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Reducing Wastage in Inventory Management by Lean Management

Yalın Yönetim ile Envanter Yönetiminde İsrafı Azaltmak

Abstract

Companies nowadays are working to improve their processes and functions; one of the most important functions is inventory management, in which companies schedule their production activity. This function has evolved and come up with many optimization tools that, unfortunately, many companies haven't adopted yet. Also, the lean management concept has largely attracted the attention of both researchers and professionals regarding its importance in improving the business process and reducing waste. The main aim of this study is to improve the function of inventory management in a company which is specialized in the production of pipes, in the context of a lean management approach. The adoption of this system allows for the detection of all sources of waste in this function through the use of a set of tools to identify and reduce waste such as ASLOG reference, ABC analysis, Brainstorming, Pareto's diagram, Ishikawa model. The use of these tools have allowed the detection of the main sources of waste to eliminate them and improve this important function to achieve a high level of firm performance. To collect data, an interview, observation, and analysis of a set of documents were relied upon. This study relied on the IMRAD methodology in the divisions of the study, and the most famous models (IMC) related to choosing the appropriate solution from a group of alternatives were used at any strategic level in the company. This model was applied to address the problem of the study, and when we followed the stages of the model and applied a set of techniques in the Inventory management function the most important problems in this function were discovered, which is a waste of both time and cost. These problems were also discussed by proposing a set of solutions and adapting them to the company under study.

Keywords: Inventory Management, Lean Management, Waste Reduction, Inventories, Pipes.

Öz

Şirketler bugünlerde süreçlerini ve fonksiyonlarını iyileştirme üzerine çalışmaktadır; bu süreçte şirketler üretim faaliyetlerini planlarken en önemli işlevlerden biri stok yönetimidir. Bu işlev uzun süredir gelişmekte olmasına ve birçok optimizasyon aracı ortaya çıkmasına rağmen birçok şirket henüz bunları benimseyememiştir. Yalın yönetim kavramı ise, iş süreçlerini iyileştirme ve israfı azaltmadaki önemi nedeniyle araştırmacıların ve profesyonellerin ilgisini çekmiştir. Bu çalışmanın temel amacı, yalın yönetim yaklaşımı bağlamında boru üretimi konusunda uzmanlaşmış bir firmada stok yönetimi fonksiyonunu geliştirmektir. Bu sistemin benimsenmesindeki amaç, ASLOG referansı, ABC analizi, beyin fırtınası, Pareto grafiği ve Ishikawa modeli gibi israfı belirlemek ve azaltmak için bir dizi araç kullanarak bu fonksiyondaki tüm israf kaynaklarının tespit edilmesini sağlamaya yardımcı olmaktadır. Bu araçların kullanılması, ortadan kaldırılması için ana israf kaynaklarının belirlenmesini ve ayrıca yüksek düzeyde şirket performansı elde etmek için bu önemli işlevi optimize etmeyi mümkün kılmaktadır. Veri toplamak için bir görüşme, gözlem ve bir dizi belgenin analizine güvenildimektedir. Bu çalışmada, çalışmanın bölümlerinde IMRAD metodolojisi esas alınmıştır ve bir grup alternatif arasından uygun çözümün seçilmesi ile ilgili en ünlü modeller (IMC) şirketin tüm seviyelerinde kullanılmıştır. Bu model, çalışmanın esas aldığı problemin çözümü için uygulanmıştır. Stok yönetimi fonksiyonunda, bu modelin aşamalarını takip ettiğimizde ve teknik setini uyguladığımızda, bu fonksiyondaki en önemli problemler hem zaman hem de maliyet israfı olarak keşfedilmiştir. Ayrıca bu sorunlar, çalışma altında bir dizi çözüm önerilerek ve incelenen şirkete uyarlanarak tartışılmıştır. Bu çalışmanın idari değerine bakıldığında; incelenen şirketin yöneticilerinin, stokların optimal yönetiminde modern ve etkili teknikleri kullanmalarını sağlamaktır. Ayrıca sanayi şirketlerinin, özellikle şirket sermayesinin büyük olduğu işlerde, israftan mustarip olduğu en önemli sorunların keşfedilip çözülmesine katkı sağlamaktadır. Japon yönetiminin savunduğu en önemli tekniklere aşinalık kazandırılmış ve etkinlikleri doğrulanmıştır.

Anahtar Kelimeler: Stok Yönetimi, Yalın Yönetim, İsrafın Azaltılması, Stoklar, Borular

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Introduction

In this era, the company is forced to compete vigorously not only by producing products and providing services but also by the high quality and superior service demanded by the consumer.

Therefore, the ability and flexibility of the company to provide its products with quality and at the right time require more than obtaining the materials necessary for the production process, but rather the adoption of appropriate systems and methods for managing those materials. Therefore, the function of inventory management can be considered as one of the most important functions in the success of the production process, and there is no doubt that requires unconventional methods when performing the inventory management process. The storage process is a striking phenomenon and has a scientific treatment of inventory that was not known until recently (1929) when the American engineer Wilson is considered the first to develop a model for organizing inventory and his goal is to reduce costs in a company. Lean management was adopted in Japan as a result of what the Japanese economy suffered from between the two wars from the depletion of various resources. During this period, the Japanese worked to create value from nothing and eliminate various sources of waste. Lean management is a philosophy looking for how to optimally use the resources within the company in all its physical, human, and financial forms. Unnecessary movements, waiting times, excessive inventory, and other forms of waste are all factors that reduce the efficient use of resources in a production company.

The idea of managing inventory according to agile management is to eliminate waste in inventory, as it comes in the form of costs, time, and effort that the company needs to manage. Lean inventory management is a combination of a philosophy and a set of tools, as a tool that companies can adopt the principles of agile management to manage their inventories and improve what needs improvement (reducing costs), as a philosophy that emphasizes lean management to minimize or eliminate abuses all materials used in the production process. This study aims to try to get more familiar with the methods of inventory management in a company in the sense of diagnosing the current situation, eliminating waste in terms of costs and in terms of eliminating lost time in the company under study, and trying to integrate the most important inventory techniques into the philosophy of agile management and its embodiment in reality; This research also aims to introduce lean inventory techniques and help managers and businessmen to adopt these tools that are successful in removing waste from the inventory function in a production company. To implement this, the technique of interview, observation, and documents citation was used

Inventories have an important role in the company, as it avoids the greatest risks of an interruption in the production process. On the other hand, a company bears the costs of maintaining it and other risks that threaten its existence. Therefore, it is assumed that an optimal solution (the optimal level) is found where there is no surplus in stock to reduce waste of all kinds; For this reason, how can inventory management tools according to lean management improve the performance of the inventory management function as a problem for this study.

Improve inventory management according to lean management

Lean is a word of English origin, as it was first launched by John Krafcik, a researcher at the MIT Institute of Technology; Based on the Toyota Production System (TPS) in the year 1980, This concept was developed in the Japanese car manufacturer Toyota, and the Japanese became more interested in this concept, especially after the book “The Machine That Changed the World” was put on the market by James P. Womack, Daniel T. Jones, and Daniel Roos in 1991. The authors believed that waste is anything that adds no value to the car production process. (Fauret, 2015: 11). Lean management is a scientific methodology applied with techniques

that allow reducing activities that do not create value in the eyes of the customer to the maximum extent possible, and this is by reducing waiting times, inventory, and other sources of waste (Njima, 2013:15). Lean inventory is what its name indicates, and the idea behind it is to eliminate waste or waste in the company's inventory, all forms of waste in the form of costs, time, and effort, which need more management, having a lot of inventory is somewhat harmful to the company and in a way Clear. Therefore, it is essential to find the right balance of the balances that you need to hold in relation to supply and demand. Improving inventory management within the framework of lean management is done by adopting a basic principle, which is the reduction of waste, which was called for by the Japanese administration when developing this philosophy and applying the lean management system, which helped major companies in the world to continuously improve their process and management, and achieve the level of quality and service and improve its competitiveness in the business environment.

