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THE ROLE OF VALUE ANALYSIS TECHNOLOGY IN REDUCING PRODUCT COSTS-AN APPLIED STUDY AT THE DIWANIYAH TIRE FACTORY

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Abstract:

This research aims to apply value analysis technology to a public rubber industry company, the Diwaniyah Tire Factory, as it is considered one of the most important strategic cost management techniques in the field of cost accounting and management accounting. To achieve the research objectives, the researcher relied on data from the Diwaniyah Tire Factory through personal interviews with factory employees to apply value analysis technology. The research concluded that eliminating waste and loss in all production processes, as well as processes that do not add value, is essential for reducing product costs. The research concluded with the consideration of transitioning to modern systems and technologies due to the diversity of customer needs and desires and the changing benefits and forms of products.

Keywords: Value proposition analysis technique, product cost reduction.

INTRODUCTION:

Recently, global markets have witnessed intense competition among economic units and ongoing efforts to reduce the cost of their products and offer products that meet customer needs and achieve customer satisfaction. Traditional accounting and traditional production systems based on large-scale production are no longer able to provide the information needed to assist in making technical decisions that contribute to reducing production costs. Therefore, the need has emerged to adopt several techniques used by economic units to achieve their goals, including value analysis technology.

1- RESEARCH METHODOLOGY:

This section addresses a set of paragraphs representing the research problem, its importance, objectives, hypothesis, community, scientific methodology, sources of information collection, and its limitations, as follows:

2-1The Research Problem:

The research problem lies in the fact that Iraqi economic units suffer from high costs compared to foreign products offered in the market. These units also suffer from quality-related problems, as foreign products offered in the market are considered of higher quality than local products. Despite this, Iraqi economic units do not apply modern administrative costing techniques, despite the remarkable development of these techniques. Among the most important of these techniques are the two techniques of value analysis and performance. The research problem can be expressed through the following intellectual question:

(Does the use of value analysis techniques contribute to reducing costs)?

2-2Importance of the Research:

The importance of the research stems from the importance of its main variables, represented by the value analysis technique. The importance of value analysis stems from its ability to analyze the components and functions of a product with the aim of identifying unnecessary components and functions that do not add value from the perspective of the economic unit and the customer. These components and functions can then be eliminated to reduce costs without compromising or improving quality.

2-3Research Objectives:

In light of the research problem and the question posed, the research primarily aims to achieve a set of objectives, as follows:

1-Addressing the cognitive foundations of one of the strategic cost management techniques, namely value analysis.

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2-The cognitive foundations of cost reduction.
3-Explaining the role of value analysis in reducing product costs.

2-4Research Hypothesis:

The research is based on the following basic hypothesis: (The use of value analysis techniques can help reduce product costs) .

2-5 Research Community and Application Area:

The research community is represented by the factories affiliated with the General Company for Rubber Industries, a subsidiary of the Iraqi Ministry of Industry and Minerals. The research sample is the Diwaniyah Tire Factory, which serves as the applied research area.

2-6 Scientific Research Methodology and Data Collection Sources:

The researcher relied on two basic approaches, as follows:
First: The deductive approach: This approach was used in the theoretical aspect of the research. Data and information related to this aspect were collected through theses, dissertations, books, periodicals, and articles, as well as the opinions of local, Arab, and foreign researchers. These data were obtained through visits to public and private libraries and the Internet. Second: The inductive approach: This approach was used in the applied aspect of the research, utilizing the value analysis technique and applying it to the economic unit under study. Data and information for the practical aspect were obtained through:
A. Interviews with those involved in the work, including engineers, technicians, accountants, auditors, experts, and designers.
B. Reviewing cost records and reports in the economic unit that comprised the research sample.
C. Reviewing production reports for all production stages through field visits.
C. Reviewing performance reports.

2-7 search Limits:

First: Spatial Limits of the Research: The General Company for Rubber and Tire Industries/Diwaniyah Tire Factory was selected as the research sample for the practical aspect of the research. Located in the Al-Iskan neighborhood of Qadisiyah Governorate, the factory is located in the city. This is because local products suffer from high costs, low quality, and an inability to compete with foreign products. Therefore, the factory needs to implement modern and contemporary technologies to contribute to supporting the national economy.
Second: Temporal Limits: The temporal limits of this study were set to the year 2016, as it is closer to reality and contains data, noting that the factory has been out of operation since 2017.

2-8 Research Variables:

The research included two variables:
A. The independent variable: represented by the value analysis technique.
B. The dependent variable: represented by reducing the product cost.

3- The cognitive foundations of value analysis technology:

3-1 The origin and concept of value analysis:

The first appearance of this technology was in 1974 by electrical engineer Lawrence Miles, who worked for the American company General Electric. It was based on American research, ideas, and efforts made earlier in the 1930s in the field of research to develop product components that were less expensive, better functional, and of higher quality. The shortage of basic materials and components of products after World War II was also a major and primary reason for the emergence of this technology, due to the great need to find alternatives to product components and functions that perform the same function at a lower cost and higher quality (Gheorghe, et al., 2013: 162). Value analysis is viewed as a systematic methodology that aims to achieve a balance between the efficiency and effectiveness of the product's function and its cost and overall performance. This is done by relying on scientific methods, with a greater focus on the needs and desires of customers, as well as solving the problems the product faces in relation to its value. (Alazemi, 2011: 49-50), as this technique is an organized methodology for determining the functions and costs of the product in order to reach a way to reduce the costs associated with the product through components and functions that do not add value from the customer's point of view. Therefore, it performs a functional analysis based on an organized work map that works to improve performance and quality and eliminate unnecessary functions that do not add value (Suhaimi, 2014: 9). This technique is also considered an organized methodology that works to analyze the functions and components of products, services, projects and programs in order to improve performance and quality and reduce the costs of the product in all stages of its production, as well as to provide safety and security requirements. Therefore, this technique requires a work team

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that has experience and knowledge in order to analyze these functions and components and match customer requirements (Patti, 2010: 3-4).

3-2 Objectives of the Value Analysis Technique:

Value analysis is an advanced methodology for solving many problems. It is one of the strategic cost management techniques that seeks to achieve a set of objectives, including:

1-The collective effort and spirit of a multi-functional and multi-disciplinary team, which works through coordination and communication to resolve all obstacles and problems encountered by economic units when applying this technique, has led to the goal of removing all professional or functional barriers within economic units (Suhaimi, 2014: 47-48).

2-The goal of this technique is to achieve customer satisfaction with the product within the economic unit, thereby increasing sales, reducing costs, and improving quality. Furthermore, the percentage of product profits within economic units will increase, improving profitability (Mahdi-a, et al., 2015: 2746)

3-This technique is considered an important tool for efficient and effective cost management. Therefore, it is one of the most important tools for achieving the target cost. It also provides important information that helps the design team reduce costs for both the product and operations during the initial design stages (Karimi & Jaafaari, 2014: 233-234.(

4-Economic units go through several stages and processes to produce products and services, so implementing this technique leads to reducing the costs of all these activities (Zanjanchi, 2014: 85-86.(

5-It is considered an important tool for communicating to all employees in economic units the importance of improving the value of products and the overall benefit this brings to the economic unit as a whole through improved performance, reduced costs, and the introduction of a product that competes with and distinguishes itself from others (Mahdi-b, et al., 2015: 200).

