center using a traditional costing system, as shown in Table (2).

Table (2) Allocation of Indirect Cost on Products using Direct Working Hours

Statement	Total	Product Share (X)	Product Share (P)	Product Share (C)	Product Share (I)
Total Direct Working Hours	440	10	100	30	300
Indirect Cost Hour Share	19848	451.1	-,4511	1353.3	13533
Unit Share		45.11	45.11	45.11	45.11
Cost per Unit		22.55	22.55	67.66	67.66

Table (2) reveals that large-volume production overcasts costs, leading to inaccuracies in allocation and labor shortages. This results in incorrect decisions, precession, and adherence to traditional principles, as per Hair et al. (2017).
The activity-based costing method simplifies solution procedures by grouping similar activities based on their causes. This approach reduces the number of recovery bases used and simplifies the process. The researcher will present several methods to reduce the number of recovery bases in Table (3), except in the final part of the research.

Table (3) Products According to Activity-based Costing System

Product	Elements Related to Direct Action			Items Related to Startup Activity			Elements Related to the Component parts of the Product			Custom Cost	Unit Share	Adjustment %
(S)	100	-	362	2	-	540	2	-	1000	1802	90.1	(+)299.55
(AM)	100	11528	2620	6	4330	1620	2	4000	1000	5240	26.2	(+)16.18
(On)	30	-	786	3	-	540	2	-	1000	2326	116.3	(+)71.88
(for)	300	-	7850	6	-	1630	2	-	1000	10480	52.4	(-)22.55

Table (3) reveals a correlation between recovery bases, resulting in bases for cost creation related to purchasing raw materials, direct work, and operating machines. Direct work hours were considered appropriate for allocating costs. Start-up activities, operating orders, and raw material handling activity were based on startup times, with startup times being considered an appropriate basis for allocating costs.

The results from Table (3) can be compared with the results from Table (2), indicating the following conclusions:

1. The activity costing system accurately determines production unit costs by highlighting the differences in input consumption between products.
2. Table (2) reveals inaccuracies in determining the cost of the previous four products. Small products, produced and ordered in small or large quantities, carried an equal share of cost components at $22.55, while large products (P) and (L) carried an equal amount at 67.66.
3. The activity-based costing system determines product costs based on technical difficulty and consumption of cost elements from various activities. Small orders have higher costs due to consumption from non-production volume activities like start-ups and subsidiary activities. Table (1) shows the percentage of products consumed from necessary production activities. The high cost of small orders may be due to consumption from non-production activities like design.
4. The researcher can validate and stabilize activity-based costing results across different firms by referencing practical results from Hicks (1992), Kaplan, and Cooper (1998).

Activity cost systems primarily focus on cost-inducing factors, assuming activities generate costs for resource consumption and products cause costs due to design-related activities, maintenance, marketing, distribution, and handling of raw materials, as well as various service activities supporting the production process (Shacheendram, 2020).
Activity-based costing allows for long-term cost control by directly controlling the activities that generate the cost, focusing on cost reduction activities rather than achieving cost control itself.
The activity-based costing system aims to accurately and fairly allocate production costs by considering the complexity and difficulty of production types. It uses various cost drivers to achieve fair allocation (Thomas, 1971, El-Gibaly, 2021). The system also provides a meaningful average cost for decision-making, such as changing production mix or evaluating

profitability. This is particularly useful for projects involving intensive use of production technology for continuous enhancement, as it helps assess the efficiency of the firm (Mahto, 2013).

The study aims to evaluate the feasibility of the activity-based costing system in achieving project objectives and its suitability as a long-term strategic approach for continuous enhancement systems, as per Wegmann's 2019 research.

The Hierarchical Structure of the Activity-Based Costing to Achieve the Considerations of Continuous Enhancement Systems

Continuous enhancement refers to modern procedures and systems that aim to provide continuous service and assistance to solve performance problems and prevent future recurrence. Recent developments have expanded the scope of these systems to cover development objectives and face deterioration cases (Kinlaw, 1992), Cohen et al., 2005). This double-faced system aims to expand development in the face of gloom and progress, while reducing or stopping the anti-benefit movement in sharp states. Continuous enhancement stages range from corrective or reactive actions to proactive and predictive actions. New advancements in continuous enhancement have prepared policies valid for different expected states of forward attainment and normal or sharp deterioration (Malik et al., 2019).

