THE ROLE OF GREEN LEAN SIX SIGMA APPROACH IN REDUCING PRODUCT COSTS APPLIED STUDY IN AL WASAT REFINERIES COMPANY / DORA REFINERY THE TWO RESEARCHERS

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ABSTRACT

The aim of the research is to show the knowledge bases of the green Lean six sigma approach, as well as the knowledge bases for reducing product costs, and then knowing how to reduce product costs by relying on the Green Lean Six Sigma approach. As it has been applied in the oil sector as it is an important economic and productive sector in strengthening the national economy, as most of the oil refineries in Iraq suffer from several problems, including the obsolescence of their production units, which causes poor quality of their products, and the existence of types of waste in resources, in addition to the presence of gas emissions. And water pollutants that accompany its production processes and that affect human health and the environment as a whole. The researchers adopted the inductive approach in the theoretical aspect. In the practical aspect, the researchers relied on analyzing the data obtained from company records. The researchers concluded that the application of the green lean six sigma in the company's research sample would lower product costs.

Keywords: Lean Six Sigma, Green Lean Six Sigma, Reducing product costs.

INTRODUCTION

The contemporary business environment keeps pace with the tremendous developments in the field of manufacturing and technology, and this development requires an evolution in traditional production methods to be in line with these developments that have gone beyond the economic aspects to extend to the environmental aspects, as economic units seek to search for contemporary ways to improve their production processes in terms of improving the quality of products And reduce the waste of resources and energy, reduce costs, and also reduce gaseous emissions and pollutants that cause pollution in the environment and resulting from their manufacturing processes, so the economic units should adopt new ideas and processes that seek to achieve this through the application of contemporary approaches that help in improving their operations, which is The green lean six sigma approach, which is an integrated solution to achieve economic and environmental aspects at the same time, as this approach is characterized by the fact that it consists of three distinct management concepts, namely: the concept of Six Sigma which works to improve the quality of products by eliminating defective production, while the concept of Lean works to remove and eliminate all kinds of waste as well as activities that do not add value to the product, and the concept of green practices works to reduce environmental pollutants resulting from production processes. This approach works within one framework, which is the problem-solving methodology (DMAIC) which includes five consecutive stages It is the

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stage (definition, measurement, analysis, improvement, monitoring). At each stage, a set of tools and techniques are used.

PRESENTATION OF THE LITERATURE

The literature related to the research variables was reviewed A number of research articles were identified due to their importance and contribution to the study of research variables at an earlier time. In the following Table 1, we review some of these studies

Table 1
PRESENTS THE LITERATURE RELATED TO THE RESEARCH VARIABLES

its results	Study Title	Researcher's name and year	N
The use of graceful hexagons represents a cultural change at all levels of the economy, with an emphasis on the level of senior management, who should commit time, energy and resources to enhance the graceful hexagons	Use of graceful hexagonal diffraction to achieve competitive advantage	(Flyyih & Kazem) 2019	1
The integration of graceful hexagonal diffraction with green has achieved many advantages: Reducing process variance, reducing defects, reducing environmental impact, and achieving significant capital savings due to reducing raw material uses, as well as reducing energy consumption (electricity), which in turn reduces all environmental impacts	Putting Green Lean Six Sigma Frame work in to practice in a Jute Industry of Bangladesh : A case study	Talapatra & Gaine, 2019	2
The application of the graceful hexagonal diffraction input contributes to meeting the requirements of customers by reducing production costs and delivering the product on time.	Reducing production costs using the agile hexagonal diffraction input	Hamed, 2019	3

Source: Prepared by the researcher based on the above sources

Lean Six Sigma Approach

Origin and concept of lean six sigma

The roots of this method as a standard method for measurement go back to the German mathematician (Carl Freederinck Gauss), (1777-1855), who introduced the concept of a normal distribution curve to represent variation (Arkoudas, 2017:34). And the development took a step forward with Walter Shewhart, who showed how the triple standard deviation measures the amount of change in production that requires process correction (Bin, 2015:5). The development began in the late seventies when a Japanese company acquired the Motorola factory, which was suffering from major problems related to high costs and poor quality (Henderson, 2011:28), the Japanese began to make radical changes to the way the factory works through the use of scientific methods that led to the control of Operations with a percentage of (95%) or (5%) defects, in 1981. In 1985, engineer Bill Smith, who works in the communications sector at Motorola, studied the relationship between product reliability and the number of times it was repaired during the manufacturing process, for a year 2000 So far the focus has been on creating value for the customer and for companies by integrating six sigma with lean. A number of researchers tried to combine them in order to be able to produce a more powerful tool for continuous improvement, and George's group (a consulting

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group led by M. George) was the first to integrate and disseminate the concept of lean with six sigma (Albliwi et al., 2014: 1014). The lean six sigma approach appeared in 1999, and Allied Signal and Maytag were the first two companies to experiment with combining them (Ellis, 2016:21). The term was first introduced into the literature in the year 2000 (Timans, 2014: 29; Albliwi et al., 2014: 1014). With regard to the lean six sigma approach, it is an approach that focuses on improving quality, reducing variation and eliminating waste. It combines two continuous improvement approaches namely lean six sigma (Furterer, 2004: 5). Zugelder defined it as *"an approach that focuses on improving quality, increasing productivity and reducing cost in any economic unit"* (Zugelder, 2012:5), as it was defined as an approach that focuses on eliminating waste and reducing variance through a methodology DMAIC to achieve customer satisfaction with regard to quality, cost, delivery and focus on improving operations and achieving better financial results for businesses (Pham, 2017: 20), as defined by Zefaj as *"a fact- and data-based improvement philosophy that prevents defects and stimulates customer satisfaction by reducing variance and waste productivity cycle time and enhance the use of standardization and work flow thus creating a competitive advantage."*(Zefaj, 2019: 29).

