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The Importance of Production and Operations Management in the Application of Value Engineering Technology and its Role in Improving Product Quality (An Applied Study in a Light Industry Company)

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The research aims to study the knowledge bases of production and operations management and value engineering technology with an indication of the importance of production and operations management in applying value engineering technology and its role in improving product quality. Furthermore, the study aims to clarify how to apply value engineering technology in a manner that leads to improving product quality and at the same time reducing its cost. Two basic assumptions are: (1) The production and operations management can help provide the necessary requirements for applying value engineering technology in companies; (2) The value engineering technology can help improve product quality so that the product is suitable for customer use and conforms to specifications. The standards and criteria established, and the research was applied to a sample of division managers, people, engineers, technicians, accountants and auditors in the Light Industries Company for the financial year ending on 31/12/2019. The statistical methods in combination with the research reached a set of conclusions, the most important of which was that the production and operations management can help provide the necessary requirements for the application of value engineering technology, as this technique can help to improve the quality of the product so that the product is appropriate for customer use.

Key words: *Production and Operations Management, Value Engineering Technology, Product Quality*

Introduction

In light of the rapid and successive developments accompanying the business environment in general and the manufacturing environment in particular, many technologies and methods that are more appropriate to the requirements of this environment have emerged. One of the most important of these technologies is value engineering technology which is an integrated program with a precise and sequential work plan to solve all problems related to cost, quality and performance. It is managed by an organised group of individuals with different specialisations called a value engineering team who analyse information related to the product or service as well as make a careful and appropriate selection of optimal jobs with low cost and high performance in the same way. We get rid of jobs that do not add anything to the product. Finally, solutions are evaluated and the performance of the value engineering team is worked out and a work plan is created to help create solutions that lead to lower costs and higher quality and performance at the same time. With making resources stable, by reducing resources and making the job stable, or by increasing the job and reducing resources at the same time, it can be used primarily to improve efficiency and search for the best balance between cost and functions, quality, reliability and performance of the product or service, as well as complete operations as quickly as possible without raising costs or reducing the quality of work.

Research Methodology

Research Problem

International companies in the business environment that are characterised by their continuous development and intense competition tend to use modern technologies as much as possible to reach the optimum cost, high quality and obtain customer satisfaction. Value engineering technology is one of the most important modern programs that works to reduce cost and improve quality. In order to demonstrate this role, the follow question has been presented as the problem of the study: Is there a clear importance for production and operations management in applying value engineering technology? And what is the role of that in improving product quality?

Research Objectives

The research aims to study the knowledge bases of production and operations management and value engineering technology with an indication of the importance of production and operations management in the application of value engineering technology along with its role

in improving product quality. In addition, the research aims to clarify how to apply value engineering technology in a manner that leads to improving product quality and at the same time reducing its cost. The research aims to clarify the importance of identifying the dimensions of the product quality that the customer prefers and adds them to the priorities of companies to improve quality because they facilitate the process of applying for the value engineering program.

The Importance of Research

The importance of the research lies in the importance of its variables, represented by production and operations management, value engineering technology and improving product quality, as well as finding good solutions and methods in order to reduce the costs of the product and increase its quality. Thus the company can compete with other companies and maintain its market position and attract customers.

Research Hypotheses

The research is based on two basic assumptions which are as follows: (1) The production and operations management can help provide the necessary requirements for the application of value engineering technology in companies; (2) The value engineering technology can help improve the quality of the product so that the product is appropriate for the customer's use in conformity with the established specifications and standards.

Research Sample

The research sample consists of a group of division managers, people, engineers, technicians, accountants and auditors in the Light Industries Company. A questionnaire was designed that includes a set of paragraphs aimed at explaining the importance of production and operations management in applying value engineering technology and its role in improving product quality.

