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Research Article

Integration Value Engineering and Quality of Maintenance and its Impact on Product Quality Improvement: Field Research at Electrical and Electronic Industry Companies in Baghdad

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ABSTRACT

This research aims to study the impact of integrating value engineering (VE) and quality maintenance (QM) on improving product quality in manufacturing industries. Value engineering focuses on improving product functionality while reducing costs, while quality maintenance ensures that equipment and procedures are optimized for the purpose of preventing failures and defects. Combining these two variables is expected to improve operational efficiency, reduce equipment downtime, and enhance overall reliability and product quality, of electrical and electronic industry companies' products. in Baghdad. A questionnaire was used to determine the opinions of a sample of technicians of size (280) technician in research field companies. The research reached a number of conclusions, the most important of which were: The integration effect of both value engineering technology and quality of maintenance on product quality, has been determined. They enhance the quality of the companies' products in the research field.

1. INTRODUCTION

It is essential that the company get a site that allows it to compete and lead in markets. Their environmental variables are fast and complex, prompting them to obtain methods. Modern and advanced competition through producing premium quality products. Van Engineering. Value and quality of maintenance are the variables influencing product quality interpretation. Value engineering is the work on which methodology and organization are based. Improving the processes of production and products, using the team's working method from cluster to cluster. Data and function analysis with the objective of knowing the requirements and function characteristics and evaluating the ideas. To access the ideas with good and correct orientations, trend towards creating creation. To achieve consumers' needs and desires for a product of high quality and cost. Suitable. With interest in the quality of maintenance carried out through the implementation of the administrational and technical procedure that required for the permanence of the machine's work and machinery to maintain them perfectly or return them to the situation in which the Organization can implement its plans according to standards approved in manufacturing works, this procedure is done through the human supplier's work timely maintenance and use of valid and new spare parts. As a result, the product's quality is the extent to which it can meet the actual needs of consumers according to specifications specified by the industrial company.

2. RESEARCH METHODOLOGY

2.1 Statement of problem:

he obsession with survival and competition in local and global markets for industrial companies in light of the rapid and complex environmental changes that the industrial environment is experiencing has prompted many of them to search for new and innovative ways to help them compete by finding appropriate alternatives, reducing costs, and improving the quality of products. Likewise, these companies cannot develop and face challenges except by identifying the variables affecting product quality, and among the variables affecting them are value engineering and quality maintenance, which is represented in maintaining the continuity of production operations by maintaining the continuity of the work of machines

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and equipment within the production lines. Therefore, when the idea of integrating value engineering and quality maintenance and their role in improving the quality of industrial companies' products becomes clear, it will enable them to respond to the needs and desires of consumers, as well as preserving the company's physical assets and continuing to work without interruption, which will lead to increasingly increased production, create good working conditions, and encourage workers in the production lines. Maintenance operations focus on studying problems with machines and equipment and improving the work environment [1]. This contributes to increasing the level of product quality (Saif, 2020: 145).

Through field visits conducted by the two researchers to electrical and electronic industries companies in Baghdad, they noticed that they faced a problem with the low quality of their products and the delay in producing the specified quantities of products in the main production schedule within the time horizon specified for them. The researchers attempted to identify the factors affecting the low quality of companies' products in the field of research, as well as the lack of interest in maintenance of machines and equipment, which leads to their continuous cessation.

Accordingly, the two researchers sought to study the problem faced by the companies in the field of research (the Light Electrical Industries Company/Ishtar, the Electronic Industries Company/Al-Qaythara, the Electrical and Electronic Industries Company/Al-Waziriya, and the Electrical and Electronic Industries Company/Al-Taji).

Its objective is to improve the quality of the products of these companies in the research field by determining the effect of the integration of value engineering and quality maintenance because of their relationship in improving the quality of the companies' products in the research field. In order to define the research problem specifically and accurately, the researchers sought to formulate the research problem with the following questions:

Question 1: What are the availability levels of each of the three study's variables (value engineering, maintenance quality, Product quality) in electrical and electronic industry companies?

Question 2: Is value engineering having an impact on product quality in research companies?

Question 3: Is there an impact of quality maintenance on product quality in research companies?

Question 4: Is there an impact of value engineering integration and quality of maintenance on product quality?

2.2 Search Objectives

The research seeks to determine the level of availability of study variables (value engineering, quality Maintenance, product quality) in the research field companies. Value Engineering Impact Test by Dimensions (data collection, function analysis, ideas evaluation, and innovation) in improving product quality in Light sample search answers. Determining the impact of quality maintenance by dimensions (human resource, time Repair, flexibility, and cost) in improving product quality considering sample research answers. As well as the Value Engineering Integration Test and Maintenance Quality and Its Impact on Product Quality in Companies in Industrial research field.

2.3 Hypotheses and research model

In the light of the research problem and its objectives, a number of hypotheses will be formulated:

The First hypothesis (H1): There is a moral and statistical effect of value engineering in Product quality from the viewpoint of research sample individuals.

The Second hypothesis (H2): There is a moral and statistical effect of maintenance quality in product quality from the viewpoint of research sample individuals.

The Third hypothesis (H3): There is a moral and statistical to integration effect of engineering integration Value and quality maintenance in improving product quality from the viewpoint of research sample individuals.

Based on the research problem and its objectives, a model was designed to reflect research variables and their relationship linkages, as illustrated in Figure 1.

