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The Role Of Simultaneous Four-Dimensional Engineering In Providing Sustainable Products / An Applied Study In The State Company For The Textile And Leather Industry / Factory No. (7)

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Abstract

The lack of local sales and the tendency of most customers to buy imported products, and the decline of the industrial sector, which made it necessary for the industrial sector to adopt the latest technologies and modern methods to compete with other products.

The research aims to demonstrate the role of 4D simultaneous engineering technology in providing sustainable products

The General Company for the Textile and Leather Industry / Factory No. (7) was chosen as the subject of research, and the researcher adopted the deductive approach in the theoretical aspect of research and the inductive approach in the practical aspect.

The research reached several conclusions, the most important of which is that the application of four-dimensional simultaneous engineering technology in the economic unit in question leads to the provision of sustainable products that have high quality advantages, reduce costs and provide them as soon as possible, in addition to that they take into account the environmental, economic and social aspects.

Keywords: Concurrent engineering, sustainable products, sustainability, reuse, recycling .

INTRODUCTION

The Iraqi industrial sector is witnessing great challenges in light of the rapid developments in the business environment from economic, technological developments, openness to global markets, which led to an increase in competition between industries and the quest to provide distinguished sustainable products to ensure survival in the market and achieve a distinguished reputation among competitors and even keep pace with industries The developments that occur in the markets have to use one of the modern technologies, including the technology of simultaneous four-dimensional engineering, in order to help it provide products that compete with other products in the market and have specifications of reducing the cost and providing them in a timely manner and of high quality.

The first axis: research methodology and previous studies

First: the research problem

As a result of the dependence of economic units on old methods and techniques, increased competition in the markets, a decline in most sales of economic units, and an increase in competition,therefore, there was a need to use modern technologies to keep pace with recent developments in the markets. The research problem lies in "Does four-dimensional simultaneous engineering technology lead to sustainable products"

Second: Research objectives

1. Learn about 4D simultaneous engineering, its principles and objectives
2. Identify sustainable products, their features and stages

3. Demonstrating the role of four-dimensional simultaneous engineering technology in providing sustainable products and achieving customer satisfaction.

Third: The research hypothesis

The research is based on the hypothesis that

The use of 4D simultaneous engineering technology leads to a sustainable product

Fourth: The scientific method of research

The researcher relied on the deductive approach in the theoretical aspect of the research and the inductive approach in the practical aspect

Previous studies

• Al-Falahi study, 2019, and the study aimed to (study and analyze the nature of the relationship between effective manufacturing strategy and achieving competitive advantages for economic units, and the study concluded that there is a close relationship between four-dimensional simultaneous engineering technology and effective manufacturing strategy and achieving competitive advantages.

• Al-Jalehawi study, 2020, the study aimed to (use the information provided by environmental management accounting techniques in accordance with sustainability accounting standards to achieve product sustainability, and concluded that determining environmental costs through environmental management accounting techniques provides a clear vision for the management of the economic unit about the size and value of those costs It contributes to developing treatments to reduce environmental pollution, waste and emissions.

The second axis: the theoretical framework

First: the concept and definition of concurrent engineering

There are many definitions about simultaneous engineering due to the different points of view and the environment to which the researcher belongs, Some of them define it as: the integrated and simultaneous design of products and associated processes, including design and support processes, while achieving the ultimate goals of customer satisfaction by reducing cost, reducing product time to market and improving quality (Dongre et.al., 2017:2766), and Zamili defines it

A technique through which design and support operations are carried out simultaneously by forming a multifunctional team that develops an action plan through which savings in cost and time are achieved while maintaining the level of quality (Al-Zamili, 56: 2017).

Second: the principles of simultaneous engineering

There is another set of principles that he mentioned (Ali, 2019: 29). The basic principles that govern synchronous engineering technology and the basis for its application are:

1. Focus on customers' requirements

2. Focus on following all stages of the product life cycle

3. Senior management support

4. Forming a cross-functional work team

5. Facilitate the flow, synchronization and management of information among the synchronous engineering technology team.

Third: simultaneous engineering objectives

Simultaneous engineering achieves a set of goals, including: -

1- Rapid response to changes in customers' desires and needs: it does this by developing its current products or designing and manufacturing new products in a faster time, lower cost and higher quality with what competitors offer (Al-Asadi: 21, 2020).

2- Increasing the quality of the product: through the use of special computer equipment for measurement, testing and verification of the product's conformity with the quality specifications imposed in the design in order to shorten the life cycle of the product and raise its quality level (Dhillon, 2002: 175)

3- Achieving cost savings: Performing operations simultaneously helps to achieve savings in the total cost of the product by eliminating the cost of time that does not add value (2013:17 et.al., Basu,).

