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Enhancing key success factors in companies through the integration of time-driven product life cycle costing and activity-based management techniques \ Applied study

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***Abstract*:**
Achieving the basic success factors is a strategic goal sought by industrial organizations in an environment characterized by market fluctuations, increasing competition, and growing customer demands in terms of quality, cost, and time. Based on this context, the research aims to highlight the role of integration between two advanced cost accounting techniques—time-oriented product life cycle costing and activity-based management—in enhancing the basic success factors in industrial organizations by applying them to the Kufa Cement Factory.
The research relied on building an integrated framework that combines a temporal analysis of the product's cost throughout its life cycle, from the design stage to the post-sales stage, and an analysis of the activities that consume actual resources and linking them to actual cost drivers. Actual data from the plant's operational environment was employed, and the primary and secondary activities were identified and linked to time-oriented cost units, with precise mechanisms adopted to measure the cost performance of each activity.
The research results revealed that applying time-driven product life cycle costing (TD-PLCC) provides a high ability to accurately calculate the costs associated with each product stage, especially when combined with activity-based management (ABM), which enables the identification of activities that add value and those that do not, thus rationalizing the use of resources. This has been tangibly reflected in several vital indicators, including reducing overall costs, improving productivity, and reducing wasted time. It also enhances the clarity of information upon which management relies in planning, control, and decision-making processes. It also enhances the industrial organization's ability to achieve key success factors, which include cost, time, quality, innovation, and sustainability.

Keywords: *Time-Driven Product Life Cycle Costing (TD-PLCC), Activity-Based Management (ABM), Key Success Factors (KSFs).*

1. INTRODUCTION

The business environment is witnessing rapid developments and increasingly complex transformations as a result of economic openness, technological progress, and changing customer tastes and needs. In the face of these changes, economic units, especially industrial ones, are required to achieve high levels of efficiency and effectiveness in the use of resources, and to build advanced accounting and management technologies that keep pace with this rapid change and assist management in making sound strategic decisions based on accurate and reliable information.

Many modern accounting and management methods have emerged aimed at improving the performance of economic units. However, the real challenge lies in the integration of these tools and their ability to provide a comprehensive and integrated view of performance. Among the most prominent of these tools is the time-oriented product life cycle costing technique, which seeks to calculate product costs across its various stages, starting from concept and design through production and distribution, to disposal, with a focus on the time dimension as one of the primary factors influencing cost and performance. This technique is a development of the product life cycle accounting concept, adding a time dimension that helps improve resource allocation and reduce waste resulting from poor time utilization.

Conversely, activity-based management (ABM) contributes to improving the efficiency of operational processes by analyzing activities and identifying the true causes of costs. This enables process redesign, reduces unnecessary costs, and improves decisions related to pricing, planning, and development. This technique is based on a deep understanding of the structure of internal operations within an economic unit and works to shift the focus from traditional cost centers to the actual activities that generate them.

The integration of these two technologies is an important approach that helps provide strategic information that enhances management's ability to achieve the basic success factors, namely cost. This is achieved by improving the accuracy of cost measurement and providing information that helps reduce overall costs across the product's lifecycle and time by linking time-consuming activities to costs. This allows for a reduction in non-productive time and greater flexibility in responding to market needs and quality by linking quality assurance and development activities to their costs. This allows for improved process outputs and ensuring the sustainability of customer satisfaction and innovation. The integrated information system resulting from this integration provides better support for design and development decisions and the launch of new products with greater effectiveness. Finally, Sustainability by enabling economic units to adopt strategic decisions that reduce waste and take into account environmental and social dimensions, in addition to the economic ones.

2. MATERIALS AND METHODS

2.1. theoretical materials

2.1.1 The problem of the study

The research problem is represented by the following questions:

1- To what extent does the integration of the time-driven product life cycle costing (TD-PLCC) and activity-based management (ABM) techniques contribute to overcoming the shortcomings and problems of traditional costing systems in the economic unit, the research sample (Kufa Cement Factory)?

2- What is the possibility of applying the time-driven product life cycle costing (TD-PLCC) and activity-based management (ABM) techniques in an integrated manner in the economic unit, the research sample?
3- To what extent does the integration of the time-driven product life cycle costing (TD-PLCC) and activity-based management (ABM) techniques contribute to achieving the key success factors (KSFS) represented by cost, quality, time, sustainability, and innovation in the economic unit, the research sample (Kufa Cement Factory)?

2.1.2 Objectives of the study

In light of the research problem questions, this study seeks to achieve the following objectives:
1- Explaining the concept and foundations of both the TD-PLCC and ABM techniques.
2- Studying and applying each of the two techniques on the research sample and proving their efficiency in the economic unit
3- Evaluating the effectiveness of their integration in supporting administrative decisions and achieving optimal performance by clarifying the aspects of integration between the two technologies and its impact on the efficiency of accounting information.
4- Analyzing the impact of this integration on achieving optimal costs, reducing time, improving quality, enhancing innovation, and supporting sustainability.
5- Presenting a proposed model for applying the integration between the two technologies in the business environment and presenting an applied framework that supports economic units in adopting this integration to enhance the basic success factors

2.1.3 **The importance of the study**

1- Academic Importance:
The research contributes to bridging the knowledge gap on how to integrate cost management techniques to enhance strategic success by shedding light on the integration of two modern accounting techniques whose combined impact has not been adequately addressed in the Arabic literature.
2- Applied Importance:
The research provides a practical framework for companies wishing to improve their financial and operational performance by building advanced cost management techniques, benefiting from more accurate and effective information integration. It seeks to build an applicable model that can be implemented in the industrial environment, thus contributing to improving the operational and strategic performance of economic units.
3- Economic Importance:
It helps improve resource management and reduce waste, which supports the financial sustainability of institutions. It keeps pace with the demands of the modern environment, which forces organizations to seek more flexible and effective tools to improve decision-making efficiency and reduce risks. It focuses on five key success factors that are fundamental to building a sustainable competitive advantage: cost, time, quality, innovation, and sustainability.

