AMERICAN JOURNALS
Open Access, Peer Reviewed Journals

American Journal of Research in Humanities and Social Sciences
ISSN (E): 2832-8019 Volume 12, | May, 2023

THE APPLICATION OF THE SIX SIGMA METHOD IN REDUCING QUALITY FAILURE COSTS A CASE STUDY IN A DIWANIYAH TEXTILE FACTORY

.M.D. Khawla Radi Athab1
Hayder Hamzah Saleeh2
Dr. Laith Ali Muttar3
University of Al-Qadisiyah / College of Administration and Economics /
Department of Banking and Finance Khawlah.alshemary@qu.edu.iq
Saleh@qu.edu.iq
laithali@mustaqbal-college.edu.iq.

A B S T R A C T

Companies work in light of changes and environmental challenges represented by intense competition between various industrial companies, and the quality of products and services provided to customers is a basic issue that all companies focus on to ensure their success and continuity, in providing products to customers according to their desires, specifications and prices that they want to pay for their acquisition and to ensure their survival in market.

This research aims to measure the impact of the application of the six sigma method in industrial companies and to indicate the extent of its contribution to reducing the costs of quality failure. Prepared by the researcher, as for the second axis, it included six sigma criteria as a major variable consisting of four sub-axes (commitment and support of senior management, continuous improvement, human resources, focus on customers), and the paragraphs were formulated based on the scale (Yang, 2010). While the third axis included the costs of quality failure as a major variable consisting of four sub-axes (preventive costs, evaluation costs, internal failure costs, external failure costs) the paragraphs were formulated based on a scale (Hamouda, 2014). Departments of the lab, Diwaniyah tissue, the research sample, and only 50 forms were retrieved, and the descriptive analytical method was relied on in the research, in addition to conducting interviews with a number of department managers in the lab p soft search. For the purpose of analyzing the collected data, some statistical methods were used, such as the arithmetic mean, standard deviation, coefficient of variation, simple correlation coefficient and impact analysis. A set of conclusions has been reached, the most important of which is the presence of many difficulties that limit the ability to apply the six sigma method.

K E Y W O R D S

six sigma, quality, quality failure costs

INTRODUCTION

Quality is a key factor for the success of organizations because of its role in investing the available resources that leads to the development of work and improvement of performance in order to achieve an increase in the profitability of the organization, improvement of productivity and high quality of products, in addition to improving the reputation of the organization in the local and global markets, especially in light of the increase in the number of companies And the intensity of competition between them, Six sigma is one of the most important of these initiatives introduced by Motorola in the field of technical communications in the eighties of the last century. The concept of six sigma constitutes the backbone of the quality management strategy, and this research attempts to identify .

The research includes four axes, the first is devoted to the research methodology, the second is to review the theoretical concepts of the concept of six sigma and quality costs, the third contains the practical aspect, and the fourth includes conclusions and recommendations**.**

1.1 The research problem

In light of contemporary changes and the many and increasing pressures, companies face in order to participate in global competition by providing national products of high quality at the lowest cost and in the fastest time, despite the tremendous progress in the majority of industrial companies as a result of the use of advanced technology in addition to the use of specialized experts who work on the application of management Quality in all processes, but there is still a need for a process of continuous improvement and reduce the errors of production and industrial processes, and this is reflected in the quality of products. The research problem is represented by answering the following questions:

1- To what extent is six sigma used in the research sample factory?

Is it possible to apply six sigma in industrial companies?

3-What is the reality of applying Six Sigma (commitment and support of senior management, continuous improvement, human resources, focus on customer?

4- To what extent does factory management apply quality costing systems?

1.2 The Importance of the Research : The importance of the research is as follows:

1- The importance of six sigma standards in reducing quality costs by reducing defects to the lowest level.

2- Identifying concepts related to research variables (six sigma and quality costs) in a way that contributes to analyzing their benefits and importance..

- Identifying the availability of the requirements for applying the six sigma method in the research sample factory.

4- Informing industrial companies of the importance of quality costs, their size, methods of measuring them, the benefits of reducing them and their impact on the performance of these companies.

1.3 Research Objectives: The research aims to achieve the following:

1- To identify the possibility of applying six sigma to reduce failure costs

2- Identify the six sigma and the costs of quality and its divisions

3- To identify the types of quality costs represented in the costs of internal and external failure, control costs and prevention costs.

4- Identifying the extent to which employees are aware of the use of the six sigma method in reducing costs.

1.4 Research Outline: Based on the current research problem, its importance and objectives, a hypothetical research model was designed

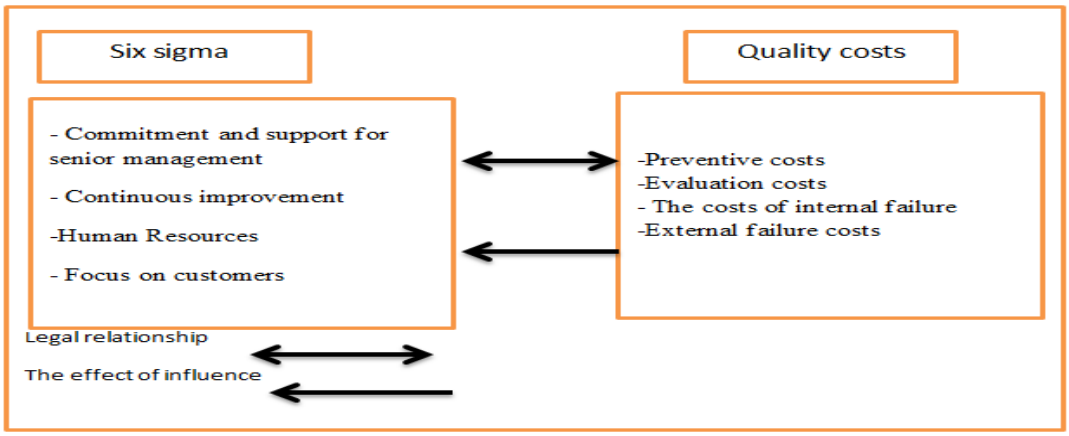

Figure (1) The hypothesis research scheme
Source: Prepared by the researcher

1.5 Research hypotheses: Based on the research problem and its objectives, two main hypotheses were formulated as follows:
1- The first main hypothesis: "there is a significant and statistically significant correlation between each of the six sigma dimensions (commitment and support of senior management, continuous improvement, human resources, focus on customers) and quality costs (prevention costs, evaluation costs, costs internal failure costs external failure.
2-The second main hypothesis "there is a significant and statistically significant effect relationship between each of the six sigma dimensions (commitment and support of senior management, continuous improvement, human resources, focus on customers) and quality costs (prevention costs, evaluation costs, costs internal failure costs external failure.

1.6 The Method of Research
1-Theoretical aspect: It was relied on what was mentioned in the Arab and foreign sources related to the research literature.
2-The practical aspect: a questionnaire was relied on to collect data, and the six sigma questions were developed with the help of a study (Yang, 2010). As for the questions related to quality costs, a study (Hamouda, 2014) was used. Table (1) shows the research variables and the sequences of the questionnaire items. It included two sections, the first dealt with paragraphs related to the general information of the research sample, while the second section was allocated to include the search variables, which numbered (40) paragraphs, and used a five-degree Likert scale, which is formed by (exactly agreed, agreed, neutral, disagree, I do not completely agree) to classify the answer scores, which range between (1-5) degrees, as well as interviews that allow the researcher to obtain information directly on the one hand, and clarify the paragraphs of the questionnaire, its content, and

inquiries about its statements if necessary, on the other hand, The researcher conducted a number of personal (unstructured) interviews, based on some questions from the questionnaire

Table (1) The structure of the questionnaire and the sources of its measurements

The main variables of research	number of paragraphs	Paragraph numbers from to	Source
1-Six sigma Senior management commitment and support continuous improvement Human Resources Focus on customers	20	5-1 10-6 15-11 20-16	Yang, 2010) (
2- Quality costs Preventive costs Evaluation costs The costs of internal failure External failure costs	20	25-21 30-26 35-31 40-36	Hamouda, 2014(
Total		40	

Source: Prepared by the researcher based on the SPSS statistical program.