4- Performance improvement: Concurrent engineering technology helps in creating a good working environment from the first time through early detection of design problems, improving the quality of products and processes and reducing their costs, thus achieving significant improvements in performance (Al Barzanji, 27: 2007)

5- Achieving competitive advantage: The simultaneous engineering technique achieves competitive advantage through its four dimensions: lowest cost, higher quality, quick response, and flexibility in responding to changes in customers' needs and desires (679 Tayal, 2012:).

Fourth: Steps to apply simultaneous engineering technology

4D simultaneous geometry technology is applied through four dimensions:-

1- After designing a sustainable product: Among the most important issues that this dimension is concerned with are: -

A. Product functional characteristics

It is a set of features and specifications required by the customer, which are mainly applied to design a product that matches the current products in the market

Albert & Thirupathi, 2009:214)).

B. The product's marketability

The ability of the factory's products to quickly convert into cash at the lowest costs while maintaining product quality (Annual Report, 2008:12)

2- After designing a sustainable production process

A. Production capacity

It refers to the ease of manufacturing a product in large and sufficient quantities, and it is defined as the level at which products can be manufactured for customers, and this is done by knowing the operating capacity of the economic unit (Al-Asadi: 29, 2020).

B. Quality and reliability

It means the quality of the product offered to customers and that it is free of defects. Reliability means that the machine performs its required function within a certain specified period of time (Al-Falahi: 64, 2019).

3. After designing a sustainable processing chain

A. Supplies

Supplies are concerned with the process of planning, implementation, planning and controlling the efficiency and effectiveness of the flow of materials and information gathering, and it is considered part of the supply chain that requires its design like the rest of the other areas in the economic unit (Al-Jaafari: 107, 2021)

B. Early containment

It means early containment of all parties to the economic unit, internal (sections of the economic unit) and external (suppliers and consumers), if the early intervention results in coordination between the different stages (valle and Bustello: 2009, 138).

4- Product sustainability

Sustainability of products is achieved by taking into account the environmental, economic and social aspects, reducing costs and recycling waste (Al-Falahi: 2019, 61).

And that the use of a reuse or recycling strategy reduces the percentage of pollutants and waste and creates a clean and sustainable environment (Al Bakri, 2012: 179)

Fifth: Defining sustainable products

Zou mentioned that a product is sustainable when it balances the economic, social and environmental dimensions (Zou: 2018, 18), which are those products that provide environmental, social and economic benefits while protecting public health, well-being and the environment during the full business cycle (AlKindi 2018, 1, 2018),

It is also defined as that product that aims to provide the benefits of the triple base line, which addresses the social and environmental concerns of the producing and consumer organization (Nasour, 739, 2020), and a sustainable lifestyle means giving priority to the use of goods derived from the most environmentally friendly resources to prevent the natural exploitation that must be preserved It is for the next generation because nature is actually theirs (Lestari and Nita:2021,543).

Second: the advantages of sustainable products (kirbit: 2019, 25-26)

1- They do not contain substances harmful to nature, whether they are in the manufacturing, use or disposal processes.

2- Do not endanger human or animal life.

3- Do not cause unnecessary waste as a result of excessive packaging or short life.

4- Preserving the natural environment by reducing environmental damage to a minimum.

5- Not consuming large amounts of energy and resources during the period of manufacture, use and disposal.

Third: The relationship of four-dimensional simultaneous engineering in sustainable products

Concurrent engineering, through its four phases, provides sustainable products. As mentioned by (Okoala and Dara), simultaneous engineering considers the overall benefit of the product from concept, design, assembly, use, manufacture and disposal, thus reducing the time required to market by significantly reducing the life cycle of the product, and engineering is a manufacturing approach To design and develop a product where all production stages are run simultaneously instead of sequentially which leads to a significant increase in the quality of the new product as well as lower production cost and time it creates an environment conducive to designing and manufacturing high quality products in a timely manner which provides a competitive advantage

(Okoala and Dara: 2017, 7869), four-dimensional simultaneous engineering reduces design times as simultaneous design activities are based on the principle of parallelism or symmetry in order to achieve integration in these activities and perform them simultaneously, which leads to reducing

product design process times And production processes and supply chain (25, 2012,: Albizzati).

The third axis: the practical side

First: An introductory overview of the place of study, Laboratory No. (7)

The General Company for the Textile and Leather Industry was established in 2016, based on Cabinet Resolution No. 360 of 2015, which included the merger of the public companies of the Ministry of Industry and

Minerals, and its name became the General Company for the Textile and Leather Industry,the State Company for the Leather Industry was established in 1970, and the study site is the Leather Factory, Factory No. (7), which was established on January 6, 1982, and produces leather sports shoes with different models. The number of workers in Factory No. (7) is 37 workers.

