The application of reverse engineering in the Iraqi economic 76 units - applied study in the Diwaniyah tire factory

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Abstract

This research indicates the importance of the application of reverse engineering for the practical application of this study in the tagged. Reverse engineering in Iraqi economic units) Orientation towards technology through the idea of central processing that suffered from that economic period This study aimed to define a sample community with the concept and benefits of reverse engineering With a focus on the latest methods used in it, and one of the most important conclusions reached by the study is Reverse engineering works to add new features and characteristics in the event of discovering unexpected defects or gaps in the product to get rid of the bad characteristics, by analyzing competitors' products to reduce the time of building a new product and a better understanding of the physical properties in the competing product, as well as the possibility of applying reverse engineering in units The Iraqi industrial sector in a way that suits modern environmental changes and developments.

Introduction

Engineering is one of the modern formal terms that appeared in the Latin system, especially in France in 1973. It derives from the engineer as an alternative to the traditional French term (Genie civil) civil engineering and according to the American term (Engineering), which denotes a group of specific activities whose goal is to identify, absorb and study a specific project. Or a particular process, through the organization, assistance and guidance through which that project or process can be accomplished, as reverse engineering analyzes the fully competing product in order to know its engineering specifications with the aim of producing evidence for it by improving the product and increasing its capabilities while avoiding defects in the competing product, where The term reverse engineering means starting from the end of something to reach its beginning for any product related to industrial fields, and this technology needs to have a scientific base and advanced technology to rely on, and this technology can be applied to the entire product or to one of its parts (a spare part) where the use of this term was included (Reveres Engineering) from the reality of industrial practices as a modern technical method for obtaining the technical secrets involved. Industrial products installation.

Research methodology

1-the Research Problem

In general, the research problem can be identified through the following questions:

A- Is there a clear awareness among the managers of the company under research about the concept of reverse engineering and its importance?

B- Is there a clear awareness among the managers of the company under consideration of the optimal sequence of reverse engineering operations?

2 - Research Objective

In light of the research problem, the goal of the research can be clarified by building a hypothetical model and selecting it to reach an image that reflects the best sequence of reverse engineering processes in the economic unit under study. Devoting the benefit of reverse engineering expertise can lead to the creation of advanced .industrial capacity for many areas that are needed by economic units

3. - Research hypothesis

The research is based on the following two main hypotheses:

The first hypothesis: that the economic unit under consideration has the basic processes or appropriate means for the application of reverse engineering.

The second hypothesis: that the economic unit under consideration has the possibility to apply reverse engineering operations.

4. Research importance

The importance of purely lies in the following

A - Indicating the diversity in the perceptions and visions of researchers regarding the concept of reverse engineering.

B_ Identify the optimal sequence of reverse engineering operations in the economic unit under consideration. It raises the importance of reverse engineering as a strategic approach that comes from the role it plays in applied stages by making all the functions related to the product operations, whether marketing, engineering or operational, work in a manner that is appropriate to the conditions in which the product operates.

5. Research sample

The reason for choosing the General Company for Rubber Industries is that the company is one of the main pillars of the Iraqi national economy and its distinguished position among other industrial units, in addition to obtaining the international quality certificate, which is a clear indication of the quality of the factory's products.

6. Data collection methods

Data and information collection methods are: -

A - Theoretical Side: -

.It was relied on letters, theses, magazines, books, and others

B - Practical Side: -

.an applied study in the State Company for Rubber Industries (Al-Diwaniyah Tire Factory)

Literature review

1- Study Yacoub and Saleh (2013) entitled "Application of Target Cost Technology Using Reverse Engineering" This study aims mainly to improve the competitive position of the products of economic units using the target cost technique and the reverse engineering method. The reference combines the two designs of the current and the competitor, and coming up with the best on the basis of calculated and targeted costs, as well as simplifying the function of the product in a way that is consistent with the desires and needs of customers.

2-Abd al-latif' study (2021) entitled "Requirements for Transforming Egyptian Universities into Pioneering Universities in the Light of Reverse Engineering." The conclusions reached by the study are to work on enacting laws that enable the use of reverse engineering in university education and to train university faculty members to do so, and to work on developing university laboratories and laboratories to be compatible with the procedures for applying reverse engineering in the educational process to implement and train students on it, and to provide a university climate that supports Innovation, creativity and excellence.