2.1.4 Study hypothesis

The research is based on the following main hypothesis:
The integrated use and application of both (TD-PLCC) and (ABM) technologies contribute to eliminating the shortcomings of traditional accounting systems, thus enhancing the basic success factors in the economic unit (research sample).

2.1.5 study Methodology:

1- The deductive approach, which includes the use of sources of research, books, theses, and dissertations, both Arab and foreign, to study them comprehensively and extract useful information for this research.

2- The inductive approach: This is achieved by being present in the field in the economic unit (the research sample) and obtaining an in-depth idea and a clear picture of the records, books, accounts, and reports available within the time limits of the research sample, in addition to applying the two techniques to the course of work of the economic unit and determining the results of this application.

2.1.6 study Limitations:

Researchers often face several obstacles during academic writing, including the following:
1- Temporal Limits:
To complete the research requirements and achieve its objectives, data from the Kufa Cement Factory for the year 2024 was used, as it is the most recent data available to the researcher.
2- Spatial Limits
The Iraqi General Cement Company was chosen as the research community and the Kufa Cement Factory as the research sample, because it is a leading company in Iraq and one of the largest Iraqi companies. It has contributed to improving the country's economic level over many years, and its continuous expansion at the local level, as it has several branches in several governorates

2.1.7 Previous studies

1- Study (Almhanh, 2020)

Study Details	Details	Seq.
Almhanh, 2020	Researcher and Year	-1
Integration of Target Costing and Time-Driven Product Lifecycle Costing Technologies and Its Impact on Cost Management	Study Title	
An Applied Study in the General Company for Electrical and Electronic Industries / Refrigerated Engine Production Plant	Study Sample	
-Presenting a cognitive discussion of some modern cost management techniques, represented by Target Costing and Time-Driven Product Lifecycle Costing. - Demonstrating the possibility of integration between the two techniques - Clarifying the role of the time-driven product life cycle costing technique in providing integrated information about resources for each stage of the product life cycle.	Study Objective	

- The focus of the time-driven product life cycle costing technique on the essential quantity of contributing resources makes it one of the modern techniques in cost and management accounting, characterized by accuracy in producing the product at each stage it goes through and on the basis of time as a cost driver calculating and managing the cost efficiently -The time-oriented product life cycle costing technique provides more reliable information by identifying unused energy and its cost, not assigning it to the stages the product goes through. This helps management make optimal use of energy, as well as helping to determine the resource pools' share of costs.	Key Findings

2- Study: (Lavolpe, 2022)

Lavolpe, 2022	**Researcher and Year**	**-2**
Activity-Based Costing (ABC) Activity-Based Management (ABM)	**Study Title**	
Hypothetical study of a lamp production company in Argentina.	**Study Sample**	
Activity-Based Management or ABM is a management technique dedicated to the search for cost reduction through process efficiency. The essence of ABM is to manage all of a company's activities using the information provided by ABC, but the goal is to maintain optimal performance.	**Study Objective**	
- A dramatic increase in the services requested by a portion of managers and information on the various costs of setting up industrial companies. -Outsourcing of activities, which, before the need to reduce costs, complements and integrates the information existing in the areas of responsibility. -The relationship between the supplier, the company, and the customer, which obligates three parts to a comfortable mutual relationship that includes other aspects and mutual knowledge of their costs in the activities they specifically intend. - Eliminating activities that do not add value.	**Key Findings**	

3- Study: (Zahidy, 2019)

Study Details	**Details**	**Seq.**
Zahidy, 2019	**Researcher and Year**	**-2**
Critical Success Factors for Corporate Social Responsibility	**Study Title**	

Adoption in the Construction Industry in Malaysia	
Construction industry companies in Malaysia	**Study Sample**
This study aims to explore and evaluate the critical factors for the success of CSR adoption in the construction industry through the lens of the Critical Success Factors Theory (CSFS)	**Study Objective**
It provides guidance for Malaysian construction companies to consider the critical factors that lead to the success of CSR adoption. By considering the critical success factors, the construction company is guided and directed towards a better understanding of how to obtain optimal CSR performance and reduce the risk of failure.	**Key Findings**

2.2. METHODS

2.2.1 The Concept of Time_driven product life cycle cost and Activity_based management: (TD-PLCC):

This technology has proven its ability to provide accurate results when used correctly, its ease of use in many companies, its industrial and environmental aspects, and its compatibility with all types of products. This has led many researchers to turn to this technology and their desire to study it more deeply. Many researchers and authors from around the world have come forward. SAVE International (2007) indicated that adopting the principle of linking costs to each stage of the product life cycle may be more important and valuable if time is considered as a cost indicator in determining the cost of each stage. The new version of the time-driven activity-based costing system aims to eliminate the problems associated with implementing and using these systems in large companies by changing the method of collecting data on activity times and modifying activity-based costing procedures. Time-driven activity-based costing takes an aggregated view of resources, meaning that they are composed of different types of resources such as materials, labor, and external services [1]. the product life cycle costing (TD-PLCC) technique as one of the contemporary strategic cost management techniques that focuses on using time as a primary cost driver in allocating resource costs to cost objectives represented by each stage of the product's life cycle, which together represent the product cost [2]. Here, the researcher concludes that in order to implement this technique, all types of resources used throughout all production stages must be taken into account, without exception, to enable us to identify the available energies and how they were directed to obtain the final product, and then to collect them using a cost measurement method using the time cost engine for each activity process in workstations, as well as before and after the production process.