(Yamagar and Ravanan, 2010)	"Material management by using lean manufacturing principles a case study"
Aim of the study	This study attempted to reach: - Continuous improvement in the product; - Reduce inventory or zero inventory; -Eliminate waste, especially wasted time.
Method	This essay is concerned with how to manage the flow and control the flow of materials using some lean manufacturing techniques; Where materials management with the use of lean principles leads to the utilization of time and reduces inventory costs
Result	The study also found the effectiveness of the lean principles and proved that the use of the supplier in determining the amount of inventory is a very effective method because it is close to the market, as well as taking into consideration the ideas of the workers. set goals and even achieved more than that.
(Pineda, 2010)	"Lean inventory management in the Wood products industry examples and applications"
Aim of the study	The goal of this essay is to show the importance of carefully managing wood inventory from raw materials to finished products in wood product manufacturing facilities throughout the United States and other countries.
Method	Gaziantep, Adana ve Osmaniye illerindeki dört ve beş yıldızlı otellerin çalışanlarına anket uygulanarak bilgi toplanmıştır. Örneklemin belirlenmesinde basit tesadüfi örnekleme yöntemi kullanılmıştır.

	Duygusal emek ölçeği olarak Diefendorff, Croyle ve Grosserand (2005) tarafından geliştirilen ölçek kullanılmıştır. İşe yabancılaşmanın ölçülmesinde Hirschfeld ve Field (2000) tarafından geliştirilen ölçek kullanılmıştır. Psikolojik sermaye ölçeği olarak Luthans (2007) tarafından geliştirilen ölçek kullanılmıştır. Bu çalışmada otel çalışanlarından elde edilen veriler SPSS 23 ve AMOS paket programları ile analiz edilmiştir.
Result	Çalışanların duygusal emek yoğunluğundaki artış, işe yabancılaşmalarını arttırmaktadır. Çalışanların sahip oldukları psikolojik sermayeleri, duygusal emek ile işe yabancılaşma arasındaki ilişkide düzenleyici bir rol üstlenmektedir.
(Zlenko and Kireev,2022)	"İnfluence of hull oscillations on loads in the power train of a crawler vehicle"
Aim of the study	The objective of this paper is to improve the work of warehouse personnel, increase the frequency of product movement, and the use of relevant lean technologies to eliminate losses in the warehouse
Method	This paper mainly applies the research methods of analysis, synthesis, coefficient, and comparative methods. Furthermore, throughout the research process, the authors carried out a SWOT analysis and various economic calculations.
Result	Analysis of the strengths and weaknesses, as well as potential opportunities and threats of the company "Coca-Cola HBC Russia" showed a stable position of the business in the market but focused on the need to be flexible and ready to adapt the company's capabilities to the changing needs of customers. Since the production workshop in which the filling production lines are located is located next to the warehouse, the movement of goods is carried out with the help of forklifts. Finished products can move around the warehouse between different technological areas

Research Methodology

Regarding the user approach to answering the problem, the descriptive-analytical approach relied on the case study approach, so the **(IMC POUR INTELLIGENCE MODELISATION CHOIX**) model was used.

The economist "Herbert Simon" put forward this to discover the company and its environment and find the appropriate solution to its problems **(**Gerer Son Entreprise, 2022**).** A productive company has been selected and has a stock, which is commensurate with the nature of the study, as well as due to the prominent importance of this company in producing pipes using fiberglass technology. That is why the sample of this study is made up of the head of the inventory management department, the head of the purchasing and supply department, the head of the production department, and the head of sales, the reason is that the others are not directly related to the subject of the study.

1. Stages of addressing the problem of the study and the tools used

As I mentioned earlier, to address the waste problem in the inventory management function, this field study will be based on the famous model presented by Simon (IMC) to make the right decisions and to find solutions for the company's problems. In this model, the tools used in this study will be clarified. Simon's model states that the process of finding solutions, whatever their level, from the strategic level to the practical level, passes through three basic stages that were employed in a study as follows:

1.1 The first stage: Intelligence

At this stage, the nature of the problems that the company suffers from in general and the inventory management function, in particular, are identified and understood, and analyzed to get a clear idea of this function. For this, the following tools were used:

1.1.1 Conducting an interview using the ASLOG reference*

Interviews were conducted with the heads of the concerned departments, namely, the Inventory Management Department, the Purchasing and Supply Department, the Production Department, and the Sales Officer, where a set of ten (10) half-directed questions were asked aimed at discovering the most important problems related to waste in the tracks related to inventory management. The **ASLOG*** reference is considered one of the most important references for assessing the maturity of practices related to supply chain management, including practices related to the inventory management function (Laghouag, & Hadid, 2013:12). In this study, only the questions related to the stock management function were limited to a group of concerned officials, as it will be addressed later when presenting the results of diagnosing the reality of the company.

1.1.2 Observation

The observation aims to ascertain the results obtained after the interview with the various officials concerned. It also aims to determine how inventory is received and exported and the machines used for that, in addition to the warehouse inspection. The external view corresponds to an idealistic approach in which the researcher tries to embody his relationship as much as possible with the people and facts he studies in a way that makes him semi-transparent; He comes discreetly to the sights he notices (Fassın, 1999: 99).

1.1.3 Documents

To verify the results of the interview, we used the company's documents for the year 2017, where I reviewed documents related to the most important raw materials in the company.

1.2 The second stage: Modeling the solution(Modélisation)

At this stage, the data and information obtained in the previous stage will be analyzed, to determine the dimensions of the problem and understand its parts, through the use of a set of tools used in the quality path to find appropriate solutions for the company under study to help it overcome wasteful problems, considering that the

latter. It is considered a cost borne by the company, which negatively affects its performance. These tools can be mentioned as follows:

1.2.1 Ishikawa Model

Ishikawa diagram is defined as a graphic representation that schematically illustrates the relations between a specific result and its causes. The studied effect or negative problem is “the fish head” and the potential causes and sub-causes define the “fish bone structure". Therefore, the diagram reveals the relationship between a problem identified in a product and its potential causes (Liliana, 2016: 2). Ishikawa's cause-effect diagram will be used to discover the most important causes of the main problem; the waste that the inventory management function suffers from to identify and classify problems according to the 5M method.

1.2.2 Brainstorming

To identify the various wasteful problems in the inventory management function, and categorize them according to the 5M method, the brainstorming method was used with different heads of departments (Bardin, 2018: 14-19). 5M; This tool is used to alleviate some problems, such as lost time in searching for equipment, and also used to clean and organize the workplace (Alaoui et al, 2011: 7-8).

1.2.3 The ABC Model

To arrange the problems according to the degree of criticality and the negative impact on the stock management function, the triple analysis method was used for the most critical problems, the greatest importance and envisioned solutions, as we explained the order of the problems in the statistical program **Minitab version 14**. The goal of the triple analysis **(ABC)** in any administrative field, is to determine the scope in which efforts must be focused to achieve the highest results, and in the field of inventory control, the basics of inventory management associated with this analysis can be identified in the following table:

Table 01: *The basics of inventory management related to the triple analysis.*

Sections	**A**	**B**	**C**
%Total number of types	10 to 70%	30 to 40%	**40 to 50%**
% Cumulative value of inventory types	70 to 80%	15 to 20%	**5 to 10%**
Monitoring level	Utmost	Medium	**A little**
Spare storage	Low	Average	**Important**
Repeat inventory decisions	High	Light	**Weak**
Inventory turnover	High	Average	**Weak**
Inventory management procedures	**Care and accuracy frequent review**	**Normal**	**Periodically once or twice a year**

Source: Plante, J. & Tchokogue, A. (1999). La gestion des stocks pour un fabricant aux grandes chaînes. Direction des communications. Québec. Canada. Septembre: 07. In French

1.2.4 Pareto model

This analysis is based on "Pareto's law" (1907) after the socio-economic scientist (Vilfredo Pareto) (1923-1848), who wrote his belief that from 80 to 85 percent of Italy's money is owned by only 15 to 20 percent of the country's population, where he called the small group B (vital few) and others called them B: (vital many) to finally know the rule (80/20) or Pareto's law (Muller, 2011: 70). after finding the most important product that includes components from the raw material that has a share of the company's money, the raw materials for this product are arranged according to their value using the Pareto model and this is to invent the materials and understand to what extent these materials suffer from the problems that were previously identified, as well **Minitab v14** was used to show the most items that represent **80%** of the money and items that represent **20%** of the money.

