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STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESIS (ES)

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

CONCLUSIONS

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- Hunker, H.L. and A.J. Wright (1963), "Factors of Industrial Location in Ohio" Ohio State University, Nigeria.

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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

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- Kumar S. (2011): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, Kurukshetra University, Kurukshetra.

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AN EMPIRICAL APPROACH TO INVENTORY COST REDUCTION

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ABSTRACT

Five different inventory classification system have been described in literature and used by companies in practice. While many companies seem to prefer the ABC system for inventory management others use the FSN or the VED for spares inventory management. A closer examination of the five systems has yielded some fresh light on the way to manage and control inventory costs. This paper describes an empirical approach which has been adopted for the first time to compare the performance of each of the inventory classification system in terms of the total stocking cost which yields some surprising results. What is evident is that the "most popular" system, ABC, could lead to the highest inventory cost.

KEYWORDS

inventory control, inventory classification, cost of inventory, ABC, SDE, VED, HML, FSN.

INTRODUCTION

Inventory control as a subject has been of great interest to operations management professionals. The reason is very simple - inventories offer many advantages for running a plant smoothly and uninterruptedly. If there are controls imposed on the accumulation of inventories then the production process has one more variable or constraint to deal with. Inventory can be defined as"stocks of products which are held in storage in anticipation of demand, to meet arising (current) demands and to meet sudden surges in demand". Variously called as stock, safety stock, pipeline stock, in-transit stock and so on, inventory is a resource which if utilized rightly can meet routine as well as suddenly developing situations. On a few occasions inventories are held in storage only because the production process could continue to operate in order to complete a"run". The administrative actions of managing inventory have been well covered in the US GAO study (2003). Various studies in the past (Leeuw, Holweg and Williams, 2010; Watts, Hahn and Sohn, 1993; Goran Svensson, 2003; V.Jayaraman, 2008; Richard and Michele Tersine, 1990) have shown the importance of inventory control to the smooth operations of a company and how the same can be managed. An excellent description of the P system, Q system, the EOQ model and its extensions is available in the paper by Buxey (2006). Buxey has also reviewed and summarized the state of inventory theory upto the year 2006. He has also discussed some case studies from the Australian industry. However his coverage is restricted to the ABC system of inventory classification. Gupta, Garg and Tewari (2012) have reviewed the inventory methods in literature and have classified the current knowledge of such methods. Deierlein (2005) describes the management of spares inventory by a new method"Connect Enterprise"wherein computers are used extensively to capture data, raise orders and track performance. However there is no reference to optimizing either costs of orders or inventory carrying. Braglia, Grassi and Montanari (2004) have proposed a"MASTA"(multi attribute spares tree analysis) method for managing spares inventory. In their paper they have proposed several methods for classification of spares for inventory control,such as, quality problem, production loss, domino effect, which helps in the preparation of"trees"to provide a basis for classification of spares. With the advent and advancement of global supply chains many authors (Sahay and Mohan, 2003; Beheshti, 2009; Chandra and Kumar, 2001; Pope and Prasad, 1998) have emphasized the need to control the cost of inventories in large supply chains. In a study of the retail industry Abernathy et al (2000) propose a method which involves the accurate prediction of the demand patterns of inventory items and using this accuracy as a method to reduce the cost of inventory. Kobbacy and Liang (1999) have proposed an"intelligent systems"approach, wherein a knowledge based inventory management system"can lead to lower inventory cost. Using a Visual Basic computer program they have studied the demand patterns of several thousand items in the automotive and airlines industries in the US and show that in many cases the demand patterns can be established using scientific formulae which can then be used for selecting the appropriate model of inventory control (although they have not specified which model is to be selected). By doing so the TSC can be brought down in some cases by 23 % (p 362, *op cit*). However in the literature a comparison of the TSC for different inventory systems has not been done so far. This gap leaves a space for proposing a methodology which can help companies choose the appropriate system to manage inventories from the cost point of view.

PURPOSE OF THIS RESEARCH

Classical inventory theory has attempted to identify factors which influence the cost of holding stocks in inventory. Typically, the Economic Order Quantity (or EOQ) has been the bedrock of this theory. Using this companies have built systems such as Fixed Order Quantity (of FOQ) or Fixed Period (or FP) for day-to-day inventory management. Over the year's inventory studies have shown that there are five different classification methods – ABC, VED (Vital, Essential, Desirable), SDE (Scarce to procure, Difficult to procure and Easy to procure), FSN (Fast moving, slow moving and Non moving) and HML (High cost, Medium cost and Low cost) – which can be used to manage inventories using EOQ and the FOQ or FP systems. (for example see http://knowscm.blogspot.in/2008/03/inventory-analysis.html, http://productivity.in/knowledgebase/Plant%20Engineering/g.%20Spare%20Parts%20Management.pdf). Usually companies choose different classifications for use in different areas of operations. For example, ABC, FSN and HML are chosen for use in manufacturing, whereas SDE and VED are used for spares management. For each of these classifications the ordering policy is clearly defined which then governs the Total Stocking Cost (or the total inventory management cost, TSC). While choosing the classification systems companies do not compare the TSC for the same items under different classifications. For example, companies choose any one of the three classifications – ABC, FSN or VED – for manufacturing without comparing which one of the classification can give the least value of TSC. In this paper we have examined the situations where for the same set of items we compare the TSC's under the different classifications and find that the TSC can vary significantly under each of the classification for the same set of items. By choosing the proper classification system companies can reduce the TSC. (For example, see http://borjournals.com/Research_papers/Jan_2013/1128%20M.pdf, http://usir.salford.ac.uk/19054/1/WP_408-11_Salford.pdf) We believe that our research will help companies to choose the least cost method for inventory management for a given set of items. If the methodology described in our research is used we believe that companies can save anywhere between 4 to 25 % or more of the TSC depending on the items under consideration and the scale of operations. An example of a similar study undertaken, but partially, has been reported in a small scale enterprise in New Zealand. (see http://www.nzabe.ac.nz/conferences/2011/2011_NZABE_Ram_Paper_Final_7%20July.pdf). A description of the importance of the five different inventory classification systems and how they can improve the cost control of inventory items is provided in brief in http://currentnursing.com/nursing_management/ material_management_ABC_VED_HML_analysis.html, and http://www.productivity.in/knowledgebase/Plant%20Engineering/g.%20Spare%20Parts%20Management.pdf.