1.7 The population of the Research sample

The reality of choosing one of the formations of the Ministry of Industry and Minerals, Al-Diwaniyah **textile** factory, affiliated to the General Company for Rubber Industries as a whole. The research sample was represented by the number of workers in the factory, as the selection was made on persons with experience in the field of design or production in the quality and marketing department, in addition to workers in the administrative side. The heads of the departments and their assistants and some of the administrators working in stores, marketing and technicians were also selected. After distributing the questionnaire by (60) questionnaires, (50) questionnaires were retrieved, i.e. the retrieval rate (83%), and it is clear from Table (2) that the percentage (32%) of the research sample members are male, and that the percentage of (18%) of females.

The percentage below also shows that the sample members are holders of a bachelor's degree, diploma and middle school, as the percentage of those who obtained a bachelor's degree was 25%), which is the highest percentage of those who obtained a diploma, amounting to (15%). As the table below shows the number of years of service, the category (21- or more) got the highest percentage (30%), while the group from (11-15) got the lowest rate (22%). Table (2) shows the distribution of research sample members by gender, educational qualification, and number of years of service

Table (2) Description of the research sample

Variables	Target groups	The number	ratio
1-Sex	Male	32	64
	females	18	36
Total		50	100
2- Qualification	Bachelor	25	
	diploma	15	
	middle school	10	

Total		50	
3- Total number of years of service	1-5	10	%20
	15-11	15	%30
	20-16	15	%30
	21-Over	10	%20
Total		50	%100

1.8 Research limits

1-Theoretical limits: The study was determined, theoretically and practically, with its variables represented by six sigma and quality costs.

2-Time limits: The field effort covered the time period between (1/9/2022 until 30/4/2022) in preparing and distributing the questionnaire and analyzing its results.

3-Spatial boundaries: - The spatial boundaries were extended for research at the Diwaniyah Textile Factory of the General Company for Rubber Industries in Iraq.

1.9 The statistical methods used

The research relied on a number of appropriate statistical methods in order to analyze the answers of the members of the research sample. The SPSS system was relied upon to show the statistical treatments:

1-Arithmetic mean: used to determine the average responses of the sample members towards any of the study variables, that is, to measure the central tendency of their answers.

2-Standard deviation: to find out the degree of dispersion of the values from their arithmetic mean.

3-Pearson and Spearman correlation coefficient: to clarify the interrelationships between the sub-variables on the one hand and the correlations between the independent variable and the dependent variable on the other hand.

4-Simple regression analysis: to clarify the relationship of the significant effect of the independent variable on the dependent variable.

2 .The theoretical side of the research

2.1 Six Sigma

The word sigma expresses a letter belonging to the Greek language that was used statistically to express the measure of the extent of change or deviation in the implementation of a process from the standard of perfection in performance, and sigma is the eighteenth letter in the Greek alphabet and its symbol (σ). Statisticians have used this symbol to denote the deviation Standard (Al-Zahrani, 2010: 21).

Early efforts to implement Six Sigma appeared in the late seventies, when Motorola decided to take seriously the quality of its products, as the company's management realized that these products fail severely compared to the quality levels of similar institutions, which puts the company in a weak competitive position. Hence, there was an urgent need to study the relationship between high quality and lower costs, with a focus on knowing the defects and how to reduce them. In 1987, Motorola issued a long-term quality program, which it called “The Six Sigma Quality Program”, Which is credited with winning the company in 1987

.)Malcolm, 2014, 1-2 (AD, the National Quality Award

1- **Concept Six Sigma**

Six Sigma Addressed from Different Views The term Six Sigma was introduced in the 1980s by Motorola in a revolutionary attempt to reduce defects to a level of just a few parts per million. Six Sigma gained popularity after it was adopted by General Electric in the mid-1990s (Pulakanam & Voges, 2010: 149).

The world has seen wide applications of Six Sigma. Researchers who have studied the pace and direction of Six Sigma application Explanation of the wide applications of Six Sigma in different types of organizations to achieve objectives (Prabu et al., 2013: 388).

The concept of Six Sigma is one of the concepts of the world of total quality management. This concept appeared in 1987 when Motorola launched the Six Sigma quality program and applied its tools in the manufacturing sector first, followed by the services, financial and hospital sectors as well as its use in the field of construction (Garcia, 2014: 8 (

The goal of using Six Sigma is to remove variation from operations and strive to manufacture defect-free products, as it is a business strategy that combines business and statistics methodologies that focus on continuous and advanced improvement to reduce manufacturing costs, improve customer satisfaction and produce world-class products and services (Rathilall, 2014: 18). (

Many researchers have mentioned concepts about six sigma, and Table (3) shows some of these concepts.

Table (3) Some researchers' views of the concept of six sigma

Researcher	**Concept**
Banuelas & Antony, 2002: 27	It is an organized business strategy to improve profitability, reduce spoilage in production, reduce the cost of poor quality, and to improve efficiency and effectiveness of all operations in order to meet the needs and expectations of customers
Al-Qazzaz, 2009: 16	It is a more effective way to solve business problems and improve organizational performance.
Swink *et.al*,2014:182	It is a strategy through which management seeks to improve the quality of outputs by removing defects and disparities in various processes
Ben Aishawy, 2014: 122	It is an integrated statistical method that uses a set of tools and methods that can be applied correctly that leads to improving the level of performance, which allows early detection of errors and early correction of them, thus reducing costs while controlling specifications to a degree not exceeding 3.4 errors per million production units, which raises the level of customer satisfaction and growth revenue to ensure its survival in the market
Al Kunsol , 2015: 15	It is a statistical system used to reduce unwanted variations that lead to better performance
Hindawi, 2016: 9	It is a corporate management system that seeks to achieve lasting success by focusing on customer concerns in order to reduce errors / defects to 3.4 defects per million

	opportunities, management and improvement of work mechanism, rational use of facts and data
Krajewski *et al*.,2016:121	It is a comprehensive and flexible system that aims to maximize the success of the organization by reducing defects and disparities in operations and focusing on limiting the spread and centralization of the process. It focuses on targeted performance measures.
Yassin, 2017: 13	It is a statistical tool through which you can quantitatively measure performance and identify weaknesses and defects in procedures or goods, and strive to address them on an ongoing basis and try to reduce the percentage of errors to zero, and to maximize the value.
Ahmed , 2019 :27	It is the ability to reduce cycle time, eliminate product defects, and dramatically increase customer engagement and satisfaction.
Ibrahim, 2019: 386	It is an integrated management system with a high degree of accuracy to improve the various operations of the organization, providing leaders with the methods and analytical tools necessary to solve problems and reach the process to a level of quality.

Source: Prepared by the researcher according to the available sources.

The basic idea of Six Sigma: method is that if the company is able to measure the number of defects in its operations, it can work hard to try to get rid of these defects in order to get as close as possible to the concept of producing a service or product free of defects Zero Defects and this is achieved when the percentage of Free from defects to 99.99966% (Al-Rashidi, 2006: 294).

Through the concepts presented in Table (3), six sigma can be described as a statistical tool that improves the performance of operations by diagnosing weaknesses in the procedures followed and working to remove defects from products in order to satisfy the customer.

2.2 Characteristics or advantages of Six sigma

There is a set of Six sigma advantages (Ahmed, 2019: 28):

A- Reduce order fulfillment time: Through the application of Sig sigma, it is possible to analyze organizations' order procedures and discover defect areas, to reduce process variances and wastage using Six Sigma DMAIC (identify - measure - analyze - improve - control) to increase scheduling of existing orders operations and create new ones With the application of DMAV methods.