3- A study (Samuelson P. and Scotchmer S., university of California, 2001) entitled "The Law and Economic of Reverse Engineering" This study aims to clarify the knowledge bases of reverse engineering and to indicate the legality of its use and to show the economic point of view of reverse engineering to indicate the importance of using reverse engineering In the semiconductor industry, as well as showing the importance of using reverse engineering in the manufacture of computer programs, while clarifying reverse engineering as a political **.**strategy

Theoretical framework

First -Reverse engineering concept

The use of this technique helps in obtaining an identical or similar product, as the identical product is the original product that is completely similar to it in terms of (shape, size, working theory, method of operation, performance), while the similar product is similar to the competing product with basic specifications such as The main dimensions, size (with freedom of adjustment in shape and mechanics) (Al-Sayyid, 62: 1992)

It was defined by (Drury, 2007:946) "One of the methods used in product design by examining the competing product to identify opportunities for improvement or cost reduction. The competing product is dismantled in order to identify the required functions and how to design them to obtain a clear picture of the product's manufacturing processes.

competitor and determine the costs of their manufacture. Thus, the comparison between the current design and the competing design and the incorporation of remarkable comparative advantages pursued by competitors in the design of his product. As defined by (Horngren, 2015:461) "one of the strategic approaches that focus in its applications on analyzing the competing product in order to determine its components and the processes that it went through during production in a way that helps in designing .the product of the economic unit in light of these components and processes

And he defined it (Gawhar, 109: 2019) "The process of detailed disassembly of the competing product and identifying its design and method of work according to engineering foundations and in the sequence known to them, and then re-designing a new product that performs the same task as the ".original product

Whereas, in fact, reverse engineering is a technique used in many industrial projects in the world to reach new innovations, and this matter is not legally correct, because each country has a legal system that is unique to it from other countries, such as the protection of intellectual property rights. In the Anglo-American system, which has what distinguishes it from the protection of intellectual property rights in the Latin system and vice versa (Abda, 2016:4).

Secondly: Benefits of reverse engineering

There are many benefits that are achieved when applying reverse engineering are summarized as :follows (Germain, 2002:9)

1.Using it to find new designs different from previous designs by making improvements to it .

2.Loss of the original design of the part to be manufactured .

3.Manufacture of spare parts, machines and tools that are no longer manufactured by the original company Like making old-fashioned auto parts.

Third: The importance of reverse engineering

(Stevenson, 2005:155) believes that the importance of reverse engineering as a strategic approach comes from the role it plays in applied stages by making all the functions related to product operations, whether marketing, engineering or operational, work in a manner appropriate to the conditions in which the product operates, and can be summarized thus; (Drury,2000;892)

1. The possibility of determining the necessary and necessary production capacities, depending on the conditions of the competing product.

2. Determining the production capacities that are surplus at an early stage, which is considered as an early opportunity that can be invested in other fields.

3. Focusing on applying the principle of resolving the problem based on the principle of analyzing the competing product and market conditions.

Fourthly: Reverse engineering tools and techniques

The tools and methods of reverse engineering have multiplied and developed greatly over the past years, including (Rushdi, 7:2009):

1.Software for analyzing components and functions of ordinary physical systems such as electrical and mechanical, as well as cognitive systems such as software systems

2.Special software in employing artificial intelligence methods, as well as computer vision algorithms that serve reverse engineering.

3-Software that recognizes the software product and rewrites it based on the significance of a high-level language.

Fifth: Rationale for using reverse engineering

There are many advantages that led to the use of reverse engineering in the creative industries, including (Mahmoud, 169: 2021), (Sorour and Muhammad, 653: 2013):

1.The desire to add new features and features in the event that unexpected defects or gaps are .discovered in the product to get rid of the bad features.

2. Analyzing competitors' products to reduce the time to build a new product and better understand .the physical characteristics of the competing product.

3.The high costs of research and development of new products .

Sixth: Reverse engineering steps

The optimal sequence of reverse engineering operations is summarized in the following steps (2002,40,Germain), (2008:35,Kolar), (2009:17,Soren) and (Mustafa 26:2016): These steps can be clarified through the following:

1- Getting to know the life history of the original product and the conditions related to its performance of its function, whether the product was a complete machine, part of equipment, or a specific spare part.