RESEARCH METHODOLOGY

We have studied the literature to identify the trends in inventory management especially with respect to TSC. We have then described the main aspects of inventory management – types of inventories carried, costs involved, classification methods. We then describe a framework for comparison. For making the

comparisons we have chosen a set of inventory items from a larger set from a metals manufacturing company in India. Using this data we have studied the TSC under the different classifications. Based on these results we have reached certain conclusions and recommendations for further work.
The key terms used frequently in this paper are defined in the Table 1 below:

TABLE 1: DEFINITIONS OF KEY TERMS USED FREQUENTLY IN THE PAPER

Term	Definition	Explanation of definition / example
Inventory Classification System	The system used to define the basis of classifying inventory items into different categories	ABC – inventory classification system used to classify items based on annual consumption value
Inventory Management System	The system by a company used to optimize the cost of inventory based on cost, convenience and other management considerations	FOQ – Fixed Order Quantity system if inventory management where orders are released whenever the stock in hand reaches a pre-defined quantity
Inventory Categorisation System	The basis on which an Inventory Classification System categorises inventory items	VED – Vital, Essential, Desirable are the three categories used by the VED inventory classification system to categorise inventory items based on requirement for use.
EOQ	Economic Order Quantity	Optimal quantity to order to minimize TSC
Consumption cost	The cost incurred in using the item	Annual consumption cost = annual consumption * item cost (landed cost at the premises of the plant or facility)

CHARACTERISTICS OF INVENTORIES

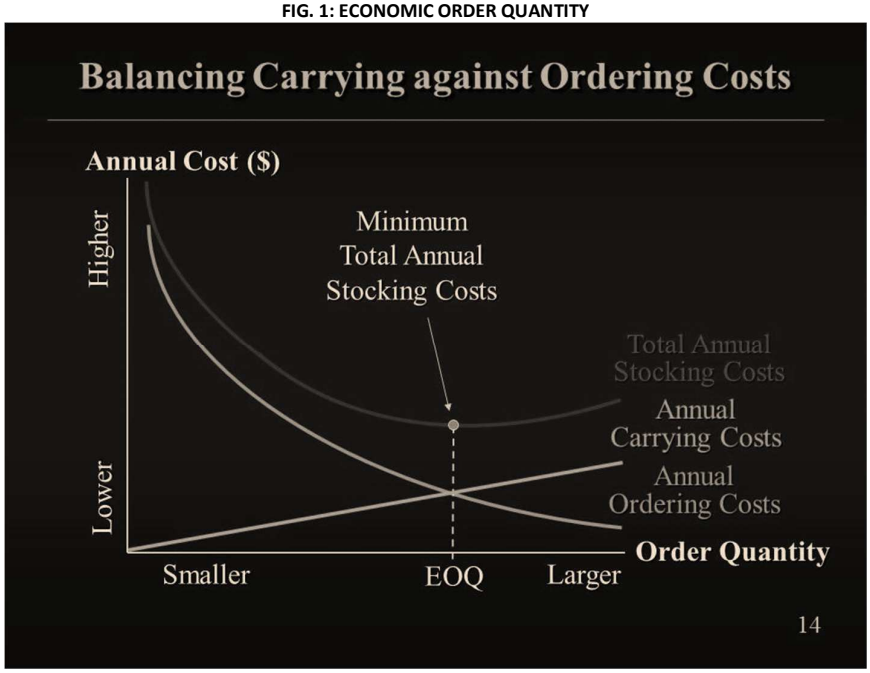
Inventories can be characterized by where they are held (location) , the purpose for which they are held (regular consumption or safety), the stage of production / value addition that they are created at (WIP, Finished Goods). Each of the stages of inventory have implications on the inventory valuation and impact on the input / output of the organization. These are summarized in Table 2 below:

TABLE 2: INVENTORY VALUATION AND ITS IMPACT ON THE INPUT / OUTPUT OF THE ORGANIZATION

Type of inventory	Purpose for holding	Implications on the value chain	Cost of the inventory	Hidden costs of the inventory
Location – at the suppliers end and in-transit between supplier and work place	Waiting for orders, transportation, inspection clearance	Could lead to cancelled orders, quality issues due to delay in despatch	Low as direct value addition is yet to take place	Loss of materials in transit or damages to goods while in transit could lead to high costs
Location – factory	Either as WIP, raw material or finished goods. Defective products awaiting clearance and disposal.	Occupies space, clutters up the shop floor, hides problems, creates a false sense of work being done.	High when in the FG form, medium if in WIP and low if in Raw Materials form. Cost of defectives is generally medium to high.	When WIP is high the hidden costs, like cost of losing production due to clutter on shop floor, disturbances to work leading to quality issues
Location – at the distributors, retailers and in – transit	Awaiting marketing decisions, dispatch clearances	Could lead to obsolescence, damages and theft at the warehouse, returns to the plant or possible write-offs/distress sales in extreme cases	Costs are usually in terms of warehousing costs, obsolescence costs, write-offs and distress sales discounts as well loss of image in the market if such distress sales happen too often.	Indicative of lack of co-ordination between marketing and production / dispatch, between retailers and wholesale distributors, reduction in demand for any reason
Purpose - regular consumption	To meet regular consumption to keep the production lines running smoothly	Minimum cost needed to run the production, must be available on or close to the shop floor for immediate use	More than raw materials but less than WIP	Too much of stockpiling may mean that production plans are going haywire, productivity could be slowing down
Stage of production – WIP	Created due to imbalances in capacities in production line equipment, sudden stoppage of equipment, breakdown of equipment	Place a burden on the production line, create disruptions and occupy floor space	Medium to high	Accumulation could lead to loss of materials, write-offs and distress disposals
Stage of production - finished goods	To meet orders placed by marketing, distributors, to keep physical track of the output	If kept for too long can lead to obsolescence, write-offs. But must be kept in stock to meet sudden surge in demands	High	If defectives have found their way into the FGF then this could lead to customer dissatisfaction if not detected in the distribution or retailer systems

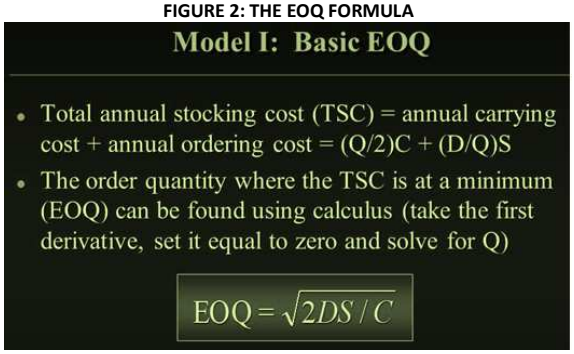
There are many practical methods available and in use for managing inventory. These systems have been designed primarily based on the Economic Order Quantity (EOQ) theory. Figure 1 shows the concept of the EOQ.