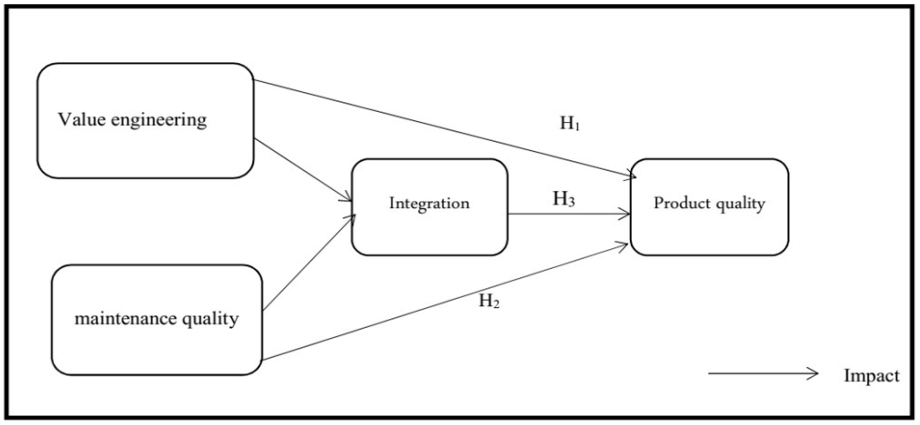

Fig. 1. research model.

2.4 Research Community and Sample:

The companies of the Ministry of Industry and Minerals (Light Electrical Industries Company/Ishtar, Electronic Industries Company/Al-Qaythara, Electrical and Electronic Industries Company/Al-Waziriya, Electrical and Electronic Industries Company/Al-Taji) were chosen as a field for the research environment because they represent the backbone of the Iraqi industry as they supply consumers with various electrical appliances. The technical staff in the four companies referred to above were chosen as the induction population, numbering (1014) technicians[2-4].

A purposive sample of technicians working in companies in the field of research was selected, with a size of (280) technicians according to the equation (Thompson, 2012: 59), shown below: n=n*p (1-p)/ (n-1(d2/z2) +p (1-p).

2.5 Tools used in collecting research data: They can be divided into two parts:

A. The theoretical part: In order to enrich the theoretical aspect, the researchers used various scientific sources, including books, research, and scientific journals, in addition to doctoral dissertations and Arab and foreign master's theses related to the subject of the research, in addition to solid websites that constituted an important and essential aspect for obtaining the latest studies related to variables search[6].

B. The practical part: The questionnaire represents the main tool for the practical part of the research. The questionnaire consisted of variables (Value Engineering, Maintenance Quality and Product Quality). Each variable included four dimensions, with a total of (60) dimensional indicators for the research variables. A five-point Likert scale was used as In Table I.

TABLE I. FIVE-POINT LIKERT SCALE

The level of practice	very high	high	average	weak	very weak
Grade	5	4	3	2	1

The questionnaire was also designed with reference to the theoretical part of the research in a manner consistent with the field of research and the opinions of the researchers, as in Table II.

TABLE II. QUESTIONNAIRE STRUCTURE AND APPROVED SOURCES.

Research	Dimensions	No. of indicators	Resources
Value engineering	Data collection	5	Abu Raghef & Almamor,i 2013
	Function analysis	5	
	Ideas evaluation	5	
	Innovation	5	
Maintenance quality	Human resource	5	Al-lami, 2005
	Time repair	5	
	Flexibility	5	
	Cost	5	
Product quality	Quality performance	5	Al-Kafaji, 2018
	Reliability	5	
	Conformance	5	
	Aesthetic	5	
Total of indicators		60	

2.6 Some study cases for each variable in the research:

2.6.1Engineering value:

Researcher name/year	Khater et al. 2020
Study	The impact of applying value engineering on the performance of engineering industries institutions by applying it to the armored glass industry, the Shield armored glass factory as a model.
Study purpose	Reducing all aspects of waste in the factory by spreading a general culture for all human resources in the factory, and improving the general policy of managing the institution.
Study classification	Scientific research
Study variables	Value engineering, enterprise performance.
Study case	Shield Factory for manufacturing armored glass.
Study methodology	Descriptive/ inductive.
Static programs	SPSS software, SPSS, Pertt chart, SWOT, Microsoft
Results	The successful application of value engineering requires providing a will within the organization's management and among all employees because it depends on some organizing concepts and procedures necessary to complete all work and activities in the organization.

Researcher name/year	Aladami, 2022
Study	Integration between quality function deployment techniques and value engineering and its impact on improving customer value
Study purpose	Interest in the technique of disseminating the quality function and the nature of dealing with it, interest in value engineering technology and providing appropriate mechanisms to implement its principles, and attention to customer value.
Study classification	Master's thesis
Study variables	Deploy the quality function, value engineering, and customer value.
Study case	Al-Ahli International Hospital, Al-Moayyed Al-Ahli Hospital, Al-Qimma Surgical Hospital
Study methodology	Descriptive/analytical
Static programs	SPSS software, AMOS software
Results	There is a statistically significant effect of the integration between the techniques of spreading the quality function and value engineering on customer value in hospitals in the field of study.

2.6.2Maintenance quality:

Researcher name/year	Dalila, 2020
Study	Maintenance strategy and its impact on improving product quality.
Study purpose	The study aims to know maintenance strategies and their impact on improving product quality and to determine the effective role of maintenance in improving product quality.
Study classification	Master's thesis
Study variables	Maintenance quality and product quality.
Study case	Mineral Water Foundation, Saida/Algeria
Study methodology	Descriptive/analytical
Static programs	SPSS software.
Results	The importance of the maintenance function in the Algerian industrial enterprise as a stand-alone strategic function, and its role in rationalizing the exploitation and use of available productive capacities in accordance with scientific principles and methods in planning and implementation in an organized manner and at the required level.