B- Create a new responsive supply chain management system: the organization's work process must be set up in such a way that any new changes in the market can be adapted quickly or in immediate response. Six Sigma defines a step-by-step analysis of the business process in the context of current market trends and designs the new business process accordingly.

C- Reducing defects to zero: The successful work process of the supply chain system must be free from defects. The Six Sigma DMAIC process helps to reach the zero defects site.

D- Enhancing the fulfillment of the demand: The work order can be fulfilled, if it is executed efficiently without any problems. The Six Sigma DMAIC process helps discover problems or defects early in the business process, thereby enhancing order fulfillment.
E- Minimize Wastage: A successful supply chain system can be referred when the cost of the business process is lower, and the output is high. Applying Six Sigma ensures that waste is minimized; Therefore, the cost is reduced.

2.3 Basic Six Sigma Principles

There is a set of basic principles upon which the Six Sigma is based (Pande & Holpp, 2002: 14-16):
A - Focus on customers: includes customers and employees of the organization, and that the continuity and success of the organization depends on meeting the needs and expectations of customers.
B - Decisions based on facts and data: It means that the organization obtains better data, as these organizations are in the process of evaluating performance by focusing on realistic and sufficient data, which reflects the requirements of customers and reduces defects.
C- Focusing on internal processes: Six sigma constitutes a process in itself, whether it is designing products and services in comparison with performance, improving effectiveness, or satisfying customers. If the focus is on services provided, customer satisfaction, and continuous improvement..
D- Effective management based on prior planning: successful management seeks to address the problem before it occurs, meaning that there are administrative and technical measures that were taken before the problem occurred, so treating the problem before it occurs means setting goals and reviewing them.
E - Unlimited cooperation: It is one of the vital elements that help to achieve success and improve teamwork at all administrative levels in the organization and with sales agents and customers.
H- Continuous Improvement: Six Sigma emphasizes the importance of continuous improvement for organizations that have a desire for development. This principle is based on the premise that work is the fruit of a series of interrelated activities that lead to reaching the final outcome.

2.4 The requirements for the success of the Six Sigma method

In order for the company to successfully implement Six Sigma, many requirements must be met (Abdel-Gawad, 2013: 273):
A - Focus on the customer The main objective of applying Six Sigma is to achieve customer requirements.
B- Supporting senior management, in addition to their continuous endeavor to reach the stage of error-free operations.
C- Employees' commitment and conviction to Six Sigma as a method of continuous improvement, and that they should bear in mind the obligation to perform the right work the first time.
D- Existence of an effective measurement and information system to deliver information to the beneficiary in a timely manner.
E- Operations analysis based on the current and future needs of customers, and based on it will be developed.
H- Appropriate strategies to avoid differences in operations.

2.5 The importance of Six Sigma method

Its importance can be clarified through the following points (Al-Ta'if, 2011: 26-27):

- Raising the level of productivity: The application of Six Sigma is linked to encouraging learning and training, clarifying the objectives of each employee, in addition to focusing on reducing defects and reducing quality costs, which leads to raising the level of productivity.

-- Continuous improvement: The goal of applying Six Sigma is to achieve zero errors by adopting the method of continuous development and improvement at accelerated rates, in addition to providing tools and methods to improve capabilities and reduce errors in any process. Relying on statistical methods to reduce errors and measure the quality of a process or product.

- Achieving a competitive advantage: It helps companies to achieve a continuous competitive advantage in the international and local markets. Depends on improving the quality of production processes and setting targeted procedures that work to meet the customer's needs and satisfy his desires with the continuous improvement of these procedures.

3. The quality

Quality as a term Quality is a word derived from the Latin word Qualities, which means the nature of the thing and the degree of its suitability.From it, whether it is (the organization), the supplier, the customer, the community and so on (Mahfouz, 2004: 12).

3.1 The concept of quality

Quality is defined as the liberation and disposal of defects and errors in the product or service that lead to rework, errors in operations, and a rise in customer complaints and dissatisfaction. In this direction, quality is directed towards reducing costs (Erekat, 2015: 11)

There are reasons that lead to poor quality control within the organization are (Claver et al., 2003: 92):

A - There are defects and differences in the specifications of the raw materials.

B - Diversity of the supplied materials and the multiplicity of origins or sources of their processing.

C- The presence of defects in the production stages for technological or human reasoned- Poor stock handling and transfer of the final product to customers.

D- The low level of standardization in the different production stages.

E - Low efficiency of employees in the quality control activity.

H - Weakness of inspection procedures in the various production stages.

G- Avoiding the use of international quality assurance standards and specifications.

3.2 Quality costs

Juran, 1951, was the first to refer to the issue of quality costs in his book Quality Control. An article on the quality costs system was Masser, 1958, then it was addressed by Harold Freeman, 1960, and Feigenbaun, 1961 (Mahros, 2000: 14). Quality costs were used primarily in industrial companies, but now they have received great attention until they are used in public sectors and service organizations (European Commission, 2012: 5).

When the concept of quality costs appeared in 1951, it included the economic costs borne by the company in Sibyl to achieve the level of quality in accordance with the specific technical specifications of the product, in addition to the economic costs that result from producing products that do not conform to specifications (Mustafa, 2013: 12).(

All organizations begin to set up departments and units. They should prepare to bear the high numbers of costs that companies must spend in order to reach their goal. He defined (Al-Najjar, 2007: 10) costs as the sacrifice or amounts incurred by the company in order to obtain goods, services, or a benefit. Or achieving a specific goal, and it is measured in cash, transferred property, or services provided.

A study of the National Association of Accountants presented a definition of quality costs as the costs that occur due to the possibility that production may be at a low quality level or that it has already appeared defective production, and this means that they are costs that include the costs incurred by the company in the event of non-conformities of products, as well as production costs The defect, with its various types of loss, loss, and the costs involved in re-repairing (Abdul Latif, 2013: 203). Table (4) shows the opinions of some researchers about the concept of quality costs.

Table (4) The opinions of some researchers about the concept of quality costs

Researcher	Concept
Chiadamrong,2003:1000	They are the costs of making sure that there are no errors and identifying quality errors
Al-Khatib, 2008: 128	The sum of unnecessary costs when doing the work correctly
Krajewski *et al*.,2013:117	They are the costs incurred by the organization in order to obtain high quality, the costs of quality assurance, the costs of inferior products, in addition to the costs of not conforming to specifications
Shibli, 2014: 57	Represents the amounts spent by the organization in order to obtain the benefits of quality, whether economic or non-economic
Bilal 2014: 28	It is a measure of the cost associated with achieving or not achieving the quality of a product or service, and this includes all the requirements for products and services specified by the organization and the contracts concluded with its customers
Al-Najjar and Jawad, 2017: 58	The costs incurred by the organization to ensure that the product is provided to the customer according to his needs and desires

Source: Prepared by the researcher according to the availability of sources.

Through what was presented in Table (4), quality costs can be defined as all amounts paid by the organization to obtain the specifications required by the customer that meet his needs.

3.3 The importance of quality costs

Quality costs are of great importance in companies, especially as they are considered an important and necessary tool in companies, as they affect the quality of the service provided that meets the needs and requirements of customers..

It can be said that the cost of quality lies in its importance through several points, the most important of which are (Ghanma, 2020: 17-18):(

A- It is considered a necessary tool in the success or failure of companies because of its role in creating a competitive position for the company in the market, through several points, namely (gaining customer confidence, greater market share, loyalty of employees, and reducing costs).
B- It helps in identifying errors and identifying the necessary means to improve the level of quality, and develop new products and services that satisfy customers and achieve higher profit rates that improve the ability of companies to face ,The pressures of fierce competition in the market and coexistence with the business environment, as well as improving the ability of The company increases the efficiency of its performance by detecting and addressing quality problems..
C- Reinforce the company's reputation through the level of quality of its services provided
D- It includes the two elements (cost and quality), which are among the four main success factors (cost, quality, time, and innovation) for the company.
E- Providing information that helps the administration at its various levels in making decisions, especially with regard to how to develop products and services with high quality.

