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STUDY ON INVENTORY MANAGEMENT IMPROVEMENT

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ABSTRACT
The management of inventories is a complex issue area that falls within the purview of supply chain management. In order for businesses to be able to meet the demands of their customers, they need to maintain stocks in warehouses. Keeping these inventories requires companies to pay holding charges, which results in funds being frozen and making them susceptible to loss. Therefore, the aim of inventory management is to determine the number of stocked items that will satisfy the demand while minimising the likelihood of having excess inventory. This article provides a case study on inventory management for the assembly firm to demonstrate its findings. It has been suggested that using inventory management in order to cut down on stock levels and using an agent system in order to automate the activities involved in inventory management are both viable options.

Keywords: Management Improvement.

INTRODUCTION
The stock of any item or resource that is utilised in an organisation is referred to as the organization's inventory. This inventory may include any items or resources that are utilised in the organisation. This phrase is applicable to any asset or resource that is used by the organisation in any capacity. The terms "raw materials," "work in progress," and "finished products" are used to refer to the three different categories of inventory that may be found in manufacturing plants (Fig. 1). The organisational structure of the document may be broken down as follows: first, the task at hand is described; next, the current circumstance is evaluated; after that, a solution is suggested; next, the experiments are shown; and, lastly, the findings are discussed.

OBJECTIVE
1. To keep enough inventory to meet customer demand,
2. To study on Inventory Management Improvement

RESEARCH METHOD
Even though inventory management is not a new concept, some businesses still choose not to use it in their operations in order to save money on stock. Finding out how much and when to order is one of the responsibilities of inventory management.
The company's employees are the ones tasked with carrying out the research; the company's primary business is the fabrication of microchips from their component parts and the subsequent sale of these products to end users. As a consequence of this, there are warehouses stocked with stockpiles of both raw materials and completed commodities (Fig. 2).

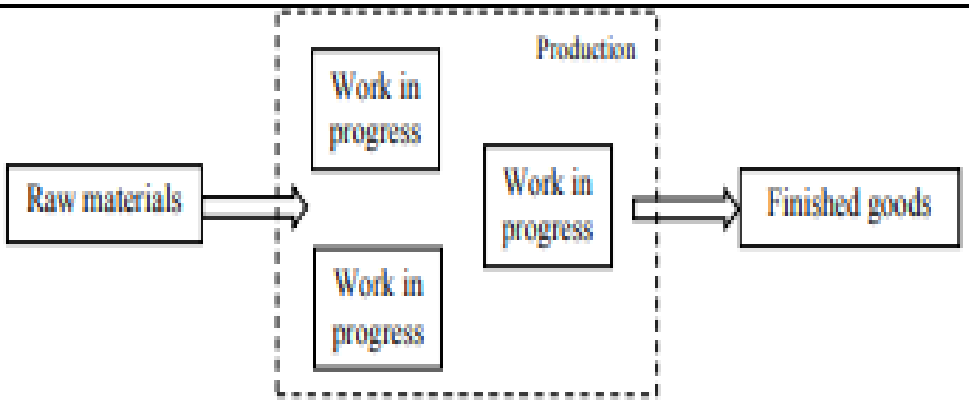

Fig. 1. Different kinds of industrial stockpiles

The author discusses numerous of the reasons why it is necessary to keep inventories, including the following:

• In order to fulfil the expected level of demand;
• To meet the needs of the industrial process;
• To reduce the risk of experiencing stock-outs;
• in order to maximise the use of order cycles;
• To protect oneself against future price hikes or to take advantage of discounts offered for larger purchases;
• To provide permission for operations;
• In order to disconnect different parts of the manufacturing and distribution chain.