2- dismantling the product, collecting data, functional analysis, and identifying the most important components and characteristics from which the competing product is made, such as the composition and parts that are used in manufacturing, and making a list of the parts, materials, components and characteristics that must be available when manufacturing the product in order to develop it.

3- Preparing the new design based on the old design and applying the necessary reciprocity and similarity.

4- Carrying out design calculations that fully correspond to the typical design systems, as this is done by studying the function of the product as well as identifying the size of the static loads that fall on the product, and then the stresses are calculated and compared to the bearing strength of the materials, especially if the materials are replaced. In addition to identifying the dynamic loads and shocks that affect the product and the acceptable level of continuous vibration in order to develop the necessary solutions to curb vibrations and achieve balance , The dynamic after this step and the solutions that have been developed can find out the validity of the product in theory.

5- the experimental and testing aspect, as this step is the final step that proves the validity of the product and its compliance with engineering and international specifications, and clarifies a program for conducting several tests on products at the level of the maximum limits as much as possible. As the tests are technically conducted through limited experiments that may be from inside the company, such as the automobile industry, as the test is conducted on the car as a whole on the factory grounds, or outside the company, such as the well-known market tests. Availability of the necessary technical competence for each of the workers, materials, machines and all requirements related to the production of this product. Then the results of this technical test are presented to the work team who approves the

design or makes some modifications such as color, shape, type of metal used, components and packaging methods. In the event that the product passes all the required tests, it becomes qualified to perform the function for which it was established, but in the event that it does not conform to the required specifications and fails, it is returned to the third step to identify the reasons that led to its .failure and carry out the necessary treatments

Practical Study

During this topic, the reverse engineering technique will be applied in the Diwaniyah tire factory, specifically on the product of the wire frame size (1200-24), in order for this topic to be an introduction to the next topic in order to use the outputs of this technology as inputs to the benchmarking technique for the purposes of improving performance and product quality.

First: Application of reverse engineering technology in Al-Diwaniyah tire factory:

In order to apply reverse engineering technology in the Diwaniyah Tire Factory, a multifunctional and multidisciplinary team must be available to undertake the process of dismantling the competing product from an engineering and technical point of view, as well as determining the cost of each component of its components. Therefore, this matter is an advantage for Al-Diwaniyah tire factory, and this factory also has special equipment to check and test the quality of its products.

The first stage: Getting to know the life history of the original product and the conditions related to its performance and function:

During this stage, the components or parts of the product are identified with the function of each of them, as well as the identification of the competing product, as well as preparing a list of customers' requirements and arranging them according to the priority and relative importance of each of them. This stage takes place in three steps, which are as follows:

1- Defining the components and functions of the wireframe (1200-24)

The wire frame (1200-24) consists of a group of components that go into its manufacture, such as rubber, carbon, oil, acids, wires, wax, sulfur, and others. These components and their functions can be clarified through the following table:

Table No.(1)

Wireframe components and functions size (1200-24)

the ingredients	Jobs
Rubber 1500 SPR	Stabilize the wheel, increase friction with the ground, prevent slipping and reduce vibration
Natural rubber	Increasing the frictional cohesion and the resistance of the car's tendency to slip
Carbon FEF	armed filler material
Carbon GPF	armed filler material
Carbon ISAF	armed filler material
Carbon SRF	armed filler material
Deuterex Oil	Increase frame flexibility
Viurex oil	Liquid plasticizer increases the flexibility of the tire
Zinc Oxide	Vulcanized and activated material to make the frame
Stearic acid	Bound, anti-oxidant and vulcanization stimulant

IPPD	Rust resistance
Inox	Anti-ozone substance
Rinaset	Inhibitor to slow down and speed movement
Retarder	digestive substance
OBTS	Accelerator
IT MBTS	Accelerator
CBS	Accelerator
IT MBT	Accelerator
Scores	Measure the amount of charge of an electron
Iron wire	Reinforced material for Bidrink
Banob	Connecting and strengthening the strength of the frame parts
Malikan	Adhesive
NY 1402 100	Reinforced fabric for frame structure
NY 1402 75	Reinforced fabric for frame structure
Resocinol	Rubber permeable adhesive
Rkilim rubber	Extended tire life
Paraffin wax	anti-oxidant substance
Sulfur	vulcanized material
Calcium carbonate	Increase the rigidity and strength of the frame and enhance the heat resistance and bending strength
Hexacoated	Prevent tire cracks

Source: Prepared by the researcher, depending on the opinions of engineers and technicians in Al-Diwaniyah Tire Factory.