Researcher name/year	Nawghare & Kulkarni, 2022
Study	1. Impact of maintenance management on productivity improvement and workplace management of production system in an explosive industry
Study purpose	2. Study the effect of effective maintenance management in improving productivity and determining effective workplace management in the explosives sector industry.
Study classification	Scientific research
Study variables	Maintenance management, productivity improvement, labor management.
Study case	Solar energy industries / India.
Study methodology	Descriptive/analytical
Static programs	SPSS software.
Results	By applying maintenance and its tools, the factory was able to increase production efficiency, reduce unwanted downtime, and improve product quality and thus factory profitability.

2.6.3Product quality:

Researcher name/year	Hayal and Mahdi , 2021
Study	Determine the factors affecting product quality using FMEA analysis
Study purpose	Apply the FMEA tool to identify defects that appear in the product, and determine the degree of severity for each factor that affects the quality of the product.
Study classification	Scientific research
Study variables	Product quality
Study case	Al-Zawraa General Company/Baghdad.
Study methodology	Descriptive/analytical
Static programs	Pareto chart, fishbone chart, FMEA tool, Microsoft software.
Results	Using the FMEA tool helped identify the factors that affect product quality.

Researcher name/year	Al-Qarghouli, 2021
Study	The effect of cleaner production strategies on product quality
Study purpose	Determine the level of application of cleaner production requirements, determine the level of product quality.
Study classification	Master's thesis
Study variables	Cleaner production and product quality.
Study case	General Company for Food Products/Baghdad.
Study methodology	Descriptive/analytical
Static programs	SPSS. V.23 ، Field 2013 ، Knapp 2018
Results	The company's weakness in motivating workers to increase environmentally friendly production. The company's commitment to government directives that support investment operations in cleaner production technology.

2.7 Statistical methods and programs used in this research:

A set of statistical methods were used to test the study scale and its hypotheses to obtain the desired results from the study, as follows:

1. Approved statistical programs: using (SPSS v.28 & AMOS v.25), Excel 2010, and (smart-plus 4) to facilitate data entry and for the purpose of dealing with it.
   A. Standard conformity testing includes the following methods:
      - Normal distribution test: Evaluating the quality of data based on the coefficient of flatness (Kurtosis) and the coefficient of skewness.
      - Confirmatory factor analysis: to measure the reliability of the study scale.
   B. Initial validity: the extent to which the scale measures the work for which it was designed through:
      - Sample adequacy test.
      - Reliability: Measuring reliability through the Cronbach coefficient to measure internal consistency.
2. Descriptive analysis: through:
   A. Arithmetic mean: one of the measures of central tendency.
   B. Standard deviation: one of the measures of dispersion or closeness of data.
   C. Coefficient of variation: comparison between dimensions and variables.
   D. Relative importance.
3. Testing and analyzing the correlation: using Pearson's coefficient to determine the relationship between variables.
4. Testing the effect between variables: The simple and multiple regression equation was used.

3. THEORETICAL REVIEW OF RESEARCH:

3.1 Value Engineering

1. Value engineering concept: defined as the work of a team with organization, function analysis various components of the product and try to improve the performance of those components and design a product at the lowest cost possible without reducing the level of performance required by the consumer [16].
2. Value Engineering Importance: Value Engineering Importance Emerges from through depending on good Alternatives contributes to the connection between function, quality, cost [38]. Product development to eliminate unhelpful activities and it's technical (Drury,2017). Successful because its work is based on job analysis, skill recruitment and finding. Alternatives with similar functions and the same level of performance or better at an appropriate cost without. Impact on quality or any basic requirements and work [44].
3. Value engineering Objectives: There are many objectives that the organization seeks to achieve it Because it is contributing to the improvement of the production of the high-quality product of through: striking the best balance between. Production and performance costs of products. Achieving consumer satisfaction through improving product quality. as well as increasing earnings by reducing costs (Abu Raghef. Almaori, 2013).
4. Dimensions of Value Engineering: Different dimensions of Value Engineering and by Nature and Activity of businesses[7-10], organizations, dimensions considered to be the most influential have been identified (data collection, Job analysis, ideas, and innovations) for several reasons, including: the nature of the relationship between Search variables and application field environment. They can be dealt with according to the following:
   A. Collection Data: The procedures required to improve the product specialized production research and development team needs it (Hisham & Hashemi ,2019).
   B. Function analysis: Actions designed to analyse and know everything Related to Employment for production purposes [39].
   C. Evaluation Ideas: evaluation of selected ideas or alternatives to identify them to improve value and select and implement the final list [31].
   D. Innovation: a method used by the value engineering team from to solve specific problems through recording the spontaneous ideas generated by the team, which is an application Selected solutions for production development or product improvement (Torelli,2011).

