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# REDUCING INVENTORY HOLDING COSTS FOR CONSUMABLE ITEMS IN A LARGE STEELWORKS

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The study in this paper involved a spare parts inventory system at a large steelworks. The inventory consisted of over 38 000 different items that were required for the day-to-day operation of the plant. To provide an efficient service to various work centres, management had to ensure an acceptable service level of spare parts inventory at minimum cost. An inventory cost area of concern was excess holding costs and possible consequent overstocking. The study reported presents a strategy and a model for dealing with excess holding costs. An inventory model was formulated and implemented to reduce inflated stock levels for certain lines. Because of the study reductions in inventory holding were noticeable with targeted reductions of a minimum of SA Rand 2 000 000 in the first year.

## 1 INTRODUCTION

Capital intensive industries, such as steel producers, often hold substantial amounts of capital in equipment spares. This capital is similar to an insurance policy to be utilised in case of a plant breakdown. A breakdown that could result in a stock-out because of a disruption in the production process. It is therefore necessary to control this significant asset in the most efficient manner to improve productivity and return on investment.

## 2 THE EXISTING STOCK CONTROL SYSTEM

A mainframe database management system, installed in 1987, was responsible for the control of all consumable spare parts inventory. The facilities provided by the system included fully automatic ordering and level setting procedures. A continuous, daily review, reorder level and quantity inventory policy was used. Each time the level of stock for a particular item reached the reorder level the reorder quantity, based on the economic order quantity model (EOQ), was calculated. The reorder point (ROP) calculation was based on meeting a service measure that was the probability of having a stock-out during the lead time for obtaining replacement stock. Lead times were assumed to be constant and demand patterns normally distributed

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## 3 SOME PROBLEM AREAS

Apart from information flow, training, lead time reduction and other issues that were addressed during the study the following required detailed attention:-

* Excessive time was required to review purchase requisitions printed by the reordering system. The purchase requisitions were printed automatically when the reorder point was reached for the items. This 'excessive time', approximately one week usually, formed part of the purchasing lead time required for the items.

* An ABC classification (Pareto Analysis) was available but had not been in use for a substantial period.

* Scrutiny of computer reports revealed that vast quantities of inventory items had not moved for some years since their last issue. Certain critical items, susceptible to breakage and essential to ensure smooth production, were required to be held in stock always. This stock holding policy was also critically reviewed as these items were not identified by the system. As it was decided that all stock items were to be handled similarly a program for the identification of critical spare parts was necessary.

* Computer reordering routines were found inadequate as assumptions about the system had been made without proper evaluation and with the passage of time ad hoc adjustments had been made. All types of demand patterns for all items were assessed by making use of the normal distribution method, this being the most widely used distribution in inventory control.

  The use of the normal distribution can, in certain circumstances, produces reorder points and safety stock levels that are inconsistent with the desired probability of having a stock out.**(1)** Alternate methods of calculation had therefore to be considered.

## 4 STRATEGY ADOPTED

A strategy was developed to tackle the problem and involved three phases that were as follows:-

### Phase A : A Basis for Future Improvements to the System

(i) **Classifying the items using the ABC analysis.(2)**

Conducting an ABC analysis is often a first step in designing a program of action to improve inventory performance. It provides a tool for identifying those items that will make the largest impact on the company's performance when improved inventory control procedures are implemented. It was for this reason that the ABC analysis was chosen as a necessary first step.

(ii) **Identification of Critical Items**

The identification of critical items is essential for the proper evaluation of any inventory system. This exercise is essential for the determination of certain inventory performance requirements. Without the identification of critical items the performance of the inventory system cannot be monitored effectively and certain performance criteria applied generally to both non-critical and critical items become meaningless.

**(iii) Maximizing Management Information**

With the use of (i) and (ii) above certain reports become available which has had the effect of supplying information for the improvement of the inventory management system.

**Phase B : Redesigning the Inventory Model**

**(i) Improve Control and Performance of 'A' Items (2)(3)**

'A' items, which are high volume, high cost, items were identified for the application of improved inventory control procedures. A careful analysis of the order quantity and timing decisions for 'A' items provides a larger improvement in inventory performance than will similar efforts on low cost, low volume items, i.e. 'C' items. The principle of tackling the items that provide the maximum return on investment was applied.