Second: the cost system applied in the factory

The General Company for the Textile and Leather Industry, including Factory No. (7), applies the unified accounting system, and the company relies on it in dividing the elements of costs according to its nature, type, and its double and triple branches, which includes a guide to accounts for costs. The costs are distributed to public centers according to the nature of the activity. The company adopts the total cost method plus a margin Profit in pricing its products and is determined based on the opinion of the Board of Directors.

Third: The application of simultaneous four-dimensional engineering technology in the leather factory, Lab No. (7)

1- After designing a sustainable product

Among the most important issues that this dimension is concerned with are:

A. Product functional characteristics

It is a set of features and preferences required by customers, and when designing a product, the preferences and desires of customers should be taken into account,the role of the simultaneous engineering team is to determine the reasons for the decline in sales of men's leather shoes through conducting market research activities and collecting information about everything related to the characteristics of the products that are required to be characterized by customers,the simultaneous engineering team arrives at the required specifications by conducting a survey on customers who purchase men's leather shoe products to find out their current desires and tastes.

Table (1) It shows the questionnaire that was relied upon by the researcher in collecting the data

NO.	Basic customer requirements	very important	Important	Somewhat	not important	not very important	very important	Important	Somewhat	not important	not very important
		5	4	3	2	1					
1	Shoe design in ine with current fashion	22	20	5	3		110	80	15	6	
2	Shoe design for different men's sizes	29	18	3			145	72	6		
3	The quality of the leather used in the design of the men's leather shoe (natural or synthetic)	16	23	9	2		80	92	27	4	
4	shoe price	31	17	2			155	68	6		
5	Availability of different colors	26	18	6			130	72	18		
6	Foot odor during use	30	16	4			150	68	6		
7	shoe weight	17	16	11	6		85	64	33	12	
8	The quality of the presented shoes and their resistance to	20	21	6	3		100	84	18	6	

	water and exposure to the sun										
9	Shoe designthat takes into account the environmental, economic and socialaspects (sustainable product)	14	14	14	8		70	56	42	16	
10	The materials used to make the shoes do not harm human health	24	15	5	6		120	60	15	12	
11	The period during which it is usable	13	16	12	9		65	64	36	18	

Source: prepared by the researcher

We note in the above table that the desires and requirements of the customers in the questionnaire form have been emptied into the table, and the five-factor criterion has been relied upon to calculate the numbers, and the frequency for each answer has been multiplied by the corresponding weight

Table No. (2)

NO.	Basic customer requirements	Weighted sum	Arithmetic mean	Relative importance	order of relative importance
1	Fashionable shoe design	211	52.75	9.22	5
2	Shoe design for different men's sizes	223	74.33	9.75	3
3	The quality of the leather used in the design of the men's leather shoe (natural or synthetic)	203	50.75	8.87	8
4	shoe price	229	76.33	10.00	1
5	Availability of different colors	220	73.33	9.62	4
6	Foot odor during use	226	75.33	9.88	2
7	shoe weight	194	48.5	8.48	9

8	The quality of the presented shoes and their resistance to water and exposure to the sun	208	52	9.09	6
9	Shoe design that takes into account the environmental, economic and social aspects (sustainable product)	184	46	8.04	10
10	The materials used to make the shoes do not harm human health	207	51.75	9.05	7
11	The period during which it is usable	183	45.75	7.98	11
	the total	2288			

Source: prepared by the researcher

We note in the above table, the different desires and preferences of customers, as the requirement of the relative importance of the price of the shoe reached the highest percentage in the relative importance of the customer's preferences, and then the smell of the foot inside the shoe, the design of shoes for different men's sizes, the availability of different colors and its design in line with fashion, the quality of the presented shoe and its water resistance, and exposure to the sun, the use of materials that do not harm human health, the quality of the leather used, the weight of the shoes, and the design of shoes that take into account the aspects of sustainability and the period during which they are valid for use.

2- After designing the sustainable production process

Among the most important issues that this dimension is concerned with are production capacity, quality and reliability:

1- Production Capability

Knowing the design capacity of the factory is very important for the production process design team to take into account, if the design team should find solutions to the problems that the factory suffers from (low machine efficiency, low production, low return and excessive quality control).

Table No. (3) Shows production quantities for leather shoes for the year 2021

production quantities	measruing unit	Amounts in million dinars
Design	Pair	2,790,000
Available	Pair	989,000
Planned	Pair	30,000
the Actual	Pair	72,996

Source: prepared by the researcher

We note from the above table that the plans for production are not appropriate, as the actual production quantity is more than the planned and to produce sustainable products requires increasing the production plans of the factory and increasing the production capacity to meet the needs and orders of all customers.