Theoretical Framework for the Research

The Concept and Importance of Production and Operations Management

The production and operations management takes over the responsibility associated with the manufacture of goods and services as the production and operations system is part of the organisation's production or service system. It is the main component for achieving the organisation's goals, such as production and operations managers, quality control, manufacturing managers and others. The term production managers has evolved from working

people or supervising manufacturing activities to process managers. The operations manager is the person who is responsible for making goods and services and who is concerned with making decisions related to the operations function or the transformative system used in the manufacture of the commodity (Lairize, 2014: 48).

Production operations management is seen as that activity that undertakes the process of unifying and then transferring the available resources to a specific system according to specific foundations of the best addition or creation of value appropriate to the policies exercised by the management of that system. Thus, operations management is the policy related to administrative decision-making in the field of operations function. The operations function is the department that specialises in manufacturing the goods and providing services. The production and operations management includes three directions, which are as follows: (Jean, et.al., 2015: 6-7).

1. Strategic decisions: These are decisions related to production, production processes, facilities, and others.
2. Operational decisions: These are decisions regarding production planning to meet the expected demand in the markets.
3. Control decisions: These are decisions related to monitoring the production planning pathways and determining the deviations that occur between the plan and what is actually achieved to take corrective measures.

The Concept and Importance of value Engineering Technology

Value engineering is seen as a technology aimed at reducing costs and improving processes, which is mainly used in the research and development stage and the design stage. As all available information is used on all components and functions of the product along the value chain in order to reduce its costs, it requires a distinction between the components and functions that add value and that do not add value in addition to determining the associated costs, and work to exclude components and functions that do not add value (Horngren, et.al., 2012 : 442). Tthis means that the value engineering technique is called on processes in the research and development stage and the design stage, and there are those who look at the value engineering technology as modern technology that found a basis for evaluating the product design process based on the functional analysis of its components and functions. Thus, making sure that the basic functions of the product is equipped with the quality and the lowest level of costs in order to meet the needs of customers (Atabay & Galipogullari, 2013: 39). Through this concept it is also noticed that the value engineering technology is used during the research and development stage and the design stage through the evaluation of the product design process, and technology can be described Value engineering as a structured process for studying the value of a product and estimating its costs in the early stages of its life cycle, especially in the early stages of the

design process. This technology works to eliminate costs associated with components and functions that do not add value to the product during the early stages of its design. Many studies indicate that more than 70% of the total costs of the product are determined during the design phase (Basu, et.al., 2013: 18). Thus there is a clear picture of the costs associated with each of the components and functions of the product to indicate whether it adds value or not.

Thus, value engineering is a technology that aims to improve both processes and products, and reduce costs during the early stages of the design process. It is determined what is a candidate for improvement efforts from processes and products in addition to services, with the aim of producing high-value products that can meet the needs and desires of customers. The important points can be summarised as follows: (Al-Zameli, 2017: 43)

1. The value engineering technique calls for operations in the early stages of the value chain, which is the research and development stage and the design stage in order to improve operations and reduce costs.
2. This technology seeks to find the relationship between design and cost, so that the product is designed at the lowest possible cost and with the highest quality, to produce products that can meet the needs and desires of customers.
3. This technology is applied to new products effectively and can be applied to existing products as well because it is concerned with the research and development stage and the design stage.

As for the importance of value engineering technology, this technology is a sophisticated methodology for problem-solving that has proven its effectiveness and efficiency in many fields, especially industrial ones. Thus it seeks to achieve a number of goals, which are as follows: (Mahdi-a, et.al., 2015: 2746) (Mahdi-b, et.al., 2015: 200)

Through the previous presentation, it is noted that the value analysis technique came to be of importance through its suitability of the requirements of the competitive environment in which the economic units live. It helps these units to reduce the costs associated with the components and functions of the product that do not add value and thus help them in achieving a competitive advantage.

The Importance of Production and Operations Management in Applying Value Engineering Technology

The production and operations management helps in the application of value engineering technology by providing the basic requirements for the application of this technology, as the production and operations management can help to form a multi-functional and multidisciplinary team in addition to setting an appropriate work plan for the application.