1.2.5 Graphic curves

Aim to show the imbalance in supplies and consumption for the year 2017 and the movement of the stock to show the waste in the stock management function**.**

1.3 The third stage: selection

After modeling the solutions and preparing a set of proposals that were conceived to solve the problem of waste in the inventory management function and improve its performance, it was presented and discussed with the company under study and the use of the brainstorming method; Where an attempt is made to find a solution to the problem of the study by launching a set of solutions, and then the most appropriate solutions are selected, after adapting them to the nature of the company's work.

Search limits

The search is limited to a company producing pipes with fiberglass technology in Algeria. Field training was conducted in a company from (11-01-2018) until (28-05-2018). Data provided by the company in the form of documents(01-01-2017 to 31-12-2017) were used, and face-to-face interviews were conducted with managers between (13-03-2018 to 04-04-2018), as well as the observation that took place throughout the internship period.

RESULTS

View company-specific diagnostic results: At this point, the results of the interview that took place with some officials who have a relationship with inventory management will be presented, as well as the results of Ishikawa's analysis of the various problems and obstacles faced by the inventory management function. I did the interview using the ASLOG reference: To conduct the interview, the personal data of the respondents were analyzed, which related to (job, educational qualification, and years of experience) and in light of this, the characteristics of the study sample members can be determined as follows:

Table 02: *Respondents' Data*

Profession	**Qualification**	**Years of experience**	**The interview date**
Head of the inventory management department	Senior technician	16	13.03.2018

Head of the production department	State engineer	9	27.03.2018
Head of purchasing and supply department	State engineer	9	02.04.2018
Head of sales department	Bachelor's degree	5	04.04.2018

Source: Prepared by the researcher based on interview questions

10 questions from the ASLOG reference were asked to a group of officials (Head of the Production Department, Head of the Sales Department, Head of the Purchasing and Supply Department, and Head of the Inventory Management Department), each job head had specific questions, sometimes questions about two different jobs were asked to the same person, and each of the questions was included The answers are in the following table:

Table 03: *Interview with a group of company officials*

The question	**The answer**
1-How are suppliers selected?	According to the purchasing and supply official, when the stock management department sends a supply request with raw materials, I contact a group of suppliers to specify the required specifications for the material, and then they send their offers about what they can provide and choose the appropriate supplier according to the quality and the price of materials, as well as the quantity that the supplier can provide in the time required, is often chosen according to quality more than price and time because the company bears the responsibility of enjoying the ISO 90001 certificate, but the choice is due to the process, especially in determining both the quantity and the price; This answer was confirmed by the inventory management official, who said that the last word belongs to the manager in the company in determining the appropriate supplier to bring the order
2-What type of information system is used in inventory management?	According to the inventory management official: the information about the inputs, outputs, the consumed quantity, and its location, and all information about the immediate context of the stores is recorded in an information program called PC Stock

3-How are catering operations managed?	According to the storage official, the storage procedures begin when the item arrives at the company with an external transport, for example, the raw material called resin is unloaded from the trucks, and then the resin drums are entered into the warehouse, knowing that the resin is valid for a period of six months at most. Where it is subject to inspections and examinations to ensure the conformity of quantity and quality with the invoices, if the invoices are not received on time, a receipt voucher is received. There are times when the commodity arrives not according to the required specifications, which leads the company to appeal and be compensated, but this is only in cases because if it received the commodity from abroad and with deficiencies that are borne by the company, the Head of the Stocks Department gives the invoice to the Finance Department to convert it into a national currency and then returns it to him to enter this information into a program called PC Stock. At this time, the Quality Control Department takes samples of the raw material and sends a report to the Department of Stock Management.
4-How are the requirements for basic materials and compounds for production determined?	According to the production official, the needs of the raw material are determined by the sales department, but he, in turn, sends estimates on the needs of the raw material, and determines the production vehicles, according to the projects obtained or predicted. As for the official of the inventory management department, he had a contrary opinion, as he sends his need to the purchasing department in certain quantities, but the same quantity required is not brought by the Purchasing and Supply Department, and he is not consulted in the meetings that are held, which include the production official, the sales official, and the company manager to determine the needs and basic components of production. As for the sales official, he replied that the production department determines the vehicle's production as well as material needs.
5-How does the company plan both production and supplies?	According to the production official, production and supplies are planned according to the confirmed and expected projects. As for the storage official, he said that all he has to do is fill the stores with the raw material so that he is not responsible for interruption in the production process.
6-How is the reliability of suppliers ensured (through the conclusion of a contract, or only based on mutual trust)?	According to the purchasing and supply official, when purchasing large quantities, this is according to a contract. If the quantities are small, there is no contract; This answer was the same on the part of the inventory management official and also the production official.

7-How are orders delivered to customers?	According to the sales official, he is responsible for delivering the product to the project site, but this is in very rare cases, meaning that a customer is the one who comes to the company to take his order, and this has been confirmed by the production official.
8-Is the process of supplying raw materials compatible with production needs? Or are there cases in which a drop was recorded in one of the materials, which led to the suspension or postponement of the production process?	According to the inventory management official, there is a surplus in stocks, which is greater than the production need. According to the production management official, there is a permanent delay in supplying it with the raw material, which hinders it from production; As for the purchasing and supply official, he admits that he is not in control of bringing the quantities on time,which causes delays in product delays production productively this delivery food order.
9-Is the production process in line with customers' orders and market needs, or does the customer wait a long time to get his order?	According to the sales official, the customer is obliged to wait for them due to the privileges that the product has. As for the production official, he is not satisfied with the length of the delivery period because he can produce the products in less time than the time given to customers, but the lack of the basic material (resin) disrupts production.
10-What are the problems faced by the inventory management function, which may hinder its proper functioning? Are these problems internal (i.e. related to the function of stock management) or are the problems of an external source?	According to the purchasing official, there are no internal problems. The main problem is the supply of the basic material (resin) from abroad; Which in most cases leads to non-delivery at the agreed time; As for the stock management official, he confirms that the main problem is not consulting him during determining the required quantities and not supplying it with the same quantities that he requests each time. As for the production official, he said that the interruption of the basic material and the speed of its damage compels him to produce without request to avoid loss in the raw material (resin).

Source: Prepared by the researcher based on the ASLOG reference

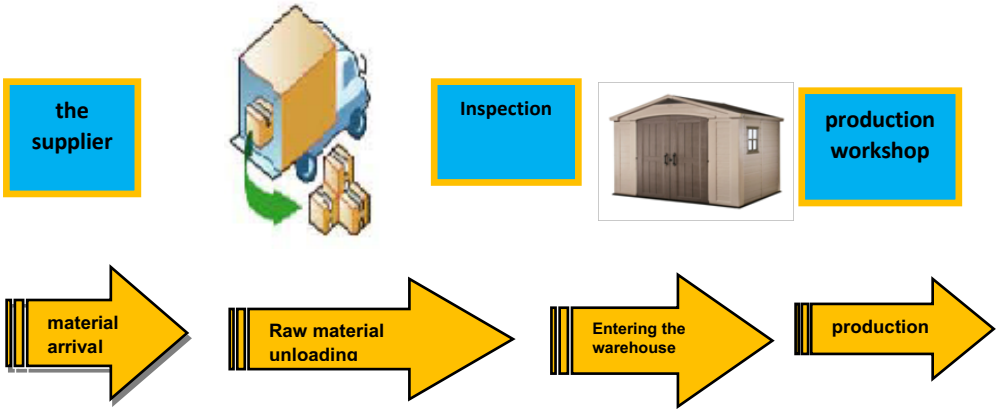
It was noticed that most of the respondents' answers are not uniform, and this is due to the contradiction of policies between jobs and the lack of defining tasks well by the first official.