2- Quality and reliability

To achieve customer loyalty to the product, the production process design team should design products

whose materials are of high quality and work to make waiting time less and price lower, and to provide sustainable products, the concurrent engineering team should work to reduce the costs of internal failure to produce high quality products and this is done through Increasing the amounts spent on the costs of prevention, prevention and evaluation costs, as the researcher noticed, through her visit to the research sample, that the amount of damaged production in the stores amounted to (11,500) and as shown in the table below.

Table No. (4) Production quantities for men's leather shoes for the year 2021

form	Amount of damaged production	price/ dinars	the cost
70202	4000	10000	40000000
7394	4000	4000	4000000
7607	2500	4000	10000000
70185	1000	6000	6000000
the total	11500	24000	60000000

Source: prepared by the researcher

We note from the above table that the amount of damaged production in the stores is large, and to provide sustainable products of high quality and free from defects, the factory must increase prevention and evaluation costs to reduce the amount of damaged production and to produce high quality products.

3. After designing a sustainable supply chain

It is represented by (supply and early containment)

Supplies: It is concerned with the planning process and the effectiveness of the flow, forward (forward flow) and backward (back flow) for each of the products and services,the researcher noticed, through her field visit to the factory, that the number of marketing outlets for the General Company for Textile and Leather Industry amounted to (19) exhibitions, and that the flow towards the back focuses on providing raw materials to the production process by purchasing them from suppliers in a way that guarantees the best quality and the best prices. The researcher noted through the data Obtained that the quantity of leather purchased from within the country is (23464,500), and the quantity of leather purchased from outside the importing country is (261,863,000),we note that the amount of imported leather is more than the local one, because the tanning factories have been less than before, and this is one of the reasons for the increase in production costs and the production of sustainable products that have low costs,the researcher proposes to the company to establish a tanning factory for the company to supply it with raw materials.

4- Product sustainability

The product sustainability design is represented in maintaining the balance of the environmental, economic and social dimension. Economic sustainability is achieved by reducing material costs through the use of recycled materials instead of relying on original materials and achieving environmental sustainability by reducing the effects and pollutants in the environment through the reuse of materials and lack of Throwing it away and achieving social sustainability by achieving the social welfare of the community and creating a clean environment suitable for living in it by reducing the percentage of pollutants. Sustainability of the factory is achieved by paying attention to the internal and external environment surrounding the factory. Filters inside the factory to purify the air inside the factory, use masks and paws, develop new machines to reduce the percentage of pollutants, and train workers on them to avoid risks and the external environment by providing a regular incinerator to burn solid waste instead of throwing it and pollute the environment. Reusing leather waste reduces costs and pollutants and creates a sustainable environment In the event that the factory implements a strategy, Reuse it will save costs worth as follows

1- The cost of the raw materials for the model = the amount of leather materials x its price

24 x 574 = 13776

2- The proportion of leather materials from the total costs spent on the model

= The cost of leather materials = 13776 = 56%

Total costs 24,633

3- To extract the cost of raw materials for leather by hitting

Percentage of leather materials x raw materials spent during the year

Which is represented by (commodity supplies) account 32

5989640 x 56% = 3,354,198

The percentage of pollutants and waste before the separation stage is 2% and after the separation stage is 8%
4- The cost of the waste that is dumped after the separation stage is
= (cutaneous residues after separation stage x 8%)
The cost of skin waste before separation = skin waste x 2%
= 3354198 x 2% = 67084
The cost of waste after separation = (skin waste - waste before separation) x 8%
= (3354198-67084) x 8% = 3,348,831 dinars
The cost of waste in the case of applying the recycling strategy

The cost of waste before and after separation = (2% + 8%) x 3,354,198

= 335420 dinars

Conclusions

1- The company suffers from a small number of sales due to the high prices of selling products because it bears high costs, as it bears the costs of gas, a percentage of the employees' salaries, the costs of carrying rubble, the costs of preventive maintenance, waste and other costs.
2- The application of four-dimensional simultaneous engineering technology in the General Company for Leather leads to the provision of sustainable products that reduce environmental impacts and reduce costs through the application of a reuse or recycling strategy
3- The application of simultaneous four-dimensional engineering in the General Company for Textile and Leather will lead to the provision of sustainable products that are environmentally friendly and recyclable.
4- Sustainable products lead to a sustainable environment because sustainable products take into account the three aspects of sustainability (environmental, economic and social) and because they work on the use of environmentally friendly materials and work on recycling materials and aim to reduce the percentage of emissions and waste left behind from manufacturing processes
5- There are positive benefits arising from the use of simultaneous four-dimensional engineering in providing sustainable products, as it works to reduce costs and pollutants, design products according to the tastes and preferences of customers, produce large and high-quality products and present them in a timely manner to the customer, and works to produce products that are used for a long time and compete with imported products.

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