Therefore the application of value analysis technology requires formation of a multi-functional work team, the size of which varies according to the size and importance of the task assigned to it. The team is mostly composed of individuals with various specialties such as administrators, accountants, engineers, technicians and others. The multi-functional value engineering work team prepares an appropriate work plan that includes enjoying flexibility after learning about the most important problems facing the economic unit and its products in relation to value, especially problems related to job performance or product quality, as well as problems related to its high costs related to components and functions that do not add value (Abdullah, et.al., 2015: 10052).

The application of value engineering technology requires five consecutive stages: (i) the stage of data collection, (ii) the stage of functional analysis, (iii) the stage of creativity and brainstorming, (iv) the stage of testing and evaluation, and finally (v) the stage of preparing the final report and development.

These stages can be clarified through the following:

First: The information-gathering stage: The information gathering stage is the first stage for the application of value engineering technology. The multifunctional and specialised team collects the necessary and appropriate information to implement the work plan of this technology in a timely manner. This process is one of the basic elements that must be provided for the purpose of analyzing product performance and quality issues (Dell'Isola, 2003: 7).

Second: The functional analysis stage: The functional analysis stage is the most important stage of value engineering technology. It represents the beating heart of value study's methodology techniques in general and value analysis technology in particular because of its distinction in solving problems from other methods. Functional analysis is seen as the activity according to which the product components and functions are analysed, in addition to analyzing the cost of each of them (Mahdi-b, et.al., 2015: 203). Thus, this stage focuses on the functions that the customer needs so that it can meet its needs and requirements, and the job analysis process is completed using the technology of job analysis systems (FAST diagram) to define the functions that can make the product match the customer's needs and requirements. This means that the primary goal of carrying out a functional analysis process is to clearly define the product functions required by the customer and to improve the value of each of them (Patil, 2010: 4).

The Role of Value Engineering Technology in Improving Product Quality

In light of the many changes that accompanied the modern manufacturing environment in terms of scientific and technological development, the information revolution, communications, globalisation, the emergence of economic blocs and global organisations, changing customer

tastes, needs and behaviours, and increased competition between economic units and others, the activities of these units have become directed towards the customer to meet his needs and expectations. and concern with quality as A strong competitive weapon that achieves a set of advantages, the most important of which is reducing costs, increasing and improving both productivity and profitability, enhancing the competitive position, obtaining customer satisfaction and loyalty, and increasing market share and others.

There are several dimensions of product quality through which the customer's needs and expectations can be met and in a manner that satisfies him. These dimensions are as follows: (Khanna, et.al, 2008: 4)

1. Performance: It represents a set of basic operational characteristics of the product that will meet customers' needs and expectations or that is how the job and its features are performed.
2. Features: These are the additional features of a product that help in performing its basic functions.
3. Reliability: It means that the product may work well during a certain period of time, given the stable conditions.
4. Conformity: It is the degree of conformity of the product to the specific standards or specifications that customers desire so that it can meet their needs and expectations.
5. Durability: It means the amount of benefit a customer receives from a product during its useful life.
6. Serviceability: It indicates the ability to quickly and efficiently repair a product when a problem occurs in its use, as well as the availability of spare tools at a low cost.

The Applied Side of the Research

Society, Research Sample and Statistical Methods Used for Data Analysis

The research community and sample consists of a group of division directors, people, engineers, technicians, accountants and auditors in the Light Industries Company. For the purpose of achieving the research goals, a questionnaire was designed specifically for this research. A five-degree Likert scale was used to answer the questionnaire paragraphs based on the following values: strongly agree (5) points, agree (4) points, neutral (3) points, disagree (2) points, disagree strongly (1) points. The apparent honesty of the tool was verified after developing its preliminary figure and displaying a number among the faculty members of the Iraqi universities to ensure that they cover the basic aspects of the research and the clarity of its paragraphs. To ensure the consistency of the research tool, the Cronbach Alpha test was used. Table 1 shows the results of this test.