It works to improve the functional performance of the product while maintaining or improving its quality, thus achieving the desired goal of satisfying customers and providing a product of high value. This requires providing a design team that performs its work efficiently, effectively and with distinction in order to help achieve this goal (Abdullah, et al., 2015: 10053)

3-3Requirements for Implementing Value Analysis Techniques:

This paragraph includes the following:

First: A multi-functional value analysis team:

Implementing this technique requires a team specialized in various specialties, such as accountants, administrators, and engineers. The number of team members varies from one task to another and depends on the size and importance of the task to which the technique is to be applied. There are important and fundamental matters that must be taken into consideration when forming the work team, including that team members have sufficient experience in their field of work, each according to their specialization. There must be consistency and convergence between the team's specializations and the project's requirements, as well as a thorough understanding of the project and a sufficient and required understanding of its objectives and the desires and demands of customers. Preference should be given to individuals who have distinguished themselves in their work over others (Tenkorang, 2011: 1). Second: Value Analysis Action Plan:

After identifying the problems facing economic units and their products regarding value, the multi-functional value analysis team prepares an action plan to be implemented across economic units. The plan is characterized by flexibility and ease of implementation. The most important problems to be identified are those related to functional performance or product quality, as well as high costs associated with components and functions that do not add value. Therefore, a value analysis action plan must be developed, including the following: (Abdullah et al., 2015: 10052(

1-After conducting a comprehensive review of the activities, the scope of the study must be determined.

2-Select the product that requires value improvement from the perspective of the customer and the economic unit.

3-Determine the location of the study and the activities to be undertaken by the team.

4-The current cost of the product prior to the value improvement process.

5-Determine the study phases and the time required to implement these phases.

6-Distribute the work according to the diversity of specializations among team members and the need for coordination and disparity among them.

7-Determine the study completion date and the deadline for submitting the final report on the plan.

3-4 Stages of Applying the Value Analysis Technique:

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The application of the value analysis technique requires passing through five consecutive stages: (information gathering, functional analysis, searching for ideas and solutions, testing and evaluation, development, and implementation).

1-The Information Gathering Stage:

This stage represents the initial launch of the value analysis technique. The value analysis team, with diverse functions and specializations, gathers whatever information they deem appropriate and necessary to implement the action plan in a timely manner. This process is considered one of the essential elements required for analyzing product-related problems related to performance, quality, and the high costs of product components and functions (Mohsen and Al-Najjar, 2006: 493) .

1-The Functional Analysis Stage:

This stage involves analyzing the components and functions of the product, in addition to analyzing the cost of each. Therefore, we consider it one of the most important stages of the value analysis technique, as it represents the fundamental foundation for all value techniques in general, and for value analysis in particular, due to its unique ability to solve problems in a unique way (Mahdi-B, et al., 2015: 203

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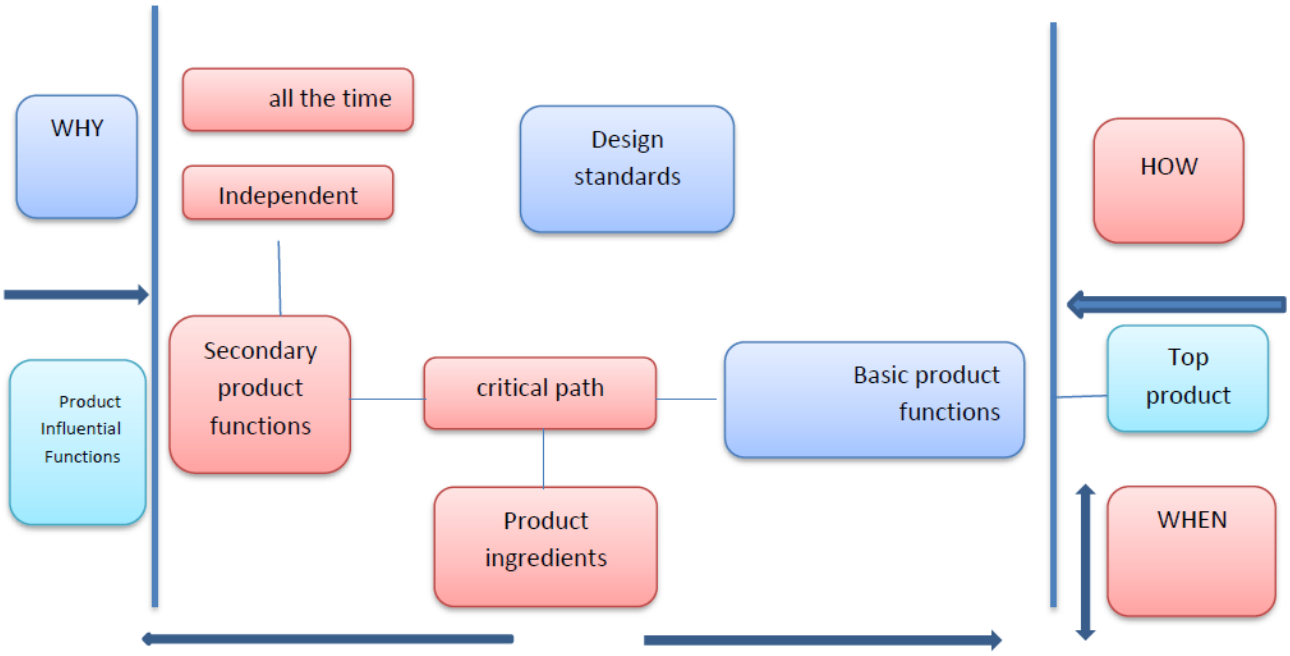
Figure (1)
Functional Analysis Strategies (FAST) chart



field of study

Source :- Shiimi, Mary. (2017)." Identifying design alternatives for the Windhoek municipality by applying the FAST diagram" (Doctoral dissertation, University of Cape Town). p.p .18.

2-The Idea and Solution Research Phase:

After the information phase, the value analysis team works to gather a larger number of ideas and solutions to review the problems presented. This is done by relying on several sources, most notably customers by listening to their opinions, as well as reviewing the work and products of competing companies. It also draws on external sources, identifying cases under consideration. There are also internal sources, including the organization's employees and its scientific centers. This results in a set of ideas that the value analysis team arranges, with each function according to a set of alternatives and options that can perform a specific function in all parts of the objective. This results in a set of solutions. In addition to the value analysis team and the value analyst, other specialists and experts participate in this phase, recruited to carry out this task (Najat, 2016: 358).