In the event that this does not occur, it will cause delays in manufacturing, shortages, and/or unhappy consumers. The management of inventory presents a issue in the sense that having inventory is necessary, yet having inventory is not desired due to the costs involved with managing inventory. Having inventory is required in the sense that having inventory is required. It is feasible that the expenditures associated with maintaining an inventory might pile up to a considerable sum over time. As a direct outcome of the aforementioned situation, inventory management is an integral part of supply chain management. Inventory management is a difficult problem domain that falls within the purview of supply chain management. The study was continued in this publication by adding fresh tests and predicting algorithms to the previously analysed data.

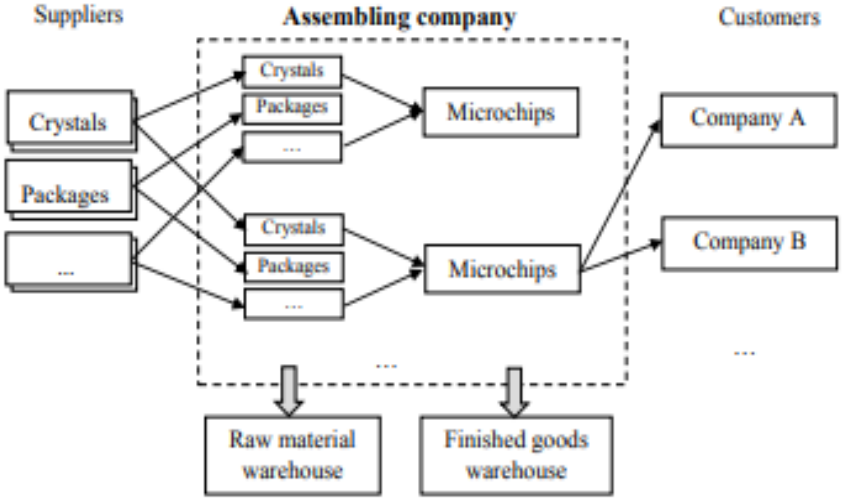

Fig. 2. putting the finishing touches on the company's stockpiles

According to the authors, just 8% of businesses have staff members who have received adequate training for inventory management. It is common practise for businesses to maintain sizable inventory reserves in order to successfully meet customer requirements.

DATA ANALYSIS

For the year 2014, the sales and inventory information for the company's warehouses and distribution centres were analysed. The data analysis of the variation in the number of microchips produced the year before revealed that there were things in stock in 2014 that did not sell. This was suggested by the fact that the variance in the number of microchips made was analysed. This was shown by the fact that there was a shift in the total quantity of microchips manufactured in the year prior to the one in question. The following is a list of the outcomes that occurred as a direct consequence of making use of these components: 16.69% of the total supplies that were kept at the warehouse (at the end of 2014) did not see any form of movement at any point over the course of the previous year; As a direct and immediate result of the passage of time, 3.95 percent of the total stocks saw a reduction in amount; and 5.13% of the total inventories that did not experience any sales during the course of 2014 saw their quantity increase as a result of the production of new ones. All of these factors contributed to the overall quantity of the inventories in the warehouse at the end of 2014. At the end of 2014, the total size of the stocks housed in the warehouse could be directly attributed to all of these various causes.

In addition, there were certain things whose combined quantity was more than the one that was sold, but at the same time there was a significant number of inventories in stock (Fig. 3). There were also goods for which the firm had a high inventory level but was simultaneously producing new ones; as a result, the amount of the company's inventory at the end of 2014 was more than the quantity of its yearly sales (Fig. 3).