(ABM):

Knowing a business at the activity level is the fundamental building block upon which a new understanding of where profits are made can be built. By making visible what was previously invisible, ABM sheds light on those aspects of the business where action can directly improve business performance. Because it deals with financial numbers, ABM is often viewed as

maintaining the financial function. In fact, its real power lies in providing truly useful information to all functions in the organization [3]. Activity-based management (ABM) is a concept that can be applied to achieve the intersection between improving quality and customer value. The integrated management control system of ABM contains two complementary dimensions: the cost dimension and the process dimension. The cost dimension improves the accuracy of cost allocations obtained from cost information about activities, resources, products, and customers. The process dimension provides information related to the analysis of the chain of production activities from raw materials to consumers—that is, what activities are performed, why they should be performed, when they should be performed, and how the activity should be performed with a focus on reducing costs [4].

Key success factors:

PIt is self-evident that each economic unit has its own priorities in its success points, which it seeks to identify in order to achieve its desired goals. These points may differ according to the type of company's work or even according to its goals and strategic plans. However, Horngren was able to identify five types of basic success factors: cost, quality, time, sustainability, and innovation [5]. These factors can be used for all types of businesses and are used according to different priorities, depending on decision-makers and their approach to developing their strategic plans.

2.2.2 The impact of integration between time-driven product life cycle costing (TD-PLCC) and activity-based management (ABM) techniques on key success factors:

1- Cost:

Cost is a crucial element in competition, so economic units must manage production at the lowest costs, provided that acceptable quality is not sacrificed. As long as some cost elements change in essence in light of technological progress, the allocation process, which is based on production volume, has become subjective. This has imposed the necessity of monitoring and controlling time, specifications, and resources as a basic cost driver, so that economic units are ahead in competition, while moving away from philosophies based on maximizing outputs with the aim of reducing costs [6].

2- Time:

There is usually a large gap between actual production and the production plan developed by management. The difficulties facing management cannot be resolved without obtaining accurate real-time data. Therefore, management must rely on a system to control real-time product data. [7]. On the other hand, reducing time is a complex process with two aspects: The first aspect is the technical aspect, which represents the extent to which the time can be reduced to complete a specific task. For example, one must wait a certain period of time so that the foundation can be built after it has become sufficiently solid before building on it. In other words, the time of an activity can be reduced to the maximum possible reduction from a practical perspective. The second aspect, the economic aspect, is related to the physical work. The additional cost incurred by the contractor as a result of the time pressure process, which requires additional resources, may make it necessary for the contractor to hire new workers in addition to the available workers, or add new machines and equipment with higher efficiency or better technology, which would increase the economic unit costs [8].

3- Quality:

Product quality is the product's ability to perform its function. Capability includes durability, reliability, accuracy, ease of operation and repair, and other valuable attributes of all products. Product quality is the product's ability to deliver performance results that match or even exceed what the customer expects. Product quality, whether in the form of goods or services, is determined by the product's quality dimensions: performance, durability, compliance with specifications, features, reliability, aesthetics, perceived quality, and serviceability [9]. The focus of those in charge of industrial companies is on intensifying the production process by minimizing downtime and avoiding all causes of defective products and addressing them in advanced stages of the production process, in their desire to reduce manufacturing costs while ensuring the desired quality. In it, the customer, and achieving the satisfaction of his desires and ensuring his satisfaction and loyalty. This can only be achieved by evaluating the role of the quality of production requirements in reducing production costs by identifying and being able to determine the various factors affecting quality costs and how to control them and analyzing the various indicators that help achieve the optimality of the duality (quality / costs) [10]. Through this text, we can observe the extent of the connection and influence of success factors on each other, as quality affects costs and costs affect quality with the participation of the other factor (time) and its influence on them.

4- Innovation:

Innovations are the creation and exploitation of value propositions or built-in value in "novelty" or "differences in products, processes, technologies, methods, and business models from elements of other products, processes, technologies, methods, and business models, or from elements of the same products, processes, technologies, methods, and business models that were previously manufactured), which are often constructed through the occurrence of one or more events with small/low probabilities of success" that may require "high problem solving and demonstrate the impact of the possibility of a particular solution or deliverable product in the case of the original occurrence of events in the product, process, technology, method, or business model" and thus can be [11]. "called innovation events.

5- Sustainability:

Sustainability is not only limited to the environment, but also includes the mental dimension. Sustainable development [12]. was originally conceived as a reconciliation of environmental, economic, and social objectives. Environmental sustainability in production is not an idea that just emerged in this millennium, although the preponderance of research has only begun to gain momentum in recent years. Calls have been made to expand the scope of environmental concerns in manufacturing and industrialization strategy in this millennium [13].

2.2.3. Steps to implement TD_PLCC and ABM technology:

TD-PLCC: The following are the steps for applying this technique:

1- Identifying the resource groups related to the product life cycle: In this step, the resource groups, divisions, and sections specific to the stages that the product goes through throughout its life are identified [14].