Green Lean Six Sigma Approach

Origin and concept of the green lean six sigma approach

The history of green lean six sigma Green Lean Six Sigma (GLSS) stands for the evolution of the concept of agility, and was invented in Japan after World War II to compete with the mass production system in the United States of America. The concept of lean manufacturing came from the Toyota production system that was invented by Japanese engineers (Taichi ohuo and Shigeo Shingo) (Kaswan & Rathi, 2020:2). In the late eighties of the last century, the term agile was introduced through a book called *"The Machine That Changed the World"* by James Womack (Kumar et al., 2015: 211). The core of Lean's philosophy is to eliminate waste in every aspect of production activities. The concept of lean allocates its ability to identify and eliminate waste, but does not take into account the environmental impacts, so the concept or green practices came to fill this gap (Cherrafi et al., 2016: 2; Sagnak & Kazancoglu, 2016: 2). Despite the integration of the Lean and Green approach, it did not help economic units achieve the highest sustainable performance (Cherrafi et al., 2016: 2). This is because the green lean approach does not use statistical tools to reduce differences in the process, and is also unable to produce high quality products, so there is a great need to create an approach that consists of tools and techniques to overcome these limitations, which is the six sigma approach (Sagnak & Kazancoglu, 2016: 3). Six Sigma (Kaswan & Rathi, 2020: 2). There is another viewpoint on the development of the concept of green lean six sigma. Cherrafi et al. (2017) and Mishra, (2018) and Sony & Naik, (2020) indicates that the integration of the Lean concept with Six Sigma leads to the emergence of a new approach, which is Lean Six Sigma. By reducing defects, decreasing the level of inventory, increasing productivity, decreasing the difference in the process, and reducing waste of all kinds, but it does not take into account the environmental impacts, so it has been integrated with green practices, and the Lean Six Sigma and Green initiatives are often seen as compatible strategies due to their common focus In eliminating waste, efficient use of resources, and focusing on meeting customer needs Anass et al. (2016) and Cherrafi et al. (2017) and some researchers have suggested that Lean Six Sigma and Green are synergistic approaches that can improve performance Sustainability (Garza-Reyes et al, 2014). In fact, the integration of these three concepts together (six sigma, lean, green) as one approach certainly helps to achieve the strategic goals required for the manufacturing and

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other services sectors (Khorshid, 2012). Therefore, the process of integrating these three concepts is viewed on the basis of It is a relatively new field of research that brings together the individual benefits of each concept, and the realization of the above brings the need for the creation of the Green Lean Six Sigma approach (Green Lean Six Sigma) (Pandey et al., 2018: 189). The green lean six sigma approach consists of three distinct concepts which are the Six Sigma concept, the Lean concept and the Green concept, which works to increase profitability while achieving customer satisfaction (Gaikwad & Sunnapwar, 2020: 2) and the Six Sigma concept reduces differences The concept of lean eliminates all activities that do not add value and aims for perfection at all levels within the economic unit with the help of multi-skilled workers, while the green concept reduces the environmental impacts resulting from production processes as well as for The product is made more environmentally friendly, but the green lean six sigma approach defends a process or product and enjoys the highest levels of quality, cost and environmental friendliness by reducing defects, waste and harmful environmental effects of the product (Kaswan & Rathi, 2020 : 1). Pandey defines it as *"a strategy that combines the principles of six sigma, lean and green diffraction to increase the overall performance of production processes while taking into account environmental measures to achieve sustainability"* (Pandey, 2016:9), as it is defined as *"an environmentally friendly approach that reduces environmental impacts and produces high products." Specifications"* (Kaswan & Rathi, 2020:1), as defined by Gaikwad & Sunnapwar as *"an approach that reduces waste generation by reducing process variance and using 3R green practices (reduce, reuse, recycle) and enhance profitability and customer satisfaction"* (Gaikwad & Sunnapwar, 2020 :2).

Differences between six sigma, lean and greenness

There are several differences between the concepts of six sigma, lean and green, and they can be summarized as follows:

Table 2
THE DIFFERENCES BETWEEN THE CONCEPTS OF SIX SIGMA, LEAN AND GREENNESS

Standards	Six sigma concept	Lean concept	green concept
1- Objectives	It aims to continuously improve the quality of operations, products and services of the economic unit, by constantly reducing defects and using appropriate tools and techniques.	It aims to identify and eliminate waste as well as other non-productive activities.	It aims to improve environmental performance by implementing environmentally friendly practices and reducing environmental impacts.
2-the focus	Focuses on the availability of costs and quality improvement by reducing defects and achieving customer satisfaction.	Focuses on reducing costs by eliminating waste (activities that do not add value)	Focuses on improving environmental performance by eliminating waste and pollution.
3-the difference	Focuses on continuous improvement of quality by reducing defects in products and services.	Focuses on wasting and eliminating it.	Focuses on environmental performance.
4- Advantages	Improving quality, reducing product rejection rates, improving process efficiency and saving costs, achieving customer satisfaction.	Reduce waste, reduce costs, save time, and increase and speed up operations.	Efficient use of resources that are environmentally friendly, reduce environmental stress, improve environmental performance, save money, support the environmental strategy of companies.
5-Defects	It requires high costs to implement the project, you need money, time and manpower.	High implementation costs and processing problems, staff resistance	High productivity costs, lack of resources, lack of information.