3.2 Maintenance Quality

1. Maintenance quality concept: maintenance quality is a technical system for maintenance management Reduce the breakdowns and put the equipment in good condition for operation or return the equipment to condition before the breakdowns to carry out tasks according to standard standards [11][12].
2. Importance of quality of maintenance: effective in maintaining the durability of productions through capabilities rationing the restart cost after maintenance, thus keeping the equipment in perfect condition to achieve product quality to gain consumer satisfaction. Also ensure the safety of users of equipment from risk Reduction, Prolongation and Preservation of Equipment from Obsolescence [8][14].
3. Maintenance Quality Objectives: quality Maintenance friendly has many goals, the organization employs Their efforts towards their completion, because it means meeting their requirements, and lead to improved production processes which aims to produce high quality products, as well as to improve reliability Equipment and ensuring effective administration in the Organization for workers' participation and empowerment through linking The full functions are manufacturing, maintenance, and engineering [35]. And reduce production cost and enhance yield and product quality, also ensure continuous production through reduction of equipment downtime [15][13].
4. dimensions of maintenance quality: There are different dimensions to the quality of maintenance in terms of its nature, activities, and the group Multiple dimensions, can identify the most dimensions impact: (human resource, time Repair, flexibility, and cost) has been selected by relationship between search variables and ease in suitable application with current search objectives. They can be dealt with as follows:
   A. Human resource (factor Human): the main cause of breakdowns or Repeated is low skill, poor execution, or failure to commitment instructions in operation and examination Equipment, so the more skills maintenance personnel have, the more they can maintain Equipment and ensure its safety on its use [19].
   B. Time Repairing: is one of the available options the quality of maintenance depends on it being a holistic measure that measures the effectiveness of production equipment [8].
   C. Flexibility: Applying flexibility to objects and equipment as a dimension requires considering all requirements leading to a reduction in production losses because of activities Maintenance which is considered quality of maintenance [36].
   D. Cost: Maintenance is referred to as a cost center and organizations seek to Reduction of those costs associated with maintenance and maintenance costs usually consist of costs Direct and indirect [13][26].

3.3 Product quality

1. Product quality concept: activities that the organization form an image among consumers that they support the production of high-quality products (Akeel & Qasim, 2022)[21], which is the product's ability to show its properties in precision, Reliability, durability, ease of repair and operation of the product [5]. Also, its the impression that consumers get from the products produced by the organization, either through purchasing (Sama & Qasim, 2023).
2. The importance of product quality: all organizations are on the difference of size and nature of their work. Their work is viewed and measured the success or failure of those organizations through quality. The product you provide to consumers. Therefore, the importance of product quality stems from the extent of concern. Those organizations differentiate their trends in producing a high-quality product and can be determined. Some of the researchers' opinions on the importance of product quality as follows: supports direct positive impact. (Tsiotsou, 2005). And importance of Product quality means that workers' behaviours are constantly assessed and therefore lead to. Developing these behaviours for consumers and organizations (Twitteri & Joijan, 2006). It reduces costs because of the high-quality product has been properly produced[34], there are no errors such as those occurring at work [40].
3. Product quality Objectives: Product quality objectives are to ensure the production of products that meet. Consumers' needs and expectations, and these goals also focus on ensuring that the product is. Conforming to the specific specifications of the following organization: accurate characterization of the product specifications. which meets the real needs of consumers, continuous documentation of the product during operations[22]. Development [27]. Reduce costs through producing quality units. High than first attempt, reduce the procedures for business completion required for the production's product [24][25]. Confirmation that the finished product has been manufactured in light. Designs and Final Technical Specifications Set by the Organization [4].
4. Dimensions of product quality: There are different dimensions in terms of their nature, activities, and it is possible to determine dimensions. The most considered effect of (performance, quality, reliability, conformity, aesthetic) of the following relationship between search variables. Easy to apply appropriate procedure with current search objectives. They can be dealt with as follows:

A. Quality Performance: is the extent to which consumers' appetite is on the product and their satisfaction with it (Al-Azzawi, 2004), consumer satisfaction is achieved the way he thinks about buying the product is what the product offers him for buying it [37][32].
B. Reliability: Reliability is the dimension that creates in a safe feeling within consumers about the quality of the product's characteristics by using more precise and efficient components to assemble and purchase the inputs involved in the production of the product from reliable sources [43].
C. Conformance: conformity, is the uniformity between design and conformity in The production of the final product is the organization's previous specifications, and one of the most important measures quality is the ratio of defective units to total production [23].
D. Aesthetic: Organizations' products are what distinguishes them in the markets, where Designers try to achieve aesthetically pleasing designs for the product that exceed Consumers' expectations, they also try to design a product that performs well and can be depending on using it, as well as they must design a product so that it can be manufactured Easily and Quickly [41][42].

3.4 The relationship between the research variables

To a achieve the objectives of the current research with regard to adding knowledge that helps specialists in the field of specialization itself and to enhance and strengthen the theoretical aspect. Starting with the foundations of the practical side, the quality of the relationship between the three variables must be clarified by returning to the ideas, intellectual visions, and previous studies of the researchers to determine. The relationship between value engineering and product quality, maintenance quality and product quality [30], value engineering and maintenance quality, as this research includes these relationships between the variables [33].