2- Determining the total resource costs for each stage of the product's life cycle: Where resource costs are represented by indirect costs, indirect costs include indirect manufacturing costs excluding direct materials [2]. and salaries and wages are added to them.

3- Determine the practical capacity for each resource group. Since time is used as a driver, the product production hours will be the practical capacity. Activities are represented by time equations, which are the sum of the times of individual activities with time drivers through a simple time equation. For example, different types of products do not necessarily require the same amount of time to produce. The percentage of theoretical capacity: assuming practical capacity is approximately 80% for people due to breaks, arrival and departure, training, and meetings, and 85% for machines due to maintenance, repair, and scheduling fluctuations of the theoretical full capacity [15].

4- Determine the unit cost of time for each resource group related to the product production processes: This step is accomplished by dividing the total operating costs, which are represented by direct and indirect costs by the practical capacity [2].

5- Identify and group the activities associated with the product life cycle stages and the time required for each activity The resulting time equation is expressed in the equation:

Process time = Σ individual activity times

Time equations allow for a detailed understanding of the dynamics of operational processes. In addition, this costing system enables the identification of idle capacity or inefficient use of resources, as consumed resources are allocated to the product instead of working resources. Identifying idle capacity helps quickly identify the root of existing problems in the organization [16].

6- Calculating operating costs for each resource group for the stages: In this step, the cost of the unit time for each activity is multiplied by the time calculated according to the time equation, so that the result represents the total operating cost, labor, and indirect industrial costs for each activity [17].

7- Calculating the total cost of the product life cycle stages: This is the final step in applying the technical steps, in which the total cost of the stages the product passes through throughout its life cycle is calculated after adding the input materials and other costs to the operating costs [18].

ABM: It consists of the following steps:

The following points illustrate the precise and detailed mechanism of the technique: [19].

1- Identifying Activities:

It is an activity analysis that identifies all of the organization's important activities. The resulting list of activities should be divided to the most important practical level. For example, instead of listing purchasing as an activity, the list should divide the purchasing process into its component activities, such as obtaining parts specifications, compiling vendor lists, selecting vendors, negotiating prices, ordering, and expediting. That is, identifying the activities required to produce a product or service. This involves dividing the production process into individual resource-consuming activities.

This step will allow for the identification of non-value-added activities through three criteria to determine whether the activity's value-added is as follows:

- Determine whether the activity is essential or not. If it is a repetitive or non-essential process, it is not value-added.
- The ability to perform the activity efficiently. It is useful to compare the actual performance of the activity to a value-added baseline that was established using budgets, targets, or external standards.
- Sometimes an activity is value-added and other times it is not. For example, it may be necessary to move work-in-process units between production processes, but it is not necessary to move raw materials during storage.

2- Cost Assignment:
This is the assignment of costs to each activity based on the resources consumed. This involves allocating indirect costs, such as rent and utilities, to individual activities. In this step, it is necessary to identify the cost drivers used for each activity (activity cost driver analysis). A cost driver is a measure that reflects the underlying reason for creating and configuring a cost element. Within cost aggregates, it is a factor used to measure the resources and costs consumed, and better attribute them to activities or final cost purposes. Determining the cost of each activity requires allocating resources to activities, which requires a causal relationship between each activity and the resources consumed in it, which is determined by cost drivers. The costs that occur in completing each activity of the organization can increase or decrease.

Depending on two main types of engines, the cost is:

- Structural cost drivers or hierarchical and layered cost drivers: These determine the type of costs and resources consumed in performing the facility's activities. They are the main reason for the formation of costs and their general structure. The idea of hierarchical or layered cost drivers came from the observation that different levels Cost drivers affect different costs.
- Procedural or executive cost drivers, which determine how the facility performs and implements its activities and work and the reasons for consuming resources in that work. They are the set of policies, methods, and procedures used by the facility to complete its work. [20].

3- Performance Analysis:
Once costs are assigned to activities, managers can analyze the performance of each activity. This includes comparing the costs and benefits of each activity to identify areas for improvement.

4- Process Improvement:
Based on the activity performance analysis, managers can make changes to the production process to eliminate activities that do not add value and improve efficiency. This may involve changing the way resources are allocated or redesigning the production process.

5- Measuring Results:
Managers must measure the results of changes made to the production process. This includes comparing the costs and benefits of the new process with the old process to determine the effectiveness of the changes [21].

2.2.3 THE PRACTICAL SIDE

Identifying the research sample (Kufa Cement Factory):

The Iraqi General Cement Company was established according to Ministerial Order No. 2963 on June 20, 1995, and it began its work on July 1, 1995. The headquarters of the located in Najaf Governorate, Kufa District, (7) kilometers away. Its factories are distributed across several governorates. Kufa Cement Plant is one of the factories of the Iraqi General Cement Company, located in Najaf Governorate, Kufa District, Al-Barakiya area. The plant was established in 1977 by the Danish F.L.S. Company, and consists of four production lines with a design capacity of 1,781,000 tons of cement annually, using the wet method of manufacturing. The factory uses the wet method to produce cement, which is summarized as follows:

Cement production in the Kufa Cement Factory begins with the extraction of raw materials. Limestone is brought from the quarries of Bahr al-Najaf and clay from the al-Kifl and al-Dahisiyah quarries in Diwaniyah. The raw materials are then crushed and mixed in precise proportions to obtain a homogeneous mixture. Since the factory relies on the wet method, water is added to the mixture to turn it into a wet paste, and the mixture is then ground to ensure its smoothness and homogeneity.