2- Determining the competing product for the wire frame(1200-24)

After surveying the local market and seeking the opinions of individuals working in the marketing department of the Diwaniyah Tire Factory, the competing products for the wire frame (1200-24) produced by this factory were identified. These products can be clarified through the following table:

Table No.(2)

Wireframe Competitors (1200-24)

N	Competitor product name	Origin	Unit selling price
1	Tires Getty	Chinese	350000
2	Chinese Tires Grandsire	Chinese	300000
3	Tires Goodride	Chinese	280000
4	Tires Fuzion	Chinese	270000
5	Tires Maxxis	Chinese	250000
	Competitive average tire prices		291000

Source: Prepared by the researcher, relying on the marketing department of Al-Diwaniyah tire factory, and a survey of prices in the local market.

It is clear from the above table that the Maxxis tire is the competing product of the Diwaniyah Tire Factory product.

The second stage: dismantling the product, collecting data, functional analysis, and identifying the most important components and characteristics from which the competing product was made

During this stage, the composition and parts that go into manufacturing are reviewed and a list of parts, materials, components and characteristics that must be available when manufacturing the product is made in order to develop it. The subject of the research and determining its cost, then determining the job entitlement, then determining the value indicator and the functions to be improved, and finally determining the cost gap and

the cost of the candidate elements for improvement and the targeted reduction for each of them. The value index of the wireframe product components can be calculated (1200-24) through the following table:

Table No (3)

Calculating the value index and determining the components of the wireframe (1200-24) that need improvement in the Diwaniyah tire factory

The ingredients	Functional cost (%) (1)	Job entitlement (%) (2)	Value index (3) (1÷2)	Components that need improvement
Rubber 1500 SPR	7.75	3.27	0.42	need improvement
Natural rubber	52.7	4.83	0.09	need improvement
Carbon FEF	0.3	3.35	11.17	-
Carbon GPF	0.31	3.12	10.06	-
Carbon ISAF	2.68	3.24	1.21	-
Carbon SRF	3.21	3.24	1.01	-
Deuterex Oil	0.44	2.33	5.3	-
Viurex oil	0.35	3.01	8.6	-
Zinc Oxide	0.99	3.95	3.99	-
Stearic acid	0.42	2.67	6.36	-
IPPD	0.96	3.19	3.32	-
Inox	1.00	4.07	4.07	-
Rinaset	0.18	3.54	19.67	-
Retarder	0.15	3.69	24.6	-
OBTS	0.51	3.63	7.12	-
IT MBTS	0.01	3.33	333	-
CBS	0.56	3.2	5.71	-
IT MBT	0.57	2.65	4.65	-
Scores	0.02	3.34	167	-
Iron wire	1.73	3.94	2.28	-
Banob	0.54	2.73	5.06	-
Malikan	0.49	2.65	5.41	-
NY 1402 100	17.65	2.85	0.16	need improvement
NY 1402 75	5.83	2.7	0.46	need improvement
Resocinol	0.25	3.05	12.2	-
Rkilim rubber	0.02	3.52	176	-
Paraffin wax	0.16	2.71	16.94	-
Sulfur	0.15	3.04	20.27	-
Calcium carbonate	0.06	2.32	38.67	-
Hexacoated	0.01	3.52	352	-
The total	100	96.68	0.97	need improvement

Source: Prepared by the researcher based on previous tables.

It is noted that there are four components in the wireframe (1200-24) in which the value index is lower than the correct one: SPR 1500 rubber, natural rubber, NY 1402 100, and NY 1402 75, so there is a need to improve these components.

The third stage: preparing the new design based on the old design:

During this stage, work is done to improve the components in which the value index has fallen below the correct one, taking into account the quality and performance component of the product so that it can meet the needs and desires of customers, so the current product will be re-designed according to the new improvements in light of the dismantling of the competing product, and thus work to avoid All problems that occurred in the original product and were identified in the previous steps, with a review of the list of materials that were used in

the original product, with a focus on the typical parts to be replaced with new ones when the latter is preferred or if the former is not available.