1. Relation between the engineering value and product quality: Value engineering is closely related to product quality. Value engineering is an approach to improving the value of a product by examining function and cost. It can improve the quality of products by eliminating unnecessary product cost sources [17]. Its importance to the organization is that it works to reduce the times required for development, allowing the organization to introduce new products more quickly and at acceptable costs, which allows it to save more money to invest in quality [18].
2. Relation between the maintenance quality and product quality: to reach a high-quality final product, there must be a basic correlation between the quality of maintenance and the quality of the product, because maintenance is the effective tool to ensure the operation of production machines and equipment by improving activities and reliability, eliminating malfunctions in machines by responding quickly to them, reducing repair time, and careful planning of their requirements. and continuity of production [20].
3. Relation between the engineering value and maintenance quality: The quality of maintenance looks for: cost, guarantee, quality and time (Niraj, 2011:2), and the relationship of value engineering with the quality of maintenance appears through:
   - Cost: the field of value engineering is a creative, organized approach that aims to balance cost and performance, and it also aims to reduce excess costs without disturbing the aesthetics of the product (Khatir et al., 2020: 455).
   - Guarantee: many mistakes occur in most organizations and at all stages of production, especially in the first stage, resulting in excessive costs, and one of these factors is (exaggerating security as a goal for obtaining a guarantee). It helps to reduce the value and is considered one of the obstacles to obtaining good value, and the best way to overcome it is to use the teamwork method done by a multidisciplinary work team composed of all relevant parties in production processes [29].
   - Quality: Value engineering is an integrated program with an action plan that includes several stages that is adopted as a solution to problems related to quality in any organization on the basis that it ensures achieving the principle of achieving more with little [28].
   - Over time: It represents completing activities as quickly as possible without compromising the quality of work. (Taghipour, et al., 2015: 319).
4. Relation between variables: from the above that value engineering and maintenance quality have a-close relationship and impact on product quality. When value engineering is used in the product design stage, specific goals are set for quality, improving performance and reducing cost. By determining the value required from the product, the specifications and standards that must be determined are determined. The product conforms to it with regard to the quality of maintenance, in addition, the quality of maintenance greatly affects the quality of the product. When regular and effective maintenance is carried out on production machinery and equipment, this contributes to maintaining the performance and reliability of the product in a long term, and this leads to increased consumer satisfaction and reduced the number of breakdowns and problems that may occur.

4. ANALYSE AND DISCUSS THE RESULTS OF THE DESCRIPTIVE STATISTIC OF SEARCH VARIABLES.

4.1 Independed variable (value engineering):

Results analyses using (SPSS, V.25) show that a variable (value engineering) achieved Arithmetic mean (3.160) and at average level, the Standard deviation variable of (0.907), with a coefficient of deviation (28.07), in Table III.

TABLE III. SUMMARY OF DIMENSIONS OF THE VALUE-ENGINEERING VARIABLE

Dimension of V.E .E	Arithmetic .D mean	Standard .C deviation	Coefficient .B of deviation	Ranking .A of variables
Collection data	3.133	0.942	30.07	4
Function analysis	3.122	0.909	24.49	3
Evaluation ideas	3.163	0.864	22.44	1
Innovation	3.222	0.911	23.98	2
Value Engineering (VE)	3.160	0.907	28.07	

(Source: output of program (SPSS, V.25)

4.2 Independent variable (maintenance quality):

Results analysed using (SPSS, V.25) show the variable (quality Maintenance) achieved Arithmetic mean (3.173) and at average level, the Standard deviation variable of (0.911), with a coefficient of deviation (28.73) as in Table IV.

TABLE IV. SUMMARY OF DIMENSIONS OF THE MAINTENANCE QUALITY VARIABLE

Dimensions of MQ	Arithmetic mean	Standard deviation	coefficient of deviation	Ranking of variables
Human resource	3.250	0.909	27.97	2
Time Repairing	3.181	0.876	27.57	1
Flexibility	3.094	0.945	30.52	4
Cost	3.167	0.913	28.84	3
Maintenance Quality(MQ)	3.173	0.911	28.73	

(Source: output of program (SPSS, V.25)

4.3 Depended variable (product quality):

Results analysed using (SPSS, V.25) show the variable (the products quality) achieved Arithmetic mean (3.268) and at average level, the Standard deviation variable of (0.917) , with a coefficient of deviation (28.08) as in Table V.

TABLE V. SUMMARY OF DIMENSIONS OF THE PRODUCT QUALITY VARIABLE

Dimensions of PQ	Arithmetic mean	Standard deviation	coefficient of deviation	Ranking of variables
Quality Performance	3.232	0.962	29.77	4
Reliability	3.172	0.896	28.28	2
Conformance	3.303	0.856	25.91	1
Aesthetic	3.363	0.953	28.35	3
Product Quality(PQ)	3.268	0.917	28.08	

Source: output of program(SPSS,V.25).

4.4 Relative importance of research variables in the companies of study.

Table VI shows the summary of relative importance of search variables.

Table VI. Summary of relative importance of search variables

Research Variables	Arithmetic mean	Standard deviation	coefficient of deviation	Ranking of variables
Value Engineering(VE)	3.160	0.907	28.70	3
Maintenance Quality(MQ)	3.173	0.911	28.73	1
Product Quality(PQ)	3.268	0.917	28.08	2

(Source: output of program(SPSS,V.25)

Is clear from the results of Table (VI) that the level of availability of the research variables was as follows:

The product quality variable achieved the highest percentage level in terms of the arithmetic mean, as it came in second ranking, reaching (3.268), with a standard deviation of (0.917), and the highest coefficient of variation was (28.08). The maintenance quality variable came in first ranking, with a standard deviation of (0.911) and a coefficient of variation of (28.73). In last ranking was the value engineering variable with a standard deviation of (0.907) and a coefficient of variation of (28.70).

TABLE VII. INDICATORS AND STATISTICAL TESTS TO TEST HYPOTHESES

No.	Test	Description	Standard
1	F	Testing the significance of the model in general	The arithmetic value is compared with the tabular value to accept or reject the hypothesis
2	t	Parameter significance test (fixed slope) or (marginal slope)	The arithmetic value is compared with the tabular value to accept or reject the hypothesis
3	β	The influencing power of the independent variable or dimension on the dependent variable	The influential power of the dimension or variable depends on the t-test.
4	R^2	The ability of the independent variable to explain the dependent variable	From (0-1), the closer to 1, the better the explanatory power
5	adj R^2	The ability of the independent variable to accurately explain the dependent variable	From (0-1), the closer to 1, the better the explanatory power

5. TEST RESEARCH HYPOTHESES

5.1 Testing and Analyzing the effect between the research variables:

The test and analysis of the impact of the research variables is divided into two parts:

- Simple linear regression: The statistical model consists of one independent variable and one dependent variable.
- Multiple linear regression: between several independent variables with one dependent variable.