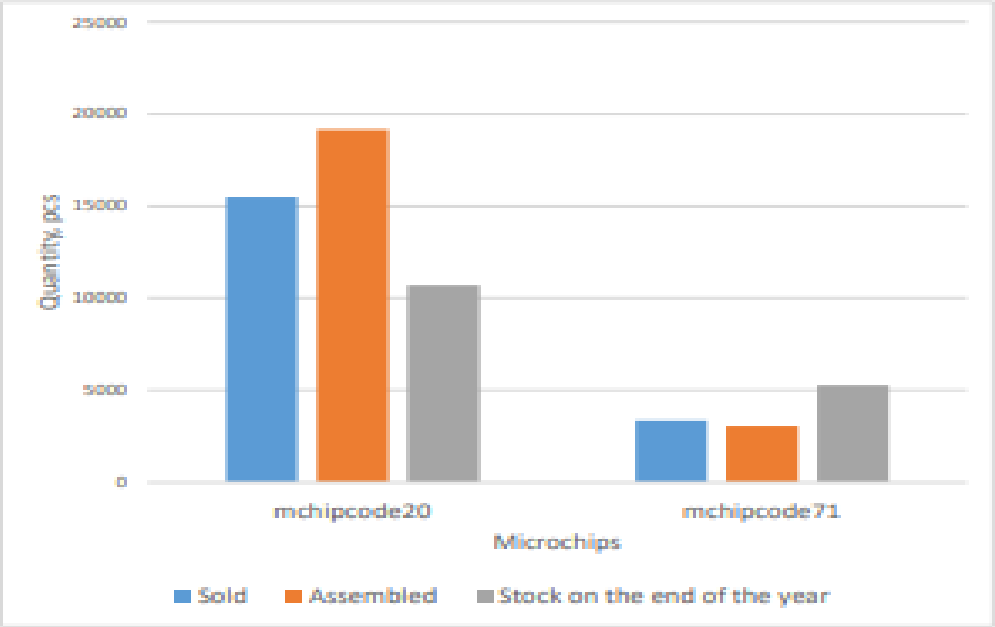

Fig. 3. The activities of two microchips on an annual basis

It was also discovered that the inventory level for some goods was excessively high, despite the fact that the amount sold each month was lower than the item's safety supply (Fig. 4).

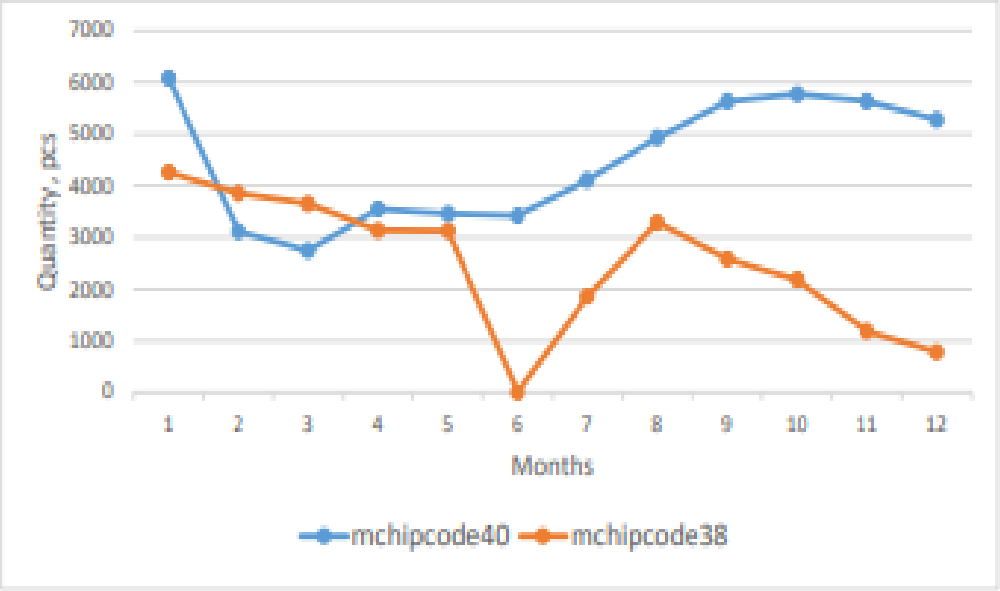

Fig. 4. The amounts of inventory for two different types of microchips

Additionally, it was seen that the inventory level for one item had dropped to zero, which suggested that the item was no longer available for purchase (Fig. 4). Therefore, inventory management was strongly suggested to be included into this company's operations.