After the grinding process, the paste is heated in rotary kilns at temperatures up to 1450°C, forming clinker, the basic material in cement production. The clinker is then quickly cooled to maintain its physical properties and then ground again with the addition of a small percentage of gypsum to obtain the final cement powder. In the final stage, the cement is packed in special paper bags or prepared for bulk sale according to market needs. The factory produces ordinary Portland cement that conforms to Iraqi specifications and markets the product through the factory.

Stages of Cement Production:

The product life cycle is a very important element for reducing unit costs. It is a technology that works to reduce production costs in the early stages of product preparation. In the Kufa Cement Factory, the product consists of five production stages: research and development, planning and design, production, marketing and distribution, and after-sales services. Thus, all stages of product preparation before and after production were included.

Laboratory accounting data:

After reviewing the laboratory records, it became clear that the laboratory uses the standardized accounting system in its calculations and the traditional costing system to calculate costs. According to the standardized accounting guide, it was divided into cost centers as follows:

1. Production centers, numbered (5)
2. Production services centers, numbered (6) according to the accounting system
3. Marketing centers, numbered (7)
4. Administrative centers, numbered (8)

Table No. (23) Costs of cement production in the Kufa Cement Laboratory for the year 2024

Costs / in Iraqi dinars	Account Name	Guide
32,001,616,111	Salaries and Wages	31
7,396,891,656	Raw Materials and Supplies	321
9,787,782,825	Fuel and Oils	322
18,494,313,972	Spare Parts	323
3,026,033,732	Packaging Materials	324
716,273,048	Miscellaneous	325
188,559,842	Employee Supplies	326
2,611,200,360	Water and Electricity	327
2,626,657,714	Maintenance Services	331
–	Research and Consulting Services	332
3,446,000	Advertising, Printing, and Hospitality	333
1,697,092,777	Transportation, Statements, and Communications	334
1,106,506,159	Rental of Fixed Assets	335
175,263,902	Miscellaneous Service Expenses	336
–	Interest and Land Rent	36
7,764,540,399	Depreciation	37
–	Conversion Expenses	38
–	Other Expenses	39
87,596,178,497	Total	

Source: Prepared by the researcher based on the laboratory's accounting records. Data was used for the year 2024

	Quantity of cement produced (680,737 tons)		Details		
Cement cost per ton	Cement grinding cost (10% dinars	Clinker cost (90% dinars per ton)	Amount 100% (in dinars)	Account name	Account number

Table No. (25) shows the factory's annual costs per ton

	per ton)				
47,010	4,701	42,309	32,001,616,111	Salaries and Wages	31
61,035	5,215	55,820	42,221,055,435	Goods and Services	32
8,241	825	7,416	5,608,966,552	Service Requirements	33
–	–	–	–	Land Interest and Rent	36
11,407	1,141	10,266	7,764,540,399	Depreciation	37
–	–	–	–	Transfer Expenses	38
–	–	–	–	Other Expenses	39
127,693	11,880	115,811	87,596,178,497	Total	

Source: Prepared by the researcher based on cost accounting data

Table No. (26) shows the annual revenue and selling price after adding the marketing and administrative costs and the profit margin for the year 2024 per ton

Cost per ton (in dinars)	Statement
62,875	Fixed costs
64,255	Variable costs
127,693	Manufacturing cost
12,769	Marketing and administrative costs 10%
140,462	Total cost
14,046	Profit margin 10%
154,508	Selling price per ton
95,000 100,000	Actual selling price per ton (bulk) Actual selling price per ton (bagged)
(59,508) (54,508)	Profit/loss (bulk) Profit/loss (bagged)

Source: Prepared by the researcher based on factory account data

3. Applied study

In this step, each stage of the product life cycle will be identified, the costs of each stage will be assigned, the time unit will be calculated, and direct costs will be separated from indirect costs for ease of tracking and control. As for indirect costs, the cost of the time unit can be determined by

dividing the indirect costs by the operational capacity. Based on the factory data, the number of workers in the factory reached (1,773), including (537) procedures. After subtracting the 1,773 procedures - (537), the remaining (1,226) workers will be calculated for them indirect costs, according to the following table:

Table No. (29) Time costs per minute for all stages of cement production for the year 2024

Cost per minute	Other monthly indirect costs	Cost per minute	Monthly indirect cost per worker	Cost per minute	Monthly indirect cost, stage responsible	Number of workers or employees	Stage	
1,306.7	463,634,521	101	850,000	225	1,900,000	42	Research and Development	1
1,428.4	663,707,649	98	825,000	219	1,850,000	55	Planning and Design	2
							Production	3
307.3	194,694,795	106.5	900,000	215.4	1,820,000	75	Production Management (Division)	•
378	517,104,466	106.5	900,000	210	1,774,000	162	Stone Quarry	•
509.1	477,392,507	125.5	1,060,000	159	1,343,000	111	Rubber Conveyor	•
453	596,594,384	118.4	1,000,000	254.5	2,150,000	156	Mills Raw Materials	•
614.2	996,322,973	109.5	925,000	275.3	2,326,000	192	Kilns	•
786.2	796,998,178	103	870,000	212	1,791,000	120	Cement Mills	•
338	396,757,589	98	825,000	266	2,247,000	139	Packaging	•
1,369.4	1,330,417,297	95	800,000	183.2	1,548,000	115	Marketing and	4