**(ii) Reduce Stock Levels of Non-Critical Items**

Changes to the reordering routines to reduce stock levels of non-critical items was done. Since stock-out situations will have negligible effects on non-critical items good results were expected from this exercise.

**(iii) Other Changes**

Other recommended changes to the inventory model were carried out and proved to be beneficial. These included improvement of forecasting techniques, introduction of lead-time prediction, re-evaluation of assumed statistical distributions for demand patterns, etc.

**Phase C : Other Contributions for the Improvement of the Inventory System**

**(i) Training of Employees**

Stock controllers and buyers were trained in the fundamentals of scientific inventory control. The emphasis was to place certain costs into perspective to show the effect of specific variables for which employees have a direct or indirect influence, e.g. lead times.

**(ii) Reduction of Lead Times**

An area of concern was the time taken, the internal lead time, for checking purposes within the system. This had the effect of increasing lead times. By improving the information flow within the system lead times were reduced. An immediate improvement was to speed up review time for critical and 'A' items.

(iii) **Disposal of Inactive Stock**

All stock was reviewed regularly to identify obsolete, poor quality, surplus and slow moving items. Disposal alternatives included returning goods to vendors, scrapping, salvage and reduced price sales.

(iv) **Standardizing Stock Items**

Inventories can be reduced by a number in the quantities of each item, or by a reduction in the number of different items used in stock. Inventory investment can be lowered by carrying one standard item instead of, say, five different items that are essentially used for the same purpose. A Standardization Committee has been established and is active in dealing with these problems.

## 5 REDESIGNING THE MODEL

Fine tuning the control of inventories with the application of the EOQ method and other computer oriented mathematical approaches inevitably lend themselves to the use of simulation. This study was no exception and simulation was an integral part of redesigning the inventory model. The benefits of first simulating a system are obvious and will not be discussed.

The design stages can be summarized as follows:-

* Development of computer model on a PC based system.
* Simulation of theoretical model on the PC based system.
* Simulation of the model on the current mainframe. The model was run parallel to the existing system for an entire month to evaluate its performance.
* Setting up of the new model on the main frame.
* Monitoring the effects of the new system as an ongoing procedure.

## 6 SOME ESSENTIAL FEATURES OF THE MODEL

* The distinction between critical and non-critical items. Critical items will halt production and therefore a service level of at least 95% was assigned to these items. Non-critical items were assigned a service level of 90%.
* All 'A' items (i.e. high cost, high volume usage items) were carefully analysed for correct demand distribution type. This was achieved using the Chi-Square Goodness-Of-Fit test. (4)(5) depending on the results of this test the Normal, Poisson or Actual distributions were used. The Actual distribution method uses the particular item demand pattern to

form its probability distribution table. This latter method produced excellent results for demand patterns that were neither Normal nor Poisson distributions.

* Forecasting of demand was achieved through a basic exponential smoothing model with trend enhancement.

* The EOQ was calculated with carefully designed constraints applicable to the industry.

## 7 MODEL ALGORITHM

For each item required to be reordered the following algorithm was applied:-

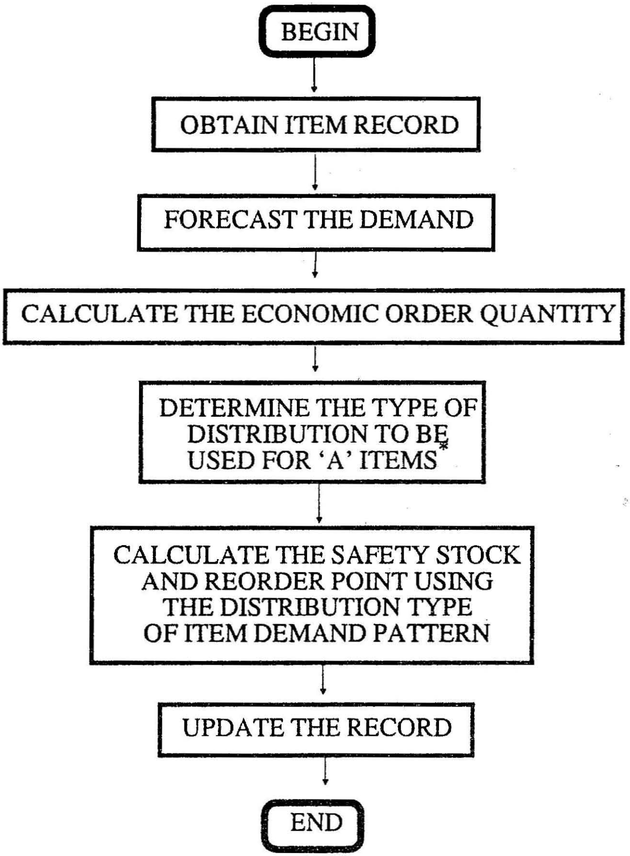



**Figure 1. Model Algorithm**

* The Normal Distribution was used for all other items.