FIG. 1: ECONOMIC ORDER QUANTITY



Source: Gaither and Frazier, "Operations Management"

FIGURE 2: THE EOQ FORMULA



Source: Gaither and Frazier, "Operations Management"

Based on the above formula one can calculate the quantities to be ordered for different values of ordering costs. In companies ordering costs usually include the following:

1. Cost of personnel used to place orders
2. Cost of follow-up or expediting the delivery against orders. (These can be in the form of phone calls, suppliers visits, meetings with suppliers and time otherwise spent with suppliers)
3. Cost of ensuring quality of supplies (inspection prior to dispatch at the suppliers end, inspection at the buyers end, third party inspection, sensei efforts by buyer to improve quality at the suppliers)
4. Cost of tracking deliveries (time spent in tracking deliveries, discussion with transporters / logistics operators)
5. Cost of identifying suppliers who can supply on a regular basis to meet the company's requirements (sometimes these are called strategic sourcing efforts)
6. Cost of vendor management (includes cost of appointing vendors, monitoring suppliers performance, cost of providing access to suppliers through use of IT tools to buyers systems)

Such costs obviously will vary depending on the nature of the items being procured, the status of the suppliers, the clauses in the contract between the buyer and the supplier, as also the vendor's overall performance. Hence to find the costs per order some amount of experience, judgment and methodology have to be evolved through a consensus process in the procurement cell.

Before we take a look at the ordering costs for different items, there is another aspect of inventory control which needs to be understood. In practice there are five different types of inventory classification systems prevalent, depending on the way the usage of items are classified. These are shown in Table 3 below:

TABLE 3: DIFFERENT INVENTORY CLASSIFICATION SYSTEMS

Inventory classification system	Basis for classification	Remarks
ABC (based on the consumption pattern)	Total value of usage per annum of each item	The usage is based only on the cost incurred for using the consumable and no other characteristic. This leads to an intrinsic bias towards high consumption items which get more attention.
VED (Vital, Essential and Desirable) (degree of requirement for the production of the outputs)	Based on the usage requirement	This type of classification is used typically for inventory control of spares. however the basis of classification is based on the need of the item for producing the output. For example, a car cannot be complete without the engine, the wheels, whereas the external rear view mirror or the"singing"horn can be fitted as optional.
SDE (Scarce, Difficult, Easy) (difficulty of sourcing the item)	Based on the ability of the company to procure the items.	This type of control is biased towards the suppliers. The scarce items have to be paid more attention. For example, if an item is being imported from a far off country the availability of the item could be a problem. Similarly if the item is in great demand and the production volumes are low then the availability could be scarce.
FSN (Fast, slow and Non-moving) (based on the usage pattern in terms of regular or irregular)	Based on the rate of quantity consumed.	For example in an electric motor manufacturing company the smaller motors could be produced in large volumes in comparison to the large motors whose demand is restricted. Hence the parts needed for the smaller motors could be needed fast moving due to frequent scheduling.
HML (High, Medium, Low) (based on the cost of the item)	Based on the cost of the individual items	For example, the crank shaft of a car is a high cost item,whereas the mirror will be a low cost item

The ordering costs for each of these systems if inventory control could vary for each item, as shown in Table 4 for the reasons cited.

TABLE 4: POSSIBLE ORDERING COSTS BASED ON THE TYPE OF INVENTORY CLASSIFICATION SYSTEM ADOPTED

Type of inventory classification systems	Basis of ordering costs	Comments on the nature of the ordering costs	Remarks on the ordering costs
ABC (based on the consumption pattern)	Based on whether the item is an A or B or C item	Usually the costs of A items are more, B is less and C is the least	The ordering cost is based on the consumption pattern which indicates the importance attached, leading to more monitoring, more follow-up etc
VED (Vital, Essential and Desirable) (degree of requirement for the production of the outputs)	Based on whether the item is V,E or D	Usually the costs are in the descending order of V,E,D	Ordering costs based on the importance of the use of the item
SDE (Scarce, Difficult, Easy) (difficulty of sourcing the item)	Based on whether the item is S or d or E	Usually the costs are in the descending order of S,D,E	Ordering costs are based on the availability of the item. For example, if the item is a scarce one, more care is required to deal with the vendors.
FSN (Fast, slow and Non-moving) (based on the usage pattern in terms of regular or irregular)	Based on whether the items are F or S or N	Usually the costs are in the descending order of F,S,N, however difficult to say	The ordering cost of fast moving items is more due to the greater attention paid to them, to ensure zero stock out
HML (High, Medium, Low) (based on the cost of the item)	Based on whether the item is H or M or L	Usually the costs are in the descending order of H,M,L, however difficult to say	The cost of ordering of the high cost items could be more due to the nature of the item. The assumption is that high cost items are more carefully handled.

INVENTORY CARRYING COSTS

Apart from the ordering cost the other important cost of inventory is the inventory carrying cost. This is the cost of financing the. The comprehensiveness of the inventory carrying cost has been updated in line with modern business practices (as shown in Table 5 below):

TABLE 5: COSTS OF CARRYING INVENTORY AS APPLICABLE IN THE MODERN BUSINESS CONTEXT

Location of inventory	Cost of carrying inventory
Location – at the suppliers end and in-transit between supplier and work place	Cost of inspection Cost of uncompensated in – transit damages Cost of delayed supplies (in terms of holding up the production of the output) Cost of write-offs due to obsolescence and demand failure
Location – factory	Cost of inspection Cost of storage in plant, including damages, theft, other losses Cost of unloading Cost of moving materials inside the plant Cost of uncompensated return supplies Cost of wastages due to wrong issue, quality issues
Location – at the distributors, retailers and in – transit	Cost of storage Cost of loading and unloading Cost of uncompensated losses and obsolescence Cost of distributor returns Cost of"loss of sight"
Purpose - regular consumption	Cost of wastages on shop floor due to damages, misplacement, wrong issues Cost of obsolescence Cost of occupying plant floor space Cost of storage on plant floor Cost of transportation inside the plant
Stage of production – WIP	Cost of transportation inside the plant Cost of wastage due to misplacement, damages Cost of occupying plant floor space Cost of storage on plant floor
Stage of production - finished goods	Cost of storage, floor space occupied Cost of obsolescence Cost of wastage / damaged goods Cost of taxes paid (for example, in India, all finished goods are levied excise duty which has to be paid as soon as the inventory is moved into the FG godown)
Stage of Production – customer returns	Cost of transport Cost of processing the customer returned product Cost of the write-offs of the product cost Cost of loss of goodwill of the customer due to the bad experience

Table 5: Costs of carrying inventory as applicable in the modern business context

Location of inventory	Cost of carrying inventory
Location – at the suppliers end and in-transit between supplier and work place	Cost of inspection Cost of uncompensated in – transit damages Cost of delayed supplies (in terms of holding up the production of the output) Cost of write-offs due to obsolescence and demand failure
Location – factory	Cost of inspection Cost of storage in plant, including damages, theft, other losses Cost of unloading Cost of moving materials inside the plant Cost of uncompensated return supplies Cost of wastages due to wrong issue, quality issues
Location – at the distributors, retailers and in – transit	Cost of storage Cost of loading and unloading Cost of uncompensated losses and obsolescence Cost of distributor returns Cost of"loss of sight"
Purpose - regular consumption	Cost of wastages on shop floor due to damages, misplacement, wrong issues Cost of obsolescence Cost of occupying plant floor space Cost of storage on plant floor Cost of transportation inside the plant
Stage of production – WIP	Cost of transportation inside the plant Cost of wastage due to misplacement, damages Cost of occupying plant floor space Cost of storage on plant floor
Stage of production - finished goods	Cost of storage, floor space occupied Cost of obsolescence Cost of wastage / damaged goods Cost of taxes paid (for example, in India, all finished goods are levied excise duty which has to be paid as soon as the inventory is moved into the FG godown)
Stage of Production – customer returns	Cost of transport Cost of processing the customer returned product Cost of the write-offs of the product cost Cost of loss of goodwill of the customer due to the bad experience

INVENTORY CONTROL AND MANAGEMENT

The EOQ forms the basis of inventory control mechanisms. In practice there are two broad types of inventory management systems : fixed order quantity (FOQ) and fixed period (FP) ordering.

