

## Employing Quality Costs in Achieving Sustainability an Applied Study in Karbala Cement Factory

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**Abstract:** The aim of the present research was to identify the costs of quality in its dimensions (prevention costs, evaluation costs, internal failure costs, and external failure costs) as industrial companies are currently facing the need to balance production efficiency and preserve the environment and society to enhance long-term sustainability by reducing environmental impacts and waste and improving efficiency. In order to achieve the research objective, a cement factory in Karbala was selected as a sample for the research, and after studying the reality of the laboratory and applying quality costs based on the laboratory data for the year 2024, the practical analysis was conducted using a set of statistical tools that suit the research goal based on the (SPSS) program, and the research included a set of conclusions, the most important of which are: The effective application of the quality cost system enhances the reduction of waste and contributes to enhancing operational efficiency, which reflects positively on achieving sustainability in various dimensions, especially economic. and technical, as well as paying attention to the costs of evaluation and prevention helps reduce the costs of failure and enhances the sustainable performance of the research sample laboratory .The most important recommendation was the need to integrate the concepts of quality costs within the strategic and operational policies of the laboratory, with the importance of focusing on raising the costs of prevention and evaluation as tools to improve quality and reduce waste, thus achieving sustainable performance that enhances the economic, social and environmental dimensions.

**Key words:** Quality Costs, Quality Cost Dimensions, Corporate Sustainability.



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### Introduction

In today's world, and in light of the environmental impacts and increasing economic challenges, companies are required to search for strategies and tools that enable them to enhance their operational efficiency and ensure their long-term continuity and survival, and among the most

prominent of these tools, the concept of quality has become a major goal that institutions and companies in various sectors are trying to reach, as it is important to consolidate this concept in all activities and operations, starting from contracting and purchasing raw materials that take into account sustainability, through production and manufacturing, to distribution and after-sales services. As a result of the growing interest in environmental and social issues and with increasing awareness of the impact of economic and industrial activities on the environment, companies are required to support sustainability and environmental quality issues by integrating environmentally friendly activities at all stages of production and management. The research included four sections, the first was the research methodology, the second included the theoretical aspect of the research, identifying the concept of quality, quality costs, and the types of these costs, and addressing the concept of sustainability and its dimensions, while the third topic was the practical application of the research through the division of quality costs into their types, indicators for measuring each type, sustainability with its dimensions, and the indicators adopted in measurement and statistically analyzing them to know the impact and correlation between each type of costs in each of the dimensions of sustainability, and the research was concluded with a set of conclusions and recommendations.

### **First: Research Methodology**

#### **1- Research Problem:**

The problem of the research is summarized in the failure of the Iraqi economic units to keep pace with the rapid technological developments, their failure to apply modern cost management techniques (quality costs), and the lack of attention to the aspects and dimensions of sustainability and the environment, which reflected negatively on the quality of the product and the service provided to the customer, the high cost of production, and the increase in the percentage of pollution as a result of emissions from production processes. To what extent does the application of quality cost dimensions contribute to achieving the sustainability dimensions in Karbala Cement Factory?

#### **2- Research Importance:**

The importance of the research stems from the advantages provided by the current research in finding a solution to a major problem in the Iraqi economic environment, represented by the Karbala Cement Factory, which is considered a source of pollution that affects the environment on the one hand and society on the other hand through harmful emissions and wastes resulting from its processes and production activities, and this is done through the impact of calculating quality costs on the dimensions of sustainability (economic, environmental, social and technical).

#### **3- Research Objectives:**

This research aims to study the impact and relationship of quality costs in achieving sustainability in the research sample by addressing the types of quality costs adopted in the Karbala Cement Factory, their concept and mechanisms of application.

#### **4- Research Hypothesis:**

The research is based on a main hypothesis that there is an impact and correlation between the dimensions of quality costs, which are (prevention costs, evaluation costs, internal failure costs, and external failure costs) and the company's sustainability in its various dimensions, which are

(The economic dimension, the environmental dimension, the social dimension, and the technical dimension), and the following hypotheses are derived from it:

1- There is a significant correlation and impact relationship between the costs of prevention (prevention) and the dimensions of sustainability used in the research.