The indicators and statistical tests will be used as in Table (VII) based on the calculated (F) value, the coefficient of determination (R2), the adjusted coefficient of determination adj (R2), the marginal slope coefficient (β), and the (t) test.

1. The First Hypothesis (H_1): There exists a moral significance Impact of Value engineering in product quality, and can be written by equation: Y= 0.432+0.900X1

TABLE VIII. ANALYZING THE IMPACT OF VALUE ENGINEERING IN PRODUCT QUALITY

Sig.	(t)	(F)	Adj (R^2)	R^2	R	(β)	(α)	Dependent variable	Independent variable
0.000	29.663	879.900	0.759	0.760	0.871	0.900	0.423	Engineering value	Product quality
N=280 sample size, 1.984= tabular (t) , 3.984= tabular (F)									

Source: output of program (SPSS, V.25)

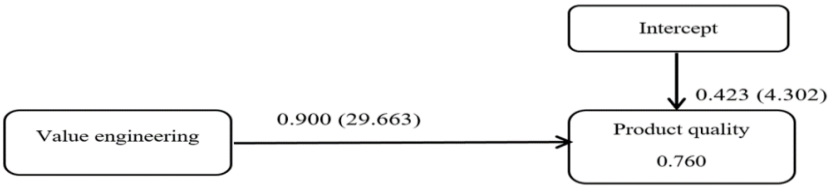

Fig. 2. Analysis of the impact of value engineering on product quality

Source: output of program (smart plus 4)

A. Table (VIII A) and figure (2) show the results of the analysis of the impact of value engineering on product quality, as the value (F) Computed achieved a value (879.900) which is greatest that it standard value (3.984) at signific level (0.05) and the result indicates a geometric effect Value in product quality, and considering this acceptance of hypothesis: there is a moral significance impact for value engineering in product quality.

TABLE VIII (A). ANALYZING THE IMPACT OF VALUE ENGINEERING AND ITS DIMENSIONS ON PRODUCT QUALITY

Depended Variable	Dimensions of VE			(R^2)	Adj.)R^2(	(F)	(t)	Sig
Product quality	Collection Data	(α)	0.953	0.669	0.668	561.778	23.702	0.000
		(β)	0.739					
	Function Analysis	(α)	1.156	0.506	0.504	284.299	16.861	0.000
		(β)	0.676					
	Evaluation Ideas	(α)	0.609	0.673	0.672	572.389	23.925	0.000
		(β)	0.840					
	Innovation	(α)	0.635	0.754	0.753	852.017	29.189	0.000
		(β)	0.817					
	Value Engineering(VE)	(α)	0.423	0.760	0.759	879.900	29.663	0.000
		(β)	0.900					
Value (F) Tabular =3.984 Value (T) Tabular = 1.984								

Source: output of program (SPSS, V.25)

B. Table (VIII A) show the results of the analysis of the impact of value engineering dimensions on product quality, The value of (F) was (561.778, 284.299, 572.389, 852.017) respectively, as it indicates the presence of a significant effect (of dimensions on product quality).

There is a statistically significant effect of the dimensions of value engineering together on product quality. This hypothesis will be expressed by a multiple regression equation with the following formulation:

$0.411 = Y \quad +0.313X_1 -0.155X_2 +0.269X_3+0.469X_4$

TABLE VIII (B). EFFECT OF VALUE ENGINEERING TOGETHER ON PRODUCT QUALITY

Sig.	(F)	(R^2) Adj	(R^2)	(R)	Sig.	(t)	(β)	(α)	Value engineering dimensions
0.000	303.088	٠.812	٠.815	٠.903	٠.000	6.827	٠.313	٠.411	Data collection
					٠.002	-3.179	-٠.155		Function analysis
					٠.000	4.633	٠.269		Ideas evaluation
					٠.000	9.730	٠.469		Inovation
2.422					Standard F				
1.984					Standard t				
Number of effected accepted dimensions=4									
Number of effected unaccepted dimensions=0									

Source: output of program(SPSS,V.25)

C. Table (VIII B) show the results of the impact analysis of the dimensions combined on product quality, as the extracted (F) value showed an amount of (303.088), which is greater than its tabulated value of (2.422) and indicates that there is a significant effect of the dimensions of value engineering together on product quality.

5.2 The Second Hypothesis(H2): which states:

There is a moral significance impact of quality Maintenance in product quality, and can be written by equation:

$Y= 0.211+0.964X1$

TABLE IX. ANALYZING THE IMPACT OF MAINTENANCE QUALITY IN PRODUCT QUALITY

Sig.	(t)	(F)	Adj (R^2)	R^2	R	(β)	(α)	Dependent variable	Independent variable
0.000	38.112	1452.547	0.839	0.839	0.915	0.964	0.211	Engineering value	Product quality
N=280 sample size, 1.984= tabular (t) , 3.984= tabular (F)									

Source: output of program(SPSS,V.25)