Figure (4) presents a simplified traditional improvement model focusing on continuous enhancement and its associated activities, primarily aimed at enhancing project outputs or products through specific sub-activities.

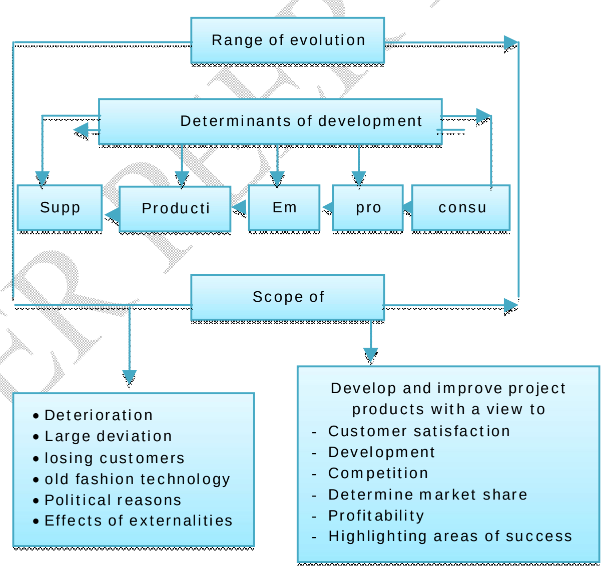

Figure (4) The Range of Activities Required for Improving Production

The scope of previous development serves as the main entry point for development, determining the feasibility of development strategies. This is reflected in six indicators in the two phases of deterioration and steps of development. The concept of continuous enhancement arises in response to product quality or supply chain issues (Askarany et al., 2010).

The modern production trend emphasizes the importance of quality controls and flexibility in production over cost control, as these factors are crucial for maintaining continuous firm enhancement and achieving the concept of lowest cost, while also promoting flexibility in production.

Activity analysis can lead to cost reduction by reducing start-up times, reducing product quantity, and reducing inventory problems. This was demonstrated in Toyota, a Japanese company, where reduced start-up times allowed them to meet customer orders and achieve just-in-time/agile production systems (Ranjan et al., 2022). This approach can be applied to startup activities to reduce costs and improve inventory management (Thyssen et al., 2006).

The researcher needs to strengthen the relationship between activity-based costing and continuous enhancement in profit enhancement due to environmental differences between the two concepts, which may cause conflict. This will be the focus of the final part of the current work.

Intermediate activity centers' agents have autonomy, allowing them to sell their products to integrated departments or external markets. This consolidates self-benefit and reallocates resources among centers, motivating managers. Previous departments must work continuously to maintain operational efficiency. The project supports these policies due to the urgent desire to achieve competitive and strategic goals in the long-term.

It is noted that the output price that is charged out or which can take the form of transfer prices has become a topic of concern for firm management, and perhaps because of its importance, it has been used as a means of evaluating the internal performance of activity centers and production cells, to the extent that it has become a means of determining the level of achievement of these departments for the objectives assigned to them, and also a method for determining the motivation of managers of these centers, Elzzamel (1987), Johnson (1988), Tsai et al. (2008),and Singer and Donoso (2008), which help to reach to the important fact that transfer prices will impose some restrictions on the intermediate sections used for internally produced goods, prompting them to try to make more effort to achieve an added value for their final products that are sold to the consumer (Kee, 2008) .

This work focuses on the relationship between the activity-based cost system and the continuous enhancement approach, describing the stages of this relationship:

1. The process involves a detailed analysis of the activities from the initial stage of achieving the added value of a commodity to the final stage of transferring it to the consumer.
2. The study focuses on identifying areas for consumer satisfaction, determining the cost of each element of the commodity cost, and eliminating activities without added value through profit analysis using ABC.
3. Reducing waste and waste first-hand and as soon as it is discovered in the operational activities, which represents a developmental goal for the aspects of the agreement (Kaizen enhancement (Kim et al., 2014).
4. The process involves creating efficiency indicators and limits for permissible losses in various operational areas, which can be used to set future cost standards at the activity level, rather than the production unit. This approach allows for budgeting based on expected activity needs, allowing for better control and planning of future development by analyzing deviations at the activity consumption level.