3-The Testing and Evaluation Phase:

In this phase, the team evaluates the ideas and solutions proposed and prioritizes important ideas that can meet the needs and desires of customers and add value to the product. Ideas that do not meet customer needs and add value are rejected and not accepted. The value analysis team must have the necessary skills and experience. Objectivity in evaluating these ideas is essential, by examining all their advantages and disadvantages (Mahmoud, 32:2021.(

4-Development and Implementation Stage:

In this stage, we ensure that the proposed alternatives and ideas are within the reasonable range and meet customer expectations, creating cost savings. This is achieved by describing each idea or alternative with a simplified explanation of it and the possibility of a development process that could improve it. Focusing on cost alone is not sufficient; it must be combined with maintaining or improving the quality and performance of the

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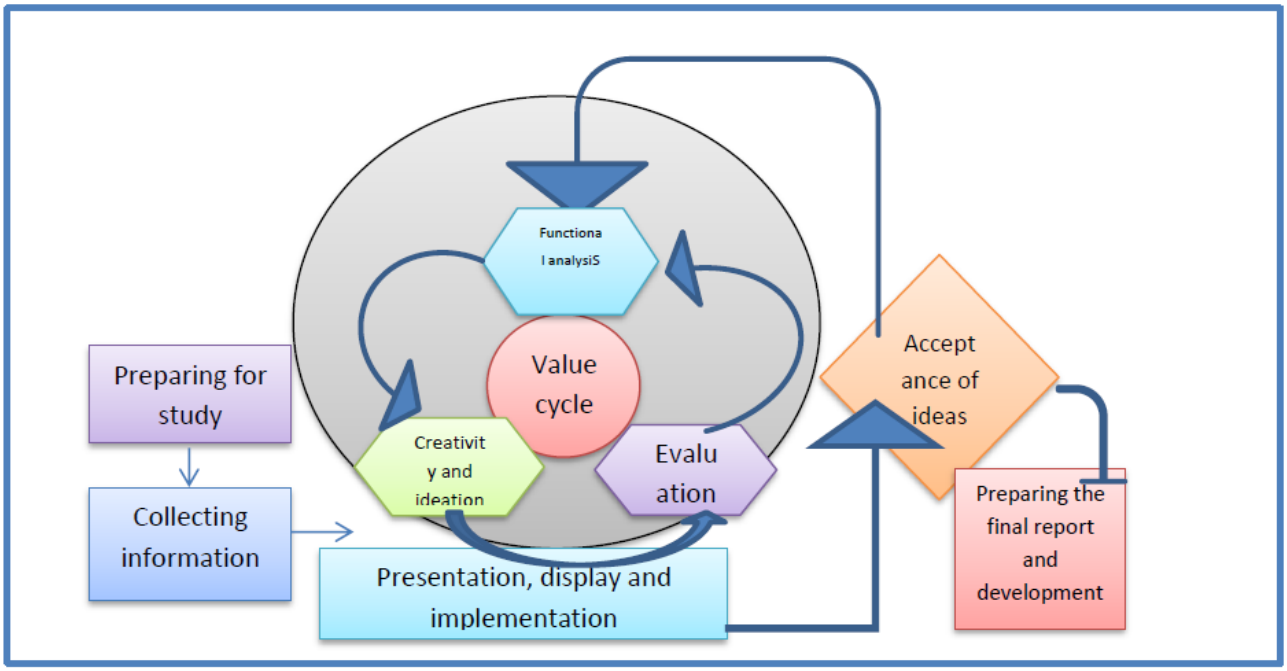
products, especially with regard to the engineering and technical specifications of the product. The most important consideration at this stage is that the cost of the proposed alternative be within the targeted cost ceiling for the economic units (Al-Samarrai and Al-Zamili, 2018:201).

Figure (2)
Stages of applying value analysis technology



Source:(Rashti,S.&Zanjanchi,P.2014,"The Role of Value Engineering\ Value Analysis in Reducing the cost and Time of the Construction Project ,"Journal of Civil Engineering and Environment, Vol.1,No.2,p:86) .

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4- Cognitive Foundations for Cost Reduction:

4-1The Concept of Cost Reduction:

Cost reduction means gradual progression from one cost level to a lower cost level. An example of this is when using a new machine that performs the same operations but costs less, or when production is greater and the cost is the same (Shujaa, 2017: 7). The topic of cost reduction is considered an important topic that has captured the attention of management. The goal of this focus is to reduce the cost of operations, products, and services provided by the economic unit to customers to their lowest possible level. Therefore, economic units must focus and strive to control their costs and work to reduce them while maintaining quality and performance, as well as disseminating the culture of cost reduction at all administrative levels of economic units (Delotto, 2014: 57 & Knoedler). Furthermore, the philosophy of cost reduction focuses primarily on achieving optimal use of available resources, which leads to reduced waste, misuse, and overspending, so that costs are directed towards important activities that add value, while taking into account the issue of achieving customer satisfaction through the provision of high-quality products at competitive prices.

4-2 The Importance of Cost Reduction:

The importance of cost reduction can be explained through the following: (Al-Habib 2021, Al-Sayed 2019, Al-Zamli 17-2, Lucile 2019)

1- Cost reduction contributes to significant advantages for economic units, enabling them to continue operating their businesses through the proper use of product elements and components.

2-True cost reduction should be accompanied by an improvement in the functional merit of the product, thus improving the product's value from both the economic unit and the customer's perspective.

3-The importance of cost reduction stems from the relationship between cost and the level of realized profits, as lower costs lead to increased profits and improved profitability indicators.

4-Cost reduction helps employees perform their jobs properly and appropriately by providing incentive rewards through the resulting abundance.

5-Reducing costs will lead to increased profits for economic units and an increase in their capital, thus expanding the operations and future plans of economic units and creating new horizons for society and the economy.

6-Reducing costs contributes to the economy in the use of production factors, as it is considered the most appropriate way to achieve efficiency and productivity in economic units.

Based on the above, we can say that reducing costs is a fundamental goal pursued by economic units in order to survive and continue. This is due to the intense competition they face, both domestically and internationally. This also includes efforts to expand the business environment and increase profitability indicators, or at least maintain their current position in a rapidly competitive world.

4-3Cost Reduction Conditions:

There are a set of conditions that must be met when reducing costs, as follows (Musa, 2012: 66.(

1-Conditions of Continuity: Cost reduction occurs as long as the economic unit continues to operate, i.e., it has the characteristic of continuity.

2-Conditions of Improvement and Development: By identifying losses and waste in economic units resulting from cost reduction, this leads to improved productivity and performance efficiency.

3-Conditions of Achieving Availability: The process of reducing costs must lead to a reduction in the costs of various activities, whether at the administrative, production, or marketing levels.

4-Conditions of Maintaining Quality: The process of reducing costs must not affect the necessary components and characteristics of the product or reduce its usefulness.

5- Conditions of Setting Standards: The process of reducing costs requires setting standards at all levels and achieving them through various methods.