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		to change, large investments in equipment and manpower.	

Source: (Garza-Reyes, 2014: 237-239 (Kumer et al., 2015: 3) (Pandey, 2016: 12-13) (Caiado et al., 2018: 1666) (Hussain et al., 2019: 3)

The role of green lean six sigma in reducing product costs

In the competitive business environment at the present time, terms such as cost reduction, waste disposal, environmental and economic impacts, and continuous quality improvement are the main issues in economic and service units, as improving environmental impacts through the disposal of waste and environmental pollution resulting from their operations, as well as improving the cost of Improving the quality of products / services at the present time is one of the main goals that these units seek to achieve. Improving environmental performance in general is the main objective of the concept of green practices, eliminating waste is the main objective of the concept of lean, and continuous improvement of quality is the main objective of applying the concept of six sigma (Pandey, 2016: 9), so it was suggested that the green lean six sigma is of fundamental importance in developing products towards reducing costs and contributing to improving the quality of products and reducing the environmental impacts resulting from them (Kumer, 2016). These three basic concepts (six sigma, the concept of lean and green practices) focus on win-win solutions as the economic benefits are balanced with environmental performance. Environmental protection by reducing waste and energy consumption and others (Khana et al., 2020). To achieve this, the industrial units must contribute to relying on a method capable of achieving this, which is the Green Lean Six Sigma approach. This approach works to reduce environmental impacts by reducing waste and consumption of energy and resources, as well as improving the process and efficiency of materials and producing environmentally friendly products (Kaswan & Rathi, 2020: 3). In fact, contemporary manufacturing operations should enjoy a balance between these three concepts, in order to achieve the required business goals and competitiveness (Pandy & Gary, 2018: 189), the combination of these three concepts as one approach will certainly help in achieving strategic goals not only in Industrial units but also in the service sector (Gaikwad & Sunnapwar, 2020: 2). Explained combining these three concepts as a single approach will certainly help in achieving strategic objectives not only in industrial units but also in the service sector (Gaikwad & Sunnapwar, 2020: 2). explained Combining these three concepts as a single approach will certainly help in achieving strategic objectives not only in industrial units but also in the service sector (Gaikwad & Sunnapwar, 2020: 2) explained (Cherrafi et al., 2016: 1). The results of his study that the green lean six sigma approach will help economic units reduce the average consumption of their resources from (20% to 40%) Parmar & Desai, (2020) as well as reduce energy cost and energy flow by (7 - 12%) (Timarsh et al., 2020: 590).

The Practical Side

Introduction to wasat refineries company / dora refinery

The Dora refinery is one of the oldest refineries in Iraq and represents the real beginning of the advancement of the oil industry. The construction of the refinery was started in the year 1953 with the participation of a group of major international companies such as (Exxon Research & Engineering, MW, Foster Wheeler Kellogg), and the refinery began operating in 1955 and has continued to develop and grow since then. The Dora Refinery is located in the Dora area, southeast of the capital, Baghdad, on the banks of the Tigris River,

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with an area of approximately 250 hectares. Its name came from the area in which it was established, which acquired its name from the circulation of the Tigris River around it.

Calculating Product Costs

The measurement of productivity costs in the economic unit depends on the cost elements of the product, which are necessary for the purposes of preparing the financial statements, as the product costs are represented by direct materials, direct wages, indirect industrial costs and administrative costs, in addition to the costs of environmental pollutants. Table 3 shows a list of costs for an oil product Diesel 154 of 2018.

Table 3
COST LIST FOR DIESEL OIL PRODUCT 154 FOR 2018

No	cost items	Total costs
1	direct material	7,880,802,386
2	direct wages	405,948,820
3	Indirect industrial costs	460,750,348
4	administrative costs	735,714,127
5	cost of environmental pollutants	1,371,522
Total total costs		9,484,587,303
cost per liter[1]		3,133 dinars / liter

Source: prepared by the researcher

Application of the green lean six sigma approach in the Wasat Refineries Company / Dora Refinery

This step involves applying a model (DMAIC), which consists of five successive stages (definition, measurement, analysis, improvement, control) in the Middle Refineries Company / Dora Refinery, in order to improve the performance of the production process and then reduce costs, as follows (Barone & Franco, 2012):

Introduction Stage

At this stage, the problems that the research sample suffers from (the fat unit) are identified, which were represented by three problems:

First problem: Through field experiments by the researcher, it was found that there is a weakness in the quality of oils produced from fat units, due to the obsolescence of fat production units, which led to an increase in defective ones, which caused a decrease in the level of productivity and then increased costs.

The second problem: The researcher found out that there are many types of waste (losses) that do not add value, causing high costs.

Third problem: Through direct observation of the production processes of fat units, it was found that there were gaseous emissions as well as water pollutants associated with the production process, which led to an increase in environmental pollution.

Measurement Stage

Measurement of defective production

To calculate the cost per liter, it was done through the equation (total total costs 9,484,587,303 Dinar / amount of diesel oil production 154, which is 3,027,048 liters=3,133 dinars / liter).