A. Answer No. (01) on how to choose suppliers, assuring them that the manager is the one who chooses both the supplier and the required quantity of raw materials; This is considered a dangerous indicator for a company, because of the lack of intervention of the financial department and coordination with each of the departments of inventory management, production, and purchase will lead to an imbalance in the material flows of the company.

B. Answer No. (02) about the user information system in the Department of Inventory Management. It uses one of the oldest PC stock programs. Through this program, the stock official can know the content of the stores and quantities, while the other departments do not see his work.

C. Answer No. (03) on how to conduct the purchase process; As for the procedures for supplying the raw material, it is the responsibility of the head of the Procurement and Supply Department to supply the raw material, but there are no strict procedures when the quantities required from the company do not match the quantity received by the suppliers. As for the receiving procedures, the head of the inventory management department. The following figure shows the different stages of storage:

Figure 01*: Stages of the raw material storage process*

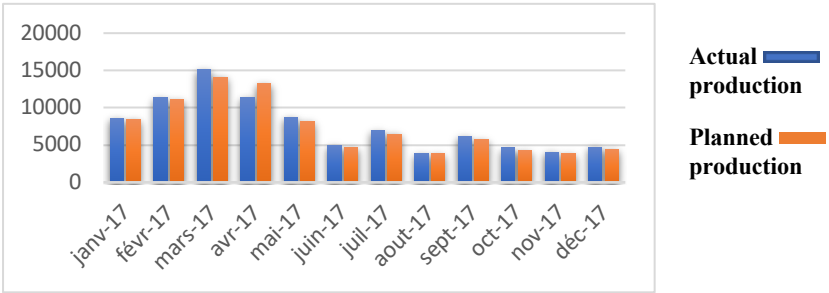


Source: Prepared by the researcher

D. Answer No. (04) on how to determine the need for materials and who determines the components of production. There is inconsistency in the answers and the reason is due to the lack of good definitions of tasks..

E. Answer No. (05) on how to plan production and supply, it appears that planning is according to the received and forecast projects, but in the end, the sales office consulted to determine the final plan but what the production official needs are not taken into account. The following figure shows the expected production quantities by the company and the actual quantity of the company's products.

Figure02: *Planned and actual production of a produc*



Source: Prepared by the researcher based on the outputs of the Excel program

It is noticeable that there are differences between the planned production and the actual production of this product in the company, which explains the existence of a flaw in the forecasting method. This is due to several

reasons, including a lack of agreement between the various departments during the preparation of product preplanning.

F. Answer. (06) on how to ensure the reliability of suppliers, there was no difference in the answer, but it is noticeable when the quantities are small that it is not important when a problem occurs with the supplier.

G. Answer. (07) About how to deliver orders to customers, there is an agreement on the answer.

H. Answer. (08) the extent of compatibility in material needs with production, there is a difference in the answer between the production official and the inventory management official, and the inventory management official confirms the presence of surplus in stock. The production official confirms the delay in supplying. As for the purchase official, he confirms that he does not have control over the time of receiving the materials, and this is due to the receipt of the material from abroad. It is noticeable that there is fluctuation, there are periods when the stock management official falls into the problem of surplus and sometimes there is a shortage of the basic material and this is a result of randomness in management and lack of control in estimating changes. The external environment and the incompatibility between the three departments.

I. Answer No. (09) about the extent of compatibility between the customer's needs and what has been produced. There is a lack of agreement between the production department and the purchasing and supply department.This reflects several problems that go back to creating the problem of customer dissatisfaction.

J. Answer No. (10) Regarding the various problems that inventory management suffers from, according to the answers of the respondents, the problems are of an external nature and are related to the supply of raw materials from outside the country, especially resin.

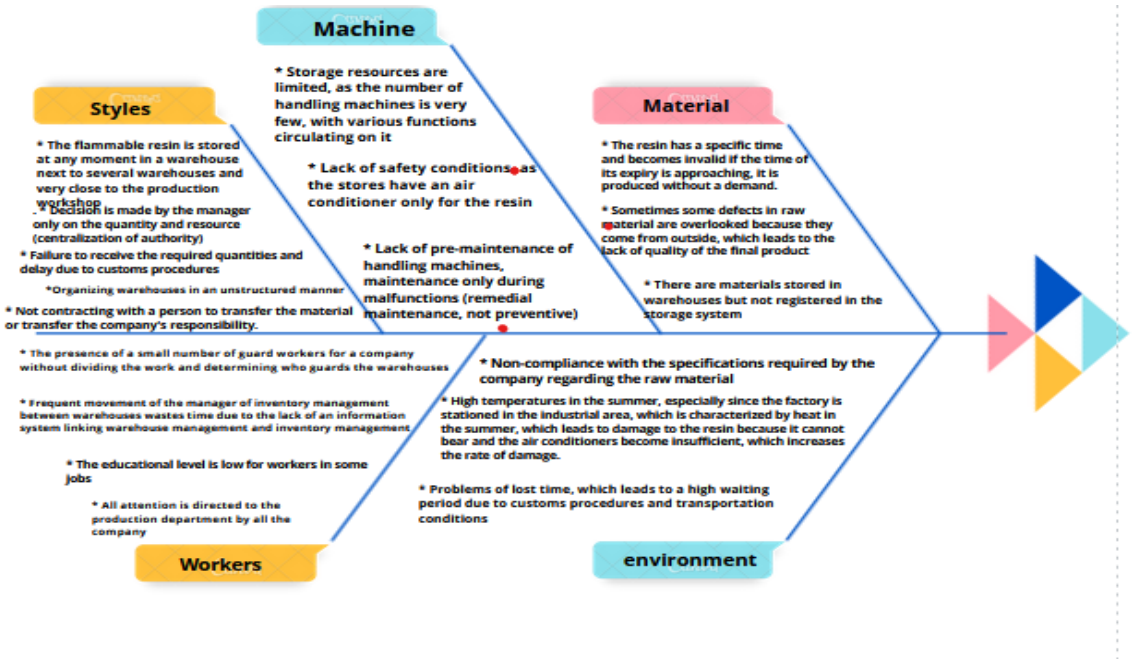
Classification of problems according to the 5M method: Using the research tools, we analyzed the interview to discover the various problems related to inventory management, Hence, the main problem that you suffer from is waste. This is shown in the following table, which was displayed using the Ishikawa model:

5M	
Material	* The resin has a specific time and becomes invalid if the time of its expiration is approaching, it is produced without a demand. * Sometimes some defects in raw materials are overlooked because they come from outside, which leads to the lack of quality of the final product * There are materials stored in warehouses but not registered in the storage system
Machine	* Storage resources are limited, as the number of handling machines is very few, with various functions circulating on it * Lack of safety conditions, as the stores have an air conditioner only for the resin * Lack of pre-maintenance of handling machines, maintenance only during malfunctions (remedial maintenance, not preventive)

Styles	* The flammable resin is stored at any moment in a warehouse next to several warehouses and very close to the production workshop. * Decision is made by the manager only on the quantity and resource (centralization of authority) * Failure to receive the required quantities and delay due to customs procedures *Organizing warehouses in an unstructured manner * Not contracting with a person to transfer the material or transfer the company's responsibility.
Workers	* The presence of a small number of guard workers for a company without dividing the work and determining who guards the warehouses * Frequent movement of the manager of inventory management between warehouses wastes time due to the lack of an information system linking warehouse management and inventory management * The educational level is low for workers in some jobs * All attention is directed to the production department by the company
Environment	* Non-compliance with the specifications required by the company regarding the raw material * High temperatures in the summer, especially since the factory is stationed in the industrial area, which is characterized by heat in the summer, which leads to damage to the resin because it cannot bear and the air conditioners become insufficient, which increases the rate of damage. * Problems of lost time, which leads to a high waiting period due to customs procedures and transportation conditions

Source: Prepared by the researcher

Figure03*: Ishikawa diagram of various problems of the inventory management function*



Source: Prepared by the researcher

Study Results Analysis

After identifying the various problems that the inventory management function suffers from in general, at this point I will delve into the analysis, and this is by presenting, analyzing, and ranging the problems that the important products suffer only, in the application of the principle of priorities in management trying to find solutions to these problems.