3.4Types of quality costs

Costs have different concepts and types that go back to the type of industry and define quality costs he divided (Garrison et al., 2010:77) the costs of quality into two parts
First: the matching costs, which include:
A- Prevention Costs
B- Appraisal Costs

Second: Non-conformity costs, which include:
A- Internal Failure Costs
B- External Failure Costs

Prevention Costs: The costs incurred to ensure that companies produce products in accordance with international quality standards ISO 9001, and to avoid preventing defects before producing the product in its final form by designing good, defect-free products (Hendawy, 2016: 34). It includes several activities, such as (Ahmed, 2020: 39)
- Identify potential problems and put in place correct processes before manufacturing errors (poor quality) occur.
-Training and development of employees to perform their jobs in the best way
- Design and improve the design of products, services and processes to reduce quality problems.
- Process control through statistical monitoring of operations.
This group includes (Erekat, 2015: 19-20):
1- Quality planning costs: which are those costs that are directed to the processes of developing and implementing quality management.
2-Product design costs: These are costs that aim to achieve good design, free from defects and easy to use.
3-Operation costs: These are costs that aim to make the production activities conform to the quality specifications specified in advance.
4-Training costs: These are costs that are directed towards spreading and deepening awareness in the field of quality, as well as preparing training programs for all employees

5-Information costs: These are costs that are directed towards increasing the activities necessary to develop quality performance reports and use them in the evaluation of the quality control system.

Appraisal Costs-

It includes all costs associated with studying, examining and evaluating the activities related to quality and verifying whether these activities have been performed correctly according to what is planned in the quality programs or not (Al-Kiji, 2018: 4.(

It includes several activities, such as (Ahmed, 2020: 39:(

The time and quality required to examine the inputs, processes and outputs.-

Obtain inspection, processing and test data.-

Investigate quality problems and submit quality reports.-

Conducting customer surveys and quality audits.-

Internal Failure Costs-

They are the costs incurred by the organization before delivering products to customers and include several activities (Bass & Barbara, 2009: 3) (

Costs of re-audit in the formulation of products-

Bad marketing costs-

Scrap costs-

-The costs of activities that do not add value to a product

External Failure Costs-

The cost of external failure is defined as the costs that the company pays as a result of non-conformity of products

or services to specifications and standards after they are delivered to customers, the consequences of which are often greater than the costs

The cost of external failure with the loss of customer confidence, and the cost of external failure includes the following (Holotaa et al., 2016: 121):(

Market loss-

Transportation costs of inferior products.-

Discounts on poor and low quality products.-

The cost of returning and sending the product.-

3.5 Six sigma as a measure of quality cost

Practical experiences indicate that there is a relationship between the level of quality and quality costs, and the low level of quality leads to an increase in costs in general and quality costs (prevention, examination, external failure) in particular, which affects its operating revenues and thus its competitiveness, and research indicates that whenever The higher the level of sigma, the lower the quality cost, where the cost of quality at the level three sigma is between 49% - 25% of the total income, while at the level of six sigma it decreases to less than 1% of the total income of sales, as shown in Table (5).

Table (5) Quality cost relationship to six sigma levels

sigma level	2	3	4	5	6
cost ratio	more than 40%	from 25-40%	from 15-25%	from 5-15%	%1

Source: Al-Nuaimi, Mohamed Abdel-Al, (2007), Six Sigma, a modern approach to facing defects. The Scientific Conference of Al-Zaytoonah University, Amman Arab University for Graduate Studies, Amman. Jordan, p. 21.

4. The field aspect of the research

4.1 Describe the answers of the research sample to its variables within the framework of field results:

1-Diagnosing the reality of the independent variable (six sigma)

In order to achieve the objectives of the research by six sigma - for the opinions of a sample of workers in the Diwaniyah tire factory, it is necessary to diagnose the reality of its sub-components (commitment and support of senior management, continuous improvement, human resources, focus on customers.(

A - Commitment and support of senior management: Table (6) shows the arithmetic means, standard deviations, and coefficient of variation for the answers of the research sample about the paragraphs related to the dimension of commitment and support of senior management.

Table (6) Arithmetic means and standard deviations of the answers of the research sample to the paragraphs related to the commitment and support of senior management (N=50)

T	paragraphs	Arithmetic mean	standard deviation	Variation coefficient
1	The management of the laboratory is working to develop a clear plan about commitment to quality	3.75	0.79	21.0
2	The laboratory management encourages the suggestions raised by the quality department	4.18	0.81	19.3
3	The management of the laboratory determines the responsibilities of each employee	3.58	0.88	24.5
4	The management of the laboratory is concerned with building a vision that focuses on improving quality	3.50	1.00	27.0
5	The factory management holds its employees responsible for providing high quality services	3.90	0.77	19.7
General Average		3.80	0.856	22.5

Source: computer output

By studying the data of the above table (6), it is clear that the arithmetic mean of paragraph (2) which states (the laboratory management encourages the proposals raised by the quality department) was 4.18, while the standard deviation is 0.81 and the coefficient of variation is 19.3, while the arithmetic mean of paragraph (5) which states On (the management of the laboratory holds its workers responsible for providing high quality services), it was 3.90, with a standard deviation of 0.77. They were very agreeable, and this reflects the importance of the question in paragraph (2) to the sample, as it means that there is a general tendency among the sample, which is described as encouraging the laboratory management of the proposals raised by the Quality Department, according to the sample's conviction. As for the overall average of the middle of the circles for the total dimension of commitment and support of the senior management, it reached (3.8), which is higher than the hypothetical mean, which

indicates that the degree of agreement in the sample answers was good. While the mean value of the deviations was (0.85), which indicates a decrease in the dispersion in the sample answers to the scale statements and this confirms that the sample answers to the scale items were homogeneous and in good agreement, in addition to that the value of the mean of the differences coefficients amounted to (22.5), which confirms that the commitment and Senior management support is the basis for the rest of the other dimensions.

B - Continuous improvement: Table (7) shows the arithmetic means, standard deviations, and coefficient of variation for the answers of the research sample about the paragraphs related to the continuous improvement dimension.

Table (7) Arithmetic means and standard deviations of the answers of the research sample on the items related to continuous improvement (N=50)

T	paragraphs	Arithmetic mean	standard deviation	Variation coefficient
6	The laboratory management is keen to follow up on recent developments in the practical field	3.81	0.94	24.22
7	The laboratory defines methods for continuous improvement of its activities and processes to ensure that no errors occur	3.98	1.00	26.95
8	The laboratory management seeks to acquire new knowledge and skills to reduce the error rate	3.90	0.94	23.94
9	The management of the laboratory encourages employees to use various methods in order to permanently improve work performance	3.77	1.22	30.65
10	The laboratory is always keen to provide an environment that supports continuous improvement and development	3.53	0.98	27.76
General Average		3.77	0.94	22.19

Source: computer output.

By studying the data in Table (7) above, it is clear that the arithmetic mean of paragraph (7) that (the laboratory determines methods for continuous improvement of activities and operations in it to ensure that no errors occur.) It reached 3.98, while the standard deviation is 1.00 and the coefficient of variation is 26.95, while the arithmetic mean Paragraph (8), which states (The laboratory management seeks to acquire new knowledge and skills to reduce the error rate.) It was 3.90 and standard deviation was 0.94. They were very agreed, and this reflects the importance of the question in paragraph (7) for the sample, as it means that there is a general trend in the sample that is described as the laboratory management determines the appropriate methods for the continuous improvement process to ensure that mistakes do not occur.

As for the overall mean of the mean of the total after continuous improvement, it reached (3.77), which is higher than the hypothetical mean, which indicates that the degree of agreement in the sample

answers was good. While the mean value of the deviations reached (0.94), which indicates a decrease in the dispersion in the sample answers to the scale expressions, and this confirms that the sample answers to the scale items were homogeneous and well in agreement, in addition to the fact that the mean value of the difference coefficients was (22.19).