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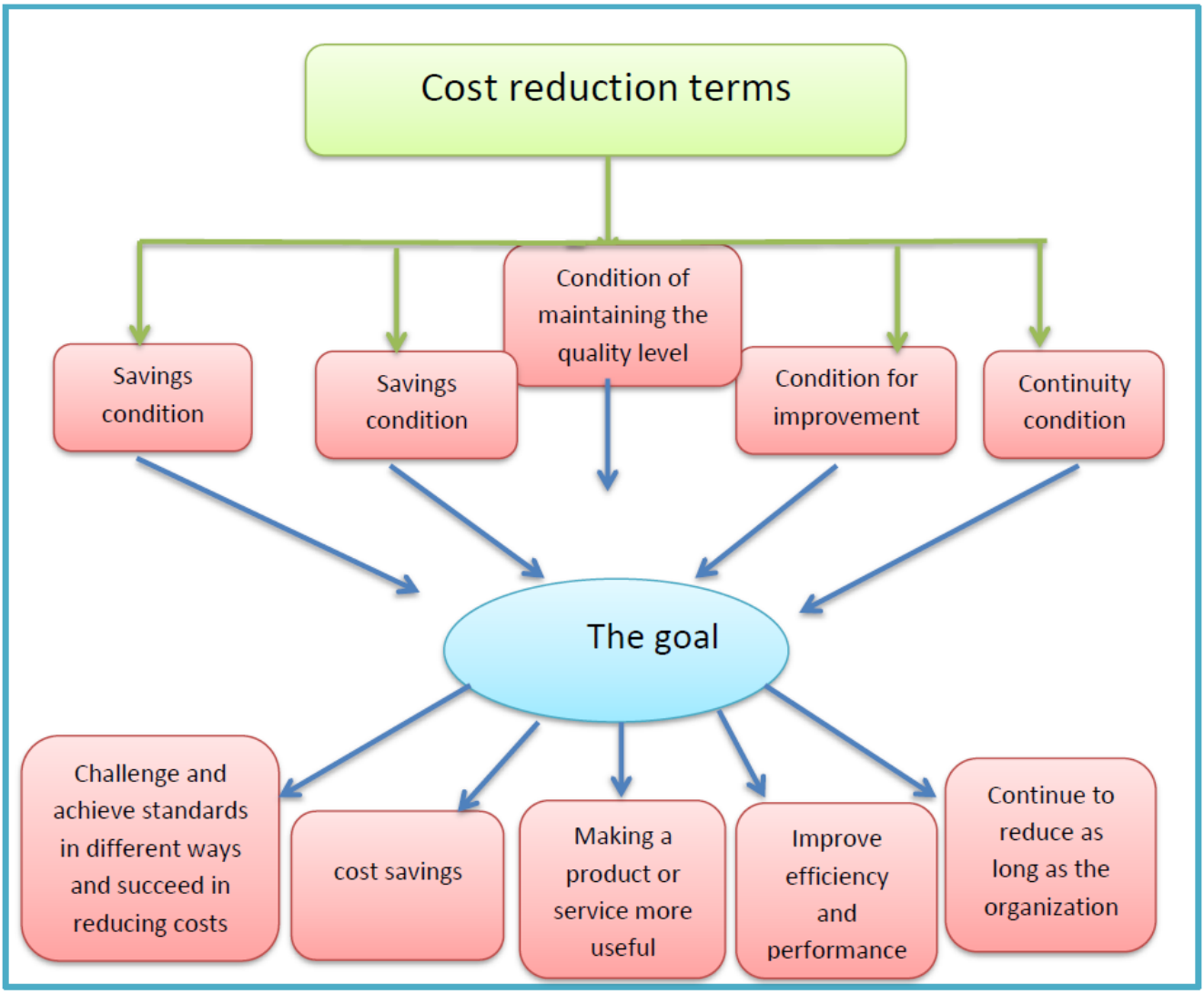
Figure (3)
Cost reduction terms



Source: Musa, Ruwa Hussein Abdul Hussein (2012) "The role of quality costs in reducing costs and improving product quality" Master's thesis, University of Baghdad, College of Administration and Economics, Department of Accounting (66). -5Practical Aspect

5-1Research Sample (Diwaniyah Tire Factory)

The Diwaniyah Tire Factory is one of the companies affiliated with the Ministry of Industry and Minerals when it was established in 1974. It was later linked to the General Company for Rubber and Tire Industries. The factory was chosen as a sample for the research because it is an important pillar upon which the national economy can rely if properly invested. The factory also enjoys a distinguished position among the company's factories. However, it has suffered greatly in recent years, especially after 2003. This was due to the changes that have taken place in the Iraqi market and the entry of competing products in large quantities, at lower prices, and of acceptable quality. This was also due to the lack of government interest and funding for such important projects that provide significant resources to the national economy. The factory produces two types of tires: 24-1200 and 20-1200. Production is limited because it is not available on the market and is allocated to meet the needs of government departments only. This was the case in 2016 when it resumed operations. However, this did not continue, and operations ceased in 2017 due to weak demand from government departments. The high cost of the tire, size 24-1200, is as follows:

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Table (1)
Production for 2016

Frame size1200-24	**Month**
305	**March**
285	**April**
134	**May**
254	**June**
75	**July**
122	**August**
169	**September**
130	**October**
130	**November**
198	**December**
1802	**Total**

Source: Factory Planning Department.

Table (2)
Actual cost of tire size 24/1200

Actual cost of tire size 24/1200 (dinars)	**Cost elements**	**T**
13,059	SPR 1500 Rubber	**1**
111,676	Natural Rubber	**2**
844	FEF Carbon	**3**
8,885	SRF Carbon	**4**
7,417	lSAF Carbon	**5**
858	GPF Carbon	**6**
1,215	Diotrex Oil	**7**
956	Furex Oil	**8**
2,749	Zinc Oxide	**9**
1,170	Stearic Acid	**10**
2,762	Anox	**11**
2,649	lPPD	**12**
414	Retarder	**13**
506	Rinacet	**14**
1,560	CBS	**15**
40	IT MBTS	**16**
1,414	OBTS	**17**
1,586	IT MBT	**18**
1,399	Millican	**19**
1,487	Banube	**20**
4,778	Iron Wire	**21**
67	Escores	**22**
16,136	NY 1420(75)	**23**
48,866	NY 1420(100)	**24**
682	Resocinol	**25**
64	Recalim Rubber	**26**
453	Paraffin Wax	**27**
439	Sulfur	**28**
24	Calcium Carbonate	**29**
169	Hexacoated	**30**

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234,324	Total Direct Materials Cost	
41470	Direct Labor Cost	**31**
5354	Manufacturing Overhead	**32**
19648	Marketing and Administrative Overhead	**33**
300796	Total Product Cost	

Source: Prepared by the researcher based on data from the Costing Division of the Finance Department.