After identifying the various problems that the inventory management function suffers from using the tools mentioned, the analysis was deepened by presenting, analyzing, and identifying the problems that the important product suffers from, according to the application of the principle of priorities in management by trying to find solutions to these problems.

First: ABC analysis to arrange the problems of the inventory management function (Courtois et al. 2003: 124). The ABC analysis aims to determine the scope on which the control efforts must be based to achieve the highest results. I rank waste-related issues in the inventory management function from the largest cause of problems to the least cause so that control efforts focus on this category and give it importance in finding solutions. Table 05 arranges the causes leading to the main problem, which is waste in the stock function. The method of voting was chosen to rank the importance of the reasons for waste, and to do this we asked the officials to give a weight between 1 and 10 for each reason, and the most wasted reason would be the highest weight, and the result of the vote is calculated by taking the average vote between three sections in the following table:

Table 05:*Arranging the problems according to the degree of criticality*

	The reason	Inventory Management	Purchasing and supply department	production management	Average answers
01	* The resin has a specific time and becomes invalid if the time of its expiry is approaching, it is produced without a demand.	10	8	8	8.66
02	* Sometimes some defects in raw materials are overlooked because they come from outside, which leads to the lack of quality of the final product	9	9	10	9.33
03	* There are materials stored in warehouses but not registered in the storage system	1	6	1	2.66
04	* Storage resources are limited, as the number of handling machines is very few, with various functions circulating on it	8	1	9	6
05	* Lack of safety conditions, as the stores have an air conditioner only for the resin	9	2	8	6.33
06	* Lack of pre-maintenance of handling machines, maintenance only during malfunctions (remedial maintenance, not preventive)	7	2	8	5.66
07	* The flammable resin is stored at any moment in a warehouse next to several warehouses and very close to the production workshop.	9	4	8	7
08	* Decision is made by the manager only on the quantity and resource (centralization of authority)	7	7	10	8
09	* Failure to receive the required quantities and delay due to customs procedures	10	10	10	10
10	*Organizing warehouses in an unstructured manner	2	1	3	2

11	* Not contracting with a person to transfer the material or transfer the company's responsibility.	8	10	9	9
12	* The presence of a small number of guard workers for a company without dividing the work and determining who guards the warehouses	1	2	1	1.33
13	* Frequent movement of the manager of inventory management between warehouses wastes time due to the lack of an information system linking warehouse management and inventory management	1	6	8	5
14	* * The educational level is low for workers in some jobs	1	6	9	5.33
15	* All attention is directed to the production department by all the company	1	10	9	6.66
16	* Non-compliance with the specifications required by the company regarding the raw material	7	9	9	8.33
17	* High temperatures in the summer, especially since the factory is stationed in the industrial area, which is characterized by heat in the summer, which leads to damage to the resin because it cannot bear and the air conditioners become insufficient, which increases the rate of damage.	10	3	10	7.66
18	* Problems of lost time, which leads to a high waiting period due to customs procedures and transportation conditions	10	10	9	9.66

Source: Prepared by the researcher

After determining the weight value for each problem, I did the following in order to determine this:

• Arrange the list of causes problem in descending order of weight value;

• Percentage per weight; • I calculate the cumulative percentage of the weight value (%);

• Determining the categories of varieties A B C according to the proportions. The following table shows this:

Table 06: Arranging the problems according to the ABC method

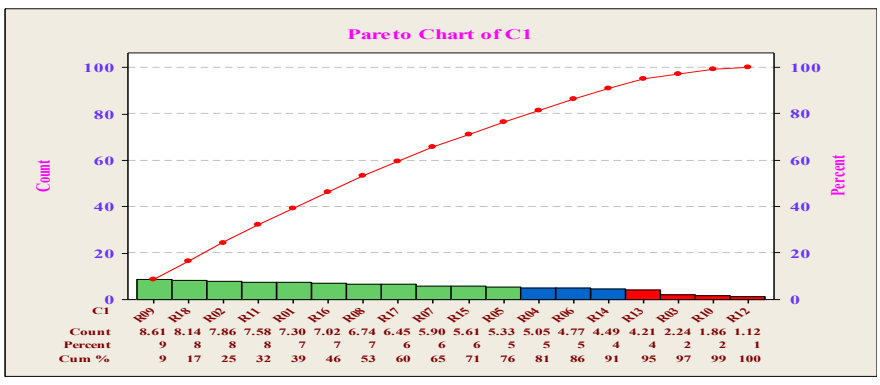
	The reason	Weight	Weight %	Cumulative percentage of weight value (%)	ABC. Category
09	* Failure to receive the required quantities and delay due to customs procedures	10	8.61%	8.61	A
18	* Problems of lost time, which leads to a high waiting period due to customs procedures and transportation conditions.	9.66	8.14%	16.75	A
02	* Sometimes some defects in a raw material are overlooked because it comes from outside the country, hichwhichds to the lack of quality of the final product	9.33	7.86%	24.61	A
11	* The expenses of transporting the material are large due to the lack of transportatilargely the company.	9	7.58%	32.19	A
01	* The resin has a specific time and becomes invalid if the time of its expiry is approaching, it is produced without demand	8.66	7.30%	39.49	A
16	* Non-compliance with the specifications required by the company with regard to the raw material	about	7.02%	46.51	A
08	* Decision is manmade about on the quantity andmanmadecaboutralization of authority)	8	6.74%	53.25	A
17	* High temperatures in the summer, especially since the factory is concentrated in the are a that is characterized by heat in the summer, which leads to damage to the diverticulum material because it cannot bear and the air conditioners become insufficient, which increases the rate of its damage	7.66	6.45%	59.7	A
07	* The flammable resin is stored at any moment in a warehouse next to several warehouses and very close to the production workshop	7	5.90%	65.6	A
15	* All attention is directed to the production department by the company	6.66	5.61%	71.21	A

05	* Lack of safety conditions, as the stores have an air conditioner only for the resin	6.33	5.33%	76.54	A
04	* Storage resources are limited, as the number of handling machines is very few, with various functions circulating on it	6	5.05%	81.59	B
06	* Lack of pre-maintenance of handling machines, maintenance only during malfunctions (remedial maintenance, not preventive)	5.66	4.77%	86.36	B
14	* The educational level is low for workers in some jobs	5.33	4.49%	90.85	B
13	* Frequent movement of the manager of inventory management between warehouses wastes time due to the lack of an information system linking warehouse management and inventory management	5	4.21%	95.06	C
03	* There are materials stored in warehouses but not registered in the storage system	2.66	2.24%	97.3	C
10	*Organizing warehouses in an unstructured manner	**2**	1.86%	99.16	C
12	* The presence of a small number of guard workers for a company without dividing the work and determining who guards the warehouses	**1.33**	1.12%	100.00	C
	Total	**118.61**	**100**%	/	/

Source: Prepared by the researcher

To obtain a comprehensive overview of the various types of problems experienced by the inventory management department, the previous table can be translated into the following figure

Figure04: *Problems according to the degree of criticality depending on the ABC method*



Source: Prepared by the researcher based on Minitab (V14)

In light of the above figure, the company can benefit from this method through the following:

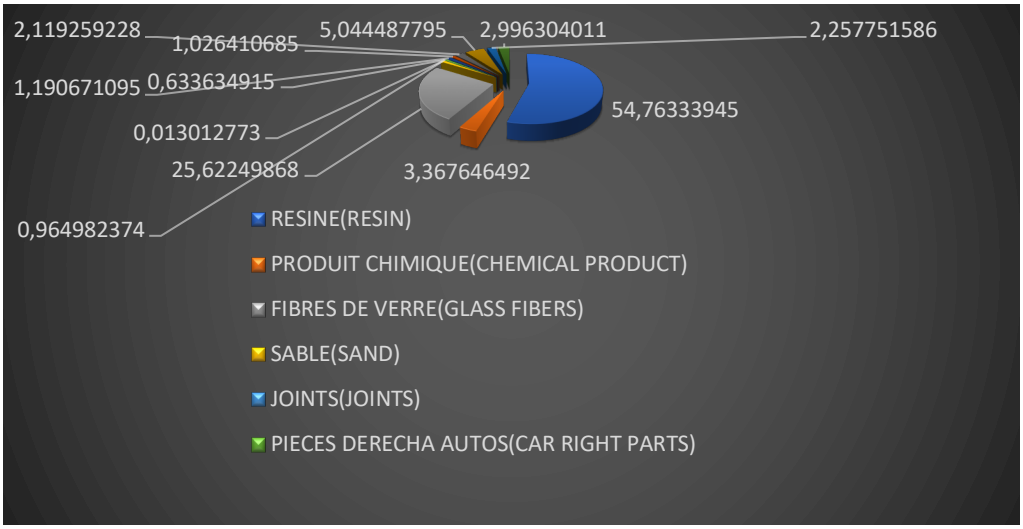
o Directing maximum efforts to find solutions for category A

o Directing medium efforts to find solutions for category B

o Directing minimal efforts to find solutions for category C. From the above table, it can be seen that category A is centered around cost and time issues.

Second: Pareto analysis is used to determine the most important materials. After identifying and arranging the various problems, and showing that the problem of time and cost are the most important problems, now comes the stage of knowing the extent to which these problems affect the most important materials in the company (the materials that are included as components in the products that make up the largest percentage of the company's turnover). I will classify all the raw materials owned by the company according to their families and find out which raw materials take the largest share of the company's funds, for more clarification, they are placed in a relative circle as follows:

Figure05: *Raw materials for the foundation according to its families*



Source: Prepared by the researcher based on the outputs of the Excel program

As it is clear from the relative circle that the resin material (RESINE) takes the largest share compared to all the raw materials that the company uses in the production process, as it took 54.76%, and its percentage took more than half of the circle, this shows the importance of this type of raw materials. It is an essential component of the company, then comes the fiberglass material (FIBRES DE VERRE), and this material also represents a significant percentage of the company's funds, representing 25.62%, and this shows the importance of these two families of raw materials; Any defect that occurs in them is considered a waste that the company will bear. For more detail and to be sure, I chose one of the company's products, considering that this product is one of its main components, materials from the type of glass fibers (HOOP2400, HOOP4800, CHOP2400). Moreover, this product is one of its components, materials from the resin family (RESINE ISOPHTALIQUE, RESINE ORTHOPHTALIQUE),and also it is characterized by the highest percentage of the company's money, so we chose the axial winding tube product and conducted the study on it, where we classified the components of this product in a table using Pareto (20% /80%) to extract the most important stock for this product, and this is as follows:

Table 07*: Components of the axial winding tube product*

MATERIAL	The quantity purchased in 2017	Unit price	Inventory value	Inventory value in proportion to the total
HOOP 2400	300636,20	/	36027578,10	**10,51**%
HOOP 4800	408492	/	47192586,84	**13,77**%
CHOP 2400	135240	/	19150756	**5,58**%
RESINE ISOPHTALIQUE	258000	/	68190382	**19,89**%
RESINE ORTHOPHTALIQUE	**754700**	/	155730466,80	**45,44**%
SABLE	**777**	/	4662000	**1,36**%
ACCELERATEUR	6120	/	5347841,40	**1,56**%
CATALYSEUR	17280	/	6374246,40	**1,86**%
Total	/	/	342675857,54	**100**%

Source: Prepared by the researcher based on documents

Note: The unit price is not included in the table as it varies throughout the year.

These materials are arranged in order according to their importance to the company and according to the 80/20 method, they are arranged according to what the materials represent from the total value of the materials shown in the fifth column. After calculating their proportions, we create the second table, but the arrangement will be according to the proportions in a descending manner and this is shown in the following table:

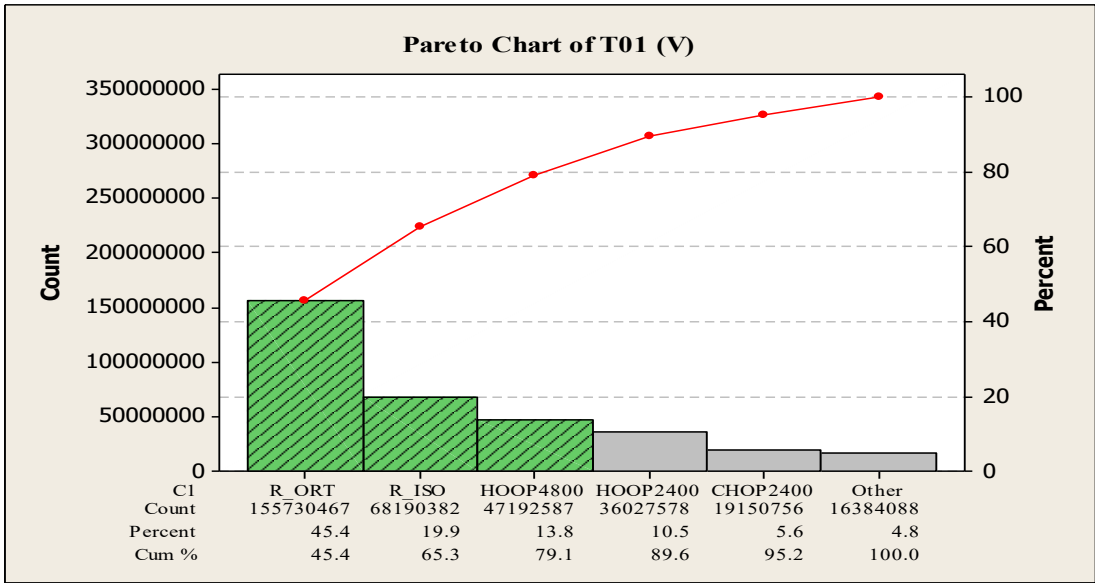
***Table* 08:** *Arrangement of axial winding tube product Components by (80%/20%)*

Material	The quantity unit purchased in price 2017	Inventory value	Inventory value in proportion to the total
ORTHOPHTALIQUE	754700	155730466,80	**45,44**%
ISOPHTALIQUE	258000	68190382	**19,89**%
HOOP4800	408492	47192586,84	**13,77**%
HOOP2400	300636,20	36027578,10	**10,51**%
CHOP2400	135240	19150756	**5,58**%
CATALYSEUR	17280	6374246,40	**1,86**%
ACCELERATEUR	6120	5347841,40	**1,56**%
SABLE	777	4662000	**1,36**%
Total	/	342675857,54	**100**%

Source: Prepared by the researcher based on documents

As it can be seen, three materials represent 80% of the total value of the materials that make up the product, and the rest (the five materials) represent only 20% of the total value of the materials that make up the product. Through this table, we can draw the following figure:

Figure06: *Arrangement of Materials According to Pareto's Law*



Source: Prepared by the researcher based on Minitab v:14

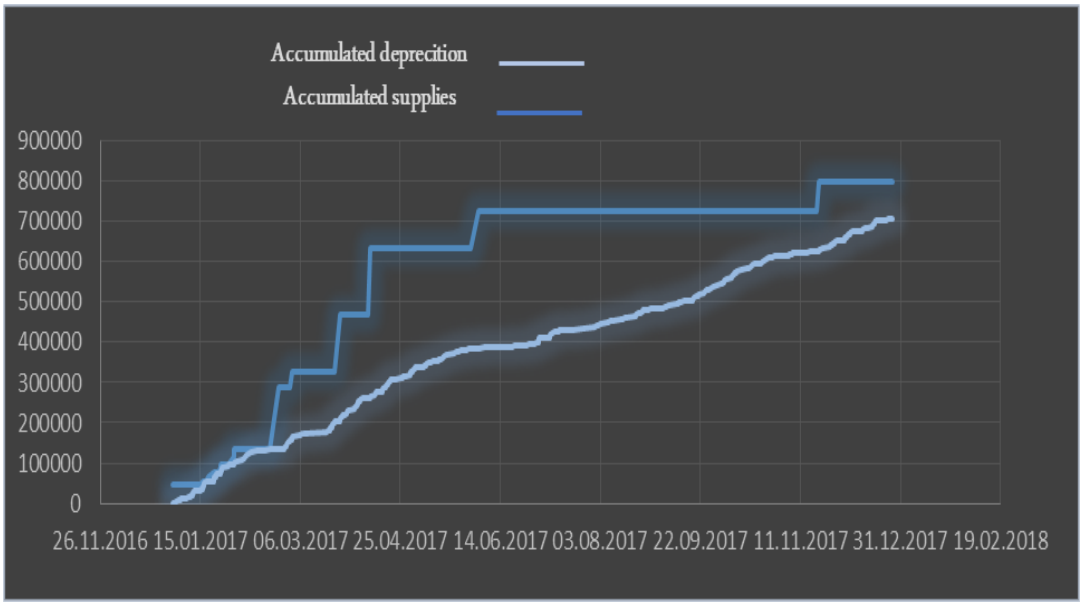
This figure represents the extent of the importance of some materials distinguished by a minority over other materials distinguished by a large number. Therefore, the company should pay more attention to the three materials by imposing control over them and taking measures that give them priority in the negotiation process aimed at purchasing and further consolidating relations with suppliers of these materials to avoid interruption.

Third: Analyzing the movement of stocks to find out the problems of time and costs for the most important materials. I will try to shed light on the basic material from the ORTHOPHTALIQUE family that the company uses to try to discover the weaknesses in the management of these stocks to reach tohtoiminate thatastethatlosses. By analyzing the waste company's data related to the quantities and dates of supplies, as well as the volume and pace of consumption of these materials during 2017, in addition to the data related to the orders placed for this basic material, I was able to note the following:

• The idea of the minimum stock and the reserve stock is completely nonexistent with the company, which is explained by the fact that the stock reached zero in several cases, as shown in Figure 07 and confirmed by Figure 08 on January 18 and February 19. This situation can be explained by the delay of supplies beyond the specified Date shows the lack of realistic programming for supplies that takes into account all the obstacles or delays that may occur with the supplier, or with shipping companies, or those related to procedures before the customs authorities, the port administration or even with banks.

• The process of optimal inventory management states that the curve of accumulated supplies must move away a little to the left from the curve of accumulated consumption and this is in order not to fall into the case of stock interruption, but the company does not respect this basic rule, although this material is very important as the basic material that It enters into the product and takes the largest percentage of the total value of the product as shown previously in the Pareto model.

Figure07: *The movement of accumulated entries and outputs for ORTHOPHTALIQUE for the year 2017*

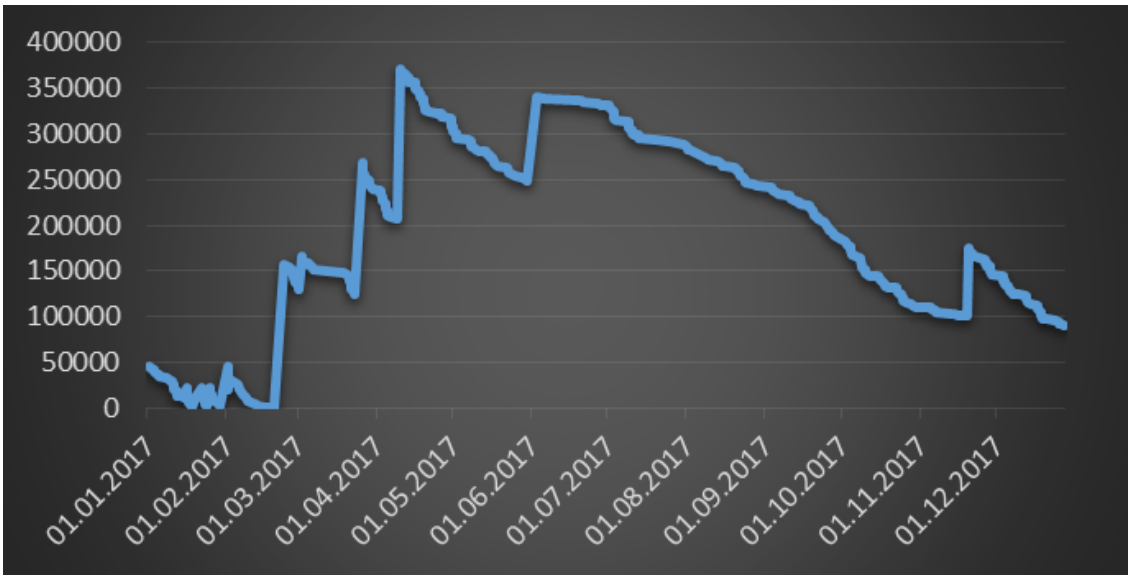


Source: Prepared by the researcher based on documents

• The arrival of the stock of basic materials to zero as shown in Figure 07, would obstruct the production program, and it also reflects the unemployment cost of production resources. As the company bears large fixed costs and the pace of production is either low or non-existent, this leads to a lack of meeting customers' requests on time.

• The lack of good programming of orders and their arrival date made the company receive the largest percentage of its annual needs in the first third of the year, as shown in Figure 08 and Figure 09. This rule is considered correct if the company expects a future rise in the prices of raw materials, and this rise allows covering the opportunity cost, but by reference to the company's bills, we find that prices at the global level are still fixed, but the increase was in the exchange rate in Algerian banks, and therefore the decision to supply large quantities was not taken rationally considering that the exchange rate is always fluctuating, whether an increase or decrease.

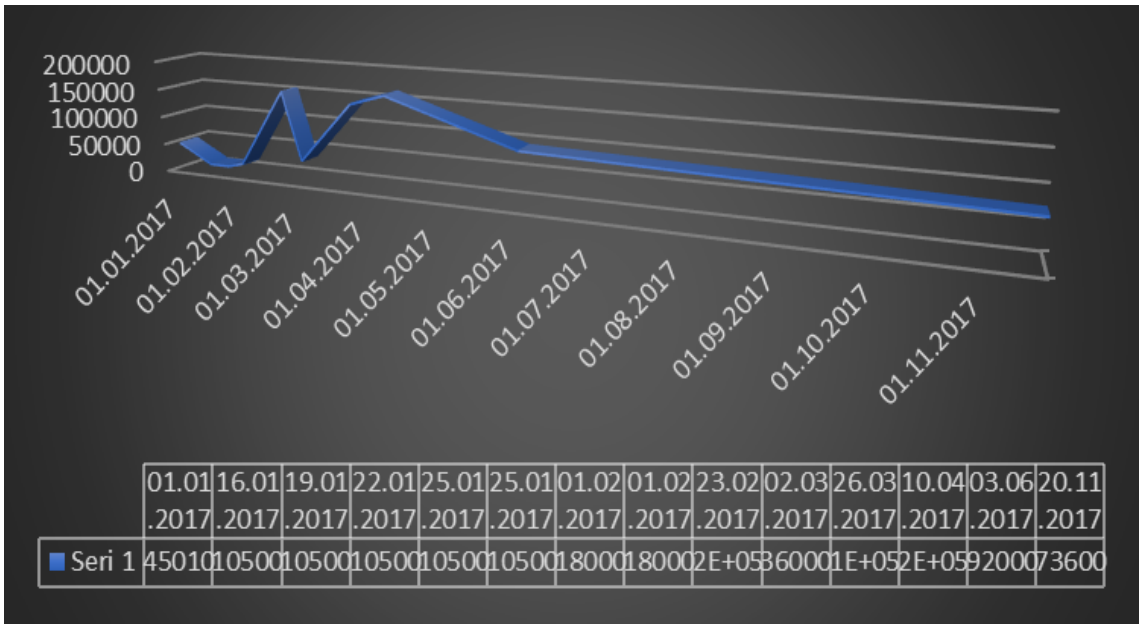
Figure08: *OTHOPHTALIQUE ınventory curve for 2017*