The need for restructuring and developing the accounting control function is evident, with proposed stages outlined in light of previous points:

- That control should not focus on cost as much as it should focus on cost-generating activities.
- The more detailed the control of activities, the more this leads to the identification of the best operating deviations coupled with the causes of the occurrence of such deviations.

- The criteria of waste and waste, especially those related to indirect elements, must be shifted from being aggregate criteria to being detailed criteria in order to be able to identify deviations at the level of activities (activity analysis).
- Evaluating activity effectiveness and efficiency requires considering both financial and non-financial factors, such as competition quality and production flexibility.
- The control system should be more positive, aiming beyond cost comparisons to include developmental goals and consider alternative opportunities. This ensures control is within the limits of the best possible alternatives, not just the plan's limits.
- The researcher identifies that analysis system by activities and activity-based costing are complementary tools for understanding cost kinetics and flow, and for continuous performance improvement, whether upward or downward, in both upward and downward direction.

The importance of cost systems and continuous enhancement systems in financial analysis has led to the need to strengthen their connections and refute apparent contradictions. By replicating the accounting income statement with previous systems' principles and separating activities with added value from those without, researchers can create indicators that indicate the percentage of cost of activities with added value to total revenue and those without added value (Brusset and Teller, 2017, Dabhilkar et al., 2016, Kamalahmadi, and Parast 2016).

The continuous enhancement approach is a multi-purpose operational method that aims to eliminate waste, reduce start-up waiting time, simplify production, and improve product quality. However, it requires a system and effective cost measurement, necessitating the adoption of an activity-based costing system to measure costs at previous activities.

The activity-based costing system has caused a conflict between cost reduction and continuous development. The researcher argued that using the largest number of allocation bases is incompatible with cost reduction and continuous improvement. Turney et al. (1990) suggested using general allocation bases directly from the production unit to resolve this conflict. This approach would help reduce product differences and allocate resources more efficiently.

General allocation bases are internal databases used in industrial enterprises for efficient allocation processes. By reducing the number of allocation bases in the activity-based costing system and reducing production quality at a single batch level, a continuous enhancement approach can be implemented, addressing conflicts between previous systems. This approach also represents a system of continuous development towards standard specification methods, reducing the number of industrial parts in production.

The researcher aims to understand the relationship between activity-based costing and continuous enhancement systems, focusing on their performance methods. They note a trend towards multiplicity of allocation foundations in activity-based costing, leading to greater accuracy. Conversely, in continuous enhancement, the trend is to conceal the number of allocation bases to reduce cost measurement, highlighting the need for a common relationship between these systems.

The continuous enhancement aims to reduce costs, but how can it be reduced as the need grows due to the increase in measurement costs due to the multiplicity of allocating bases in activity-based costing (El-Gibaly, 2024).

The continuous improvement trend towards products with small differences in components or stereotypes has led to the abandonment of unnecessary parts and the arrival of more general engineering designs. This results in products that perform different functions and are similar in design benefiting from common services and activities, creating a family of products. The strategic capacity of this approach often leads to the realization of generality in goods production, posing the question of integrating activity-based costing activities for continuous enhancement.

The continuous enhancement system has caused diversity in production despite a reduction in design differences. To determine the cost at the production unit level, divide the cost of production line activities by the line's volume of production. This analysis helps determine the commitment to both previous systems' principles.

The theory of continuous enhancement often results in two outcomes: reducing the number of production activities and reducing diversity in functionally similar and form-only production unit components. This system of continuous enhancement in theory is crucial for efficient production.

Despite the ongoing conflict between the system of continuous enhancement and activity-based costing, several sub-factors still support the existence of the latter, despite the nominal conflict between the two systems.