Table 1: Alpha Cronbach test of search variables according to the method of internal consistency

Cronbach Alpha factories	The number of variables	Hypothesis test	Hypotheses
0.83	**6**	Production and operations management can help provide the necessary requirements to implement value engineering technology in companies**.**	**First**
0.85	**6**	The technology of value engineering can help to improve the quality of the product so that it is suitable for use and conforms to the specifications set.	
0.84	**12**	**Total**	

Source: prepared by the researcher.

It is noted through the above table that the value of the Alpha Cronbach coefficient for the study variables ranged between 0.83 - 0.85. This means that there is a large degree of credibility in the answers, and the sample can be distributed according to demographic characteristics, as shown in Table 2.

Table 2: Analyse the demographic characteristics of the individuals in the research sample

Percentage	Number	Category	Variable	Sr#
%20 **%28** **%52**	**10** **14** **26**	40 years and under 41-50 years old 50 years and over	Age of the respondent	**1**
%80 **%20**	**40** **10**	Male Females	The gender of the respondent	**2**
%88 **%12**	**44** **6**	BA M.A.	Academic qualification of the respondent	**3**
%18 **%22** **%60**	**9** **11** **30**	5-10 years 11-15 years Over 15 years old	Years of experience for the respondent	**4**

Source: Prepared by the researcher.

From Table 2 it is evident that:

1. 20% of the respondents were younger than 40 years old, 28% of them were aged 41-50 years, and the rest were over 50 years old.

2. The percentage of males for the individuals in the research sample reached 80%, either the percentage of females has reached 20%, which means that males bear additional burdens that females have not.
3. The percentage of students holding a bachelor's degree from the research sample was 88% and those holding a masters degree was 12%, which means that they are qualified to understand the subject.
4. In relation to years of experience for individuals of the research sample, the largest percentage was over 15 years at 60%, which indicates accumulated experience in the work of the individuals of the research sample.

The Statistical Packages for Social Science - SPSS16 has also been applied. The following statistical methods have been used:

1. The mean is attributed to the maximum value of the five-degree Likert scale. The study is acceptable if it has a ratio higher than 60%, that is, if the mean is more than three degrees of the scale area. The mean is one of the measures of central tendency and is used to represent a set of data with a value of one is extracted by calculating the sum of the values divided by their number, as well as using percentages and standard deviation which is one of the scattering scales and aims to express the amount of dispersion of values from their arithmetic mean.
2. One-sample T-test, which aims to test the research hypotheses by inferring the arithmetic mean of the statistical community and showing its statistical significance, and that the relationships between the study variables are real and not coincidental, as the calculated T is compared with the tabular T if its calculated value is greater than its tabular value. The study is accepted, and it can be generalised to the statistical community, given that this sample is representative of it.

The Results of the Field Study and Testing the Hypotheses

During this paragraph, the results of the responses of the members of the research sample will be presented, then the hypotheses will be tested to demonstrate the importance of production and operations management in applying value engineering technology and its role in improving product quality. As follows:

First: The results of testing the first hypothesis, which states: The production and operations management can help in providing the necessary requirements for the application of value engineering technology in companies. To answer this hypothesis the researcher extracted the arithmetic averages and standard deviations for each of the paragraphs or special variables. The first research hypothesis is shown in Table 3:

Table 3: Arithmetic averages and standard deviations of respondents' answers to the subjects of the first hypothesis

Standard Deviation	Arithmetic mean	Paragraphs	#Sr
0.674	**4.566**	The production and operations department can help in forming a multi-functional and multidisciplinary work team whose size varies according to the size and importance of the task assigned to it. The team is composed of administrators, accountants, engineers, technicians and others.	**1**
0.567	**4.121**	The Production and Operations Department assists in preparing a suitable and flexible business plan after identifying the most important problems facing the economic unit and its products in relation to value, especially problems related to performance and quality**.**	**2**
0.458	**3.241**	The Production and Operations Department helps in gathering the information necessary to implement the business plan in a timely manner, as this process is one of the basic elements that must be provided for the purpose of analyzing and solving problems**.**	**3**
0.459	**3.244**	Enables the production and operations department to perform the functional analysis according to which the product components and functions are analysed in addition to analysing the cost of each and focusing on the functions that the customer needs or prefers**.**	**4**
0.454	**3.162**	The production and operations department contributes to enhancing the creativity component to reach the best solutions to make the product conform to the requirements of the customer in terms of performance, quality and cost, as well as improving the value of the product and choosing the best.	**5**
0.466	**3.362**	The Production and Operations Department assists in testing and evaluating the alternatives and ideas put forward to ensure that they are applicable in practice and that it helps in maximising the value of the product by improving its job benefits and reducing its costs.	**6**
0.513	**3.616**	**Overall average**	

Source: Prepared by the researcher.