5-2 Stages of Implementing the Value Analysis Technique

In this step, the value analysis technique is being applied at the Diwaniyah Tire Factory due to the factory's high costs, due to its use of outdated techniques and systems for calculating costs. Value analysis takes place in several stages: information gathering, functional analysis, creativity, and brainstorming, then evaluation of ideas, cost estimation, and finally decision-making. The steps can be explained as follows:

First: Information Gathering:

After identifying the product with high costs, namely the 24/1200 tire and the 20/1200 tire, information about this product will be collected from within the factory, including work procedures, the machines used in its production and their operating hours, the number of workers involved in the production process for each department, and their wages. Information will also be collected about the tire specifications to which the tire is manufactured, in addition to collecting information about the costs of each component, and about competing products and their prices.

Second: Functional Analysis:

This stage is considered the cornerstone of the value analysis technique because it focuses on the functions required by customers. It analyzes the components and functions of the product and determines their cost, as well as determining functional merit and identifying the value index for the functions to be improved. To conduct a functional analysis of a 24/1200 tire and a 20/1200 tire, the following steps must be taken:

.1Identify the components and functions of the 24/1200 and 20/1200 tires and determine their cost:

The 24/1200 and 20/1200 tires consist of five parts: the tread, the sidewall, the coated wires, the undertread, and the inner layer. These parts include a group of components or raw materials that go into the production process of the 24/1200 and 20/1200 tires.

Table (3)

Actual cost and functional cost ratio for the 24/1200 tire size and the 20/1200 tire size

Functional cost ratio of tire size 20/1200	**Functional cost ratio of tire size 24/1200**	**Actual cost of tire size 20/1200 (dinars(**	**Actual cost of tire size 24/1200 (dinars(**	**Cost Elements**	**Sequence**
%4.48	%4.34	11,650	13,059	F1	**1**
36.7	37.1	95458	111676	F2	**2**
0.28	0.28	730	844	F3	**3**
2.72	2.95	7,073	8,885	F4	**4**
2.47	**2.46**	**6,440**	**7,417**	**F5**	**5**
0.28	0.28	736	858	F6	**6**
0.38	0.4	1,013	1,215	F7	**7**
0.2	0.31	535	956	F8	**8**
0.91	0.91	2,366	2,749	F9	**9**
0.39	0.38	1,020	1,170	F10	**10**
0.91	0.91	2,373	2,762	F11	**11**
0.88	0.88	2,307	2,649	F12	**12**
0.12	0.13	316	414	F13	**13**
0.17	0.16	457	506	F14	**14**
0.57	0.51	1,499	1,560	F15	**15**

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0.01	0.01	32	40	F16	**16**
0.42	0.47	1,096	1,414	F17	**17**
0.67	0.52	1,749	1,586	F18	**18**
0.39	0.46	1,014	1,399	F19	**19**
0.44	0.49	1,165	1,487	F20	**20**
1.37	1.58	3,564	4,778	F21	**21**
0.02	0.02	52	67	F22	**22**
2.61	5.36	6,725	16,136	F23	**23**
19.2	16.2	49,951	48,866	F24	**24**
0.12	0.22	328	682	F25	**25**
0.01	0.02	31	64	F26	**26**
0.15	0.15	395	453	F27	**27**
0.14	0.14	368	439	F28	**28**
0.02	0.01	23.8	24	F29	**29**
0.05	0.05	143	169	F30	**30**
		200,610	234,324	Total direct raw material costs	
14.2	13.8	37395	41470	Direct labor costs	**31**
				Indirect manufacturing costs	
1.91	1.81	4845	5354	Marketing and administrative costs	**32**
6.82	6.83	16916	19648	Total indirect costs	**33**
		21761	25002	Total product costs	
%100	%100	259766	300796	Total direct raw material costs	

Source: Prepared by the researcher based on data from the Costing Division of the factory's Finance Department.

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Note: The functional cost ratio represents the ratio of the actual cost of each job to the total actual cost.
We note from Table (12) that the actual cost of jobs for the 24/1200 tire size amounted to (300,796 dinars), including the cost of direct raw materials (234,324 dinars), distributed across five departments. The preparation department received (199,238 dinars) and the forming department (35,086 dinars), while the construction, installation, and inspection departments received zero raw materials. As for the cost of direct wages, it amounted to (41,470 dinars), of which the preparation department had a share of (7,055 dinars), the shaping department (4,821 dinars), the construction department (9,590 dinars), the installation department (11,214 dinars), then the quality and inspection department had a share of (8,790 dinars), while the cost of indirect industrial expenses amounted to (5,354 dinars), of which the preparation department had a share of (2,349 dinars), the shaping department (774 dinars), the construction department (1,652 dinars), the installation department (144 dinars), then the quality and inspection department had a share of (435 dinars). The factory followed a special allocation policy for indirect manufacturing overheads, including administrative and marketing overheads, of 7.5% of the direct raw material cost and 5% of the direct wage cost, respectively. Administrative costs, which amounted to 17,574, were calculated using 234,324 * 0.075, while marketing costs, which amounted to 2,074, were calculated using 41,470 * 0.05. The actual cost of the 20/1200 tire was 259,766, including 200,610 direct raw material costs, distributed across five sections. The preparation section received 170,905 dinars, the forming section received 29,705 dinars, and the construction, installation, and inspection sections received zero raw material costs. As for the direct wages cost, the preparation department's share was (5879 dinars), the shaping department (4821 dinars), the construction department (9590 dinars), the installation department (10037 dinars), then the quality and inspection department's share was (7032 dinars), while the indirect industrial expenses were the preparation department's share was (1948 dinars), the shaping department (645 dinars), the construction department (1652 dinars), the installation department (129 dinars), then the quality and inspection department's share was (435 dinars). The factory followed a special charging policy for the indirect industrial expenses, which were administrative and marketing expenses, which were (7.5%) of the direct materials cost and (5%) of the direct wages cost, respectively. That is, the administrative costs, which amounted to (15046), were calculated through (200610*0.075), and the marketing costs, which amounted to (1870), were calculated through (37395*0.05.(
2- Determining the Job Entitlement:
We can determine the percentage of job entitlement for each job in the 24/1200 frame size and the 20/1200 frame size, as well as the percentage of job entitlement for both direct wages and indirect expenses using the following table:

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Table (4)
Determining the Job Entitlement (%) for Jobs and Cost Components for the 24/1200 frame size and the 20/1200 frame size.