ABC Classification

ABC classification, also known as ABC analysis, is a fundamental supply chain approach that is often executed by inventory controllers and materials managers. It is also the first step in the inventory management process. With the use of this categorization, managers are able to give priority to their time and money resources. The Pareto analysis, upon which the ABC analysis is founded, asserts that only 20% of the products are responsible for 80% of sales. It suggests that a limited number of goods in inventory are responsible for the highest levels of sales (Table 1). In most cases, fewer than twenty percent of the products categorised as class A are responsible for as much as eighty percent of the income. The following 15% (80%–95%) of income contribution comes from goods classified as Class B. The remaining 5% of income comes from goods and services categorised as class C.

TABLE 1 ABC CLASSIFICATION

	Number of items	Number of annual sales revenue
Class A items	About 20 %	About 80 %
Class B items	About 30 %	About 15 %
Class C items	About 50 %	About 5 %

The goods of a corporation are often divided into three categories using the ABC categorization in order to give priority in terms of inventory management.

- Items designated as Class A are the most important ones. For these goods, stringent inventory controls, regular reviews of demand predictions and use rates, extremely accurate component data, and frequent cycle counts are required to ensure the correctness of the permanent inventory balance;
- Items in the Class B category have a lower level of criticality. These goods need just rudimentary inventory management, periodic evaluations of demand projections and consumption rates, data that is relatively reliable, and cycle counting that occurs less often but on a regular basis;
- Because Class C goods have the least effect in terms of warehouse activity and financials, they are the ones that need the fewest inventory management.

The definition of class A products, which are microchips that account for the top 80% of total yearly sales, serves as the beginning point for inventory management. Class B items are those that account for the next 15% of income, while class C things make up the remaining 5%. In order to have a deeper comprehension of the mathematics required for ABC categorization, kindly refer to.
Table 2 displays the results of the ABC categorization that was performed on the analysed firm based on their total yearly revenue.

TABLE 2 PART OF THE MICROCHIP CLASSIFICATION OF THE COMPANY FRAGMENT

	Microchips	ABC classification
1	mchipcode56	B
2	mchipcode71	A
3	mchipcode139	C
4	mchipcode49	C
5	mchipcode133	C
6	mchipcode33	A
7	mchipcode264	C
8	mchipcode471	C
9	mchipcode473	C
10	mchipcode38	C
11	mchipcode39	C
12	mchipcode40	A
13	mchipcode96	C
14	mchipcode620	B
15	mchipcode674	C

It is recommended to employ a make-to-order manufacturing method for class C goods that have a demand volume that is either low or nonexistent.

Demand Forecasting Methods

The process of estimating the number of consumers who will buy a product or service in the not-too-distant future is known as demand forecasting. This may be used to predict the amount of products or services that will be Methods for predicting future demand fall into the following categories:

- Methods of qualitative prognostication;
- Methods of quantitative prediction.

When quantitative forecasting techniques cannot be performed due to a lack of accessible historical data, restricted historical data, or an absence of present relevance, qualitative forecasting methods are often used. The accuracy of the prediction is reliant on the abilities and expertise of the forecaster(s), in addition to the information that is readily accessible. This is a technique that is employed, and its application is based on how consumers and industry professionals believe or feel a product will sell. When it comes to developing company plans and estimating their revenues for the

first year, many new enterprises turn to this strategy. The following are some examples of qualitative models:

- A jury composed of senior executives;
- Sales force composite;
- Delphi method;
- Consumer market survey.

Quantitative approaches of forecasting are used to the numbers or quantities of products that were sold in the past in order to provide forecasts about the amount of product that will be sold in the near future. The vast majority of the time, this forecast will also contain quantity predictions for the next monetary year. Methods of quantitative forecasting may include things like multiplicative seasonal indices, moving averages based on the most recent period of demand, as well as basic and weighted moving averages. In each of these approaches, historical information is factored into a variety of mathematical equations to arrive at a conclusion about the quantity of a product or service that is expected to be purchased at certain periods in the foreseeable future.