After deliberation with the design and production engineers at the Diwaniyah Tire Factory, it became clear that there was an increase in the amount of materials spent on components in which the value index was less than the correct one, and this increase was the result of damage during production, and those engineers indicated the possibility of reducing these components, As shown in the following table:

Table No.(4)

Amount of reduction in the quantity of wireframe components (1200-24) after redesign under reverse engineering technology

The ingredients	Amount of ingredient (kg) before optimization(1)	Amount of ingredient (kg) after optimization(2)	Quantity reduction (2-1) = (3)
Rubber 1500 SPR	6.750	4.800	1.95
Natural rubber	45.500	25.000	20.5
NY 1402 100	5.988	0.800	5.188
NY 1402 75	1.977	0.400	1.577
The total	60.215	31	29.215

Source: Prepared by the researcher based on the opinions of engineers and technicians in Al-Diwaniyah Tire Factory.

The quantity of components for the local and competitive product and the product can be clarified after re-designing the wire frame (1200-24) according to the capabilities available to the Diwaniyah tire factory as follows:

Table No. (5)

Quantity of components for the local and competitive product and the product after re-design of the wire frame (1200-24) according to the available capabilities of the Diwaniyah tire factory

The ingredients	he local product (the Diwaniyah tire factory)		Competitor product (maxxis company)		Product after redesign	
	Quantity(kg)	Relative importance(%)	Quantity(kg)	Relative importance(%)	Quantity(kg)	Relative importance(%)
Rubber 1500 SPR	6.750	7.49	5.213	8.35	4.800	8.8
Natural rubber	45.500	50.52	30.000	48.07	25.000	45.84
Carbon FEF	0.723	0.8	0.525	0.84	0.525	0.96
Carbon GPF	0.735	0.82	0.855	1.37	0.855	1.57
Carbon ISAF	6.361	7.06	4.224	6.77	4.224	7.75
Carbon SRF	7.620	8.46	2.332	3.74	2.332	4.28
Deuterex Oil	2.541	2.82	3.445	5.52	3.445	6.32
Viurex oil	2.000	2.22	1.420	2.28	1.420	2.6
Zinc Oxide	1.571	1.74	0.915	1.47	0.915	1.68
Stearic acid	0.911	1.01	0.800	1.28	0.800	1.47
IPPD	0.295	0.33	0.214	0.34	0.214	0.39
Inox	0.375	0.42	0.300	0.48	0.300	0.55
Rinaset	0.030	0.03	0.015	0.02	0.015	0.03
Retarder	0.055	0.06	0.045	0.07	0.045	0.08
OBTS	0.258	0.29	0.300	0.48	0.300	0.55
IT MBTS	0.015	0.02	0.027	0.04	0.027	0.05
CBS	0.178	0.2	0.200	0.32	0.200	0.37
IT MBT	0.680	0.75	0.800	1.28	0.800	1.47
Scores	0.022	0.02	0.166	0.27	0.166	0.3

Iron wire	3.415	3.79	4.500	7.21	4.500	8.25
Banob	0.060	0.07	0.122	0.2	0.122	0.22
Malikan	0.039	0.04	0.454	0.73	0.454	0.83
NY 1402 100	5.988	6.65	1.656	2.65	0.800	1.47
NY 1402 75	1.977	2.2	2.000	3.2	0.400	0.73
Resocinol	0.077	0.09	0.900	1.44	0.900	1.65
Rkilim rubber	0.078	0.09	0.045	0.07	0.045	0.08
Paraffin wax	0.439	0.49	0.330	0.53	0.330	0.61
Sulfur	0.927	1.03	0.200	0.32	0.200	0.37
Calcium carbonate	0.407	0.45	0.300	0.48	0.300	0.55
Hexacoated	0.041	0.05	0.100	0.16	0.100	0.18
The total	90.068	100	62.403	100	54.534	100

Source: Prepared by the researcher based on cost records and data kept in the records of the planning and follow-up department in the factory and surveying the prices of raw materials from the local market.

Fourth stage: carrying out design calculations:

During this stage, the design calculations will be carried out by calculating the cost of the new design of the wireframe product (1200-24), and before calculating this cost, the amount of reduction in the cost of the wireframe (1200-24) must be determined after re-design under the protection of reverse engineering, and as It is illustrated in the following table:

Table No.(6)

Amount of reduction in wireframe cost (1200-24) after redesign under reverse engineering

The ingredients	Actual costs (IQD) (1)	Component cost after discount(IQD)(2)	Amount of reduction in component cost (2-1) =(3)
Rubber 1500 SPR	22086	15706	6380
Natural rubber	150150	82500	67650
NY 1402 100	50299	6720	43579
NY 1402 75	16607	3360	13247
The total	239142	108286	130856

Source: Prepared by the researcher .