- Regardless of eliminating extra activities or gaining no added value, there are still many activities that require independent tracking when determining the cost of a production unit at the production line level.
- The volume of each production type at one production line level varies due to variance in different volumes.

The study emphasizes the importance of activity-based costing in tracking product costs accurately and reducing production costs. It also highlights the learning curve assumptions and the comparative advantage of repetition of production experience. The researcher acknowledges the contradiction between the two previous systems and emphasizes the ideal costing system aims to provide cost reduction in measurement and errors resulting from incorrect measurement. The traditional costing approach, which links cost to production volumes, has been found to cause damages and inaccurate determination of both cost and profitability. The ideal costing system should focus on reducing errors and reducing costs in the measurement process (Shacheendran, 2020).

As a result of some contradictions and conflicts between the activity-based costing and the continuous enhancement, and also to reduce the gap between them, some suggested ideas are presented here to reach an agreement between those systems, as follows:

First: The Effect of Using the Information Technology Approach

The cost measurement of accounting has significantly decreased due to the emergence of information technology, such as computer-based production and resource planning systems, electronic expertise systems, and artificial intelligence. These technologies have made the process of collecting and tracking cost data and information easier and faster, from the moment it occurs at different activities to the stage of using complex mathematical methods to allocate them to products using appropriate allocation bases (Askaran et al., 2020).

The proposed objectives will rely on actual data from the project database, which can be accessed through electronic spread pages, a requirement for the activity-based costing system implementation. This will reduce measurement costs in line with the continuous enhancement system.

Second: Using the Correlation Method to Integrate Multiple Sub-Activities

The primary goal of utilizing the degree of correlation among sub-activities is to group these activities into an acceptable number of main activities, enabling access to them.

The primary goal of using the degree of correlation between foundations of allocation is to determine the correlation between the quantities consumed by different production units and the activity's cost, aiming to create a basis for common or general allocation, which accurately reflects the real consumption of different products from previous activities.
Table 1 provides information on the correlation between different allocation foundations, which can be found in Table (4).

Table (4) : Correlation between the different elements affecting the allocation

	Consumables	Working Hours	Turnover Hours	Startup Times	Run Commands	Handling	Parts
Working Hours	1	-	1	0.021	0.11	0.09	0.08
Turnover Hours	1	1	-	0.035	0.15	0.25	0.11
Startup Times	0.11	0.15	0.1	-	1	1	0.22
Job orders	0.14	0.21	0.1	1	-	1	0.15
Parts	0.11	0.11	0.12	1	1	-	0.9
Rates	0.11	0.22	0.21	0.10	0.15	0.12	-

The researcher found a complete correlation between various allocation bases, indicating that using one of these bases accurately represents the extent of consumption of different types of production.
The previous correlation method shows inconsistencies between the accuracy required for allocating cost of activities and the number of bases used. Even if a high correlation degree occurs, there are still foundations not subject to it due to their distinct occurrence. This suggests the previous solution is only a partial solution and calls for more use of multiple allocating foundations. Correlation methods also suffer from illogical assumptions, such as the assumption of simultaneous activity occurrence.

Third: Using the Aggregate Weights Method for the Different Allocation Bases

The activity-based costing system requires the use of the largest number of allocation bases to achieve accuracy and reduce measurement costs. The researcher aims to achieve both goals by reducing the number of allocation bases and achieving an aggregate coefficient that reflects the impact of different bases on production unit needs. This approach considers the multiplicity of allocation foundations and reduces measurement costs by using one coefficient or mathematical relationship to measure the effects of different types of production and their impact on the production process, demand, and resource consumption (Khatun et al., 2023; Gosling et al., 2016).
The proposed relationship for allocation involves expressing the product's self-deviation according to the quality of the allocating basis used, to the general standard deviation of the products different ones for the same allocation basis plus the correct one Hair, et al., (2014). This relationship can be expressed in the form of relative weights, representing the ratio of what belongs to the product (x) to the cost of the activity (p). This approach helps to understand the differences in design and ensures accurate allocation of resources.