2- There is a significant correlation and impact between the evaluation costs and the sustainability dimensions used in the research.

3- There is a significant correlation and impact relationship between the costs of internal failure and the dimensions of sustainability used in the research.

4- The existence of a significant correlation and impact relationship between the costs of external failure and the dimensions of sustainability used in the research.

#### **5- Research borders: -**

**The spatial boundaries of the research are: -** In the Karbala Cement Factory in the holy province of Karbala, which is one of the formations of the Ministry of Industry and Minerals / Iraqi General Cement Company, this factory was chosen because of the importance of the industrial sector in supporting the Iraqi economy and being one of the specialized factories that have multiple and large activities and use huge resources, as well as increasing the intensity of competition between imported and local foreign products.

As for **the time limits of the research: -** The financial reports and statements of the Karbala Cement Factory for the year 2024 were relied on, which represent the most recent available data that was relied on to achieve the research objective.

#### **6- Research Method: -**

In order to address the research problem to reach its objectives, **the deductive method** was used by reviewing the sources, studies and researches related to the research topic in addition to the website. Also, **the analytical method was relied on**, represented by the data and financial reports related to the laboratory, on which the research relied.

#### **Theoretical aspect of the research**

##### **First: Quality Costs (Concept, Types, Benefits)**

The literature has agreed that the first cognitive contributions to the concept of quality costs are due to (Juran, 1951 & Feigenbaum, 1956) and (Jafari 2013: 13) and in its traditional sense, the cost of quality is often understood from the point of view of production by focusing on the costs arising from the deviation of production from the specifications. Quality cost management today is one of the most important indicators in the development of the quality management system, as it is useful as a comprehensive measure of operational performance, and the measurement or calculation of quality costs facilitates the field of quality improvement and guidelines for the application of total quality management (Glogovac & other, 2019:278). Quality costs can be defined as (the cost borne by the unit in order to achieve the required quality from the customer's point of view by detecting defects during the production processes and monitoring the activities of the operations to identify the weaknesses and work to address them before the product reaches the customer, thus enabling the unit to provide defect-free goods (products and services) and ensure that the needs and satisfaction of customers are met (189 ).He agrees with this definition (Al-Swehli, 2009: 10) as he defined it as "the costs borne by the unit to maintain and protect the environment in which the unit is located in order to eliminate pollution. Glogovac et al. (2019: 278) defined it as "a good indicator associated with the introduction of quality improvements and useful for measuring operational performance as a whole, and the measurement of these costs is to facilitate quality improvement and as a guide for the implementation of total quality management programs.

##### **Types of Quality Costs**

1- Prevention costs: It is represented in the costs incurred to ensure that high quality products reach customers, and it represents the goal of total quality management, which is to make products

in the right way and from the first time, and includes (quality planning, process design review, training and learning on the quality function, monitoring processes to verify the suitability of the product for use, collecting quality data for analysis, preparing a report on quality costs, continuous improvement of processes (Chopra, 2015).

2- Evaluation costs: Regarding the second type of quality costs, it includes all the costs of testing or monitoring and other costs to achieve the quality requirements and conformity of the process or product, and include (inspection of raw materials, inspection of the product at certain points during production, testing and inspection of finished products, and costs of quality review and audit (Balouchi et al, 2019).

3- Internal Failure Costs: These are all the costs that are incurred due to the defects of the product within the unit as well as all the costs associated with the defects before the service or product is delivered to the customers such as (waste, damage, remanufacture and repairs, rework or rescheduling).

4- External failure costs: These costs occur due to defects in the product after they are provided by the unit and include (costs of replacing the product during the warranty period, handling complaints, repairing the product, loss of the company's reputation, maintenance and after-sales warranty).