The EOQ is: √2DS/C, where D = annual demand, S = ordering cost, C = inventory carrying cost per unit of item per annum and EOQ is the quantity to be ordered. C = (I / 100) * item cost, where I = interest rate (percentage per annum) of the bank(s) financing the inventory purchases and 'item cost"is the cost per unit of the item (Rupees)

The total stocking cost (TSC) is: ICC + OC (where ICC is the inventory carrying cost per item per annum and OC is the ordering cost for the item per annum)
TSC = (EOQ/2) * C + (D/EOQ) * S

When the fixed order quantity (FOQ) system is used the quantity ordered remains constant and the period of ordering may vary. In fixed period (FP) system the time period of ordering is constant while the quantity ordered varies. Typically in practice companies follow the FOQ for some items and FP for others. In the FOQ system the record keeping and tracking of inventory levels is continuous whereas in the FP system it is periodic. Quantities to be ordered depend on the lead time for receiving materials from the suppliers.

DEPENDENCE OF THE TSC IN THE INVENTORY CLASSIFICATION SYSTEM

Irrespective of the type of classification used the optimization is achieved by balancing the inventory carrying cost (ICC) with the ordering cost (OC). It would be useful to check out how the five systems of inventory classification work in practice. This is shown in Table 6 below.

TABLE 6: CLASSIFICATION METHODOLOGIES FOR THE FIVE INVENTORY CLASSIFICATION SYSTEMS

Type of items classification	Basis for classification	Practice used for classification
ABC (based on the consumption pattern)	Total value of usage per annum of each item	Collect data for the past three years, arrange all times in the descending order of consumption per annum and calculate the percentage contribution to the total cost of consumption. Those which contribute the top 70 % will be termed A items, the next which contribute about 20% will be classified as B items and the rest as C.
VED (Vital, Essential and Desirable) (degree of requirement for the production of the outputs)	Based on the usage requirements	Collect data for the past three years, identify and pre[pare the list of items with their consumption patterns. Arrive at a consensus on which are Vital, which are Essential and which ones are Desirable. The criteria for classification will include whether the items are Vital for producing many of the products, whether the items are required frequently. For example, if there is an item which is required in the production of 70% of the products then it can be classified as Vital. Another criterion could be – all parts used in the most profitable products. Profitability and profit (ie, volume of production) could be used as the criterion.
SDE (Scarce, Difficult, Easy) (difficulty of sourcing the item)	Based on the ability of the company to procure the items.	In this system items are classified based on whether the procurement is easy – in terms of ordering, transport, documentation, hassle free delivery.
FSN (Fast, Slow and Non-moving) (based on the usage pattern in terms of regular or irregular)	Based on the rate of quantity consumed.	Fast items are those which are consumed in the largest numbers, then the next ones and finally those which are consumed periodically and in smaller quantities. The A,B,C type of percentages can be used for the classification.
HML (High, Medium, Low) (based on the cost of the item)	Based on the cost of the individual items, irrespective of the consumption volume	Arrange all items in the descending order of cost. Then the top 20% of items can be classified as H, the next 20 % as M and the rest as L. However each company has to decide on the cut-off percentages to make business sense.

The TSC is governed by two main factors – the choice of the inventory management system – FOQ or FP, and the inventory classification system. While the choice of the inventory classification system is based on the"importance"of the inventory items to be controlled, the choice of the inventory management system is one of convenience or ease of use or some other such reason. For example, typically, for A items (in the classification ABC) the FOQ system is used . This is because of the high importance of A items (based on their annual consumption value, which is defined as the cost * units consumed per annum), their high consumption cost and the need to monitor continuously the high consumption patterns of these items to establish a close control. However the B and C items are usually controlled by the FP system. This is usually due to the high numbers of such items, the comparatively lower consumption costs, the convenience of administration and the"lesser importance"that the company's personnel attach to these items.

The ABC classification is popular, while others are also used. The belief is that this system, in conjunction with the appropriate choice of FOQ or FP allows companies to optimize their TSC's. However our current research shows that such a choice could be non-optimal under many situations. In fact it appears that the ABC system could lead to the highest cost from amongst the five options.

AN APPROACH FOR AN APPROPRIATE CHOICE OF THE INVENTORY CLASSIFICATION SYSTEM TO ACHIEVE OPTIMAL TSC

It is well established in inventory theory that the FOQ system leads to lower levels of TSC but higher monitoring (or more frequent) and the FP system leads to higher TSC due to higher stock levels but lower monitoring (or less frequent) levels. Companies therefore adopt the FOQ for the highest or the most important items (ie, for the A,V,S,F,H items in the five different inventory classification systems) and for all others adopt the FP system (see Table 7 below for an explanation of the"importance"levels or the"inventory categorization system")

TABLE 7: EXPLANATION OF THE"IMPORTANCE"LEVELS OR THE CATEGORIES UNDER EACH INVENTORY CLASSIFICATION SYSTEM

Inventory classification system	Levels of"importance"or the"Inventory categorization system"		
	High	Medium	Low
ABC	A	B	C
VED	V	E	D
FSN	F	S	N
SDE	S	D	E
HML	H	M	L

For the sake of illustration and calculations we will adopt a set of uniform inventory policies which are shown in Table 8 below:

TABLE 8: INVENTORY POLICIES FOR DIFFERENT INVENTORY CATEGORIES UNDER THE FIVE DIFFERENT INVENTORY CLASSIFICATION SYSTEMS

(for example, the policy applicable for"E"items under the SDE classification is given in row 3)

Items categories	Inventory Policies				
	Ordering Cost	Inventory system to be adopted	Order quantity	Average inventory	Safety stock
A or highest importance	Highest	FOQ	EOQ	As per EOQ	One month
B or Medium importance	Medium	FP	Six orders per annum	One month inventory	One month
C or least important	Least	FP	Four orders per annum	One and a half months inventory	One month

In order to illustrate the effect of the selection of the inventory classification system on the TSC, we looked at a large number of items being used in a large metals manufacturing company in India and selected 98 out of these which we felt would be adequate to illustrate the basic purpose of our research. We classified the items under each of the 5 inventory classification systems . These are listed in Annexure 1.