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This stage includes obtaining data related to how to measure the processes related to the product under study, in order to determine the defects that cause the production of defective units, as well as calculating the percentages of defects and the percentage of accuracy in the process and defects per million opportunities to determine the level Sigma for Al-Wasat Refineries Company / Al-Dora Refinery in its current position. The Table 4 shows (4The types of defects and the number of their recurrences for the diesel oil product 154.

Table 4
TYPES OF DEFECTS AND THE NUMBER OF RECURRENCES FOR THE DIESEL OIL PRODUCT 154 DURING THE YEAR 2018

Diesel Oil 154		
NS	**types of defects**	**number of repetitions**
1	viscosity	6
2	viscosity coefficient	2
Total Disadvantages of Diesel Oil 154		8

Source: Prepared by the researcher

Through Table 3, the percentages of defects for the diesel oil product 154 are determined as shown below:

Defects percentage = (total defects / number of times of examination)* 100
For diesel oil product 154 = (8 / 33) * 100=24%

After knowing the percentage of defects for the diesel oil product, the level of is determined Sigma for the blending phase in which the company operates according to the following:

Defects percentage = (number of defective units / number of units produced)* 100
24% = (Number of defective units / 3,027,048)* 100
Number of defective units = 726,492 liters (defective production)
The percentage of accuracy in the process = 1 - the percentage of defects = 1-24% = 76%
Defects per million opportunities (DPMO (= (Number of defective units / Number of units produced * Number of types of defects) * 1,000,000
= (726,492 / 3,027,048 *2)* 1,000,000 defects per million opportunities (DPMO) = 0.120,000,079 * 1,000,000
120,000 = liters
That level The sigma of diesel oil 154 is approximately (2.7), which represents the second level, with a defect rate of 24%, and an accuracy level of 76% in the performance of operations.

Measuring and identifying areas of waste

At this stage, the areas of waste are determined by calculating the processing time (C/T) and the number of workers for each production stage, as shown in the Table 5 below:

Table 5
CALCULATING WORKING HOURS AND THE NUMBER OF EMPLOYEES FOR EACH STAGE

No	machine type	Worktime	Stage	processing time (C/T)	Number of employees
1	tank / bag	8 hours	blending phase	8 hours	18 workers
2	plastic box making	20 seconds = 0.3			

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	machine	minutes	container making stage (making plastic boxes + making metal barrels)	12.1 minutes	18 workers
3	Shredding	2 minutes			
4	Welding	1 minute			
5	Punching	20 seconds = 0.3 minutes			
6	Assembly	5 minutes			
7	Laundry	3.5 minutes			
8	plastic box filling machine	10 seconds = 0.16 minutes	Filling stage (Filling plastic boxes + barrels)	3.16 minutes	18 workers
9	barrel filling machine	3 minutes			
10	-	-	storage stage	9 hours	9 workers
Total working hours and number of employees				**17 hours 15.26 minutes**	**63 workers**

Source: Prepared by the researcher based on daily observations

It is evident from the above Table 5 that the total production cycle time (17 hours and 15.26 minutes)[2] and Figure 1.

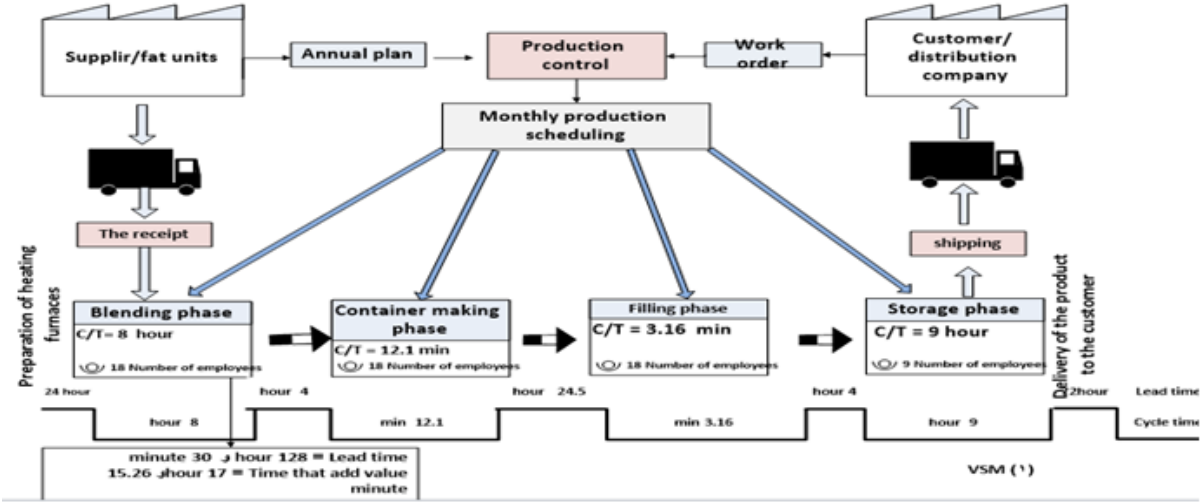

FIGURE 1
SHOWS THE CURRENT VALUE STREAM MAP

Measurement of environmental pollutants

This stage includes obtaining data related to the measurement of environmental pollutants represented by gaseous pollutants (air pollutants) and water pollutants.

Analysis Stage

Defective production: Regarding the first problem, which is the presence of defective production, which caused a weakness in the quality of these oils, and it became clear through the data collected by the quality control department / fat laboratory that there was a deviation in the specifications of diesel oil 154, from the permissible limits, and that this deviation led to the production of defective units Hence, it caused its poor quality and a

[2] To calculate the actual time through: - Number of days in the year 365 days - Number of annual holidays 120 days = 245 days Number of actual working days
The annual energy (in hours) = 245 working days * 7 working hours / day = 1715 hours / year)
To convert hours into minutes by (1715 hours * 60 minutes = 102,000 minutes / year).