While the Grosby model divides quality costs into two types: conformity costs and non-conformity costs, and this division is similar in content to the division mentioned above: prevention, evaluation, failure, the term conformity costs refers to all the costs achieved in order to do a good job the first time, and includes prevention and evaluation costs, while non-conformity costs include all costs that the unit spends when the products do not meet the customer's requirements, and these costs are related to the costs of failure in both internal and external aspects. Daunoriene, 2015). **As for the benefits of measuring (calculating) recognition, it has been mentioned by researchers** including Sahinoglu, 2011 (Al-Swehli, 2009:16).

- 1- It stimulates management to implement and apply environmental costs.
- 2- Identify opportunities for improvement and increase profits as well as the potential to reduce overall product or service costs.
- 3- Good reputation and increased competition.
- 4- Develop and improve product design and raise performance efficiency.
- 5- Reduce errors by leveraging natural resources and human potential.

The next paragraph will address the sustainability of the company, which is the second variable in the research, and we will clarify its concept and types.

## **Second: Sustainability of the Company (Concept and Dimensions)**

As a result of economic and social fluctuations and environmental problems, global interest in the concepts and culture of sustainability has increased, which is one of the most prominent topics that have been discussed, and sustainability can be defined in a simplified way as "an approach to conducting business responsibly that has positive effects on the environmental, social and environmental levels" (Badri: 2014). It can also be defined as "awareness of the positive effects of the company (unit) on the society and the surrounding environment, and working to reduce the negative effects caused by the unit's operations by adopting initiatives that take into account the areas of development (society, economy, environment) (Sovie, 2017: 178). The term sustainability in manufacturing refers to the production and manufacture of things without the occurrence of waste or carbon footprint that affects society and the environment to achieve maximum convenience, and it is done through the design, manufacture, and operation of the most efficient

and effective product or systems and devices with the least amount of resources consumption (Huang & Badurdeen, 2017) In light of the intellectual proposals and to clarify the concept of sustainability, it is necessary to point out that sustainability is the strategy adopted by the units in order to achieve superiority over competitors by providing or producing products or services that meet the needs of modern customers, take into account quality and cost, and at the same time preserve the environment. As for the dimensions of sustainability, it is three dimensions, and a fourth dimension has been added, which is the technical dimension.

**1- Economic dimension: Economic:** units are working to improve the current production system that targets a number of performance measures in a sustainable product, including reducing the cost of manufacturing, reducing carbon dioxide emissions, as well as increasing the recycling rate, as a number of manufacturing units spend a large amount of resources to improve industrial technologies to eliminate waste and pollution. In terms of the economic dimension, sustainability is the current and future reflection of the economy on the environment, and the concept of economic sustainability can be referred to as the ability of the unit to manage its resources and achieve profitability responsibly and in the long term (Ferri et al, 2016).

**2- Environmental dimension:** The adoption of the environmental protection strategy by the units is one of the important strategies that focus on it and help them achieve a sustainable competitive advantage and superiority, because paying attention to the environmental dimension is one of the dimensions that the units take into account, which means following an environmentally friendly product through the strategies adopted by the unit to protect the environment from the damages caused by the manufacturing process, which is of great importance at the present time to increase the customer's awareness of environmental protection (Titmarsh et al, 2020:1). Sustainability in the environmental dimension focuses on the protection and integrity of the environment, the proper handling of natural resources and their use for the benefit of human beings without harming the components of the environment, including water, land and air.

**3- The social dimension:** This dimension is defined as the right of the human being to live in a clean environment in which all activities are practiced and to ensure that he obtains his right (equitably) from natural resources, in addition to social and environmental services, in order to be invested in order to ensure access to complementary and basic needs and raise the standard of living without compromising the rights of future generations (Yilmaza & Bakis, 2015: 2256). Social sustainability is a strategy that reduces the risk of uncertainty and meets consumer demands by saving energy, addressing social responsibility as well as increasing the productivity of the industrial sector because it helps to address global challenges such as the need for access to renewable energy sources and green buildings that have positive impacts on society, all of which contribute to achieving sustainability in manufacturing (Leng et al., 2020:5). In light of this, the social dimension relates to the impact of the unit on the society in which it is located in terms of environmental damage, as well as in terms of equal opportunities, social justice, occupational health and safety, and the role of these units in providing high-quality products that meet their needs and contribute to achieving social welfare.