Job merit (%) (4)=(3*2)	**Conversion rate (%) (3)**	**relative importance (%) (2)**	**Arithmetic mean 1)(**	**degree of relative importance**					**Cost elements**	**T**
				5	4	3	2	1		
4.91	1.30	3.78	8.26	12	10	8	0	0	F1	**1**
2.64	0.82	3.23	7.06	0	20	6	4	0	F2	**2**
1.46	0.34	4.31	9.41	21	9	0	0	0	F3	**3**
0.44	0.16	2.75	6.01	0	3	24	3	0	F4	**4**
4.83	1.55	3.12	6.81	6	4	17	2	1	F5	**5**
6.87	2.13	3.23	7.06	2	18	4	6	0	F6	**6**
2.81	0.83	3.39	7.41	0	24	4	1	1	F7	**7**
3.78	1.11	3.41	7.46	0	26	2	0	2	F8	**8**
2.74	0.85	3.23	7.06	0	22	2	6	0	F9	**9**
2.13	1.00	2.13	4.66	1	4	6	12	7	F10	**10**
3.66	1.00	3.66	7.73	0	27	2	1	0	F11	**11**
3.36	1.00	3.36	7.33	0	25	2	1	2	F12	**12**
3.34	0.93	3.6	7.73	1	24	5	0	0	F13	**13**
3.30	1.00	3.3	7.21	0	22	5	2	1	F14	**14**
3.46	1.02	3.4	7.41	0	21	9	0	0	F15	**15**
3.06	1.02	3	6.33	0	8	19	3	0	F16	**16**
3.40	1.00	3.4	7.41	0	24	4	1	1	F17	**17**
2.80	1.07	2.62	5.73	0	1	26	1	2	F18	**18**
2.48	1.07	2.32	5.66	2	1	18	8	1	F19	**19**
2.58	0.89	2.9	6.21	0	3	27	0	0	F20	**20**

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2.83	1.03	2.75	6.01	0	4	23	2	1	F21	**21**
2.43	0.90	2.7	5.81	1	4	2	3	3	F22	**22**
2.37	0.83	2.86	6.26	0	8	18	4	0	F23	**23**
2.30	0.91	2.53	5.53	0	0	23	7	0	F24	**24**
3.24	1.14	2.85	6.13	0	8	18	2	2	F25	**25**
3.18	1.07	2.98	6.46	3	4	20	3	0	F26	**26**
3.07	1.06	2.9	6.33	1	8	16	5	0	F27	**27**
2.76	1.04	2.66	5.81	0	11	7	10	2	F28	**28**
2.99	1.00	2.99	6.53	3	4	21	2	0	F29	**29**
2.94	1.03	2.86	6.26	0	5	24	1	0	F30	**30**
92.16		92.22	201.08						Total Direct Material Cost	
3.36	1.00	3.36	7.33	2	17	10	1	0	Direct Labor Cost	**31**
									Indirect Expenses	
1.80	1.00	1.80	4.00	0	9	8	2	1	Manufacturing	**32**
2.62	1.00	2.62	5.73	0	1	25	3	1	Marketing and Administrative	**33**
4.42		4.42	9.73						Total Indirect Expenses	
%99.94		%100	218.14						Total	

Source: Prepared by the researcher based on the opinions of technicians and engineers at the tire factory.

We can clarify some important points about how the above items were calculated for a given job, as follows:

•The relative importance score represents the opinions of the 30 tire factory employees, including technicians, engineers, accountants, and administrators, regarding the importance of the job from the customer's perspective.

•The weighted arithmetic mean for job F1 was calculated as follows:

.8.26 = 15 / {(5*12)+(4*10)+(3*8)+(2*0)+(1*0)}

•The relative importance of job F1 was calculated as follows: 8.26/220.47 = 3.74%.

•The conversion rate for product jobs was calculated from Appendix (5), which represents the company's view of job importance. The conversion rate for F1 was 1.30%, representing the total number of rows in this appendix.

•The functional entitlement for job F1 was calculated by multiplying the relative importance by the conversion rate as follows: 3.78% * 1.30% = 4.91%.

•These equations were applied to all other product functions.

It is noted from the above table (13) that the functional entitlement ratio for direct raw materials reached (92.16), which is a very high percentage. This is due to the use of high-quality imported raw materials, which provide functions that meet the needs and desires of customers for a product with high functional performance and excellent quality, thus competing with imported products on the market. The functional entitlement ratio for direct wages reached (3.36), and for indirect expenses reached (4.42), indicating their importance in improving product

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performance and quality. It is worth noting that direct wages received the lowest entitlement ratio due to the unjustified increase in the number of workers in the factory, as well as the failure to use modern technology to manufacture the product in question.

3-Determine the Value Index and the functions to be improved:

After calculating the functional cost ratio in Table (12) and the functional entitlement ratio in Table (13) for each job in the 24/1200 and 20/1200 frameworks, in addition to determining the ratio for direct wages and indirect expenses, the value index is calculated according to the following equation:

Value Index = Functional Entitlement (%) / Functional Cost(%)

If the value index is greater than one, this means that the functional entitlement has exceeded its cost. If the value index is less than one, this means that the cost has exceeded the functional entitlement. This indicates that there are functions that need improvement by improving the functional performance and quality of the product, reducing its cost, or both. However, if the functional entitlement is equal to the cost—that is, the value index is equal to one—this means that the optimal value for the job has been achieved. Third: Creativity and Idea Generation:

In this step, creativity and idea generation are used to develop proposals and solutions to achieve good performance and the required functions. This is achieved by following organized methodologies to reduce direct materials, direct wages, and indirect expenses, as follows:

1-Reducing the cost of direct materials:

Direct material costs will be reduced by reducing the cost of jobs that achieved a functional merit lower than the cost, i.e., the value index for these jobs was less than one. Some important aspects of reducing the cost of jobs related to the components of the 24/1200 tire and the 20/1200 tire will be clarified, as follows:

•Using cheaper materials from other sources that perform the same function as the previous product or better with higher quality.

•Using modern machinery to produce raw materials used in the tire industry.

•Using fewer components than some raw materials, provided the product's functional performance remains the same as before.

A- Reducing the cost of the traction function (F2)

The actual cost of the traction function for the 24/1200 tire was 111,676, while for the 20/1200 tire it was 95,458. To reduce the cost of this function, natural rubber can be imported from other sources that are geographically closer (for example, Turkey and Iran) to the import sources in Southwest Asia. After making this change, we can achieve financial savings, according to the opinion of technicians and engineers, that may reach 30%. This means that the cost for the 24/1200 tire is 78,173, while for the 20/1200 tire it is 66,821. Therefore, the savings achieved for the two tires are 33,503 and 28,637, respectively.

b- Reducing the cost of the job used as a reinforced filler material (F4)

The actual cost of this job for the 24/1200 tire was 8885, while for the 20/1200 tire it was 7073. This cost can be reduced by maintaining the machines that previously manufactured the SRF carbon component, which was previously produced locally, or by importing modern machines to produce this component. According to the factory manager and production manager, this will reduce the cost by 50%. This means that the cost for the 24/1200 tire is 4443, while for the 20/1200 tire it is 3537. Therefore, the savings achieved for tires 4442 and 3536, respectively.

c- Reducing the cost of the reinforced fabric job for the F23 and 24F tire structures.