Table 4: The results of the One Sample T-test for the answers of the individuals of the sample searching for the first hypothesis paragraphs

The confidence interval is 95% for the difference Arithmetic average		The difference in SMA	Level indication	Degree freedom	T value calculated	Deviation of the normative	The average arithmetic
Upper	Lower						
1.702	1.454	1.566	0.000	49	4.295	0.513	3.616

Source: Prepared by the researcher.

1. Forming a multi-functional and multidisciplinary work team whose size varies according to the size and importance of the task assigned to it. The team consists of administrators, accountants, engineers, technicians and others.
2. Prepare a flexible and appropriate business plan after identifying the most important problems facing the economic unit and its products in relation to value, especially problems related to performance and quality.
3. Collecting the information necessary to implement the work plan in a timely manner, as this process is one of the basic elements that must be provided for the purpose of analysing and solving problems.
4. Carrying out the functional analysis according to which the product components and functions are analysed, in addition to analysing the cost of each of them and focusing on the functions that the customer needs or prefers.

Second: The results of the test of the second hypothesis which states: The value engineering technique can help in improving the quality of the product so that the product is suitable for the customer's use and conforms to the specifications and criteria set. The results are shown in the Table 5:

Table 5: Arithmetic averages and standard deviations of the answers of the respondents for the second hypothesis

Dtandard deviation	Arithmetic mean	Paragraphs	#Sr
0.576	**4.121**	Value Engineering technology helps to improve product performance in terms of providing a set of operational characteristics that will meet the needs of customers, in addition to providing additional features for the product that help in performing its basic functions**.**	**7**
0.677	**4.568**	The value engineering technique can help in providing sufficient reliability in the product, increasing the possibility of the product working well during a specific period, as well as reducing the number of holidays during the warranty period to the lowest possible**.**	**8**
0.458	**3.157**	The value engineering technology provides the feature of conformity by matching the product to the specific or established standards or specifications that customers desire so that it can meet their needs, requirements and expectations.	**9**
0.541	**3.322**	The value engineering technology helps to provide the required durability in the product and increase the amount of benefit that the customer gets from the product during his production life, in addition to the ability to repair the product with the speed and efficiency required**.**	**10**
0.406	**3.089**	The value engineering technology provides an aesthetic feature in the product, as it contains a set of characteristics or features that the customer prefers based on his own preferences and desires such as shape, sound, colour, and others.	**11**
0.458	**3.244**	The value engineering technology helps achieve perceived quality by improving the customer's image or impression of the product generated from its reputation, as well as improving the degree of harmony between the expectations of customers and their awareness of these expectations.	**12**
0.519	**3.584**	Overall average	

Source: Prepared by the researcher.

It is clear from the previous table that the paragraph “The value engineering technique can help provide a sufficient degree of reliability in the product, and increase the possibility of the

product working well during a specific period, in addition to the decrease in the number of holidays during the warranty period to the lowest possible amount" has the highest arithmetic mean of 4.568 with a standard deviation 0.677. The paragraph "Value engineering technology provides an aesthetic feature in the product, as it has a set of characteristics or features that the customer prefers based on his own preferences and desires such as shape, sound, colour, etc." has the least arithmetic mean at 3.089 with a standard deviation of 0.406. With respect to the Mitus, the year for the second hypothesis variables has reached the mean 3.584 with a standard deviation of 0.519. It is noted from the previous table that all the paragraphs have achieved higher than 3 degrees from the Likert scale of five degrees, meaning that the percentage of these variables has exceeded 60%. This indicates that the second hypothesis is accepted, meaning that value engineering technology can help improve product quality. To test this hypothesis, one sample T-test was used to make sure that the relationship between these variables is a real relationship and does not belong to pure chance. Table 6 shows the results of the One-Sample T-test for the answers of respondents to the second hypothesis.