**4- Technical dimension: It** means the use of clean technology in all fields, especially industrial ones, and this is done through research and development activities, reliance on information and communication technology, and reliance on sustainable methods, which requires strengthening and forming capabilities in technology and science to increase knowledge and scientific level (Al-Dulaimi, 2006: 5).

### **Third Topic: The Applied Aspect of the Research**

Karbala Cement Laboratory has been compiled and measured by the quality control department in the laboratory, which is concerned with inspection and inspection tasks, as well as controlling the conformity of materials, processes and products to standards and specifications.

**Table (1) Data on Quality Costs and Types for the Year 2024**

No.	Quality Costs and Types	Costs for 2024	Percentage by Type %
<b>First: Costs of Prevention</b>			
1	Product Design & Processes	9400000	18.577
2	Research & Development	7165100	14.160
3	Staff Training	6330000	12.509
4	Maintenance Costs	277057600	54.754
<b>Total Prevention Costs Ratio of prevention costs to total quality costs</b>		<b>50600860</b>	<b>100%</b>
<b>Second: Evaluation costs</b>			
1	Raw Material Inspection	1775000	7.1
2	Device Failures (Inspection)	675630	2.7
3	Examiners' Wages and Salaries	12880600	51.5
4	Inspection and Test Reports	3315000	13.3
5	Inspection and final product testing costs	6354000	25.4
<b>Total Evaluation Costs Ratio of total evaluation costs to total quality costs</b>		<b>25000230</b>	<b>100%</b>
<b>Third: Costs of Internal Failure</b>			
1	Re-Examination	203092	6.9
2	Rework (manufacturing)	129990	4.4
3	Mismatch costs	1300250	43.9
4	Internal Failure Cost Analysis	1327500	44.8
<b>Total Internal Failure Costs Ratio of total internal failure costs to total quality costs</b>		<b>2960832</b>	<b>100%</b>
<b>Fourth: Costs of External Failure</b>			
1	Yield Screening	6725000	25.3
2	Returned units	19350000	72.7
3	warranty	544000	2
<b>Total External Failure Costs Ratio of total external failure costs to total quality costs</b>		<b>26619000</b>	<b>100%</b>
<b>Total Quality Costs</b>		<b>105180922</b>	

Source: Prepared by the researcher based on laboratory data

### Third: Sustainability of the Company

The company's sustainability can be measured through a number of indicators, as shown in the following table:

**Table (2) Indicators of the Company's Sustainability**

NO.	Dimensions	Indicators	Amount	Ratio
1	Economical	1- Sales	98679653861	0.40
		2- Net income	103048027.54	0.00
		3. Production	62010546000	0.25
		4. Total Costs	87959125842	0.35

<b>Total</b>			<b>248752373730.54</b>	<b>100</b>
2	Environmental	1- Waste Treatment & Recycling	8740000	0.001
		2-Environmental Regulations	6804462000	1.00
		3. Industrial emissions	3402232	0.00
		<b>Total</b>	<b>6816604232</b>	<b>100</b>
3	Social	1-Salaries and expenses for workers	14442602000	0.94
		2- Retirement	117925000	0.01
		3- In-kind benefits	779810000	0.05
			2251700	0.00
<b>Total</b>			<b>15342588700</b>	<b>100</b>
4	Technology	1- Equipment costs	22516000	0.70
		2. Research and development	7165100	0.22
		3- Automatic control systems	2500000	0.08
		<b>Total</b>	<b>32181100</b>	<b>100</b>

### Testing research hypotheses

1- Testing the first sub-hypothesis, which states that there is a correlation and statistical and significant effect between the first dimension of quality dimensions, which is the costs of prevention (prevention) and the dimensions of sustainability measurement used in the research, which are (economic, environmental, social, and technical) using correlation and simple regression, and the results appeared in the table below:

**Table (3) Results of the first sub- hypothesis test**

Sig Significance Level	Calculated t	Degree of Impact $\beta$		Level of significance	Calculated F	R2	R	Acceptance or rejection	Dependent variable
0.558	0.601	0.342	The Economic Dimension	0.558	0.486	0.196	0.442	refuse	Prevention costs
0.837	0.262	0.244	Environmental dimension	0.837	0.069	0.064	0.254	refuse	
0.755	0.357	0.145	Social Dimension	0.755	0.128	0.060	0.254	refuse	
0.031	20.273	0.992	Technical Dimension	0.031	41.013	0.998	0.999	accept	

**Prepared by: The researcher based on statistical analysis using statistical software (SPSS).**

The results of the statistical analysis of the first sub-hypothesis of the research in Table (3) showed that there is a positive and significant correlation and effect between the costs of prevention and the technical dimension, as the correlation coefficient R (0.999) with a significance level of (0.031), which is lower than the significance level adopted by the research, which is (0.05), and the value of the interpretation coefficient R2 reached (0.998), which explains the degree of effect of the independent variable of prevention costs with the technical dimension of measuring sustainability by its value of (0.998), while the rest of the dimensions used to measure sustainability, which are the economic dimension, the environmental dimension, and the social dimension, the results of the analysis showed that there is a very weak and non-significant correlation with the costs of prevention, and confirms the insignificance of this effect. The value of the significance levels is greater than the significance level adopted in the research, which is (0.5), which means that there is a positive and non-significant effect statistically, and the value of the impact of the dimensions of sustainability on the costs of prevention reached different results based on what the statistical analysis showed, as the value of the degree of impact of  $\beta$  for the

**economic dimension (0.342), the environmental dimension (0.244), the social dimension (0.145), and the technical dimension (0.992), which means that The increase of one degree in the costs of prevention is reflected in the dimensions of measuring sustainability in the Karbala Cement Factory, the research sample by the value of " $\beta$ " for each dimension.**

2- Testing the second sub-hypothesis, which states that there is a correlation and a significant statistical impact between the second dimension of quality dimensions, which is the costs of evaluation and the dimensions of measuring the sustainability used in the research, which are (economic, environmental, social, and technical) using correlation and simple regression, and the results appeared in the table below:

**Table (4) Results of the second sub- hypothesis test**

Sig Significance Level	Calculated t	Degree of Impact $\beta$		Level of significance	Calculated F	R2	R	Acceptance or rejection	Dependent variable
0.856	0.206	0.124	The Economic Dimension	0.856	0.043	0.021	0.144	refuse	Evaluation Costs
0.614	0.693	0.470	Environmental dimension	0.614	0.480	0.324	0.570	refuse	
0.696	0.451	0.314	Social Dimension	0.696	0.204	0.092	0.304	refuse	
0.580	0.774	0.512	Technical Dimension	0.580	0.600	0.375	0.612	refuse	

**Prepared by: The researcher based on statistical analysis using statistical software (SPSS).**

The results of the statistical analysis of the second sub-hypothesis of the research hypothesis in Table (4) showed that there is a weak correlation and positive effect and no significant and statistically significant relationship between the costs of evaluation and the dimensions of sustainability measurement used in the research, as the correlation coefficient reached "R" (**0.144, 0.570, 0.304, 0.612**) respectively with a significance level (**0.856, 0.614, 0.696, 0.580**), which is higher than the level of significance adopted in the research, which is (0.05), which means that the relationship between them is not statistically significant, and the value of the interpretation coefficient R2, which explains the degree of the effect of the independent variable on the costs of evaluation in the dimensions of sustainability used in the research, reached its value of (**0.021, 0.324, 0.092, 0.375**) respectively, and (0.979, 0.676, 0.908, and 0.625) respectively of the variances are due to other factors, and the value of the impact of the sustainability dimensions on the evaluation costs reached different results based on the results of the statistical analysis, as the value of the degree of impact of the economic dimension (**0.124**), **the environmental dimension (0.470), and the social dimension (0.314)**, and the technical dimension (**0.512**), which means that the increase of one degree in the evaluation costs is reflected in the dimensions of the sustainability measurement used in the research by the amount *of  $\beta$*  value for each dimension in the Karbala Cement Plant.