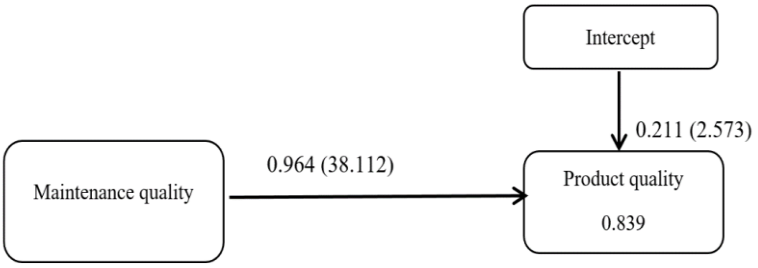

Fig 3. Analysing the impact of maintenance quality on product quality

Source: output of program (smart plus 4)

A. The results of the impact analysis the quality of maintenance in Product quality, are shown in table (IX) and figure (3), as the value (F) Computed achieved a value (1452.547) which is greatest than its standard value (3.984) at signific level (0.05), indicates the impact the quality of maintenance in the quality of the product, and in light of this result we accept the hypothesis that is: there is a moral significance impact of quality and dimensions of maintenance in product quality.

TABLE IX (A). ANALYZING THE IMPACT OF MAINTENANCE QUALITY AND ITS DIMENSIONS ON PRODUCT QUALITY

Depended Variable	Dimensions of MQ			(R^2)	Adj. (R^2)	(F)	(t)	Sig
Product quality	Human resource	(α)	0.726	0.670	0.669	565.083	23.771	0.000
		(β)	0.785					
	Time Repairing	(α)	0.426	0.793	0.793	1066.968	32.664	0.000
		(β)	0.893					
	Flexibility	(α)	0.892	0.728	0.727	744.839	27.292	0.000
		(β)	0.767					
	Cost	(α)	0.929	0.584	0.583	390.875	19.771	0.000
		(β)	0.738					
	Maintenance Quality(MQ)	(α)	0.211	0.839	0.8839	1452.547	38.112	0.000
		(β)	0.964					
					Value (F) Tabular =3.984		Value (T) Tabular = 1.984	

Source: output of program (SPSS, V.25)

B. Table (9A) shows the results of the impact test for the dimension of maintenance quality on product quality, as the extracted (F) value reached (565.083, 1066.968, 744.839, 390.875), respectively, as it indicates (the presence of a significant effect (for the dimension of maintenance quality on product quality).

There is a statistically significant effect of the dimensions of maintenance quality together on product quality. This hypothesis will be expressed by a multiple regression equation with the following formulation:

$0.251 = Y \quad +0.184X_1 +0.388X_2 +0.284X_3+0.097X_4$

TABLE IX(B). EFFECT OF MAINTENANCE QUALITY TOGETHER ON PRODUCT QUALITY

Sig.	(F)	(R^2) Adj	(R^2)	المتعدد (R)	Sig.	(t)	(β)	(α)	Maintenance quality dimensions
0.000	383.664	٠.846	٠.848	٠.921	٠.000	4.257	٠.184	٠.251	Human resources
					٠.000	6.525	٠.388		Reparing time
					٠.000	7.146	٠.284		Flexibilty
					٠.012	2.541	٠.097		Cost
2.422									Standard F
1.984									Standard t
Number of effected accepted dimensions=4									
Number of effected unaccepted dimensions=0									

C. Table (9Bindicate the results of an analysis of the dimensions of maintenance quality together in product quality, as the extracted (F) value showed an amount of (383.664), which is greater than its tabulated value of (2.422) and indicates that there is a significant effect of the dimensions of maintenance quality together in product quality.

5.3 The Third Hypothesis(H3):

There is a moral significance impact of the integration Engineering value and quality maintenance in product quality.

The results of table (X) and figure (4) show that critical value (CR) for integration between (Value engineering and maintenance quality) in product quality has reached (21.292) which is greater than the tabular value of (1.96). In the light of this result, we accept the hypothesis: there is an impact with moral significance to integrated value engineering and quality maintenance in product quality.

TABLE X. THE IMPACT OF INTEGRATING VALUE ENGINEERING AND MAINTENANCE QUALITY ON PRODUCT QUALITY

Depended Variable	Path	Variable	S.E.	C.R.	P	Decision
Product quality	<---	Integration	0.966	21.292	0.000	Effect

Source: output of program (Amos v.25)

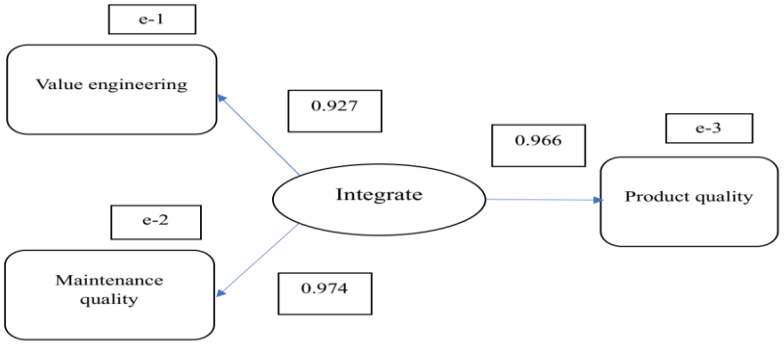

Fig 4. The effect of integrating value engineering and maintenance quality on product quality.