In this specific circumstance, in order to anticipate future demand using historical data on demand for the year 2014, the quantitative forecasting methodologies that are used in this instance are those that are indicated below:

- A technique of predicting that is naive;
- Prediction based on the simple moving average;
- Prediction based on the weighted moving average;
- A technique of exponentially smoothing data;
- Single moving average.

The accuracy of the prediction may be evaluated based on the forecasting errors, which are understood to be the disparity between the actual demand amount and the quantity that was projected. The following is a list of some measurements of the accuracy of forecasting: Indicators of bias in predictions include The direction in which bias might take can be either positive or negative. The tracking signal establishes whether or not the prediction is within the permissible control boundaries. If the tracking signal slips beyond the control limits that have been pre-set, there is a bias issue with the technique of forecasting, and it is necessary to conduct an examination of the process by which predictions are made. The offered article provides a more in-depth description of the techniques of predicting as well as the measurements of accuracy.

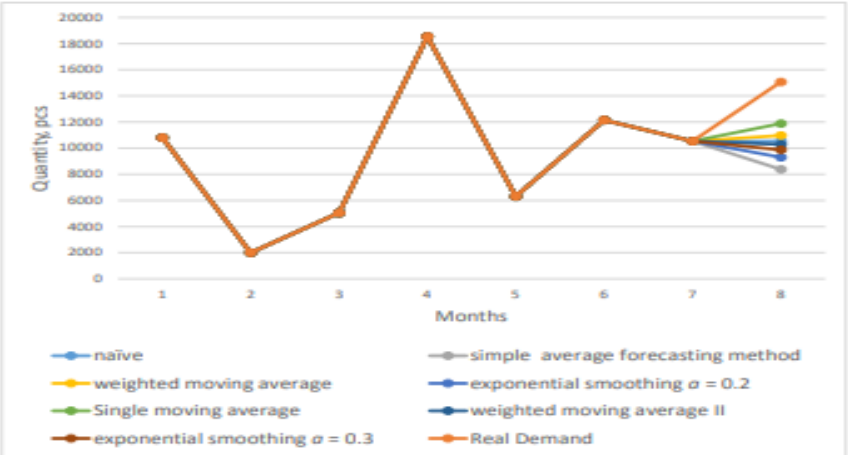

Fig. 5. The real demand and forecasted demand for one microchip.

Figure 5 depicts the inventory level graph together with the results of the forecasting process for one class A microprocessor. The results of the calculations used to assess how accurately forecasts are made have yielded the forecasting algorithm that is suitable for this kind of microprocessor. All of the microchips produced by the corporation have been predicted using the procedures that were described above.

Replenishment Policies

Maintaining and exercising control over stored products is made easier with the help of an inventory system, which offers the organisational framework and operational regulations necessary for this. The system is in charge of the ordering and receiving of commodities, including the instant at which the order was placed, in addition to the maintenance of a record of what was ordered, how much of it was ordered, and from whom the order was made.

The two basic kinds of inventory management software are single-period systems and multiple-period systems respectively.

- In an inventory system with just one period, unsold products at the conclusion of the period are discarded rather than being carried over to the next period (for example, newspapers). However, there is a possibility that the unsold objects have some value as salvage.
- In an inventory system with many periods, any products that were left unsold at the conclusion of one period are made available for purchase in the next period.

In this section, we will talk about a system for managing inventory that incorporates a number of different time periods. These two categories of models each have a certain time span that they cover. When the predetermined reorder level has been achieved, an order is placed according to the fixed-order quantity model. For this model to work, it is necessary to do constant inventory checks. In contrast, in the model with a set time period, the ability to place orders is not accessible until the model's final specified time period has passed.