C - Human resources: Table (8) shows the arithmetic means, standard deviations, and coefficient of variation for the answers of the research sample about the paragraphs related to the human resources dimension.

Table (8) Arithmetic means and standard deviations of the answers of the research sample on the items related to human resources (N=50)

T	paragraphs	Arithmetic mean	standard deviation	Variation coefficient
11	The management of the plant delegates the powers to increase the completion of work	4.09	0.83	17.25
12	The lab encourages workers to complete their tasks through work teams	3.98	0.95	21.02
13	The laboratory is keen to hold multiple training courses to develop the capabilities of the workers	3.90	0.90	22.82
14	The lab is keen to give employees opportunities to express their opinions openly	3.65	0.97	26.35
15	The laboratory stimulates the participation of employees in making decisions related to their work	3.88	0.85	25.00
General Average		3.915	0.853	21.78

Source: computer output.

By studying the data of Table (8) above, it becomes clear that the arithmetic mean of paragraph (11) which states that (the management of the laboratory delegates the powers to increase work completion) was 4.09, while the standard deviation is 0.83 and the coefficient of variation is 17.25. As for the arithmetic mean of paragraph (12), which states that (The lab encourages workers to complete their tasks through work teams) It was 3.98 and a standard deviation of 21.02. They were very agreeable, and this reflects the importance of the question in paragraph (11) for the sample, as it means that there is a general trend in the sample that is described as the laboratory management delegating more powers to the workers to ensure the completion of work.

As for the general average of the median of the total human resources dimension, it reached (3.915), which is higher than the hypothetical mean, which indicates that the degree of agreement in the sample answers was good. While the mean value of the deviations reached (0.853), which indicates a decrease in the dispersion in the sample answers to the scale expressions, and this confirms that the sample answers to the scale items were homogeneous and in good agreement, in addition to that the value of the mean of the differences coefficients was (21.78).

D- Focus on customers: Table (9) shows the arithmetic means, standard deviations, and coefficient of variation for the answers of the research sample about the paragraphs related to the dimension of focus on customers.

Table (9) Arithmetic means and standard deviations of the answers of the research sample on the paragraphs related to the focus on customers (N=50)

T	paragraphs	Arithmetic mean	standard deviation	Variation coefficient
16	The management of the laboratory works to solve the problems facing customers as quickly as possible	3.86	0.79	20.46
17	Factory management focuses on customer satisfaction, a necessary requirement for success and survival in the market	3.76	0.87	23.13
18	The management of the factory is keen on the speed of the worker's response to the demands of customers	4.00	0.84	21.00
19	The management of the factory seeks to meet the needs of customers	3.51	0.88	22.50
20	The laboratory takes complaints from customers seriously and follows up on them	3.95	0.70	18.13
General Average		3.84	0.72	23.29

Source: computer output.

By studying the data of Table (9), it is found that the arithmetic mean of paragraph (18) which states (the factory management is keen on the speed of the worker's response to the demands of customers.) was 4.00, while the standard deviation is 0.84 and the coefficient of variation is 21.00, while the arithmetic mean of paragraph (20) Which states (The laboratory takes complaints from customers seriously and follows them up) it reached 3.95 with a standard deviation of 0.70. They were very agreeable, and this reflects the importance of the question in Paragraph (18) in the sample, as it means that there is a general tendency among the sample about paying attention to complaints received from customers.

As for the mean of the means for the total after focusing on customers, it reached (3.84), which is higher than the hypothetical mean, which indicates that the degree of agreement in the sample answers was good. While the mean value of the deviations reached (0.72), which indicates a decrease in the dispersion in the sample's answers to the scale expressions, and this confirms that the sample's answers to the scale items were homogeneous and in good agreement, in addition to the fact that the mean value of the coefficients of variation was (29.23).

4.2 Describe and evaluate the level of answers about the dependent variable (quality costs)

This paragraph is concerned with describing the level of answers of the members of the research sample by extracting the arithmetic means and standard deviations for the paragraphs related to the dependent variable (quality costs), as the research questionnaire included (20) paragraphs related to this variable, consisting of (21-40):

A - Preventive costs: Table (10) shows the arithmetic means, standard deviations, and coefficient of variation for the answers of the research sample about the paragraphs related to the preventive costs dimension.

Table (10) Arithmetic means and standard deviations of the answers of the research sample to the items related to preventive costs (N=50)

T	paragraphs	Arithmetic mean	standard deviation	Variation coefficient
21	New product design costs must be accurately measured	4.28	0.84	19.82
22	The costs of assessing the reliability of suppliers should be measured as necessary to avoid a sudden stop in supply	4.03	0.92	22.82
23	The costs of the company holding training courses for employees should be measured on the grounds that this contributes to improving the performance and efficiency of employees	3.80	0.83	21.84
24	The costs of planning and the costs of implementing these plans must be measured	4.20	0.87	20.71
25	Prevention costs can be considered investment costs	3.93	1.10	27.98
General Average		3.98	0.85	21.35

Source: computer output.

By studying the data in Table (10), it appears that the arithmetic mean of paragraph (21) which states (the costs of designing new products must be accurately measured) was 4.28, while the standard deviation is 0.84 and the coefficient of variation is 19.82. As for the arithmetic mean of paragraph (24), which states On (the planning costs and the costs resulting from the implementation of these plans must be measured), it reached 4.20 and a standard deviation of 0.87 was very agreeable and this reflects the importance of the question in paragraph (21) for the sample, as it means that there is a general trend in the sample about measuring the planning costs related to the completion of work.

As for the mean of the means for the sum of the preventive costs dimension, it reached (3.98), which is higher than the hypothetical mean, which indicates that the degree of agreement in the sample answers was good. While the mean value of the deviations reached (0.85), which indicates a decrease in the dispersion in the sample's answers to the scale statements, and this confirms that the sample's answers to the scale items were homogeneous and in good agreement, in addition to the fact that the mean value of the coefficients of difference reached (21.35)

B - Evaluation costs: Table (11) shows the arithmetic means, standard deviations, and coefficient of variation for the answers of the research sample about the paragraphs related to the dimension of evaluation costs.

Table (11) Arithmetic means and standard deviations of the answers of the research sample to the items related to evaluation costs (N=50)

T	paragraphs	Arithmetic mean	standard deviation	Variation coefficient
26	The costs of inspections of raw materials and semi-finished materials must be calculated to verify their compliance with specifications	3.92	0.64	16.36
27	Specific criteria must be established by the laboratory to classify the product as good, defective or damaged.	4.15	0.70	16.86
28	The cost of testing the new product must be calculated before it is put on the market, as it is necessary to ensure the success of the product.	3.91	0.78	19.94
29	The costs of testing products must be calculated before they are delivered to the customer, to avoid discovery of product errors by the customer	4.01	0.74	18.43
30	The costs of inspection and testing tools and equipment must be taken into account.	3.88	0.89	22.82
General Average		3.87	0.85	21.35

Source: computer output.

By studying the data in Table (11), it appears that the arithmetic mean of paragraph (27) which states (specific criteria must be set by the laboratory to classify the product as a good, defective or damaged product) was 4.15, while the standard deviation is 0.70 and the coefficient of variation is 16.86, while the mean The arithmetic for paragraph (29), which states (the costs of testing products must be calculated before they are delivered to the customer, to avoid discovering product errors by the customer), it reached 4.01 and a standard deviation of 0.74 was highly in agreement. This reflects the importance of the question in paragraph (27) for the sample, as it means that there are A general tendency among the sample about setting specific standards by the factory administration for the purposes of classifying products in terms of quality.

As for the mean of the sum total of the evaluation costs, it reached (3.87), which is higher than the hypothetical mean, which indicates that the degree of agreement in the sample answers was good. While the mean value of the deviations reached (0.85), which indicates a decrease in the dispersion in the sample's answers to the scale statements, and this confirms that the sample's answers to the scale items were homogeneous and in good agreement, in addition to the fact that the mean value of the coefficients of difference reached (21.35).