$Nz_{ij} \pm p_{li}$ **are weights of the consumption of each type of product for the cost of activities**
This is given that **Nz** represents the deviation rate of the product (x) from activity (z) and that z represents the total standard deviation of activity (z). The previous relationship can achieve desired allocating bases, resulting in cost items equal to total activity cost. It's easy to add new bases as product design changes, ensuring flexibility and usability in the face of possible changes and kinetics in the assignment.

The mathematical relationship must consider the interconnected relationships between different products due to limited resources and the need to balance the consumption of one product with the reduction of other products to balance the overall resource consumption.

Balancing resource consumption and considering externalities is crucial in future planning stages, affecting product and resource choices while considering externalities with care.

The quality and form of production are determined by exogenous variables, which are independent and outside project control. To reduce costs, the previous model was modified to combine the Cobb-Douglas function and the Leontief function, considering the degree of overlap in consumption of different production types. This approach helps in understanding the project's cost structure.

$$\mathbf{X_i = min. \{(f_1 (c_{Ii} , P_{Ii} , ..., P_{m\text{-}Ii}), ...f_2 (x_{ni} , P_{Ii} , ..., p_{m\text{-}Ii})\}}$$

Whereas,

X_i = the project's achieved outputs and revenues, which express the value of the project's productivity in light of the conditions of hidden development, and the conditions of diversification of productive activities aimed at achieving the strategic objectives of the firm.

X_{Ii} , ..., X_{ni} = cost of the available activities, expressed in the form of percentages of what you benefit from the different types of production, and is intended to be allocated based on production units according to certain cost drivers.

P_{Ii} , ..., $P_{m\text{-}Ii}$ = are weights of the consumption of each type of product for the cost of activities, representing the production burden caused by the type of production, measured in terms of its participation in the allocating basis (direct hours of work, number of times of material handling, number of production parts comprising the product, number of start-up times, ... etc.).

The previous model aims to understand the impact of high-cost and low-cost products on project profitability. Any changes in productivity can predict the average unit cost of production, affecting factors like activity exploitation, controlling production factors, and expected failure rate.

The production cost minimization model should be applied to cost systems based on activities and continuous enhancement systems. The weight of the burden on each product should be calculated, considering all areas and causes of depreciating costs. The variance in cash or kind and product consumption degrees can be used to measure the relative burden of each product independently.

The deviation ratio of each product's consumption of an allocation base compared to the standard deviation of the total consumption of all products can be used to determine a relative weight. This norm of use is typically expressed due to cost occurrences, such as handling or start-up times. The deviation ratio can be used to determine the average unit cost of production divided by the production quantity of one product. To clarify the foregoing, we present the example shown in Table 5 as follows:

Table (5) : The relative weights of burden imposed by product (i) over the various activities

Product	Direct Working Hours (1)	Number of Handles (2)	Deviation (1)	Deviation (2)	Deviation Ratio (1)	Deviation Ratio (2)	1 + Deviation Ratio (1)	1 + Deviation Ratio (2)
A	350	20	- 50	Zero	-.32	Zero	.68	1
B	500	35	+100	+15	+.63	.27	1.63	1.79
C	450	15	+50	- 5	-.26	-.26	1.32	32
D	300	10	-100	-10	-.53	-.53	.27	47
Aver,	400	20						
Standard Deviation			158	19				

From the foregoing, it is possible to arrive at the relative weight or the relative burden imposed by the product (i) on the cost of the various activities in the following equation:

$$W_{ij} = \sum_{I=1}^{I} \sum_{j=1}^{j} L_{ij} \quad D_{ij} \quad N_{ij} \qquad I = 1,2 \ldots\ldots,i$$
$$J = 1,2,\ldots..,j$$

Whereas,

i = represent the quality of production.

j = represents the basis of the allocation used.

L, D, and N = represents the relative weights of what each product takes from the causes of the cost of each sub-activity.

It is noted from the previous figure that the formulation allows the products to vary in terms of the degree of benefit and their quality, which paves the way for ease of development and makes them suitable for each prepared in the form of a computer program. On the other hand, in order to highlight the internal formulation of the previous relationship more clearly, it is for the cost elements of the activity L and its accompanying suggested bases for allocating a particular type of production compared to other qualities in the extent of benefiting from that activity, L_i can be determined by:

$$L_{ij} = \sum_{I=1}^{I} \sum_{j=1}^{j} (I_{ij} \ / \ L_{ijd})$$

Whereas,

I_i = represents the deviation of product i from the rest of the products in its consumption of the causes of activity j.