Table 6: The results of (One Sample T-test) for the answers of the individuals in the sample for the second hypothesis

The confidence interval is 95% for the difference Arithmetic average		The difference in SMA	Level indication	Degree freedom	T value calculated	Deviation of the normative	The average arithmetic
Upper	Lower						
1.283	**1.148**	**1.286**	**0.000**	**49**	**4.295**	**0.519**	**3.584**

Source: Prepared by the Researcher

It is clear from the data of the above table that there is a statistical significance of the value engineering technique in improving the quality of the product, based on the calculated T value of 4.295 which is a statistically significant value at the level of significance (α <0.001). This indicates acceptance of the second hypothesis that the technology of value engineering can help in improving the quality of the product so that the product is suitable for the use of the customer and conforms to the specifications and standards set., Thus it can be said that the value engineering technique can help in the following:

1. Improving product performance in terms of providing a set of operational characteristics that will meet the needs of customers, in addition to providing additional features for the product that helps in performing its basic functions.
2. Availability of a sufficient degree of reliability in the product and increasing the possibility of the product working well during a specific period, in addition to the decrease in the number of holidays during the warranty period to the lowest possible amount.

3. Providing the matching feature by matching the product to the specific and established standards or specifications that customers desire so that it can meet their needs, requirements and expectations.
4. Providing the required durability in the product and increasing the amount of benefit the customer gets from the product during his productive life, in addition to the possibility of repairing the product with the required speed and efficiency.

Conclusions and Recommendations

Conclusions

During this research, a set of conclusions were reached, as follows:

1. Managing productive operations is the activity that undertakes the process of unifying and transferring the available resources to a specific system according to specific principles to add value that is compatible with the policies practiced by the management of that system.
2. Value engineering is a technology aimed at reducing costs and improving processes, which is mainly used in the research and development stage and the design stage. All available information on all components and functions of the product are used along the value chain in order to reduce its costs.
3. The value engineering technology is an advanced methodology for problem-solving that has proven its effectiveness and efficiency in many fields, especially industrial ones, in order to help improve the functionality of the product while maintaining a high level of quality in order to satisfy customers, as well as helping to reduce the costs of the company's activities, operations and products. These costs are often associated with components and functions that can be eliminated without affecting the performance and quality of the product.
4. The Production and Operations Department can help provide the necessary requirements for the application of value engineering technology in a manner that is consistent with the rapid and successive changes accompanying the modern manufacturing environment.
5. The value engineering technology can help to improve product quality so that the product is suitable for customer use and conforms to the specifications and standards set.

Recommendations

Based on the conclusions reached, the research recommends the following:

1. Industrial companies should try as much as possible to build a strategy to reduce work turnover to maintain their workers, taking into account the achievement of subsistence living and spreading the spirit of belonging to the organisation, given that increased leave and appointment rates burden the organisation and exhaust its efforts.

2. Employees must be trained in order to be able to achieve sympathy with customers to find out what the customer desires and needs from services to work to satisfy them. The company must take into account when preparing a value engineering program giving the cost of the training of employees to acquire skills. Communication and empathy with customers is of utmost importance.
3. The company should ask itself, does its website have easy-to-use features that are necessary to attract new customers as well as experienced customers.
4. Strengthening the step of preparing the work team, with increased attention to choosing the value engineering team and their leader on the basis of craftsmanship, experience and skill for what they have and an important role in directing, building and implementing the comprehensive work plan at the company level.
5. In order to address the reluctance of industrial companies to provide facilities for completing the deal with customers, they should reconsider by analysing all the jobs related to providing these facilities, even if they open the door for those who wish to submit suggestions and feasibility studies and benefit from the experiences of others.

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