Source: output of program (Amos v.25)

It is clear from figure (4) and the results that the integration between value engineering and maintenance quality has a strong and effective impact on the product quality process. That is when the company is interested in improving production processes and products, through the method of teamwork and interest in collecting data and the job analysis process to know the requirements and characteristics of each job and Evaluating ideas to obtain useful and constructive ideas, and moving towards innovation to fulfil the needs and desires of consumers by obtaining a product characterized by high quality and appropriate costs, and integrating this matter with the implementation of the administrative and technical processes necessary to maintain the performance of machines and equipment to maintain them in a good manner and restore them to the state in which the functions can be carried out. entrusted to it, and developing the human cadre who carries out maintenance work within the repair and replacement timings necessary to maintain the efficient performance of machines and equipment as permitted by the conditions of production operations and reduce their costs. The result of the integration will have a fundamental and effective impact on the product's meeting the needs of consumers and meeting the specifications required and set by the company to reach the ideal product with its reliability for long periods of time. The results showed that the effect of integration between value engineering and maintenance quality on product quality reached (94%). The results also indicated that the effect of value engineering on integration reached (92%), and the effect of maintenance quality on integration reached (97%).

5.4 Test the search model

Based on the data of the final tests of the research variables in the electrical and electronic industries companies in the field of research, it is possible to formulate the form of the research, which is considered a tested model that expresses the method of relationships and interaction between the research variables, in terms of connection, influence and benefit from the strengths achieved from those variables in the companies in the field of research. As in Figure 5.

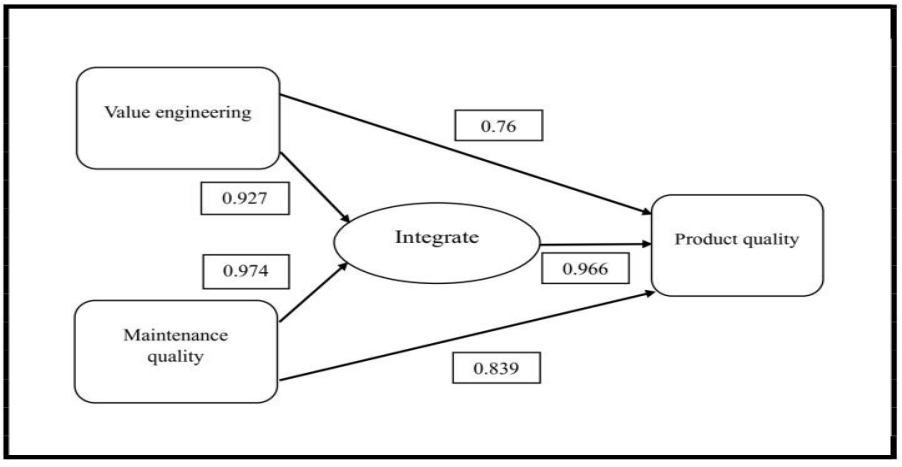

Fig. 5. The final research model that was tested.

6. CONCLUSIONS

1. The relative importance was arranged through the coefficient of variation of the research variables in the electrical and electronic industries companies / Baghdad, the field of study is (maintenance quality, product quality and value engineering), respectively, as it appears that the largest gap in relation to the level of availability of the study variables was obtained by the engineering variable. The value and the smallest gap were for the maintenance quality variable, which means that the managements of electrical and electronic industries companies, the field of study, seek to achieve quality maintenance and improve production processes because of their role in enhancing product quality.
2. The arrangement of the dimensions of value engineering according to the coefficient of variation (evaluation of ideas, innovation, job analysis, data collection) respectively, which means that the managements of companies in the field of study seek to enhance the process of evaluating ideas by relying on the application of selected ideas to develop production processes, and this contributes In improving the quality of the company's products.
3. Arranging the dimensions of maintenance quality according to the coefficient of variation (repair time, human resource, cost, and flexibility), respectively. This means that the managements of the companies in the field of study are concerned with the repair time according to the appropriate timings for carrying out repairs of machines and equipment in order for production operations to continue without interruption, and thus Reduce defective finished products and achieve consumer satisfaction.
4. The dimensions of product quality are arranged according to the coefficient of variation (conformity, reliability, aesthetics, quality of performance), respectively, which means that the managements of companies in the field of study seek to achieve competition over others through their interest in matching product quality with the standards specified by the company, and this contributes It improves performance and maintains the company's reputation
5. Value engineering has affected improving product quality in companies in the field of application, and this proves the validity of the sub-hypotheses that state (there is a statistically significant effect for each dimension of value engineering on product quality in companies in the field of research).
6. The quality of maintenance affected the improvement of product quality in companies in the field of study. This proves the validity of the sub-hypotheses of the effect of maintenance quality dimensions individually on product quality in companies in the field of research.
7. The quality of maintenance increased product quality in the companies subject to the study. This proves the validity of the hypothesis that states (there is a statistically significant effect of the combined dimensions of maintenance quality on product quality.
8. The test results proved the validity of the hypothesis that states (there is a statistically and morally significant effect of the integration of value engineering and maintenance quality on product quality). This contributes to improving the quality of the study companies' products, which contributes to addressing the study's problem of the low level of quality of their products.

7. RECOMMENDATIONS

1. Need to care of value engineering and sensitize professionals specializing in design Products in the companies in question are important through training courses and scientific seminars to increase the expertise of technicians working in the research field.
2. The companies' administrations should care about the Quality Maintenance and Professionals Awareness Employees in the maintenance and quality departments of the companies in question are important through training courses, scientific seminars, periodicals, and advertisement paintings for maintenance operations workers.
3. care of the Product quality being marked at the companies in the field of application at work through produce high quality products that fulfil consumers' wishes.
4. Maintenance care as self-operation through timing programmed with discouraging the availability of important needs and supplies for the durability of machinery and equipment for production operations.
5. The importance of integrating value engineering technology should be brought to the attention of corporate departments quality of maintenance because of their significant role in improving the quality of industry companies' products.

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Conflicts of Interest:

The authors declare that they have no conflicts of interest in relation to this work.

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