Fixed-order quantity models make an effort to determine not only the reorder point, which is denoted by the letter R, at which an order, denoted by the letter Q, will be placed, but also the quantity of the order, which is denoted by the number Q. This is done so that the model can more accurately predict future stock levels. When the inventory level (which includes items that are presently in stock and those that are on order) hits the reorder point R, an order Q is placed. This includes products that are now in stock as well as those that are on order. This covers both things that are now in stock and those that are waiting to be shipped out to customers. When individuals speak about "on-hand" amounts, "on-order" numbers, and "backordered" quantities being deducted from one another, they are referring to the equation that is shown in the following paragraph. When individuals refer to their "inventory position," they are referring to this concept.

Only at certain intervals, such as once a week or once a month, for example, does the inventory be tallied when a model is being used that has a preset time period attached to it. Customers may choose to combine their purchases in certain circumstances, such as when they want to combine their orders in order to save money on the shipping charges connected with those items. it is advantageous for the business to count its inventory and place orders on a frequent basis. The order quantities that are generated by models with fixed-time period intervals change from period to period based on the utilisation rates. In most cases, they need for a greater degree of safety stock than would be required by a system with fixed-order quantities. The quantity of an inventory that is carried in addition to the amount that is anticipated to be demanded is known as the safety stock.

The following are some final thoughts to consider:

In the event that there is no change in demand, the reorder point will mirror the level of demand experienced throughout the lead period.

- If there is uncertainty about the demand, the reorder point will often be set higher than the anticipated demand during the lead period.
- The reorder point is calculated as the expected demand plus the safety stock.

Following the completion of a demand projection, it is feasible to compute reorder and safety stock points for each and every microchip (see Table 3). For more information on the calculations of reorder points and safety stocks, please refer to references.

Table 3 Fragment Of Results Of Forecasts, Safety Stock And Reorder Points For Microchips

Microchips	Forecasted Demand	Safety Stock	Reorder Point
mchipcode33	1688	2081	3769
mchipcode40	12249	9096	21345
mchipcode20	1508	1603	3111
mchipcode102	537	5927	6464
mchipcode465	3625	6363	9988

EXPERIMENT 1

The proposed inventory management result check that is based on real data is particularly fascinating since it combines estimations on future demand as well as methods for replenishment. This makes the check a good resource. Because of this, the check is quite helpful. The actual numbers account for demand information for the first five months of 2015, which was collected.

The purpose of this experiment is to first compare the recommended quantities of inventories with the results of the replenishment method with real demand, and then compare the recommended quantities of inventories with the company's stocks. Both of these comparisons are intended to determine which set of data is more accurate. At the end of the day, the objective of this experiment is to determine which of these criteria yields the findings that are the most accurate (Fig. 6).

As a consequence of carrying out the experiment, one or more of the following findings could be made: In contrast to the actual data, which shows an average inventory level of 20860 pieces, the suggested inventory management system shows an average inventory level of just 11705 pieces. The number of things that are now available for purchase has been cut down. In none of these two probable scenarios did the inventory of the product at question get depleted, therefore that cannot be an excuse.