The summary is given below (Table 9) :

TABLE 9: SUMMARY OF CLASSIFICATION OF 98 ITEMS

Inventory Classification	Number of items	Remarks
ABC (based on the consumption pattern)	A-14	The total consumption value is: (In Rs)
	B-18	A- Rs 1,06,41,884
	C-66	B- Rs. 9,11,184
	Total -98	C- Rs 9,96,404
VED (Vital, Essential and Desirable) (degree of requirement for the production of the outputs)	V – 31	Classification based on experience and consensus
	E – 21	V- Rs 54,39,894
	D – 46	E- Rs 39,91,019
	Total -98	D- Rs 16,65,188
SDE (Scarce, Difficult, Easy) (difficulty in sourcing the item)	S – 5	Classification based on experience and consensus
	D- 20	S- Rs 18,51,351
	E – 73	D- Rs 31,35,681
	Total- 98	E- Rs 75,62,438
FSN (Fast, Slow and Non-moving) (based on the usage pattern in terms of regular or irregular)	F – 35	Classification based on experience and consensus
	S –45	F- Rs 26,40,947
	N –18	S- Rs 59,49,735
	Total -98	N- Rs 39,58,788
HML (High, Medium, Low) (based on the cost of the item)	H – 20	Classification based on experience and consensus, Cut – offs used:
	M – 19	H – Rs 78,58,091
	L – 59	M – Rs 3,58,931
	Total -98	L – Rs 43,32,448

Source: an industrial manufacturing company in India

Annual consumption of all inventory items = Rs. **1,25,49,472**

In classifying the items under three different categories in each classification the following criteria have been used (Table 10):

TABLE 10: CRITERIA USED TO CATEGORISE ITEMS IN EACH CLASSIFICATION

Classification	Categories	Criteria for categorisation
ABC	A,B,C	As per annual consumption (= number consumed per annum * cost of item per unit)
VED	Vital, Essential and Desirable	Based on the judgment of concerned stakeholders in the use of the items in production as well as past consumption data
FSN	Fast, Slow and non Moving	> 205 - Fast, 55 to 204 - Slow, <54 – NM (Numbers show the units consumed per annum)
SDE	Scarce, Difficult and Easy	Based on the judgment of the concerned stakeholders in procuring the items
HML	High, Medium and Low	> 20,000 - High, 10,000 to 50,000: Medium, <14000 – Low (Numbers show the cost of the items per unit)

The criteria shown in Table 10 will change for each company.

TABLE 11: ITEMS WITH DIFFERENT HIERARCHIES UNDER EACH TYPE OF CLASSIFICATION

1	CONVEYOR BELT,1200 MM, M-24,BTH	A	VITAL	NON-MOVING	EASY	LOW
2	HELICAL GEAR BOX, PD-18, 50:1,BTH	A	VITAL	NON MOVING	DIFFICULT	HIGH
3	PUMP,PV180R1K1T1NFWS,PARKER,LUL	A	DESIRABLE	SLOW	EASY	HIGH

As can be seen from Table 11 above, which is an extract from Annexure I, the classification of an item can differ in hierarchy under each classification. For example, the item 10, conveyor belt, has been classified as"A"under the ABC whereas it is classified as Non Moving under the FSN classification. **Hence it is possible that if we have different rules for ordering and stocking for each category under each of the inventory classification systems the TSC incurred for an item could be different** .

This is the basic proposition in our paper that we would like to emphasise. The inventory classification system chosen can change the way that the item is dealt with leading – in ordering and stocking levels - to cost differentials. It follows that the TSC for all the items put together can be lower or higher under each classification for the same set of items. Therefore we can use this tool to reduce the inventory related costs if doing so will suit the business needs.

Now let us examine some typical instances of inventory management for each classification. The ordering costs and policies are shown in Table 12 below:

TABLE 12: INVENTORY POLICIES FOR EACH TYPE OF CLASSIFICATION

Classification	Ordering poilcies	Ordering costs	Bank rate for carrying Inventory
ABC	A - FOQ	A - 1,400	10%
	B,C - FP	B-1,000	
		C-800	
VED	V - FOQ	A - 1,400	
	E,D - FP	B-1,000	
		C-800	
SDE	S - FOQ	A - 1,400	
	D,E - FP	B-1,000	
		C-800	
FSN	F - FOQ	A - 1,400	
	S,N - FP	B-1,000	
		C-800	
HML	H - FOQ	A - 1,400	
	M,L - FP	B-1,000	
		C-800	

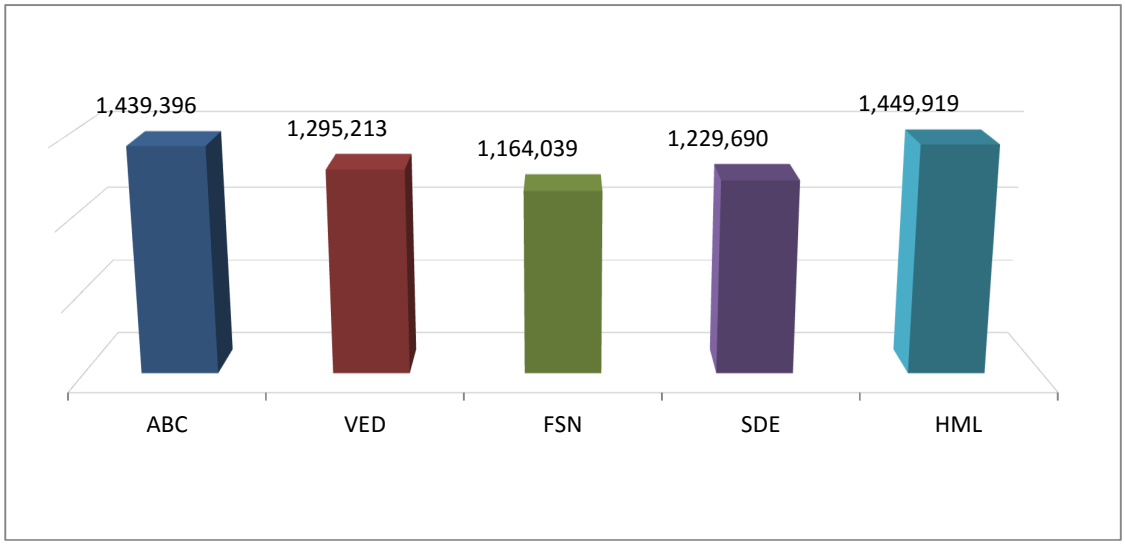
For FOQ system the ordering is done as per the EOQ and the lead time demand. The safety stock policy is: one month for all items. We recognize that the safety stock policy will be determined by the uncertainties in the demand and the lead times, as well as the level of service desired, the assumption made is only to illustrate the principles involved.