The cost of the reinforced fabric job for the frame structure of nylon (75) 1420 for the 24/1200 size frame reached (16136 dinars) while for the 20/1200 size frame (6725 dinars), while the second type of nylon material cost for the 24/1200 size frame (48866 dinars) while for the 20/1200 size frame (49951 dinars), and according to the opinions of technicians, engineers and experts in the research sample factory, it was shown that it is possible to use smaller quantities of nylon (100) 1420 and nylon (75) 1420 which may reach 50%, and after making this change the cost for job F23 will be reduced to nylon (75) 1420 for the 24/1200 size frame (8068 dinars) while for the 20/1200 size frame (3363 dinars), and the cost of job F24 for the 24/1200 size frame becomes (24433 dinars) As for the frame size 20/1200 (24976 dinars), and thus the savings achieved for the two frames from the 23F position (8068 dinars) and (3362 dinars) respectively, and the savings achieved for the two frames from the F24 position (24433 dinars) and (24975 dinars) respectively.

2- Reducing direct labor costs:

The tire factory suffers from a significant problem of surplus workers. Some departments employ a large number of workers for a single production line, even though the line actually requires fewer workers. This is known as disguised unemployment, which makes the cost of the product very high.

Wage costs can be reduced by following some important steps, including the following:

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First: Reducing the number of surplus workers.
Second: Using modern technology in all departments of the factory.
The reduction can be explained as follows:
A. Reducing the number of surplus workers:
The number of workers in the production departments responsible for the production of size 24/1200 and size 20/1200 tires in the tire factory reached 291 workers in 2016. Their annual direct wages amounted to 2186,063,952 dinars, distributed across five departments: preparation, forming, construction, installation, and inspection. After arriving at the actual load rate for each department and multiplying it by the number of working hours for each department, we obtain the direct wage cost for the size 24/1200 tire, which amounted to 41,470 dinars, and the direct wage cost for the size 20/1200 tire, which amounted to 37,395 dinars. According to the opinions of technicians, manufacturing and design engineers, the production departments for manufacturing this product need a smaller number of workers, as the preparation department requires 11 workers, forming 8 workers, construction 10 workers, installation 10 workers, and the inspection department requires 11 workers. Thus, the number of workers required to manufacture this product becomes 50 workers, and any number above that is surplus. Therefore, the workers can be reduced by 83%, meaning that the cost of wages for the 24-inch tire will decrease by 83%, and thus the cost of wages for the 24-inch tire will become (7050 dinars per unit produced and sold, which means achieving cost savings of 34420 dinars). The cost of wages for the 20-inch tire will decrease by 83%, and thus the cost of wages for the 20-inch tire will become (6357 dinars per unit produced and sold, which means achieving cost savings of 31038 dinars). There are two things that can be done to deal with this surplus number of workers, which are: As follows:
•Expanding the factory's production lines and utilizing the capacity of this surplus number of workers. This way, their costs can be distributed among the new products resulting from the opening of new production lines.
•If those in charge of the factory are unable to open new production lines for personal reasons, there is a possibility of coordinating with the Ministry of Industry and Minerals to absorb this number of workers and utilize them in other affiliated factories, given their experience and skills.
B. Using modern technology in all factory departments:
The machines and equipment used in the factory are very old and do not keep pace with the rapid changes and developments occurring in the industrial environment. Modern types of machines are available in foreign markets that produce high-quality products and require a small number of workers, thus reducing direct wage costs. However, the main problem in not doing so is the lack of liquidity due to government neglect.
3-Reducing indirect costs:
Indirect costs, including industrial, marketing, and administrative costs, have resulted in a higher functional cost than the functional entitlement, meaning their value index is less than one. Therefore, these costs must be reconsidered in order to reduce them, and the focus will be on some matters to overcome this, including:
•Avoid spending money inappropriately. This means it should have a positive impact on the product's value.
•Maintain product quality and minimize damage and time wastage.
This reduction can be demonstrated through the following:
A. Reducing manufacturing costs:
The indirect manufacturing costs for the 24-1200 tire amounted to 5,354 dinars, and for the 20-1200 tire, they amounted to 4,845 dinars. This resulted in a functional cost higher than the functional merit, meaning that the value index for both tires was less than one. This required improvements, including reducing unnecessary and non-value-added costs, which lead to higher product costs and lower quality. Through study and analysis with technicians and engineers in the laboratory, it was revealed that the equipment and machinery used in the laboratory are very old, which affects and causes increased costs. They should be replaced with newer machines and equipment. Despite their high purchase cost, they play a significant role in reducing errors and defects and reducing manufacturing and assembly time. This also contributes to reducing indirect manufacturing costs, as confirmed by the study and analysis conducted by the researcher with technicians and engineers. It was found that the potential for reduction could reach 35%. This means that the indirect manufacturing costs for the 24-1200 tire would be an amount equivalent to (3480 dinars), and for the 20-1200 tire, it will be (3149 dinars). This means that the reduction for the two tires is (1874 dinars) and (1696 dinars), respectively.
B. Reducing Marketing and Administrative Costs:
The administrative and marketing costs for the 24-1200 tire amounted to 17,574 dinars and 2,074 dinars, respectively. As for the 20-1200 tire, the administrative costs amounted to 15,046 dinars, and the marketing costs amounted to 1,870 dinars. The factory had adopted a special policy for calculating these costs, meaning that

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administrative costs represent 7.5% of direct materials, while administrative costs represent 5%. When making adjustments and reductions to the cost of direct materials and direct wages, the administrative and marketing costs will decrease accordingly, according to the applicable allocation ratios.

After completing the proposals and ideas that were put forward to reduce the costs of the functions and cost elements of the product, the size 24-1200 frame and the size 20-1200 frame, whose functional merit is less than its functional cost, i.e. its value index is less than one, we can show the amount of reduction in the product cost as a result of applying the value analysis technique based on the previous paragraphs in the following table:

Table (5)

The cost of a 24-1200 tire and a 20-1200 tire, as a result of applying the value analysis technique and adopting ideas and proposals.

Cost after discount for frame size 20 (dinars(	Cost after discount for size 24 tire (dinars((	Discount Amount (Dinars(Size 20	Discount Amount (Dinars(Size 24	Actual cost for a size 20 tire (dinars(	Actual cost for a size 24 tire (dinars(	Cost elements to be improved	T
66821	78173	28637	33503	95458	111676	F2	1
3536	4442	3537	4443	7073	8885	F4	2
3362	8068	3363	8068	6725	16136	F23	3
24975	24433	24976	24433	49951	48866	F24	4
6357	7050	31038	34420	37395	41470	الاجور المباشرة	5
3149	3480	1696	1874	4845	5354	F.O.H	6
10826	12644	6090	7004	16916	19648	M&A.O.H	7
119026	138290	99337	113745	218363	252035	Total	

Source: Prepared by the researcher based on the ideas and proposals put forward for reduction. It is noted from the table above that the actual cost of the cost elements to be improved for the 24-1200 tire size reached 252,035 dinars, while the reduction amount for these elements is 113,745 dinars. This means that the cost of the elements for the 24-1200 tire size has become 138,290 dinars after the reduction. As for the actual cost of the cost elements to be improved for the 20-1200 tire size, it has reached 218,363 dinars, while the reduction amount for these elements is 99,337 dinars. This means that the cost of the elements for the 20-1200 tire size has become 119,026 dinars after the reduction. Therefore, the reduction percentage for the 24-1200 tire has reached 45% of (252,035/113,745), while the reduction percentage for the 20-1200 tire has also reached 45% (99,337/218,363), which indicates the presence of a number of Unjustified expenditures on these components are identified. Therefore, it can be argued that using value analysis techniques can help reduce product costs for 24/1200 and 20/1200 tires, in terms of materials, wages, and expenses, without affecting the product's functional performance or quality.