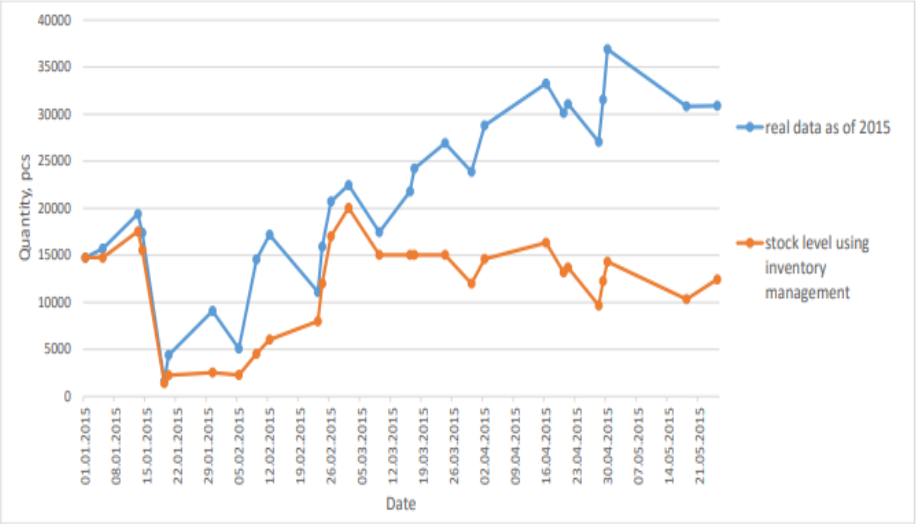

Fig. 6. Analysis of the inventory management system in comparison to actual data

The experiment that was conducted for another microprocessor revealed that safety stock was used up over the whole of the lead period. This was due to the surprisingly high level of demand for them. The demand for that particular month was 17789 pieces, which is much more than the monthly average of 9800 pieces that it had been for the previous several months. This demand will be taken into consideration as an input variable in any additional calculations that are performed about the availability of the safety stock. According to the company's actual data, the average number of products in stock is 6964, but the planned inventory management system forecasts that the average number of items in stock would be 5955.

EXPERIMENT 2

The implementation of inventory management processes and the realisation of agent systems are both necessary steps in the development of the company's condition regarding inventory management. The suggested system may get several advantages from the use of the agent system, which are as follows:

- It has the ability to draw lessons from previous histories of inventory, forecasting, and replenishment;
- If necessary, it is able to adjust the methods used for demand forecasting, the constants used for inventory management, and the rules governing replenishment;
- It is able to guarantee the monitoring and management of a significant number of SKUs;
- It has the potential to give both independence and initiative.

This article describes a portion of the current study on AEMAS, which stands for Because it is a component of the Assembling Enterprise Multi-Agent System, it has therefore been connected to the agent responsible for inventory management. The person in charge of managing the inventory should be the one to decide when and how many microchips should be manufactured, since this is a choice that should be left up to them. This is one of the responsibilities that are placed on the agent's shoulders. It includes information on the production capacity, the possible minimum reserves (often referred to as safety stock), and the strategy that is used to estimate the future demand for the

product. The feasible minimum reserves are sometimes referred to as the safety stock in certain circles. The inventory management agent has a variety of behaviours, including an ABC classification algorithm, future demand forecasting algorithms, and replenishment procedures. These behaviours are meant to prevent out-of-stock conditions while simultaneously reducing inventory levels and the costs that are associated with holding them. Additionally, these behaviours are designed to keep out of stock situations from occurring.