3- Testing the third sub-hypothesis, which states that there is a correlation and a significant statistical effect between the third dimension of quality dimensions, which is the costs of internal failure, and the dimensions of sustainability measurement used in the research, which are (economic, environmental, social, and technical) using correlation and simple regression, and the results appeared in the table below:

**Table (5) Results of the third sub- hypothesis test**

Sig Significance Level	Calculated t	Degree of Impact $\beta$		Level of significance	Calculated F	R2	R	Acceptance or rejection	Dependent variable
0.630	0.563	0.320	The Economic Dimension	0.630	0.317	0.137	0.370	refuse	Costs of Internal Failure
0.624	0.657	0.349	Environmental dimension	0.624	0.431	0.301	0.549	refuse	
0.473	0.876	0.227	Social Dimension	0.473	0.768	0.277	0.527	refuse	
0.565	0.815	0.432	Technical Dimension	0.565	0.665	0.399	0.632	refuse	

**Prepared by: The researcher based on statistical analysis using statistical software (SPSS).**

The results of the statistical analysis of the third sub-hypothesis of the research in Table (5) showed that there is a mean and non-significant correlation and effect between the "costs of internal failure" and the dimensions of sustainability measurement used in the research, as the correlation coefficient "R" reached (**0.370, 0.549, 0.527, 0.632**) respectively with a significance level (**0.630, 0.624, 0.473, 0.565**), which is higher than the level of significance adopted in the research of (0.05), which means that the relationship between them is not statistically significant, and the value of the interpretation coefficient R<sup>2</sup>, which explains the degree of the effect of the independent variable on the costs of internal failure in the dimensions of sustainability used in the research, reached its value of (**0.137, 0.301, 0.277, 0.399**) respectively, and (0.863, 0.699, 0.723, and 0.601) respectively of the variances are due to other factors, and the value of the impact of the sustainability dimensions on the costs of internal failure reached different results based on the results of the statistical analysis, where the value of **the degree of impact of  $\beta$  for the economic dimension was (0.320)**, the environmental dimension (**0.349**), and the social dimension (**0.227**), and the technical dimension (**0.432**), which means that the increase of one degree in the costs of internal failure is reflected in the dimensions of the sustainability measurement used in the research by the value of  **$\beta$  for each dimension** in the Karbala Cement Plant of the research sample.

4- Testing the fourth sub-hypothesis, which states that there is a correlation and a significant statistical effect between the fourth dimension of the dimensions of quality, which is the costs of external failure, and the dimensions of measuring sustainability used in the research, which are (economic, environmental, social, and technical) using correlation and simple regression, and the results appeared in the table below:

**Table (6) Results of the fourth sub- hypothesis test**

Sig Significance Level	Calculated t	Degree of Impact $\beta$		Level of significance	Calculated F	R <sup>2</sup>	R	Acceptance or rejection	Dependent variable
0.042	1.165	0.729	The Economic Dimension	0.042	1.356	0.576	0.759	acceptance	Costs of External Failure
0.020	2.935	0.917	Environmental dimension	0.020	8.612	0.896	0.947	acceptance	
0.852	0.237	0.210	Social Dimension	0.852	0.056	0.053	0.230	refuse	
0.986	0.043	0.033	Technical Dimension	0.986	0.004	0.001	0.023	refuse	