The cost of raw materials for the local product, the competing product and the product after re-design of the wire frame (1200-24) can be clarified through the following table:

Table No.(7)

The cost of raw materials for the local product, the competing product and the product after re-design of the wire frame (1200-24) in the Diwaniyah tire factory

The ingredients	he local product (the Diwaniyah tire factory)		Competitor product (maxxis company)		Product after redesign	
	The cost (IQD)	Relative importance(%)	The cost (IQD)	Relative importance(%)	The cost (IQD)	Relative importance(%)
Rubber 1500 SPR	22086	7.75	17057	8.24	15706	9.32
Natural rubber	150150	52.7	99000	47.82	82500	48.95
Carbon FEF	868	0.3	630	0.3	630	0.37
Carbon GPF	882	0.31	1026	0.5	1026	0.61
Carbon ISAF	7633	2.68	5069	2.45	5069	3.01
Carbon SRF	9144	3.21	2798	1.35	2798	1.66
Deuterex Oil	1250	0.44	1695	0.82	1695	1.01
Viurex oil	984	0.35	699	0.34	699	0.41

Zinc Oxide	2828	0.99	1647	0.8	1647	0.98
Stearic acid	1203	0.42	1056	0.51	1056	0.63
IPPD	2726	0.96	1977	0.96	1977	1.17
Inox	2835	1	2268	1.1	2268	1.35
Rinaset	504	0.18	252	0.12	252	0.15
Retarder	426	0.15	348	0.17	348	0.21
OBTS	1455	0.51	1692	0.82	1692	1
IT MBTS	41	0.01	73	0.04	73	0.04
CBS	1597	0.56	1794	0.87	1794	1.06
IT MBT	1632	0.57	1920	0.93	1920	1.14
Scores	66	0.02	498	0.24	498	0.3
Iron wire	4918	1.73	6480	3.13	6480	3.85
Banob	1530	0.54	3111	1.5	3111	1.85
Malikan	1404	0.49	16344	7.9	16344	9.7
NY 1402 100	50299	17.65	13910	6.72	6720	3.99
NY 1402 75	16607	5.83	16800	8.12	3360	1.99
Resocinol	702	0.25	8208	3.97	8208	4.87
Rkilim rubber	64	0.02	37	0.02	37	0.02
Paraffin wax	452	0.16	340	0.16	340	0.2
Sulfur	439	0.15	95	0.05	95	0.06
Calcium carbonate	169	0.06	125	0.06	125	0.07
Hexacoated	24	0.01	58	0.03	58	0.03
The total	284918	100	207007	100	168526	100

Source: Prepared by the researcher based on cost records and data kept in the records of the planning and follow-up department in the factory and surveying the prices of raw materials from the local market.

The fifth stage: the experimental and experimental aspect:

During this stage, the validity of the product is verified after its re-design and its conformity with engineering and international specifications, as the objective of testing the initial design of the product technically is by identifying the availability of the necessary technical competence for each of the workers, materials, machines and all requirements related to production, and then presenting the results of This technical test is for the work team that approves the design in place or makes some necessary modifications.and During the application of reverse engineering technology in the Diwaniyah tire factory, the wire frame (1200-24) was redesigned in light of the dismantling of the competing product and analysis of customer requirements, and in light of the redesign, a new product with low cost and high quality was obtained, where some modifications were made and a reduction Part of the quantity of components in a way that is compatible with international standards for the tire industry, and the cost of raw materials for the wireframe (1200-24) can be clarified after re-designing the product :in light of the reverse engineering technique in the Diwaniyah tire factory, as shown in the following table

Table No.(8)

The cost of raw materials for the wire frame (1200-24) after re-designing the product under the reverse engineering technique in the Diwaniyah tire factory