							Distribution	
397	197,714,795	83	700,000	177.5	1,500,000	59	Services After Sales	5

Source: Prepared by the researcher based on laboratory records and Table No. (28)

The table shows what was done in the stages of the product life cycle and for each stage as follows:
-1- Research and Development Stage:
The total costs for this stage are (6,131,732,495 dinars). Part of this is direct costs represented by raw materials amounting to (518,782,416 dinars), wages for the stage amounting to (16,335,830 dinars), while the remaining amount of the total
5,596,614,249 dinars (6,131,732,495 dinars - 518,782,416 dinars - 16,335,830 dinars) after annual indirect costs, which were distributed among the activities of the stage shown, based on laboratory records. After that,

it is divided by 12 months and the monthly salary of the officials and workers is subtracted.
5,596,614,249 dinars / 12 months = 466,384,521 dinars per month
466,384,521 - (1,900,000 + 850,000) = 463,634,521 dinars per month

The cost per minute was calculated by dividing the monthly indirect costs of the official or employee

(Worker) in it, which the department is responsible for implementing, or other indirect costs, which are calculated as follows:

Operational capacity = working hours per day * days of the month excluding holidays x 60 minutes/hour) x 80%
80% x (60 x 22 x 8) = 8448 minutes

Whereas in the research sample (the laboratory), the official working hours were 8 hours per day.

As for other indirect costs, their operational capacities are calculated according to the following equation:

Operational capacity - working hours per day x days of the month excluding holidays x number of activity workers x 60 minutes/hour) x 80%
80% x (60 x 42 x 22 x 8) = Operational capacity of stage workers
= 354,816 minutes
Indirect costs of the stage
Indirect cost per minute for the activity manager - Monthly indirect cost + Operational capacity
1,900,000 ÷ 8448 = 225 d/minute

Indirect cost per minute per activity worker - Monthly indirect cost: Operational energy
850,000 ÷ 8448 = 101 s/min

Indirect cost per minute of activity - Other monthly indirect cost: Operational energy
463,634,521 ÷ 354,816 = 2,750 s/min

Determine the time required to perform each of the activity events for the product life cycle stages:
Using the time equation (adding) the activity event times, which is applied to all stages.
The resulting time equation is expressed in the equatio
Process time = Σ individual activity times
-1- Determine the activities related to the research and development stage and the event times of each activity:
The activities specific to the research and development stage include a group of activities that occur in this stage, shown in Appendix No. (1), and they were identified by reviewing the manuals and procedures approved in the laboratory. The results of the aforementioned time equation were also used to calculate the time for each activity, and these activities included the following:
0.5 + 0.2 + 0.5 + 1 + 0.7 + 0.5 + 0.3 = Research and development stage time (in minutes)
= 3.7 minutes

-2- Identifying the activities related to the planning and design phase and the times of each activity
Based on Appendix No. (2)
0.5 + 0.8 + 0.8 + 1 + 0.9 + 0.6 + 0.4 0.5 0.3 0.4 Planning and Design Phase Time (min)
= 6.2 minutes

-3- Identifying the activities related to the production phase and the times of each activity
In this phase, Appendix No. (3) (4) (5) (6) (7), (8) will be used, and by taking the sum of the times for each part of this phase
2 + 2.2 + 3.3 + 2.4 + 0.2 + 7.7 + 0.5 = Production Phase Time (in minutes)
= 18.3 minutes

-4- Identifying the activities related to the marketing and distribution phase and the times of each activity
Marketing and Distribution Phase Time (in minutes) = 1 + 0.6 + 0.3 + 0.7 + 0.9 + 0.5
= 4 minutes

-5- Identify the activities related to the after-sales services phase and the times each activity occurred.
Marketing and Distribution Phase Time (in minutes) = 0.5 + 0.8 + 0.6
=1.9 minutes

Calculating the operating costs of resource groups for each production stage:
Table No. (30) shows the operating cost per ton for each stage

Activity operating cost	Total unit time cost for the stage	Total Stage Activity	Stage	Dis

for the stage (dinars) (2) x (1)	(dinars/minute) (2)	Performance Times (min) (1)		
7,709.5	1,306.7	5.9	Research and Development	1
10,570.2	1,428.4	7.4	Planning and Design	2
75,841.5	3,385.8	22.4	Production	3
5,751.5	1,369.4	4.2	Marketing and Distribution	4
754.3	397	1.9	Services After Sales	5
100,627	7,887.3	41.8	Total	

Source: Prepared by the researcher based on the results of steps (5) and (6)

From this step, after identifying the activities for the stages and the time and cost of each activity, the researcher suggests starting to introduce the activity-based management technique, comparing its results with the current results of this table, and clarifying the impact of integration on the basic success factors.

After introducing this technology, the activity times for the stages become as follows:
1- Research and Development Stage:
the time for the research and development phase (in minutes) becomes = 0.5 + 0.7 + 0.8 + 1.5
= 3.5 minutes

2- Planning and Design Stage:
the time for the planning and design phase (in minutes) is = 0.7 + 0.5 + 0.4 + 1.3 + 2 + 1.1
= 6 minutes

3- Production stage:
Production stage time (in minutes) = 1.1+2+3.1+2.6+0.7+7.6+0.9
= 18 minutes

4- Marketing and Distribution Stage:
This results in the time for the marketing and distribution stage (in minutes) = 1 + 0.8 + 0.8 + 1.2
= 3.8 minutes
5- After-sales services stage:
= 1.9 minutes

From the above, a new table can be prepared for the operating costs of the activities for the stages according to the information in the new tables.