L_{ijd} = represents the standard deviation of the basis of allocating activity.

I_{ij} = the deviation of product i with respect to the basis of allocating j. In addition to the fore-going, the variables of the previous model can take the form of matrices, which resulted in the allocation of the cost of a number of activities to a number of products, using the relative deviation of them in their varying consumption of different activities according to the consumption of each of them by certain allocation bases.

From the above, it is possible to arrive at the equation for allocating the different activities according to the different allocating bases, which is expressed by the relative deviation of what is consumed by the various products. I of the causes of the occurrence of various costs j, in the following equation:

$$\bar{X} = \left(\sum_{j=1}^{I} \sum_{i=1}^{j} \bar{X}_j X_{ij}/p_i\right)$$

Whereas,

$\underline{X}$ = average cost of different products.

$\underline{X}$ = matrix of cost centers of abandoned activities.

$\underline{W}$ = matrix of the relative burden of different products, represented in the relative deviation of those products in their consumption of different activities.

$\underline{P}$ = matrix of different products.

The conflict between activity-based costing and continuous enhancement has significantly decreased. The continuous enhancement system aims to reduce a firm's costs by eliminating unnecessary activities and developing production to reduce production components and product differences. The main objective is to reduce measurement and calculation costs. The continuous enhancement system aims to achieve operational goals, supporting profitability and long-term improvement by providing accurate production cost data and supporting management decisions. Both systems agree on achieving integration, as their direction and objectives can serve as indicators for the other system to work in line with previous practices.

Accordingly, we can summarize the most important results and objectives derived from the application of both previous systems together in the following points:

- Supporting short-term (operational) administrative decisions, especially those related to pricing decisions and production scheduling, to the extent possible to support the consumer and support project decisions related to choosing the best possible production mix.
- Assisting in making decisions related to product design and determining the most appropriate amount of production and service activities that should be used, as well as determining the components and parts of production in the appropriate amount, which leads to reducing the degrees of difference between the various products.
- Supporting long-term investment decisions.
- Take the necessary planning decisions for the preparation of budgets within the limits of the specified amount of the indirect cost elements necessary for the operation.

Summary & Conclusions and Recommendations

The activity-based costing system has gained attention due to its unique productivity and importance in determining the profitability of a firm's products. It highlights the effectiveness and profitability of each economic activity and analyzes them based on the level of value they add, providing valuable information for determining the firm's profitability.

This research aimed to align technologically advanced firms' goals with the activity-based costing system to determine costs and achieve continuous enhancement objectives. Analyzing production and cost factors that encouraged and supported the application of the system was necessary, ensuring alignment between long-term strategic and short-term operational objectives. The research discusses the activity-based costing structure, highlighting its role in continuous enhancement by analyzing activities, identifying non-value-adding activities, and eliminating them, thereby reducing costs and promoting continuous improvement.

The relationship between activity-based costing and the continuous enhancement system can be represented through four stages.

1. Determining the activities in detail from the moment the value added of the commodity begins to the moment the commodity is transferred to the consumer.
2. Determining the points and areas of gaining consumer satisfaction, whose cost represents one of the elements of costs that must be charged to the cost of the commodity.
3. Reducing extravagance and waste and getting rid of it as soon as it is discovered in the operational activities, which represents a developmental goal for spending aspects.
4. Preparing efficiency indicators, limits for permissible losses in the various fields of operation, and analyzing deviations at the level of unit consumption of activities (inputs) and not at the level of operating outputs.

   The research discusses the conflicting objectives of activity-based costing and suggests a solution by enhancing information technology to facilitate data collection, analysis, and processing. It also suggests two alternative methods to reduce measurement costs by choosing bases with full correlation. The researcher recommends more applied research on activity-based costing and suggests its application extends beyond industrial projects to service projects with multiple activities.

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