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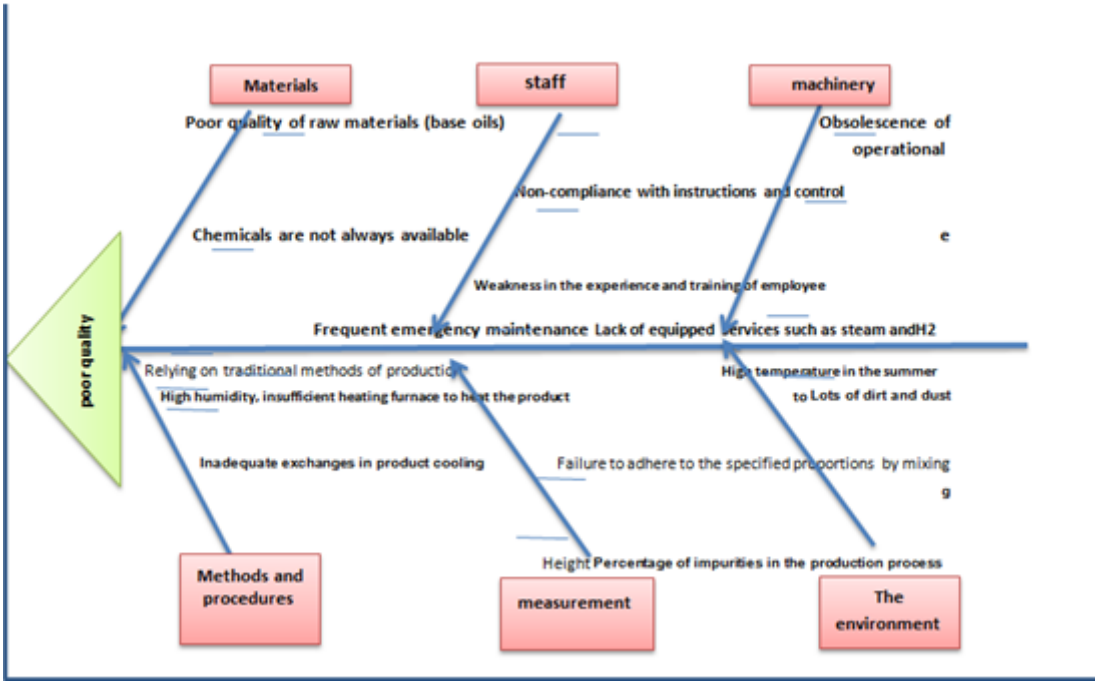
rise in its costs. Figure 2 shows the main and secondary reasons that led to the deviation of these oils from the required specifications and which caused the high cost through the use of the cause and effect scheme (C&E) or Fish Bond.



Source: Prepared by the researcher

FIGURE 2
THE SHAPE (2) PLANNED FISH BOND

It is clear from the previous Figure 2 the main and subsidiary reasons that affect the occurrence of this problem and to different degrees.

Wastage (Wastes)

The second problem was represented by the presence of two types of waste within the Wasat Refineries Company / Dora Refinery, and was represented by the following:

The first type of waste: wastage in the world n This type of waste is represented by an increase in the number of workers, and the costs of workers for each stage are calculated by the number of workers for each stage in the average monthly wage of an adult worker ([3]536,969.338 dinars for diesel oil product 154 as shown in the Table 6.

Table 6
CALCULATING THE COSTS OF WORKERS FOR EACH STAGE OF THE DIESEL OIL PRODUCT 154

NO	stage name	Number of employees	Average monthly wage for a worker	employee wages costs
1	blending phase	18	536,969.338	9,665,448.08
2	container making stage	18	536,969.338	9,665,448.08
3	Filling stage	18	536,969.338	9,665,448.08

[3] The average monthly wage of the worker was calculated through (the average annual wage of the worker (6,443,632.06) dinars / 12 months = 536,969.338 dinars per worker).

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4	storage stage	9	536,969.338	4,832,724.04
Total employee wage costs				**33,829,068.2**

Source: Prepared by the researcher

The second type of waste: waiting time (Lead time)

Waiting time is represented by transportation, inspection and interruptions that affect production stages. Waste time (waiting times) was determined by 128 hours and 30 minutes during the month. The costs related to this time are calculated by calculating the cost per minute, through the equation below:

Cost per minute=(total total costs of the product / total minutes for a year)
Cost per minute=(9,484,587,303 dinars / 102,900 minutes / year)
The cost of one minute=92,173 dinars / minute
That is, waiting time costs=number of waiting time minutes * cost per minute
=(128 hours* 60 + 30 minutes)* 92,173 dinars / minute
=7,710 minutes* 92,173 dinars / minute
Waiting time costs=710,653,830 dinars

Environmental pollutants

For pollutants, life cycle assessment technology will be used.(LCA) using one of its environmental programs, which is the (Simapro9) program to identify and analyze these pollutants.

Program Application Steps (Simapro9) Life Cycle Assessment (LCA)

Defining the goal and scope

Define the goal: Using the life cycle assessment tool to determine the environmental impacts of the product under study is (diesel oil 154) in the mixing and filling unit, starting from obtaining base oils that were manufactured in heavy fat units to the stage of mixing and filling in order to determine their environmental effects and the possibility of their treatment.