C- Costs Internal Failure: Table (12) shows the arithmetic means, standard deviations, and coefficient of variation for the answers of the research sample about the paragraphs related to the dimension of preventive costs.

Table (12) Arithmetic means and standard deviations of the answers of the research sample to the items related to the costs of internal failure N = (50)

T	paragraphs	Arithmetic mean	standard deviation	Variation coefficient
31	Costs or savings resulting from miscalculation of raw materials must be accurately and clearly calculated	3.95	0.79	20.00
32	The losses resulting from the sudden stop of operations must be calculated accurately	4.03	0.97	24.06
33	The costs of scheduling and redesigning production processes must be measured in ways that ensure that work does not stop suddenly	3.76	0.92	24.46
34	The costs of redesigning products that did not pass the initial tests should be counted as a new product.	3.71	1.02	27.62
35	Remanufacture costs for defective products must be calculated	4.10	0.85	20.73
General Average		3.91	0.88	22.56

Source: computer output.

By studying the data in Table (12), it becomes clear that the arithmetic mean of paragraph (35) that (the costs of re-manufacturing defective products must be calculated) amounted to 4.10, while the standard deviation is 0.85 and the coefficient of variation is 20.73, while the arithmetic mean of paragraph (32) which states that (The losses resulting from the sudden cessation of operations must be accurately calculated) It amounted to 4.03 and a standard deviation of 0.97 was highly in agreement and this reflects the importance of questioning in Paragraph (35) in the sample, as it means that there is a general trend in the sample about setting up a mechanism for calculating the costs of re-manufacturing defective products.

As for the mean of the sum total of the evaluation costs, it reached (3.91), which is higher than the hypothetical mean, which indicates that the degree of agreement in the sample answers was good. While the mean value of the deviations was (0.88), which indicates a decrease in the dispersion in the sample answers to the scale expressions, and this confirms that the sample answers to the scale items were homogeneous and in good agreement, in addition to the fact that the mean value of the coefficients of difference was (22.56).

D- External failure costs: Table (13) shows the arithmetic means, standard deviations, and coefficient of variation for the answers of the research sample about the paragraphs related to the dimension of preventive costs.

Table (13) Arithmetic means and standard deviations of the answers of the research sample to the items related to the costs of external failure (N=50)

T	paragraphs	Arithmetic mean	standard deviation	Variation coefficient
36	Losses resulting from loss of reputation must be estimated as a result of the company's failure to control the quality of its products	3.448	0.632	0.14
37	The costs of dealing with customer complaints must be measured seriously and satisfied them as required	3.379	0.677	0.20
38	The costs of lawsuits brought against the company as a result of harm to consumers or others must be measured	4.138	0.315	0.12
39	The costs or losses of replacing defective and damaged products discovered by the customer shall be accounted for	3.379	0.677	0.31
40	The difference between the decrease in sales volume compared to previous years must be calculated	3.828	0.529	0.12
General Average		0.222	0.766	3.234

Source: computer output.

By studying the data of Table (13), it becomes clear that the arithmetic mean of paragraph (38) which states (the costs of lawsuits filed against the company must be measured as a result of harm to consumers or others) amounted to 4.138, while the standard deviation is 0.315 and the coefficient of variation is 0.12, while the arithmetic mean Paragraph (39) which states (the difference between the decrease in sales volume compared to previous years must be calculated) was 3.828 and a standard deviation of 0.529 was highly in agreement Calculate the costs of remanufacturing defective products.

As for the mean of the total evaluation costs, it reached (0.222), which is higher than the hypothetical mean, which indicates that the degree of agreement in the sample answers was good. While the mean value of the deviations was (0.766), which indicates a decrease in the dispersion in the sample's answers to the scale expressions, and this confirms that the sample's answers to the scale items were homogeneous and in good agreement, in addition to the fact that the mean value of the coefficients of difference was (3.234).

) - Description and diagnosis of the two research variables (six sigma and quality costs

It is noticed from Table (14) that there is a great convergence in the averages of the sample answers about the two research variables, so that the differences are almost not clear as they are simple decimal values, and this confirms that there is great agreement in the intensity of the answer to the questions of the research variables, and as in the following table.

Table (14) The response level of the sample opinions to the research variables

The reality of the answer / Variable	average averages	average deviations	average coefficient of differences
Six sigma	3.85	0.88	23.03
Quality costs	3.93	0.86	22.30
Total	3.86	0.87	22.53

Source: computer output.

Also, the average mean of the two research variables reached a value of (3.86), which is greater than the hypothetical mean of the research scale of (3), and this shows the severity of the agreement of the sample answers on the research scale, and it shows the average mean standard deviations, which amounted to (0.87), that there is no dispersion in the answers The sample revealed its hypothetical mean for all the research variables, meaning that the answers to the questions of the research scale were not dispersed. As for the average mean of the coefficients of variation, its value reached (22.53), which is a good value indicating that there is homogeneity and strong agreement in the sample answers about all the questions of the research scale This is a good indication that the scale has fulfilled the research requirements.

4.3 Testing the research hypotheses

1- Testing the correlation hypotheses

The first main hypothesis was reported (there is a significant correlation between six sigma and quality costs).

In order to accept the above statistical hypotheses or not, the simple correlation coefficients mentioned in Table (15) were tested using the (t) test to determine the significance of the relationship between the independent variable, which is six sigma, and the dependent variable with its dimensions, which is quality costs. It is clear from the results presented in the following table.

Table (15) The relationship between six sigma and quality costs(N=50)

The dependent variable / Independent variable	R					p
	Preventive costs	Evaluation costs	Internal failure costs	External failure costs	Total quality costs	
Six sigma	0.85**	0.87**	0.80**	0.82**	0.86**	0.000
The value of T calculated	15.52	14.07	10.66	12.50	12.29	0.000

A- The presence of a positive, strong and significant connotation relationship at the level (0.01) between Six Sigma as a changing, independent, and quality cost as a comprehensive, approved changing, as the value of the simple correlation coefficient between them (0.86), which supports this positive link relationship that value (T) The calculated reached 12.52), which is greater than the valuable (T) tabular value (4.45), so it indicates the acceptance of the first hypothesis, and this means

that there is a positive and moral correlation relationship between Six Sigma and quality costs, and thus confirms the validity of the hypothesis of existence.

B- The results of the correlation of quality costs as sub-dimensions and individually with the Six Sigma variable indicate that all the relationships between them are positive, and what supports these positive relationships, is that the value of (T) calculated for all sub-dimensions is greater than the (T) tabular value and a significant significance and at a level (0.01), as shown in Table (15), and was the most powerful correlation coefficient with the total Six Sigma is the preventive costs as its value (0.87), and the lowest correlation coefficient that was for the service as its value (0.80).

Depending on the results of the statistical analysis, we find that all the links reached between the variable approved with its dimensions and the independent were positive and moral correlation relationships, which indicates the reliance of the authorized organization on the adoption of the Six Sigma style, which contributed to reducing quality costs.

4.4 Impact hypothesis testing

The second main hypothesis stated (there is a significant effect of six sigma on quality costs

The aforementioned sub-hypotheses, emanating from the second main hypothesis, will be tested using simple linear regression to show the amount of change and the type of effect between the independent variable (six sigma) and the dependent variable (quality costs), each separately, as well as clarifying the extent of the impact on quality costs.

A- The first sub-hypothesis, which emanated from the second main hypothesis contained in the hypothesis of the research, indicated the existence of a significant effect between six sigma and preventive costs, and this effect will be tested using simple linear regression as follows:

$$Y1 = a + bz1$$

$$=2.32 + 0.19z1$$

Since:

Z1= six sigma

Y1= Preventive costs

A= The value of the regression constant coefficient

B= coefficient value (beta)

Looking at Table (16), we find that there is a positive effect between the two variables above, as the value of the coefficient (b) was (0.19) and the percentage of the coefficient of determination (R2) (0.06), and when conducting a test (f) it was found that the calculated (f) amounted to (23.27). It is more than its tabular value of (6.30) at the level of significance (0.05) and the degree of freedom (59) .