Source: Prepared by the researcher based on documents

• In the same context, we notice in Figure 08 that the previous rule has been exaggerated. We found that starting from April, the supply curve shifts to the left terribly from the consumption curve, which explains the existence of very large catering operations that can cover consumption for a long time. In other words, these horrendous quantities these horrendous freezing off in the stock, therefore we note the lack of good management of the needs of working capital, which may waste alternative opportunities for the company that could appear in the market.

Figure 09: *Curve of supply movement for ORTHOPHTALIQUE for the year 2017*



Source: Prepared by the researcher based on documents

Conclusion:

o The industrial company producing pipes with fiberglass technology does not pay much attention to the function of inventory management, as all its attention is focused on the interest of production only since it is the sensitive function in the company, a function that significantly increases the company's profits, but without good inventory management this might directly affect the production management and any defect in inventory leads to disruption and interruption in the production process;

o The poor performance of the inventory management department, due to its irrational use of its financial resources, led to a lack of control over costs;

o Lack of a clear warehousing strategy in the company and lack of interest in the scientific application of scientific methods in management;

o Failure to take into consideration the opinions of the inventory function manager in determining needs, which does not allow good inventory management;

o There are no serious procedures when the quantity received from suppliers does not match the required specifications, and the company bears those losses;

o Not concluding contracts with suppliers and the company in the purchase of the raw material, relying on mutual trust;

o The lack of the raw material arriving in time will inevitably lead to disruption in the production process due to the external supply of the raw material;

o There is no reserve stock in the company, which reflects the failed production programming.

Suggestions

o Involving suppliers in decisions related to determining a demand for raw materials, as they are close to the market;

o The company could invest by opening a factory affiliated to the company for the production of the raw material resin and the company's supply of the company itself to respond to control the times of delivery of the raw material;

o Inventory forecasting: This is the first step to improve the company's knowledge of its needs and collecting the correct information. You need to know the number of items stored in the company's inventory, the type of items, their delivery time, and turnover, as all historical data is collected in one place to analyze and interpret the results. Storing them more frequently and participating orders for some products will eliminate waste and prevent stockpiling.

o Seeking to create a balance between the three functions of the inventory management function, the production function, and the purchasing and catering function, reconsidering how its operations are conducted; Strengthening the relationship between them, especially in the case of industrial enterprises;

o Employing specialized frameworks in the process of optimizing inventory management, as well as qualifying the workers of the inventory department for training courses in inventory management;

o Using scientific methods to manage inventory according to agile management in determining the optimal amount of inventory;

o Discovering the problems that the inventory management function suffers from and finding solutions to them by using modern methods of inventory management

The benefit of this study lies in conducting prospective studies, as the current study allows studies in each of the following:

o Optimizing the supply chain through the lean management system

o Improve production management within the framework of lean management

o Lean inventory management in service organizations

o The effect of using lean management methods in the treatment of production waste

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Structured Abstract

Inventories have an important role in the company, as it avoids the greatest risks of an interruption in the production process, on the other hand, the company bears the costs of keeping it and other risks that threaten its existence, so we are supposed to find an optimal solution (the optimal level) where there is no surplus in the inventory to reduce waste of all kinds; From here came the main problem that can be crystallized in the following main question: How can inventory management tools according to the lean management improve the performance of the inventory management function**?**

In literature, the storage process is a striking phenomenon and has a scientific treatment of inventory that was not known until recently (1929) the American engineer Wilson is considered as the first one who developed a model for organizing inventory and his goal is to reduce costs in a company. Lean management was adopted in Japan as a result of what the Japanese economy suffered from between the two wars from the depletion of various resources. During this period, the Japanese worked to create value from nothing and eliminate various sources of waste.The reason behind this research is to get more familiar with the methods of inventory management in a company in the sense of diagnosing the current situation, eliminating waste in terms of costs and in terms of eliminating lost time in the company under study, and trying to integrate the most important inventory techniques into the philosophy of agile management and its embodiment in reality; Expected from This research is also to introduce lean inventory techniques and help managers and businessmen to adopt these tools that are successful in removing waste from the inventory function in a production company.

Regarding the user approach to answering the problem, the descriptive-analytical approach relied on the case study approach, so the (IMC POUR INTELLIGENCE MODELISATION CHOIX) model was used. A productive company has been selected and has a stock, which is commensurate with the nature of the study, as well as due to the prominent importance of this company in producing pipes using fiberglass technology. The sample of this study is made up of the head of the inventory management department, the head of the purchasing and supply department, the head of the production department, and the head of sales. Simon's model states that the process of finding solutions passes through three basic stages that were employed in the study as follows:

The first stage is known as Intelligence: At this stage, in order to determine the nature of the problems experienced by the company in general and the inventory management function in particular, the famous ASLOG reference was used to conduct interviews, the observation tool and the company's 2017 documents related to the company's raw materials were also used.

The second stage is called modeling the solution (Modélisation): At this stage, the data and information obtained in the previous stage are analyzed, to determine the dimensions of the problem and understand its parts, through the use of a set of tools used in the quality path to find appropriate solutions for the company under study. Ishikawa's cause-effect diagram will be used to discover the most important causes of the main problem; the waste that the inventory management function suffers from to identify and classify problems according to the 5M method. Brainstorming: To identify the various wasteful problems in the inventory management function, and categorize them according to the 5M method, the brainstorming method was used with different heads of departments. 5M; this tool is used to alleviate some problems, such as wasting time in searching for equipments. The ABC model is created to arrange the problems according to the degree of criticality and the negative impact on the stock management function, the triple analysis method was used for the most critical problems of the greatest importance and envisioned solution, as we explained the order of the problems in the statistical program

Minitab version 14. Pareto model; After finding the most important product that includes components from the raw material that has a share of the company's money, the raw materials for this product are arranged according to their value using the Pareto model and this is to inventory the materials and understand to what extent these materials suffer from the problems that were previously identified, as well Minitab v14 was used to show the most items that represent 80% of the money and items that represent 20% of the money. Graphic curves aim to show the imbalance in supplies and consumption for the year 2017 and the movement of the stock to show the waste in the stock management function.

The third stage is the selection: after modeling the solutions and preparing a set of proposals that were conceived to solve the problem of waste in the inventory management function and improve its performance, it was presented and discussed with the company under study, and the use of the brainstorming method.

After identifying the various problems that the inventory management function suffers from using the tools mentioned, the analysis was deepened by presenting, analyzing, and identifying the problems that the important product suffers from, according to the application of the principle of priorities in management by trying to find solutions to these problems. It was concluded as the lack of a clear warehousing strategy in the company and a lack of interest in the scientific application of scientific methods in management; The industrial company producing pipes with fiberglass technology does not pay much attention to the function of inventory management, as all its attention is focused on the interest of production only, as it is the sensitive function in the company, a function that significantly increases the company's profits, but without good inventory management directly affects the production management and any defect in Inventory leads to disruption and interruption in the production process.