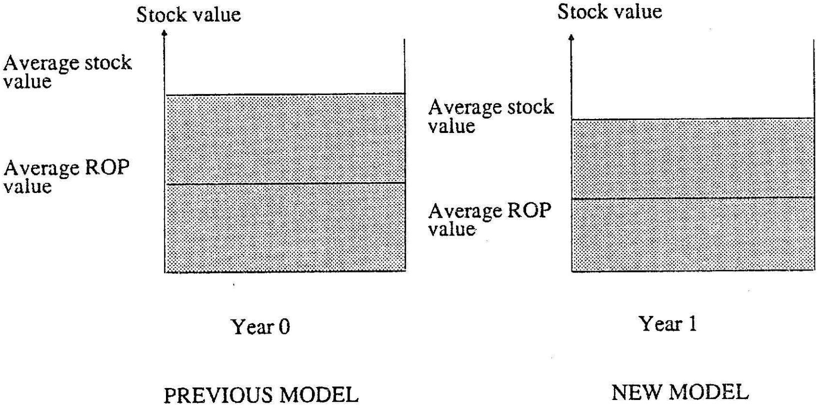
The coding of the model was more complicated than depicted and included many other features omitted for the purposes of illustration, these included:-

* Tracking of forecast errors.
* Provision for the manual triggering of purchase requisitions, i.e. forced prompts.
* Analysis routines.
* Various constraint and checking routines for order quantities and reorder levels.
* Chi-Square Goodness-Of-Fit tests for Normal and Poisson Distribution, etc.

## 8 RESULTS OBTAINED FROM THE MODEL

Results obtained from the computer model were as follows:-

* Reduction in average ROP value. By careful analysis of 'A' items inflated reorder points were reduced, since these items had a larger contribution to annual inventory costs than any other costs. Reducing inflated reorder points for 'A' items substantially reduces the average inventory holding value.
* Critical spare parts that were also 'A' items were assigned reorder point values. A stock out situation for these items was to be avoided.
* Skilfully designed constraints ensured that calculated values were realistic. Error flagging would ensure that values outside the constraints were identified for attention.




(Diagrams are not to scale)

**Figure 2. Pictorial Representation of Models**

**MAXIMISING MANAGEMENT INFORMATION**

ABC Classification - Easily achieved using computer records for each item and with the use of computer programs.

Critical Item Identification - This proved to be the most difficult task. Each of the 38 000 items were scrutinised by engineers/managers responsible. The time taken was approximately six months.

Review Information - Review of the information obtained above to redesign the model.

**REDESIGNING THE MODEL**

Redesigning the computer model for enhancements suggested. Apply simulation for successful implementation

**OTHER AREAS OF ACTIVITY**

Employee training, reduction of inactive stock, standardise stock items, reduce lead times

**RESULTS**

Reduction of stock investment (in excess of R 2 000 000)
Reduction of stock outs for critical items
Reduced lead times
Improved forecasting, reorder point, calculations, etc
Improved inventory turnover rate
Reduced total inventory

**Figure 3. Strategy Precedence Diagram**

## 9 CONCLUSION

The main objective concerning inventory control systems is to reduce costs associated with the acquisition and management of the goods held in stock. The fundamental question to be addressed is how can inventory costs are identified and measured and, through the integration of related operations, be controlled and reduced. The only way in which effective control over costs may be attained is when the total system is analysed and, following from this examination, relevant controls established, put in place and maintained. Piecemeal approaches in the handling of costs usually result in costs distortions, savings in one area appearing as cost increases in another.

The method of tackling the cost reduction programme in the study under discussion was to analyse the entire inventory control system, develop a plan for effective cost reduction, which entailed a reduction in the quantity and value of goods held in stock, install the new system and establish a regular review procedure to ensure that the new system was being maintained.

The strategy reported appears to be adequate for dealing with the problem of excess costs that were identified.

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