Table (16) Simple six sigma linear regression on preventive costs

Dependent variable Y	regression constant value (a)	B . parameter value	R^2	F	effect type
Preventive costs	2.32	0.19	0.06	23.27	influential

(f) tabular value (6.30) below the level of significant significance (0.05) with a degree of freedom (59)

B - The second sub-hypothesis, which emanated from the second main hypothesis contained in the hypothesis scheme of the research, indicated that there is a significant effect between the obstacles to

applying six sigma in evaluation costs, and this effect will be tested using simple linear regression as follows:

$Y_2 = a + bZ_1$

$= 3.12 + 0.59\ Z_1$

Since:

Z1= six sigma

Y2= Evaluation costs

A= The value of the regression constant coefficient

B= coefficient value (beta)

Looking at Table (17), it becomes clear that there is a positive effect between the two variables above, as the value of the coefficient (b) was (0.59) and the ratio of the coefficient of determination (R2) (0.112), and when conducting a test (f) it was found that the calculated (f) amounted to (8.64).), which is more than its tabular value of (6.30) at the level of significant significance (0.05) and the degree of freedom (59). This confirms the validity of the hypothesis that states (there is a significant effect of six sigma on evaluation costs), as the result indicates a positive effect of six sigma on evaluation costs in the researched organization.

The value of (R2) coefficient of determination indicates that there is a clear and significant six sigma role in explaining all the differences used in the evaluation costs, and this reinforces the acceptance of the second sub-hypothesis that (there is a significant relationship six sigma and evaluation costs).

Table (17) Simple six sigma linear regression in appraisal costs

Dependent variable Y	regression constant value (a)	B . parameter value	The value of the coefficient of determination (R2)(	)f) computed value	effect type
Evaluation costs	3.12	0.59	0.112	8.64	influential

(f) tabular value (6.30) below the level of significant significance (0.05) with a degree of freedom (59)

Source: computer output C- The third hypothesis that emanated from the second main hypothesis contained in the hypothesis of the research indicated that there is a significant effect between six sigma in the costs of internal failure, and this effect will be tested as follows:

$Y_3 = a + bZ_1$

$= 3.46 + 0.21Z_1$

Since:

Z1= six sigma

Y3= The costs of internal failure

A= The value of the regression constant coefficient

B= coefficient value (beta)

Looking at Table (18), we find that there is a positive effect between the two variables above, as the value of the coefficient (b) was (0.21) and the ratio of the coefficient of determination (R2) (0.093), and when conducting a test (f) it was found that the calculated (f) amounted to (8.89).), which is more than its tabular value of (6.30) at the level of significant significance (0.05) and the degree of freedom (59). This confirms the validity of the hypothesis which he stated (there is a significant effect of six

sigma in the costs of internal failure), as the result indicates a positive effect of six sigma on the costs of internal failure.

The value of (R2) coefficient of determination indicates that there is a clear and significant role six sigma in explaining all the differences used in the costs of internal failure, and this reinforces the acceptance of the third sub-hypothesis that emanates from the first main hypothesis that.

)There is a significant relationship between six sigma in the costs of internal failure

Table (18) Simple six sigma linear regression in internal failure costs)

Dependent variable Y	regression constant value (a(	B . parameter value	The value of the coefficient of determination (R2)(	)f) computed value	effect type
internal failure costs	3.46	0.21	0.093	8.89	influential

(f) tabular value (6.30) below the level of significant significance (0.05) with a degree of freedom (59)

T- The fourth hypothesis emanating from the second main hypothesis contained in the hypothetical scheme of the research indicated the existence of a significant effect between six sigma in the costs of external failure, and this effect will be tested as follows:

Y_3= a+ bZ_1

= 3.46+ 0.21Z_1

Since:

Z1= six sigma

Y4= External failure costs

A= The value of the regression constant coefficient

B= coefficient value (beta)

Looking at Table (19), we find that there is a positive effect between the two variables above, as the value of the coefficient (b) was (0.22) and the ratio of the coefficient of determination (R2) (0.094), and when conducting a test (f) it was found that the calculated (f) amounted to (8.95).), which is more than its tabular value of (6.30) at the level of significant significance (0.05) and the degree of freedom (59). This confirms the validity of the hypothesis that states (there is a significant effect of six sigma in the costs of external failure), as the result indicates a positive effect of six sigma on the costs of external failure.

The value of (R2) coefficient of determination indicates that there is a clear and significant six sigma role in the costs of external failure in explaining all the differences used in the service. In the costs of external failure.

Table (19) Simple six sigma linear regression in external failure costs

Dependent variable Y	regression constant value (a(	B . parameter value	The value of the coefficient of determination R2)(	)f) computed value	effect type
External failure costs	3.50	0.22	0.094	8.95	influential

(f) tabular value (6.30) below the level of significant significance (0.05) with a degree of freedom (59)

5. Conclusions and recommendations

5.1 Conclusions

1- The concern of the top management in the laboratory in the issue of quality and its use to reduce internal failure rates and continuous improvement of production processes

2-Six sigma is one of the important entrances that leads to reducing deviations, eliminating spoilage and improving the performance of production processes based on a set of statistical methods to measure quality and reduce defects

3-There is an effect of six sigma standards in reducing quality costs of all kinds, which means the ability of six sigma standards to improve performance and develop work mechanisms that are reflected in reducing quality costs and able to attract many customers.

4-The management of the laboratory is keen to analyze all costs related to material inspection operations in order to assess the level of quality and the extent of conformity with the required specifications.

5- The management of the factory is keen to match its products according to the purpose for which they were designed, with the appropriate quality and cost.

5.2 Recommendations

1- The necessity of the senior management's interest in the management of the plant to provide all the basic elements and ingredients for applying the standards of the six sigma method, both with regard to financial support, attracting specialized human resources and providing the appropriate environment.

2-The necessity of conducting training courses for laboratory workers on how to apply six sigma.

3-The need for the laboratory to adopt a quality cost accounting system, which enables it to measure and analyze the relationships between quality costs, which in turn leads to improving quality cost decisions.

4-The necessity of conducting several studies that enhance the application of concepts related to quality costs

5-The need for the factory management to seek to establish a culture of quality and do what is right from the beginning and focus on quality costs to avoid obtaining defective products.

References

1. Abdel-Gawad, Ahmed Hussein, (2013) Six Sigma methodology as an entrance to develop the role of administrative accounting in rationalizing business risk management decisions an analytical study on the banking business environment.
2. Abdul Latif, Abdul Latif Mohamed Al-Hassan, (2113), the role of administrative accounting methods in rationalizing total quality management decisions and reducing the cost of banking service. Unpublished PhD thesis, Omdurman Islamic University, College of Graduate Studies.
3. Ahmad, Othman Ibrahim Mohamed (2020), "Quality costs and their role in supporting the competitive advantage of industrial companies, a field study on the two companies of Jiyad and D. D.), unpublished Master Thesis, Sudan University of Science and Technology, cost accounting and administrative accounting.
4. Ahmed ,Tanvir ,(2019) , " Title: Application of Six Sigma towards Quality Performance in Garments Sector: A Case of Bangladesh, Master's degree thesis , Molde university college , specialized university in logistics .