Table No. (42) shows the operating cost of the activity for the stage

Activity operating cost for the stage (dinars) (2) x (1)	Total unit time cost for the stage (dinars/minute) (2)	Total Stage Activity Performance Times (min) (1)	Stage	Dis
4,573.5	1,306.7	3.5	Research and Development	1
8,570.4	1,428.4	6	Planning and Design	2
60,944.4	3,385.8	18	Production	3
5,203.7	1,369.4	3.8	Marketing and Distribution	4
754.3	397	1.9	Services After Sales	5
80,046.3	7,887.3	33.2	Total	

Source: Prepared by the researcher based on Table No. (30) and the results of applying the (ABM) technique

The last step in applying the technology steps is calculating the total cost of the stages the product goes through during its life cycle after adding the cost of materials to the operating costs after dividing them by the quantities produced. As shown in Table No. (25), the quantity of cement produced is 680,737 tons for the year 2024.

The cost of materials per ton of cement (Dinar per ton) (2) + (1)	The cost of cement grinding 10% (Dinar per ton) (2)	The cost of clinker 90% (Dinar per ton) (1)	The cost of materials 100%	Stage	Dis
65.4	6.54	58.85	44,509,854	Research and Development	1
93.3	9.34	84.07	63,585,506	Planning and Design	2
560.4	56.04	504.39	381,513,033	Production	3
186.8	18.68	168.13	127,171,011	Marketing and Distribution	4
28.0	2.80	25.22	19,075,652	Services After Sales	5
933.9	93.4	840.66	591,345,202	Total	

Table No. (43) The cost of direct materials per ton of cement
Source: Prepared by the researcher

In order to fully calculate the total cost of the product life cycle, administrative and marketing costs must be added, and according to the methods
adopted in the laboratory's calculations, they amount to 10%, as in the following table:

Table No. (44) shows the total costs of the laboratory after applying the two technologies (Dinars per ton)

Total costs (4) + (3)	Administrative and marketing costs 10% (4)	Manufacturing costs (3) − (2) + (1)	Material costs (2)	Operating costs (1)	Stage	Dis
5,102.79	463.89	4,638.9	65.4	4,573.5	Research and Development	1
9,530.07	866.37	8,663.7	93.3	8,570.4	Planning and Design	2
67,655.28	6,150.48	61,504.8	560.4	60,944.4	Production	3
5,929.55	539.05	5,390.5	186.8	5,203.7	Marketing and	4

					Distribution	
860.53	78.23	782.3	28.0	754.3	Services After Sales	5
89,078.22	8,098.02	80,980.2	933.9	80,046.3	Total	

Source: Prepared by the researcher based on laboratory records and previous tables

By comparing the total cost of Table No. (44), which amounted to (89,078.22) dinars per ton, with Table No. (26) of the previous section, which amounted to (140,462) dinars per ton, a very large difference is observed after using the two technologies in the plant, amounting to (51,383.78) dinars per ton. With this result, the plant can continue using the imposed pricing and achieve profits after applying these two technologies in the plant, or even reduce the price and sweep the market, or work to increase quality and compete with the rest of the company's plants.

4. RESULTS AND DISCUSSION

4.1. Conclusions

This chapter includes a set of conclusions reached by the research after completing both the theoretical framework and the analytical practical section:

1. It became clear through the applied of the time-oriented product life cycle costing technique, which is a modern cost- and management-related technique, to the laboratory that there were satisfactory results that would help improve the position of the economic unit, as it contributed to addressing some of the gaps and shortcomings caused by the traditional costing system.
2. The method of presenting and working with information when using the (TD-PLCC) technique is simple and does not require a fundamental change in the fundamentals of the economic unit's work.
3. Both techniques, whether the (TD-PLCC) or the (ABM) technique, achieved a positive difference when used on the research sample in reducing costs and achieving profits
4. The difference in results achieved by the integration of the two technologies at the total cost amounted to (51,383.78) dinars per ton, proving the potential of this integration to achieve the study's objectives.
5. The integration provided a clear picture of its ability to enhance the basic success factors. Reducing costs and rationalizing time can benefit other factors if used correctly by management.

4.2. Recommendations

1. The accounting department at the plant needs to keep pace with developments in costing methods and adopt modern techniques and methods, including time-driven product life cycle costing (TD-PLCC).
2. The importance of using integration between modern accounting techniques in economic units because it produces better and more beneficial results and achieves part or all of the basic success factors.
3. The necessity of using at least one of the techniques (TD-PLCC) or (ABM) that were applied in the study on the plant or some of the parent company's other plants to benefit from them.
4. Addressing the problem of the lack of modernity in the manufacturing methods of the product (cement) currently used to preserve available capacities from waste.
5. Laboratory management should work on innovation, not ignore it, but develop it through human resources and utilize all available human energies, even if they are small, as they can make a difference.

REFERENCES

[1] Szychta, Anna, (2010): "Time-Driven Activity-Based Costing in Service Industries", SOCIAL SCIENCES / SOCIALINIAI MOKSLAI, Nr.1 (67). Poland

[2] Al-Awad, Zahraa Yahya Abdul Zaid (2022) Balancing the time-driven product life cycle and its role in achieving the dimensions of competitive advantage. An applied study in the General Company for Electrical and Electronic Industries / Refrigerated Engine Production Plant, Master's Thesis, College of Administration and Economics, University of Karbala.