For the FP system we order the second level items once every two months and the third level items once every three months. Ordering is done for the three months and two months requirements without any reference to the EOQ. Based on the above criteria we have calculated the total cost of carrying inventory and the ordering costs. The total inventory related costs for the five different classifications based on the assumptions made in Tables 10 and 12 are shown in Table 13 and Figure 3:

TABLE 13: COMPARISON OF TSC FOR THE FIVE DIFFERENT INVENTORY SYSTEMS

Inventory Classification	TSC (in Rupees per annum)
ABC	14,35,244
VED	12,82,219
FSN	11,47,544
SDE	11,98,180
HML	14,31,867

FIGURE 3: TSC UNDER THE FIVE DIFFERENT TYPES OF INVENTORY SYSTEMS



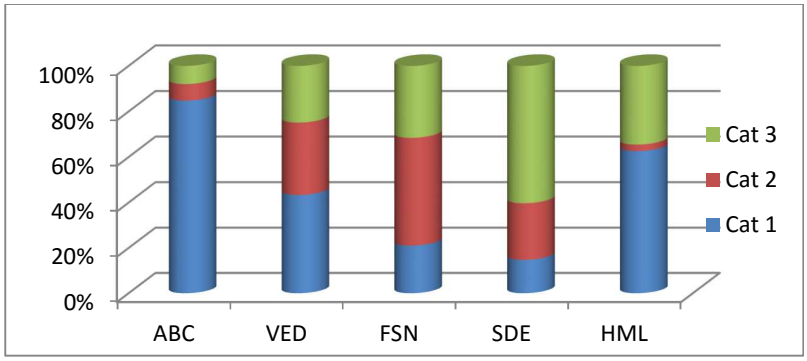
The ranking based on the lowest TSC is shown in Table 14 below:

TABLE 14: COMPARISON OF THE TSC FOR THE FIVE DIFFERENT INVENTORY CLASSIFICATION SYSTEMS

Classification System	Cost higher by
FSN	Base
SDE	Higher by 4 %
VED	Higher by 12 %
HML	Higher by 25 %
ABC	Higher by 25%

The categorization of items into the 3 categories under each classification varies according to the rule selected under the inventory classification system. As per the rules selected and described in the Table 10 the costs of items categorised under A,B,C; V,E,D etc is shown in Figure 4. It is interesting to see that the cost of the category 1 item (most important) is the highest in the ABC and the least in the case of the SDE system. This signifies that in the chosen data set of items the cost of the scarce to get items is much less than the ABC system. Since the most effort is spent in the category 1 items, in terms of inventory monitoring and control, any system that results in fewer items tends to be less expensive in terms of the TSC. However the cost of the other items also need to be taken into account before we can say that the TSC of the inventory will be lower under a specific classification.

FIGURE 4: COMPARISON OF THE COST OF DIFFERENT CATEGORIES OF ITEMS UNDER EACH INVENTORY SYSTEM



In order to check out whether the results shown in Table 14 are of a general nature and not specific to this data set only we ran a series of sensitivity analyses making different assumptions regarding the"bank rate"and the ordering cost which are the key drivers of the TSC. We examined and calculated the TSC for options of bank rates of 0.05,0.10,0.15 and 0.20 (which are the most likely values of the bank rate, although in developed countries the bank rate could be lower than 0.10) (see Figure 5) as also ordering costs as shown in Table 15 below:

TABLE 15: 4 DIFFERENT CASES OF ORDERING COSTS (RS PER ORDER) CONSIDERED TO CALCULATE THE VARIATIONS IN TSC

	Ordering costs			
Inventory System Categories	Set 1	Set 2	Set 3	Set 4
Highest	1,400	1,600	2,000	2,500
Middle	1,000	1,200	1,700	2,000
Low	800	1,000	1,400	1,800

The comparison of the TSC with the lowest TSC (base case) are shown in Table 16 below. Evidently the benefits of choosing and using an appropriate inventory classification system has advantage to the extent of between 4 to 25 % in TSC.

TABLE 16: COMPARISON OF TSC OF DIFFERENT INVENTORY CLASSIFICATION SYSTEMS

Inventory System	% difference in TSC
ABC	+24 to 25
VED	+ 11 to 13
FSN	Base Case
SDE	+4 to 8
HML	+ 24 to 25

The TSC under various bank rates (varying from 0.10 or 10 % to 0,20 or 20%) is shown in Figure 5 and under the four different sets of ordering costs is shown in Figure 6.

FIGURE 5: VARIATION IN TSC WITH INCREASING BANK RATE FOR THE FIVE INVENTORY CLASSIFICATION SYSTEMS

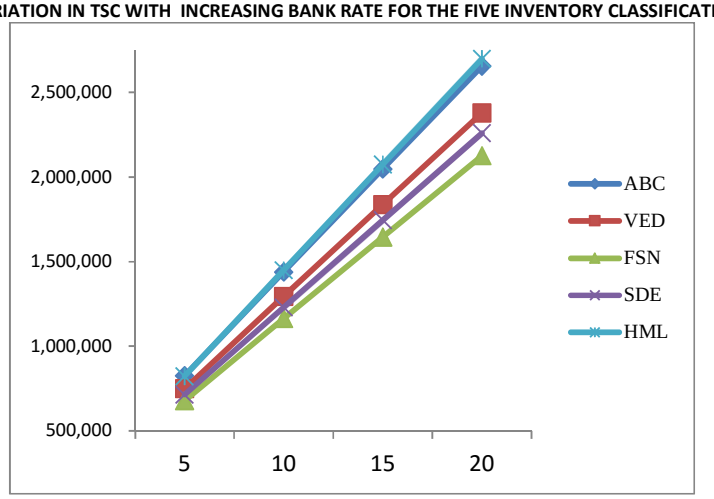
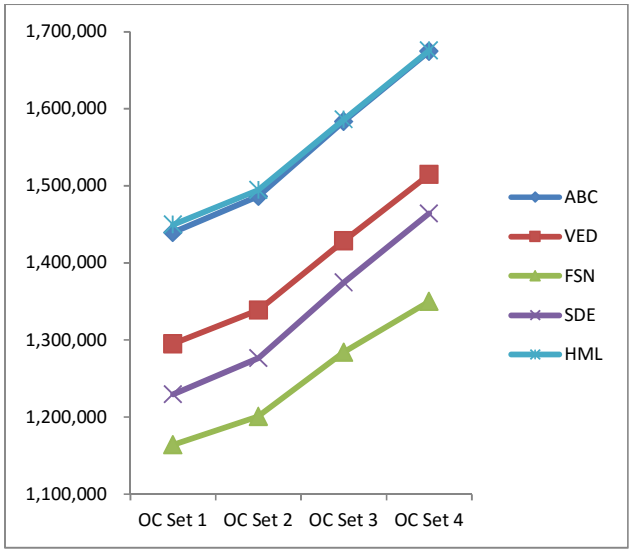


FIGURE 6: VARIATION IN TSC WITH CHANGING OC FOR THE FIVE INVENTORY CLASSIFICATION SYSTEMS



ANALYSIS AND DISCUSSIONS OF THE RESULTS

Results show the following for the dataset examined:

- FSN yields the lowest TSC
- The cost difference between the base case and the other cases can be as high as 25 % and as low as 4 %
- The FSN remains the most favoured system over a range of bank rates (5 to 20 %) and a wide range of ordering costs, including the case of one OC for all the categories.
- The TSC increases with increasing bank rate for any of the systems
- The TSC also increases with the increase in ordering costs
- The TSC for ABC and HML are close to each other and quite distinctively different form the other three. The other three are somewhat close to each other though not as close as the other two.
- The TSC for the ABC, a very popular system in use in many companies, appears to be the highest. In this case it is 25 % more than the base case.