5. Al -Khatib, Samir Kamel (2008), (Total Quality Management and Izu: Contemporary Introduction, Jaafar Al -Adhami Press, Baghdad - Iraq.
6. Al Kunsol, William Hanna (2015) , "The Effect of Lean Six Sigma on the Jordanian Pharmaceutical Manufacturing Organizations' Business Performance" , Master Degree in Business Administration Department Management Department - Business Faculty Middle East University Amman – Jordan.
7. Al -Najjar, Sabah Majeed, Jawad, Maha Kamel (2017), Quality Management: Buildings and Applications, First Edition, Memory for Publishing and Distribution, Baghdad - Iraq.
8. Al -Nuaimi, Muhammad Abdel -Al, (2007), - Six Sigma is a modern approach to defects. The Scientific Conference of the University of Daytona, Oman Arab University for Graduate Studies, Amman. Jordan, p. 21.
9. Al -Qazzaz, Ismail, Ibrahim, (2009), Six Sigma and other modern methods in Total Quality Management, Dar Al Masirah for Publishing and Distribution, Jordan.
10. Al-Kiji, Majdi Wael (2018), the extent of the Six Sigma application as an entrance to reduce quality costs in Palestinian public joint stock companies, "Jordanian Journal of Business Administration, Volume 14, No. 1.
11. Al-Najjar, Youssef Mohamed Awad (2007), applying the ABC cost-based cost system in the Jordanian industrial sector: its justifications and components: a field study, unpublished Master Thesis, Oman Arab University, Jordan.
12. Al-Rashidi, Tariq Abdel-Azim) 2009 (The role of strategic cost management in activating investment decisions in the e-commerce environment: Applied Study.
13. Al-Zahrani, Muhammad bin Saleh Muhammad, 2010)), The possibility of applying the Sixa Set Set in the Security Forces Officers Club in Riyadh, unpublished Master Thesis, College of Graduate Studies, Naif Arab University for Security Sciences, Saudi Arabia.
14. Anamah, Anwar Suleiman Kamal (2020), the impact of quality costs on the financial performance in Jordanian service companies listed on the Amman Stock Exchange ", unpublished Master Thesis, Middle East University, Department of Accounting.
15. Banuelas, R & Antony, J (2002), Key Ingredients for The Effective Implementation OfSix Sigma Program, *Measuring Business Excellence*, 6(4):20-27.
16. Bass, Issa, and Barbara Lawton. (2009). "Lean six sigma using SigmaXL and Minitab." Copyright by The McGraw-Hill Companies, Inc United States of America.
17. Bilal, Ghoul (2014), "Total Quality Management and its role in the low quality costs, a case study of the Iron Mines- Tebessa Company", unpublished Master Thesis, College of Economic Sciences, Commercial Sciences and Management Sciences, Umm Al-Bouaghi University.
18. Bin Aishawi, Ahmed (2014), Six Sigma method as a tool to improve total quality management (TQM), Journal of Algerian Institutions Performance, Issue 05.
19. Chiadamrong, Navee. (2003). "The development of an economic quality cost model". Total Quality Management & Business Excellence, vol. 14.no(9).PP. 999-1014.www.tandfonline.com/loi/ctqm20.
20. Ching-Chow Yang (2010), Six Sigma, Quality Management and Six Sigma, Abdurrahman Coskun (Ed.), ISBN: 978-953-307-130-5, InTech, Available from: http://www.intechopen.com/books/quality-management-and-sixsigma/six-sigma

21. Claver, Enrique; Tari, Juan Jose & Moline, Jose Francisco, (2003), "Critical factors and results of quality management: an empirical study", Total Quality Management, Vol.14 No.1: 91-118
22. Erekat, Shaker Mahmoud Ahmed (2015), "The Impact of Quality Control on Cost Reducing: An Applied Study on Food Companies in the Hashemite Kingdom of Jordan", Unpublished Master Thesis, Middle East University, College of Administration and Economics Department of Accounting and Finance.
23. Europian Commission, (2012), Quantifying Quality Costs and the Cost of Poor Quality in Translation, Publications Office of the European Union, Luxembourg
24. Garcia, Francisco Ribes , (2014), Six Sigma Implementation within the Building Construction Industry. A Case Study of the Research Building Construction , Master's Degree in Building Constructions at the University Polytechnic of Valencia,
25. Garrison, Ray H, Noreen, Eric W, Brewer, Peter C, (2010), Managerial Accounting, Thirteen edition, McGraw-Hill Irwin
26. Hindawi, Muhammad (2016), "The role of using a six-siga style in the emancipation of the goals of strategic cost management", unpublished Master Thesis, University of Aleppo, College of Economics, Department of Accounting.
27. Holotaa, T., Hrubeca, J., Kotusa, M., Holienčinováb, M. & Čapošová, E. (2016). The Management of Quality Costs Analysis Model. Serbian Journal of Management, 11(1):119-127.
28. Horngren, Charles T., Datar, Srikant M., Rajan, Madhav V., (2012), Cost Accounting A Managerial Emphasis, 14th Edition, Prentice Hall, New Jersey.
29. Ibrahim, Mohamed Abdel Moneim Mohamed (2019), "The use of six Sigma methodology as an introduction to the competitive advantage of national industries in the Kingdom of Saudi Arabia: Applied Study, the Scientific Journal of Economy and Trade..
30. Krajewski , Lee J., Manoj K. Malhotra, and Larry P. Ritzman (2013)."Management Processes and Supply Chains". Ninth edition. Global Edition, Typeset in Utopia Std by Lumina Datamatics Printed and bound by Courier Kendallville in The United States of America .www.gen.lib.rus.ec
31. Krajewski.Lee.J.,Maojk. Malhotra,Larry.P. Rtzman (2016)."Management Processes and SupplyChains", Eleventh Edition, Global Edition, Typeset in Utopia Std by Lumina Datamatics Printed and bound by Courier Kendallville in The United States of America.
32. Mahfouz, Ahmed Joudeh (2004), "Total Quality Management: Concepts and Applications", Wael Publishing House, Jordan.
33. Mahrous, Ahmed (2000), "Quality costs are an introduction to the development and continuous improvement ISO9000/TQM, Nour Al -Iman Center for Writing and Printing, Egypt – Cairo.
34. Malcolm, Baldridge (2014), **the Evolution of Six Sigma, Process Quality Associates Inc.**, Available online at: http://www.pqa.net.
35. Mustafa, Samar Adel (2013), Measuring the effects of comprehensive quality reinforcement with reference accounting standards to maximize the competitiveness of business facilities: a field study, unpublished Master Thesis, Cairo University, all trade.
36. Pande, Pete & Holpp, Larry, (2002). "What Is Six Sigma", McGraw- Hill, New York:16
37. Prabu ,K , & Makesh ,J., &Naveen Raj K., & Devadasan , W.R.(2013), " Six Sigma implementation through DMAIC: a case Study *Int. J. Process Management and Benchmarking, Vol. 3, No. 3.*

38. Pulakanam, V.; and Voges, K.E. (November 2010). "Adoption of Six Sigma by organizations: What Has Empirical Research Discovered?" **International Review of Business Research Papers,** 6(5), 149-163.
39. Rathilall, Raveen (2014), " A Lean six sigma framework to enhance the competiveness in selected automotive component manufacturing organizations ", thsis **Doctor of Technology: Quality,** Durban University of Technology, Faculty of Management Sciences.
40. Salaheldin, S. and Abdelwahab, I. (2009), Six Sigma Practices in the Banking Sector in Qatar, Global Business and Management Research: ***An International Journal***, 1(1): 23-35.
41. Shibli, Muslim Allawi (2014), total quality and environment: concepts - entrances, cases, first edition, Al -Ghadeer for Printing and Publishing, Baghdad - Iraq.
42. Swink, Morgan, Steven A. Melnyk, Janet L. Hartley, and M. Bixby Cooper.(2014). "Managing operations across the supply chain". McGraw-Hill Education,. Second Edition, Published by McGraw-Hill/Irwin, a business unit of The McGraw-Hill Companies, Avenue of the Americas.
43. Taif, Muhammad Ahmad Muhammad (2011), the possibility of applying six Sigma in the obesity factories in the Republic of Yemen: (A case study of the tower cement factory, unpublished Master Thesis, University of Aden, Yemen.
44. Yassin, Al-Hakam Ayoub, the impact of the requirements of the hexagon to reduce the cost of poor quality: a case study on the captain factory in Najaf, Master Thesis, Unpublished, Middle East University, Business Administration.