**Prepared by: The researcher based on statistical analysis using statistical software (SPSS).**

The results of the statistical analysis of the fourth sub-research hypothesis in Table (6) showed that there is a strong and significant positive correlation and effect between the costs of external failure and the dimensions of sustainability measurement used in the research (the economic dimension and the environmental dimension) as the correlation coefficient R (**0.759** and 0.947) respectively with a significance level (**0.042, 0.020**), respectively, which is lower than the level of significance adopted in the research, which is (0.05), which means that there is a statistically significant relationship between them, while the rest of the dimensions of sustainability, which are the social dimension and the technical dimension, the results of the analysis showed that there is a very weak positive correlation and no significant and statistical significance between them, and the value of the interpretation coefficient R<sup>2</sup>, which explains the degree of impact of the independent variable The external failure of the dimensions of sustainability used in the research amounted to (**0.576, 0.896, 0.053, and 0.001**) respectively, which is high for the environmental and economic dimension and appeared weak for the social and technical dimension, and that (0.424, 0.104, 0.947, and 0.999) respectively of the variances are due to other factors. The value of the impact of the sustainability dimensions on the costs of external failure reached different results based on the results of the statistical analysis, where the value of **the degree of impact of  $\beta$  for the economic dimension was (0.729)**, the environmental dimension (**0.917**), and the social dimension (**0.210**), and the technical dimension (**0.033**), which means that the increase of one degree in the costs of external failure is reflected in the dimensions of the sustainability

measurement used in the research by the value of  $\beta$  for each dimension in the Karbala Cement Plant of the research sample.

#### **Fourth: Conclusions and Recommendations**

##### **First: Conclusions**

1- Quality costs are considered as one of the modern accounting concepts aimed at reducing waste and improving performance, and it is closely related to sustainable performance, as it is seen as a strategic tool to reduce waste, increase operational efficiency, and ensure customer satisfaction.

2- The results of the statistical analysis indicated that there is no statistical relationship between the costs of prevention and each of the dimensions of sustainability (economic, environmental, social), and with this result, the analysis showed that there is a relationship between the costs of prevention and the technical dimension of sustainability, which means that the activities related to prevention contribute to raising the production and technical efficiency in the laboratory, which is included in the technical or operational sustainability.

3- The results of the statistical analysis showed that there is no significant relationship between the evaluation costs and the dimensions of sustainability (economic, social, and environmental), and this indicates that the activities related to the evaluation costs such as (inspection, inspection, and testing) do not contribute tangibly or directly to achieving sustainability.

4- The results of the statistical analysis showed that there is no statistical relationship between the costs of internal failure and the dimensions of sustainability, and it may be that the laboratory does not record these costs clearly and accurately, or because these costs represent losses resulting from processes that fail internally and do not reflect real efforts to achieve sustainability.

4- Statistical analysis of the costs of external failure and the dimensions of sustainability showed that these costs are positively related to the dimensions of sustainability in particular (economic and environmental dimension), and this indicates that the costs resulting from failures discovered after the delivery of the product or service, the research sample laboratory takes long-term corrective measures, which contributes to enhancing environmental and financial performance.

5- Companies, especially industrial ones, play a significant role in achieving sustainability by developing quality-based accounting and financial policies and implementing effective control systems to reduce unnecessary costs resulting from external or internal failures.

##### **Second: Recommendations**

1- Promoting the use of quality cost accounting systems in industrial companies and working to train accounting staff to document and analyze this cost as a strategic means to improve performance and achieve sustainability.

2- Increasing investment in prevention activities that focus on improving technical efficiency and prevention by Karbala Cement Plant and linking them to the overall sustainability plans of the plant and not only technical ones.

3- Conducting a review and development of inspection and inspection procedures in the laboratory to ensure effective assessment work in reducing environmental waste and improving economic and social quality.

4- Adopting a system to record and classify the costs of internal failures within the laboratory and include them in the sustainable performance report, in a way that enhances its role in improving the quality of operations and reducing losses and repetition.

5- The need to exploit the results of external failure as an indicator of poor quality, and turn it into an opportunity for improvement to adopt sustainable corrective plans that focus on protecting the environment and enhancing economic efficiency.

6- Industrial companies adopt clear financial policies that focus on sustainable quality techniques, in addition to activating accounting control tools that ensure the rationalization of costs arising from external and internal failures and enhance transparency.

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