[3] Plowman, Brian, (2017): "Activity Based Management: Improving Processes and Profitability", "1th", London

[4] Husna, Nadzifah Sabila & Hasanudin, Mohamad & Al Farizi, Musyafa, (2022): "The Analysis of Activity-Based Management Implementation to Increase Cost Efficiency in Hotel XY Semarang", Ilomata International Journal of Management, Volume. 3 Issue 2, Page: 175-193, Indonesia

[5] Datar, Srikant M. & Rajan, Madhav V., (2021): "Horngren's Cost Accounting: A Managerial Emphasis", 17th Edition, Global Edition, PEARSON, USA

[6] Al-Maamouri Hatem Karim Kazim Ahmed Maher Muhammad Ali Alaa Muhammad Obaid Ali Nouri Abdul Zahra (2024): Compatibility of the Theory of Innovative Solutions and the Strategic Approach to Cost Management in Enhancing the Objectivity of Cost Allocation, Al-Ghari Journal of Economic and Administrative Sciences, Volume (20), Special Issue

[7] Badawi, Mustafa Hatem Muhammad Fida Idris Ahmed Muhammad Al-Sheikh Tariq Muhammad Zaghloul (2021) Application of Automated Identification and Point/Data Collection (AIDC) Systems in Real-Time Monitoring of Production Data in Ready-Made Garments Factories, Journal of Applied Arts and Sciences, Volume (8), Issue (1).

[8] Taleb Ali Osama Raed Majeed Abdul Muhammad Al-Iham Salman Youssef (2022): Integration between Just-in-Time Production and Accelerated Implementation Methods and Their Role in Reducing Costs, Journal of the City of Knowledge College Volume (14), Issue (2)

[9] Brata, Baruna Hadi & Husani, Shilvana & Ali, Hapzi, (2017): "The Influence of Quality Products, Price, Promotion, and Location to Product Purchase Decision on Nitchi At PT. Jaya Swarasa Agung in Central Jakarta", Saudi Journal of Business and Management Studies, Vol. 10, ISSN 2415-6663, Indonesia.

[10] Diop, Muhammad Abbas, and Ammar, Ibrahim Ghassan (2014) Evaluating the Role of Production Requirements Quality in Reducing Production Costs: A Field Study on the General Textile Company in Lattakia Governorate, Tishreen University Journal for Scientific Research and Studies - Economic and Legal Sciences Series, Volume (36), Issue (1).

[11] Kanagal, Nagasimha Balakrishna, (2015): "Innovation and product innovation in marketing strategy", Journal of Management and Marketing Research, Vol. 18, India

[12] MCKINNON, ALAN & CULLINANE, SHARON & BROWNE, MICHAEL & WHITEING, ANTHONY. (2015): "GREEN LOGISTICS: Improving the environmental sustainability of logistics", "3th", The Chartered Institute of Logistics and Transport (UK)

[13] Sarkis, Joseph & Zhu, Qingyun, (2018): "Environmental sustainability and production: taking the road less travelled", International Journal of Production Research, Vol. 56, Nos. 1-2, (USA)

[14] Al-Mahna, Qusay Abdul-Aimmah Aswad (2020) Integration of target costing and time-driven product life cycle costing technologies and its impact on cost management / An applied study in the General Company for Electrical and Electronic Industries / Refrigerated Engine Production Plant, Master's Thesis, College of Administration and Economics, University of Karbala

[15] Guzman, Lorena Siguenza & Abbeele, Alexandra Van den & Cattrysse, Dirk, (2014): "Time-Driven Activity-Based Costing Systems for Cataloguing Processes: A Case Study", LIBER QUARTERLY, Vol. 23, No. 3, Belgium.

[16] Vedernikova, Olga & Guzman, Lorena Siguenza & Pesantez, Johanna & Carrion, Rodrigo Arcentales, (2020): "Time-Driven Activity-Based Costing in the Assembly Industry", Australasian Accounting, Business and Finance Journal, Volume 14, Issue 4, Australia

[17] Al-Silawi, Ali Obaid Fahad, and Al-Ghaban, Faiza Ibrahim Muhammad (2024) "The Extent of the Impact of Applying Time-Driven Activity-Based Costing (TD-ABC) Technique in Achieving Competitive Advantages," Journal of Accounting and Financial Studies, Volume (19), Issue (66).

[18] Al-Kishwan Ali Muhammad Hassan Muhammad (2023) Employing the deployment of the green quality function and the total cost of the time-driven product life cycle to achieve sustainable competitive advantage, PhD thesis, College of Administration and Economics, University of Karbala.

[19] Hilton, Ronald W. & Platt, David E., (2016): "Managerial Accounting Creating Value in a Dynamic Business Environment", "11th" Edition, Mc Graw-Hill

[20] Al-Yamour, Ali Hazem Younis (2010) Using the Activity-Based Management System (ABM) to Identify Cost Reduction Opportunities, A Case Study in Mosul Dairy Factory, Al-Rafidain Development Journal, Volume (32), Issue (98).

[21] Al-Husseini, Ezz El-Din Hassan Kazim, and Al-Tamimi, Muhammad Taban Muhammad (2023): Applying Activity-Based Management to Increase Sustainable Profitability - A Survey Study, The Iraqi Journal of Economic Sciences, Special Issue of the Proceedings of the (6) Annual International Scientific Conference (17).