Defining the scope: Heavy fat units in Al Wasat Refineries Company / Dora Refinery.

Data analysis: The necessary data is collected to form a database for the purpose of evaluating the life cycle of the product under study, by referring to the company's records for program input. This is explained in the Table 7.

Table 7
DATA NEEDED FOR THE PROGRAM (SIMAPRO9)

NS	product name	Input and its unit of measurement	Output and its unit of measure	fuel type	energy used	emissions invasive	water pollutants
1	Diesel Oil 154	base oils 9,023 kg	Diesel Oil 154 10,440 kg	fuel oil 1,252,653 kg	electric energy 1,750 kw/h	CO	PH
							TC
						CO2	Phé
							BOD
		chemicals 1,367 kg			steam energy 645 Kj /kg	H2S	Oil
							COD
						Pm total	CL-1
						SO2	TDS
							SO4

Source: Prepared by the researcher based on the records of the Costing Division

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Calculating the costs of environmental pollutants for the diesel oil product based on the program outputs Table 8.

Table 8
CALCULATING THE TOTAL COSTS OF ENVIRONMENTAL POLLUTANTS FOR THE PROGRAM OUTPUTS

pollution type	pollutant name	pollutant cost
air pollutants	vinyl chloride gas (C2H3Cl for carcinogens	6,894,120
	vinyl chloride gas (C2H3Cl for non-carcinogenic substances	1,725,720
	suspended particles in the air) (PM 2.5	2,803,200
	carbon gas C	4,721,640
	Chlorofluorocarbon CFC-11	70,940
	ethylene gas C2H4	7,481,040
	carbon dioxide Co2	1,611,840
water pollutants	Ethylene glycol TEG	14,454,000
	sulfur dioxide So2	10,482,800
	tetraoxide phosphate Po4	10,132,400
soil pollutants	Ethylene glycol TEG	458,440
	sulfur dioxide So2	1,048,280
Total costs of environmental pollutants		**61,884,420**

Source: Prepared by the researcher

Improvement Phase

Elimination of defective production

Degraded production is eliminated by upgrading (Sigma) in the economic unit on the performance of the process, if we suppose raising the level of (Sigma) in the unit under study will lead to a reduction in the amount of defects, when reaching the level of Sigma (6), the amount of defects will be (3.4) liters per million opportunities, by applying the equation below The number of defects in the company will become:

Defects per million opportunities=(number of defective units / number of units produced* number of defect types)* 1,000,000
3.4=(Number of defective units /)3,027,048 * 2) * 1,000,000
The number of defective units at a level (Sigma6)=20.58=21 liters
Defects percentage = (number of defective units / number of units produced) * 100
=(21/ 3,027,048) * 100 = 0.006%
The percentage of accuracy in the process = 1- The percentage of defects = 1 – 0.006 = 99.9994

It becomes clear that the amount of actual defects at the current level of the company i.e. level (Sigma 2) was 726,492 liters, while after raising the level of Sigma to (6) it reached (21 liters), and the amount of difference between the two levels is 726,471 liters. As for the costs that will be saved when the company operates at the level of (Sigma 6), it will be as follows:

Cost savings=(Number of defective units at. level Current Sigma - the number of defective units at Sigma level 6)* cost per unit
cost saving=(7,26,492 -21) * 3,133 dinars / liter
cost saving=726,471 liters * 3,133 dinars / liter = 2,276,033,643 dinars

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Thus, the difference between the two costs is clarified at the level of The current Sigma 2 of the company and when the company works at a level (Sigma 6) as in the Table 9 below.

Table 9
A COMPARISON BETWEEN THE COSTS AT THE CURRENT LEVEL OF A COMPANY WITH THE LEVEL (SIGMA 6) FOR DIESEL OIL PRODUCT 154

No	Costs at the company's current level	costs at the level of (Sigma 6)	The difference between the two costs
1	2,276,099,436 dinars	65,793 dinars	2,276,033,643 dinars

Source: Prepared by the researcher

Thus, the total (total costs of the diesel oil 154 product) will be reduced through the following:-

Total costs of a product after the reduction=Total costs of the product before the reduction – the difference in costs at the level (Sigma 6)
Total costs of the product after reduction=9,484,587,303 - 2,276,033,643 total costs of the product after the reduction=7,208,553,660 dinars

Eliminate Wastage

The first type of waste: wastage of workers

The redundant number of workers is eliminated by determining the daily required quantity of products.as I reached the required quantity per day (5.5) m^3 / day. Accordingly, the required energy is determined in terms of the number of workers for each stage through the equation below:

The number of workers for each stage = (the time required for one unit * the amount required per day) / the time available after deducting the energy reserve
Mixing stage=(240 minutes * 5.5 m^3) / (420 / 80%)
= 2640 / 336 = 7.8 = 8 factor
The stage of making containers = (3.16 minutes * 5.5 m^3) / 336
= 66.55 / 336 = 0.19 = 1 factor
Filling stage = (3.16 minutes * 5.5 m^3) / 336
= 17.38 / 336 = 0.05 = 1 factor
Storage stage = (540 minutes / 5.5 m^3) / 336
= 2,970 / 336 = 8.8 = 9 factor

Then the difference between the numbers of employees is determined to determine the amount of reduction:

Blending stage = (18-8) * 536,969.338 dinars = 5,369,693.38 dinars
The stage of making containers = (18-1) * 536,969.338 dinars = 9,128,478.75 dinars
Filling stage = (18-1) * 536,969.338 dinars = 9,128,478.75 dinars
Thus, the difference between the two costs is clarified when (there is a waste in the number of workers) and in the event of disposal of the surplus in the number of workers as shown in the Table 10 below:

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Table 10
COMPARISON BETWEEN COSTS WHEN THERE IS WASTE IN WORKERS WITH COSTS IN CASE OF DISPOSAL OF SURPLUS DIESEL OIL PRODUCT 154

NS	stage name	Employee wages costs before the reduction	Employee wages costs after reduction	Reduction amount
1	blending phase	9,665,448.08	4,295,754.7	5,369,693.38
2	container making stage	9,665,448.08	536,969.338	9,128,478.75
3	Filling stage	9,665,448.08	536,969.338	9,128,478.75
4	storage stage	4,832,724.04	4,832,724.04	0
Total		**33,829,068.3**	**10,202,417.4**	**23,626,650.9**

Source: Prepared by the researcher

The second type of waste: waiting time (lead time)

Based on that, the amount of time that was wasted was determined (70 hours) Figure 3. As for the costs that can be saved when eliminating waste in waiting time, they are as follows:

Amount of cost savings = Amount of time removed * Cost per minute
The cost per minute is calculated after deducting the costs of the production costs and the costs of the wages of the workers, i.e. the total total costs of the product are
(6,925,307,028) dinars/year
Therefore, the cost per minute = (total total costs / number of minutes per year)
=(6,925,307,028 / 102,900 minutes)
=67,301 dinars / minute
The amount of cost savings = (70 hours * 60 minutes) * 67,301 dinars / minute
=4,200 * 67,301 dinars / minute
=282,664,200 dinars

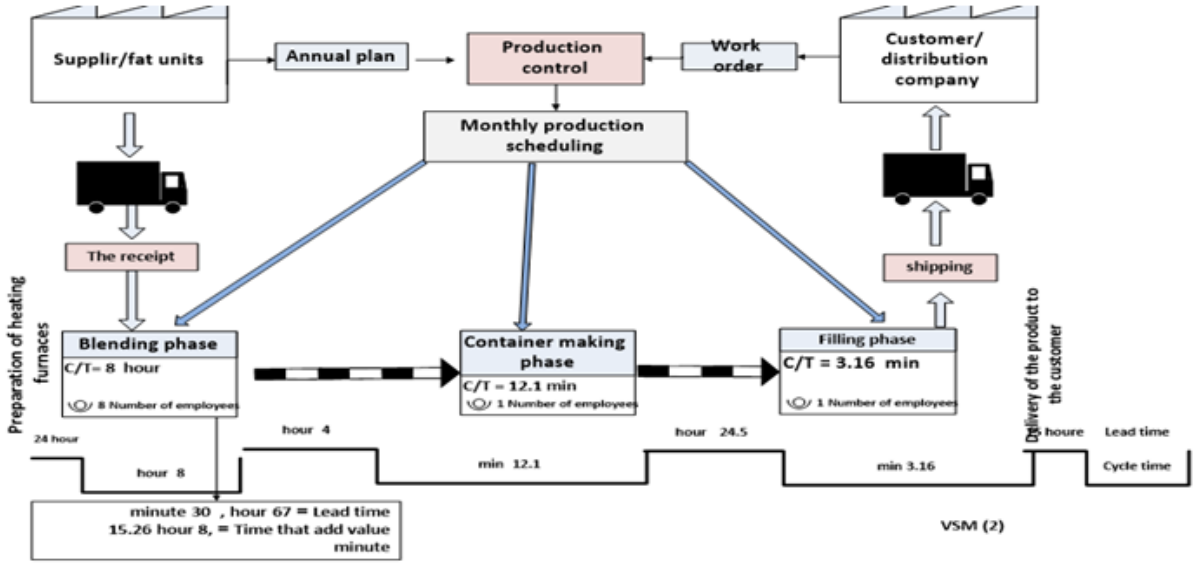

FIGURE 3
SHOWS A MAP OF THE FUTURE VALUE STREAM

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Elimination of Environmental Pollutants

Environmental pollutants are eliminated by replacing fossil fuels made from petroleum products with another type of fuel that is environmentally friendly, renewable and inexhaustible, which is biodiesel. Bio Diesel is one of the types of biofuels. To clarify the comparison between petroleum diesel and biodiesel in terms of environmental impact analysis using the Simapro9 program, it will be based on some experiences of countries, including the Greek experience, which used sunflower oil as a raw material for the production of biodiesel. Table 11 shows the raw materials used in the production of biodiesel oil, which are considered Inputs for Siampro9.

Table 11
THE DATA NEEDED FOR THE PROGRAM SIAMPRO9

NO	product name	Input and its unit of measurement	Output and its unit of measure	energy used	emissions invasive	water pollutants
1	biodiesel oil	Sunflower seed oil 840 kg	biodiesel oil 834.40 kg	Medium voltage electric power 180 MJ	CO	PH
						TC
		SODUIM hydroxideNAOH 6.70 kg			CO2	Phé
						BOD
		methanol alcohol MeOH 181.70 kg			H2S	Oil
						COD
		phosphorous acid H3PO4 5.20 kg			Pm total	CL-1
					SO2	TDS
						SO4

Source: Prepared by the researcher

Table 12 calculating the costs of environmental pollutants for the biodiesel oil product based on the program outputs.