The ingredients	The price of a ton in dollars	The price of a ton in dinars	The price kg in dinars	Quantity kg	Material cost for tire size 1200-24
Rubber 1500 SPR	2727	3272400	3272	4.800	15706
Natural rubber	2750	3300000	3300	25.000	82500
Carbon FEF	1000	1200000	1200	0.525	630
Carbon GPF	1000	1200000	1200	0.855	1026
Carbon ISAF	1000	1200000	1200	4.224	5069
Carbon SRF	1000	1200000	1200	2.332	2798

Deuterex Oil	410	492000	492	3.445	1695
Viurex oil	410	492000	492	1.420	699
Zinc Oxide	1500	1800000	1800	0.915	1647
Stearic acid	1100	1320000	1320	0.800	1056
IPPD	7700	9240000	9240	0.214	1977
Inox	6300	7560000	7560	0.300	2268
Rinaset	14000	16800000	16800	0.015	252
Retarder	6450	7740000	7740	0.045	348
OBTS	4700	5640000	5640	0.300	1692
IT MBTS	2265	2718000	2718	0.027	73
CBS	7475	8970000	8970	0.200	1794
IT MBT	2000	2400000	2400	0.800	1920
Scores	2500	3000000	3000	0.166	498
Iron wire	1200	1440000	1440	4.500	6480
Banob	21250	25500000	25500	0.122	3111
Malikan	30000	36000000	36000	0.454	16344
NY 1402 100	7000	8400000	8400	0.800	6720
NY 1402 75	7000	8400000	8400	0.400	3360
Resocinol	7600	9120000	9120	0.900	8208
Rkilim rubber	-	825000	825	0.045	37
Paraffin wax	-	1030000	1030	0.330	340
Sulfur	-	474000	474	0.200	95
Calcium carbonate	-	415000	415	0.300	125
Hexacoated	-	579000	579	0.100	58
The total	-	-	-	54.534	168526

Source: prepared by the researcher.

Thus, it is possible to determine the cost of the wire frame (1200-24) after re-designing the product in light of the reverse engineering technique in the Diwaniyah tire factory, as shown in the following table:

Table No.(9)

The cost of the wire frame (1200-24) after product re-design under reverse engineering technology at Al-Diwaniyah tire factory

Cost element	The cost (IQD)	Percentage
direct material	168526	% 72.27
direct wages	43650	% 18.72
direct industrial expenses	21006	% 9.01
total cost	233182	% 100

Source: prepared by the researcher.

It is noted from the above table, that the cost of the wireframe (1200-24) became (233,182) dinars after re-design under reverse engineering technology, after the cost before design was (356758) dinars, which indicates that this technology can The research sample factory helps in reducing costs.

Conclusions and Recommendations

1-Conclusions:

1.Reverse engineering is a technique used in many industrial projects in the world to reach new innovations by dismantling the competing product and working to improve the current product in light of it.

2.There are reverse engineering tools and methods, which are software for analyzing components and functions of ordinary physical systems such as electrical and mechanical, as well as cognitive systems such as software systems, as well as special software for employing artificial intelligence methods.

3.Reverse engineering works to add new features and characteristics in the event of discovering unexpected defects or gaps in the product to get rid of the bad characteristics, by analyzing competitors' products to reduce the time of building a new product and a better understanding of the physical characteristics of the competing product.

4.The tests are conducted from a technical point of view and help in identifying the availability of the necessary .technical competence for each of the workers, materials, machines and all requirements related to production

5.There is a possibility to apply reverse engineering in Iraqi industrial units in a manner that suits modern environmental changes and developments.

2-Recommendations:

1**.**Working on developing cost systems in a way that fits with the requirements of the modern manufacturing environment and benefiting from costly and administrative techniques, the most important of which is reverse engineering technology in order to help manage and reduce costs.

2.Understand and adhere to the principles of reverse engineering technology, which should be taken into account when applying this technology on the ground in order to achieve its objectives effectively and efficiently in order to manage costs during the early stages of the product life cycle.

3.Commitment to the steps of applying reverse engineering technology to achieve the objectives of this technology represented in managing and reducing costs during the early stages of the product life cycle in an effective and efficient manner, and benefiting from other technologies in order to reduce and manage costs.

4.The use of reverse engineering to obtain a low-cost and high-quality product that contains components and functions that can add value to the company and the customer.

5.The necessity for Iraqi industrial companies to depend on the data of this research and to follow the specific methodology and the initial steps for the application of reverse engineering in order to manage costs and reduce them in a manner commensurate with modern environmental requirements.

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