Given the magnitude of the difference in the TSC between each type of inventory classification system there is a good case for trying to understand the underlying reasons for the behavior shown by the results. In Table 9 are given the annual consumption cost of the items under different categories under each inventory classification system. If we tabulate these values we get Table 17, from which we can derive Table 18:

TABLE 17: COMPARISON OF VALUES OF ANNUAL CONSUMPTION COST IN EACH INVENTORY CATEGORY UNDER EACH INVENTORY CLASSIFICATION SYSTEM

Inventory classification system	Annual consumption cost (Rupees per annum)			Total annual consumption cost (rupees per annum)
	High importance	Medium importance	Low importance	
ABC	1,06,41,884	9,11,184	9,96,404	1,25,49,472
VED	54,39,895	39,91,019	31,18,557	1,25,49,472
FSN	26,40,948	59,49,735	39,58,789	1,25,49,472
SDE	18,51,351	31,35,682	75,62,439	1,25,49,472
HML	78,58,091	3,58,931	43,32,449	1,25,49,472

TABLE 18: COMPARISON OF VALUES OF ANNUAL CONSUMPTION COST IN EACH INVENTORY CATEGORY UNDER EACH INVENTORY CLASSIFICATION SYSTEM (PERCENTAGE TO TOTAL ANNUAL CONSUMPTION COST)

Inventory classification system	Annual consumption cost (percentage to total annual consumption cost)			Total annual consumption cost (percentage)
	High importance	Medium importance	Low importance	
ABC	85	7	8	100
VED	43	32	25	100
FSN	21	47	32	100
SDE	15	25	60	100
HML	63	3	35	100

The TSC depends on three costs:

- Cost of carrying inventory (ICC) (or inventory carrying cost)
- Cost of ordering (OC) (or the ordering cost)
- Cost of carrying safety stock (CSS)

The SS for each category is the same – one month of consumption. Hence CSS for each category will be affected by the total cost of the items in the category. While in the ABC system this cost is the highest for the A category the same cannot be said of the other systems. The total OC for the high category depends on the EOQ, which in turn is a function of the ICC and the OC. For the other categories the same will depend on the unit consumption for each item in the category. For example if the consumption is less than 6 and if the item belongs to the medium category then the total OC for that item will be the same as for one order, because the logic is that the entire consumption can be ordered once and the stock carried through the year. Similarly for any item in the low category if the consumption is less than 4 the same rule applies. If not then number of orders will be 6 or 4 for that item.

Given below is a Table which shows the percentage of the TSC under each category. It appears that the TSC for the inventory classification system for which the percentage cost of high importance items is the lowest will likely yield the lowest total TSC.

TABLE 19: PERCENTAGE OF TSC TO TOTAL TSC FOR EACH CATEGORY

Inventory Classification System	High importance	Medium importance	Low importance	Total
ABC	81	7	13	100
VED	47	32	20	100
FSN	13	57	30	100
SDE	23	19	58	100
HML	80	3	17	100

This conclusion can be justified on the basis of the logic that high importance items need the maximum care in inventory management and hence likely to cost the highest. However some more work will be required to make this statement universally true.

In view of the many combination of costs possible it is not possible to be very precise about the outcome of the TSC results for each dataset of inventory items. However one can, from the example given below, understand the reason why the TSC for an item can change under the different inventory classification systems.

TABLE 20: COMPARISON OF TSC FOR THREE CHOSEN ITEMS (SHOWN IN TABLE 9) UNDER THE FIVE DIFFERENT INVENTORY CLASSIFICATION SYSTEMS

Item Number	Item Name	ABC	VED	FSN	SDE	HML
1	CONVEYOR BELT,1200 MM, M-24,BTH	18,739	18,739	16,555	16,555	3,718
2	HELICAL GEAR BOX, PD-18, 50:1,BTH	89,380	89,380	66,785	64,541	89,380
3	PUMP,PV180R1K1T1NFWS,PARKER,LUL	87,080	65,060	62,880	65,060	87,080
		1,95,199	**1,73,179**	**1,46,220**	**1,46,156**	**1,80,178**

The TSC varies from Rs. 195,199 to Rs. 146,156 due to the fact that the items have been categorized under different heads in each of the inventory classification system. For example, under ABC the items have been categorized as A,A,A while under the FSN they have been categorized as NM, NM and Slow. Hence the TSC's for each item are comparatively lower for the FSN than the ABC because of the underlying method of calculating the inventory management actions – number of orders to be placed and the quantity per order.

CONCLUSIONS AND RECOMMENDATIONS

What is evident is that the most popular inventory classification system, ABC, could also be the most expensive. On of the important conclusion from this study is that for any inventory system it may be a good idea to check if the classification of the items can be done under the five different categories (ideal situation) and make the calculations to see which one results in the lowest TSC. Whether to choose this system for practice is a choice that each company has to make. It is likely that for every set of inventory items one of the classification systems will yield the lowest TSC.

Based on our empirical study it is possible to conclude that the FSN classification system is to be preferred over the ABC or any other system of inventory classification for the dataset of items used in this paper as it results in the lowest TSC. This conclusion appears to be valid over bank rates varying between 5 % to 20 % which are the prevalent values in most economies as well as varying ordering costs. The nature of the inventory management systems and the application of these to the different categories as well the choice of the safety stock levels influence the TSC but the rankling of the TSC remains the same. Since the cost differential can vary between 4 to 25 %, it may be a good idea to try and use the FSN system for this dataset.

Companies can benefit from using these calculations for their inventory items, either in part or encompassing all inventory items, to derive benefits due to the different actions to be taken for managing the inventory under each type of inventory classification system. We believe that we have hit upon a simple but elegant method, which can stand the test of empiricism, to obtain cost benefits. We recommend all companies to take advantage of the contents of this paper to manage their inventories better.