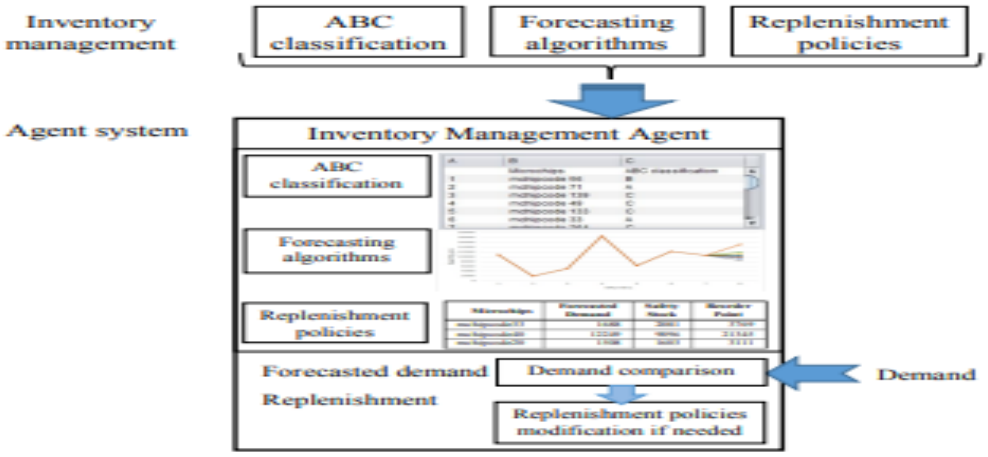

Fig. 7 The use of agent systems in the management of inventories as a concept

After the forecasting methods have been applied to microchips and the forecasting errors have been calculated, the Excel file will be supplied as input data to the ABC classification algorithm of the agent system. This will be done after the forecasting techniques have been applied to microchips. The facts that were gathered are being put to use to choose the method of forecasting that is going to be most suitable for each microchip that is going to be used in the not too distant future. The conclusions drawn from the exercise of forecasting are included into the computations performed by the algorithm that manages replenishment. Based on these calculations, the algorithm decides both the reorder points and the quantity of the safety stock. The agent-based inventory management system performs an analysis on this demand, and then compares the outcomes to the demand that was forecasted. This assessment is carried out in order to ensure that the true demand can be satisfied. After that, it modifies the incoming orders to create the product, if it turns out that is necessary in order to do so.

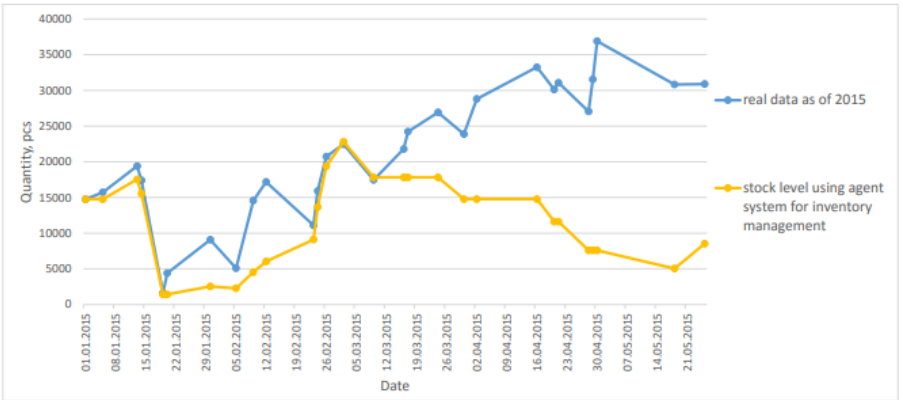

Fig. 8. Examination of the inventory management agent system in comparison with actual data

The second experiment is designed to test the hypothesis that different replenishment strategies may be used while still fulfilling the actual demand for the product. Once again, the comparison of the amounts of the various inventory levels is provided.

The following findings have been uncovered from the experiment: When compared to the actual inventory level held by the corporation, the quantity of the first kind of microchips held in stock has been reduced. The agent system suggests an average inventory level of 11461 pieces, which is much lower than the company's actual inventory level of 20860 pieces.

CONCLUSION

Management of inventory is a vital function for every business that maintains stock. It is necessary for businesses to maintain inventory, but only up to a certain level in order to prevent both running out of stock and having too much on hand. Inventory management has the potential to improve the present situation with the firm's inventory control and reduce the expenses incurred by the organisation. The agent system, on the other hand, suggests automating this process, as well as the fact that It can support a variety of techniques to predicting and adjust to changes in the environment that it is in. The current condition of inventory management is broken down and analysed in this article, and a solution that would improve things by a factor of two is proposed as a solution to the problem. The first thing that needs to be done in order to make improvements is to implement inventory management. This should be done with the goal of reducing both the total amount of inventory held by the organisation and the costs associated with maintaining that level of inventory by removing any surplus supplies. The implementation of the agent system is the second necessary step in the process of making improvements. This will make it possible to automate the operations that are involved in inventory management, as well as respond in a timely manner to demand variances that are different from the demand that was expected by adjusting the regulations governing replenishment.

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