Fourth: Evaluation of Ideas:

During this step, previously proposed ideas for reducing costs for functions or elements where the value index fell below one are evaluated. These ideas are modified to keep pace with developments and new circumstances in the business environment, while estimating the costs incurred by the product for its cost elements, based on what the factory management deems appropriate and likely to add value to the product and contribute to increasing its functional merit.

Fifth: Development and Implementation:

During this step, proposals and solutions are developed, including the selection of the best solution to help solve problems such as high product component costs. It also addresses problems that increase costs and decrease product quality. A final report is prepared, including information on costs and product improvements. This report is sent to senior management to implement the best alternative chosen to increase the product's functional merit and reduce its cost.

The cost of a 24-1200 tire and a 20-1200 tire can be explained after applying the value analysis technique for each function level and each of the other cost elements, as shown in the following table:

Table (6)

Cost of a 24/1200 tire and a 20/1200 tire after applying the value analysis technique

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Functional cost ratio of tire size 20/1200(%)	Functional cost ratio of tire size 24/1200(%)	Actual cost of tire size 20/1200 (dinars(	Actual cost of tire size 24/1200 (dinars(	Cost elements	T
7.26	6.98	11,650	13,059	F1	**1**
41.65	41.79	66821	78173	F2	**2**
0.45	0.45	730	844	F3	**3**
2.20	2.37	3536	4442	F4	**4**
4.01	3.96	6,440	7,417	F5	**5**
0.45	0.45	736	858	F6	**6**
0.63	0.64	1,013	1,215	F7	**7**
0.33	0.51	535	956	F8	**8**
1.47	1.46	2,366	2,749	F9	**9**
0.63	0.62	1,020	1,170	F10	**10**
1.47	1.47	2,373	2,762	F11	**11**
1.43	1.41	2,307	2,649	F12	**12**
0.19	0.22	316	414	F13	**13**
0.28	0.27	457	506	F14	**14**
0.93	0.83	1,499	1,560	F15	**15**
0.01	0.02	32	40	F16	**16**
0.68	0.75	1,096	1,414	F17	**17**
1.09	0.84	1,749	1,586	F18	**18**
0.63	0.74	1,014	1,399	F19	**19**
0.72	0.79	1,165	1,487	F20	**20**
2.22	2.55	3,564	4,778	F21	**21**
0.03	0.03	52	67	F22	**22**
2.09	4.31	3362	8068	F23	**23**
15.56	13.06	24975	24433	F24	**24**
0.20	0.36	328	682	F25	**25**
0.01	0.03	31	64	F26	**26**
0.24	0.24	395	453	F27	**27**
0.22	0.23	368	439	F28	**28**
0.01	0.01	23.8	24	F29	**29**
0.08	0.09	143	169	F30	**30**
87.32	87.61	140100	163878	Total cost of raw materials	
4.02	3.80	6357	7050	Direct labor costs	**31**
				Indirect costs	
1.96	1.90	3149	3480	Manufacturing	**32**
6.80	6.81	10826	12644	Marketing and administrative costs	**33**
8.71	8.62	13975	16124	Total indirect costs	
%100	%100	160432	187052	Total product cost	

Source: Prepared by the researcher based on tables (2), (5)

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The role of value analysis technology in reducing costs:
We will explain the cost reduction for tire sizes 24-1200 and 20-1200 after applying value analysis technology, as shown in the following table:

Table (7)

Amount of reduction in frame cost: 20-1200	Amount of reduction in frame cost 24-1200	Cost after applying the value analysis technique for the 20-1200 frame	Cost after applying the value analysis technique for the 24-1200 frame	Cost before applying the value analysis technique for the 20-1200 frame	Cost before applying the value analysis technique for the 24-1200 frame	Details
60,510	70,446	140,100	163,878	200,610	234,324	**Direct Materials**
31,038	34,420	6,357	7,050	37,395	41,470	**Direct Wages**
7,786	8,878	13,975	16,124	21,761	25,002	**Overhead**
99,334	113,744	160,432	187,052	259,766	300,796	**Total**

Source: Prepared by the researcher based on Tables (5) and (6)

It is noted from the table above that the total cost of the 24/1200 tire amounted to (187,052 dinars), which is equivalent to 62.18% of the actual cost before the discount of 300,796 dinars. This means a discount rate of 37.18%. Meanwhile, the total cost of the 20/1200 tire amounted to (160,432 dinars), which is equivalent to 61.76% of the actual cost before the discount of 259,766 dinars. This means a discount rate of 38.24%.

6- CONCLUSIONS AND RECOMMENDATIONS:

1- Value analysis is considered one of the most important modern techniques for strategic cost management. It contributes to analyzing product functions and components to identify and consolidate activities that add value to the product, while eliminating activities that do not add value. We seek to find successful solutions for these activities to increase the product's functional merit (quality and performance) and meet customer needs.
2- We can use value analysis on new and existing products. Its effectiveness increases when used on existing products to help economic units find solutions to their product-related problems.
3- Applying value analysis requires successive stages, including (information gathering, functional analysis, innovation, development, and evaluation)
4-It has become clear that the factory is unable to sell its products in the Iraqi market at prices that cover costs and profit margins. This is due to the following reasons:
Lack of protection for domestic products, and an increase in the supply of imported foreign tires from inferior global sources.

Based on the conclusions we have reached, we offer the following recommendations and proposals:

1-Emphasize the importance of the factory adopting value analysis technology by forming a multi-tasking team capable of developing an appropriate plan for the activities of the research sample laboratory. This team will engage experts and consultants in the field of design and manufacturing to prepare for the plant's implementation of this technology and contribute to finding solutions to recurring problems related to high production costs.
2-It is recommended that the management of the Diwaniyah Tire Factory remove redundant workers who do not contribute to adding value and transfer them to the waste tire recycling project. Furthermore, training courses should be conducted to enhance the expertise and skills of value-adding workers.
3-The management of the Diwaniyah Factory should utilize newly discovered administrative and cost-effective methods and techniques, foremost among which is value analysis, to analyze and manage costs. Management should also accelerate the implementation of effective and continuous cost reductions and improve the production process to adapt to changes occurring in the modern manufacturing environment. 4) It is necessary for the factory management to offer products that meet the customer's desires in terms of providing acceptable quality and low

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prices in order to be able to continue and compete with imported products. It is necessary to work on studying and analyzing the market on an ongoing basis to understand the customer's needs and begin to meet them.

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