Table 12
CALCULATION OF THE TOTAL COST OF ENVIRONMENTAL POLLUTANTS FOR THE BIODIESEL OIL PRODUCT FOR THE PROGRAM OUTPUTS

pollution type	pollutant name	pollutant cost
air pollutants	vinyl chloride gas(C2H3Cl for carcinogens	271,560
	vinyl chloride gas(C2H3Cl for non-carcinogenic substances	1,699,440
	suspended particles in the air) (PM 2.5	1,893
	carbon gas C	1,690,680
	Chlorofluorocarbon CFC-11	3,609,120
	ethylene gas C2H4	420
	carbon dioxide Co2	534
water pollutants	Ethylene glycol TEG	8,280
	sulfur dioxide So2	28,244
	tetraoxide phosphate Po4	1,421
soil pollutants	Ethylene glycol TEG	601,520
	sulfur dioxide So2	20,440
Total costs of environmental pollutants		**11,542,672**

Source: Prepared by the researcher

Table 13 shows the comparison between the costs of environmental pollutants for the diesel oil product 154 and the biodiesel oil product.

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Table 13 COMPARISON BETWEEN THE COSTS OF ENVIRONMENTAL POLLUTANTS FOR THE DIESEL OIL PRODUCT 154 AND THE BIODIESEL OIL PRODUCT			
No	Pollutant cost of diesel oil product 154	Pollutant costs of biodiesel oil product	The amount of reduction between the two costs
1	61,884,420	11,542,672	50,341,748 dinars

Source: Prepared by the researcher

Monitoring Phase

The last stage of the (DMAIC) This stage includes how to maintain the situation after making improvements and addressing problems, as well as monitoring the performance level to maintain these improvements. The results reached in the improvement phase, in order to remain permanent, measures should be implemented to ensure the effectiveness of these improvements in the long term. Therefore, formal procedures should be developed that include activities aimed at preventing the emergence of productivity, waste, and environmental pollutants that may reappear. Accordingly, the total costs that were reduced when applying the Green Lean Six Sigma approach through the DAMIC methodology were as shown in the following Table 14:

Table 14 THE TOTAL COSTS THAT HAVE BEEN REDUCED FOR THE DIESEL OIL PRODUCT 154 FOR THE YEAR 2018 (AMOUNTS IN DINARS)					
No	**Element**	**Costs before applying the green hexagonal diffraction approach**	**The costs of applying the Green Lean Six Sigma approach**	**Reduction amount**	**discount percentage**
1	defective production	2,276,099,436	65,793 dinars	2,276,033,643	99%
2	direct wage costs	405,948,820	122,429,009	283,519,811	69%
3	Waiting time costs	1,036,154,610	753,490,410	282,664,200	27%
4	cost of environmental pollutants	61,884,420	11,542,672	50,341,748	81%
Total		**3,780,087,286**	**887,527,884**	**2,892,559,223**	**77%**

Source: Prepared by the researcher

It is clear from the above table that the reduction rate for the diesel oil 154 product amounted to 77% of the total costs when applying the green lean six sigma approach. Thus, the research hypothesis was achieved by reducing product costs by applying the Green Lean Six Sigma approach.

CONCLUSIONS

Distance completing the research in its theoretical and practical aspects that to a set of conclusions that can be summarized as follows:

1. Not adopting contemporary management approaches such as the green lean six sigma approach in the oil industry sectors.
2. The integration of three distinct concepts, namely, six sigma , the concept of lean ,and green practices, into one integrated approach, the green lean six sigma approach, achieves many advantages if both work independently.
3. The defective production costs were at the level of The company's current (Sigma2) for the diesel oil product is 154 (3,318,615,456) dinars, but when the level of Sigma was raised to (6), it led to a

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reduction in the quantity of defects and then achieved a cost savings of (2,276,033,643) dinars for the oil product.

4. The environmental pollutants resulting from diesel oil were removed 154 by replacing it with another product that is more environmentally friendly, which is the biodiesel oil product. The cost of the environmental pollutants of the biodiesel oil product, depending on the program's outputs, amounted to (11,542,672) dinars, which represents the amount of reduction in the cost of environmental pollutants The result of the replacement is (50,341,748) dinars.

Recommendations

Based on the findings of the researchers, some recommendations can be made as follows:

1. The Iraqi industrial sectors in general and Al-Wasat Refineries Company / Al-Dora Refinery should adopt contemporary administrative approaches such as the green lean six sigma approach and pay attention to its concept and spread its theoretical and applied thought, because of its role and great importance through the correct use of resources and reducing gas emissions, which leads to achieving economic benefits and environmental.
2. Holding training courses among employees on an ongoing basis in order to spread the concepts of agility and green practices among the individuals working in the company, and the continuous follow-up to get rid of all kinds of waste at all levels, as well as reducing gas emissions and pollutants and saving in energy and resource consumption to achieve high quality and environmentally friendly outputs.
3. Full commitment to the working hours specified for the production process and seeking to eliminate times that do not add value, in order to avoid a waste of resources, which negatively affects the performance of the company.
4. Guardian of the two researchers managers Al-Wasat Refineries Company Al-Dora Refinery Establishing a production unit specialized in manufacturing the environmentally friendly biodiesel product, in order to reduce dependence on fossil fuels that are harmful to the environment (diesel oil 154) to reduce environmental pollutants, as well as provide new job opportunities, which enhances the national economy Which achieves economic and environmental goals at the same time.

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