SCOPE FOR FURTHER WORK

While we have studied one set of data (some other datasets have also been studied, with the conclusion that one classification system yields the lowest TSC consistently over many different types of assumptions, but this system may not always be the FSN, as in the case of the dataset used in this paper) . One may obtain different results for the reason that the cost and consumption for each item will be differently related as well as the categorization will change for each item under the different inventory classification system due to the nature of use, availability in the market and vendor capabilities. However for each dataset once the comparative values are obtained then it becomes easy to decide which system of classification to use to derive the maximum benefits. We propose to do some more work in this area and in future publications report on the differences, if any. Another area for further work is to derive a generic model for the problem and study the nature of the costs. We have started this work and perhaps sometime soon we will come back with a proposal.

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ANNEXURE

TABLE 21: FINAL LIST OF 98 ITEMS CLASSIFIED UNDER THE FIVE DIFFERENT INVENTORY CLASSIFICATIONS

Sl No	MATERIAL DESCRIPTION	ABC	VED	FSN	SDE	HML
1	BC 31911,B1200X4(4.5+1.5)	A	DESIRABLE	FAST	DIFFICULT	LOW
2	TRUNNION ROLLER ASSEMBLY,211748, BTH	A	VITAL	NON-MOVING	SCARCE	HIGH
3	SCSRSX1;modified scissor lift,lul,rodding	A	ESSENTIAL	SLOW	EASY	HIGH
4	SCSRSX2;modified scissor lift,lul,rodding	A	ESSENTIAL	SLOW	EASY	HIGH
5	SCSRSX3;modified scissor lift,lul,rodding	A	ESSENTIAL	SLOW	EASY	HIGH
6	BE GEAR BOX TYPE:ZSY 200 FOR RMT	A	VITAL	NON-MOVING	SCARCE	HIGH
7	GEARBOX,31911	A	VITAL	SLOW	EASY	HIGH
8	PUMP;PUMP, SST	A	ESSENTIAL	SLOW	DIFFICULT	HIGH
9	CONVEYOR BELT,1200 MM, M-24,BTH	A	VITAL	NON-MOVING	EASY	LOW
10	CONVEYOR BELT,1200 MM, M-24,BTH	A	VITAL	NON-MOVING	EASY	LOW
11	HELICAL GEAR BOX, PD-18, 50:1,BTH	A	VITAL	NON-MOVING	DIFFICULT	HIGH
12	PUMP,PV180R1K1T1NFWS,PARKER,LUL	A	DESIRABLE	SLOW	EASY	HIGH
13	BUCKET ELEVATOR BELT RMT	A	VITAL	SLOW	EASY	LOW
14	ROLR;WALKING BEAM MODIFIED ROLLER,LUL	A	ESSENTIAL	FAST	EASY	HIGH
15	COVER;42050,CAITC	B	DESIRABLE	SLOW	EASY	HIGH
16	BEARING ROLLER 22232CCK/W33	B	VITAL	FAST	EASY	HIGH
17	SHELL TELUS 46	B	DESIRABLE	FAST	EASY	LOW
18	SHELL TELUS 46	B	DESIRABLE	FAST	DIFFICULT	LOW
19	SHELL TELUS 46	B	DESIRABLE	FAST	EASY	LOW
20	STOPPER PLATE, P&F	B	DESIRABLE	SLOW	EASY	MEDIUM
21	STOPPER PLATE, P&F	B	DESIRABLE	SLOW	EASY	MEDIUM
22	INPUT PINION SHAFT FOR GB, PD 16,50:1	B	VITAL	SLOW	EASY	HIGH

23	BRACKET BEARING,RAM CYL. TOP,10338042,BP	B	VITAL	SLOW	EASY	HIGH
24	FILTER BAGS,ID-125MM,L-2110MM,RMT	B	DESIRABLE	FAST	SCARCE	LOW
25	SHELL ALVANIA RL3	B	VITAL	FAST	EASY	LOW
26	BEARING ROLL,22220CCK/W33	B	ESSENTIAL	FAST	EASY	LOW
27	DUST SEAL, 204401, BTH	B	DESIRABLE	SLOW	DIFFICULT	HIGH
28	CLEVIS ASSEMBLY, 06-4259-0311-01,LUL	B	DESIRABLE	NON-MOVING	DIFFICULT	HIGH
29	CLEVIS ASSEMBLY, 06-4259-0311-03,LUL	B	DESIRABLE	NON-MOVING	DIFFICULT	HIGH
30	FRL - 3/4' BSPP, P3NCA16SGMNNLNA,SST	B	DESIRABLE	FAST	EASY	HIGH
31	TAIL PULLEY 500DIAX1410 LX30MM,BTH	B	DESIRABLE	NON-MOVING	EASY	HIGH
32	BEARING COMB, 4.061 FLANGE AP-4, CAST	B	VITAL	FAST	EASY	HIGH
33	SHELL TELUS 46	C	ESSENTIAL	FAST	EASY	LOW
34	SERVOMESH SP 320, IOCL	C	DESIRABLE	FAST	EASY	LOW
35	SERVOMESH SP 320, IOCL	C	DESIRABLE	FAST	EASY	LOW
36	Bearing 22216cck+H316	C	VITAL	SLOW	DIFFICULT	LOW
37	RETURN IDLER,1200MM BELT,114MM,BTH	C	DESIRABLE	SLOW	EASY	LOW
38	SPHERICAL PLAIN BEARING, GE60DO- 2RS, AB	C	VITAL	FAST	EASY	LOW
39	SHELL VITREA M 460	C	DESIRABLE	FAST	DIFFICULT	LOW
40	SERVO SYSTEM 68	C	ESSENTIAL	FAST	EASY	LOW
41	SHELL VITREA M 460	C	DESIRABLE	FAST	EASY	LOW
42	UNION TEE, 16JLO	C	DESIRABLE	NON-MOVING	EASY	LOW
43	BEARING ROLL,22220CCK/W33	C	ESSENTIAL	SLOW	EASY	LOW
44	EXPANSION UNIT CARD, MESSUNG,X6418	C	VITAL	SLOW	DIFFICULT	MEDIUM
45	PISTON SEAL KIT,MATING STN LIFT TABLE	C	DESIRABLE	FAST	EASY	MEDIUM
46	ISO VG 32	C	DESIRABLE	FAST	EASY	LOW
47	EXPANSION UNIT CARD, MAKE-MESSUNG, X6616	C	ESSENTIAL	NON-MOVING	DIFFICULT	MEDIUM
48	KIT VLV REPR;TYP AIR PULSE	C	DESIRABLE	SLOW	EASY	LOW
49	CARRYING IDLER,1200MM BELT,140MM,BTH	C	DESIRABLE	SLOW	EASY	LOW
50	KIT VLV REPR;TYP PULSING	C	DESIRABLE	SLOW	EASY	LOW
51	KIT VLV REPR;TYP PULSING	C	DESIRABLE	SLOW	EASY	LOW
52	DRIVE SPROCKET BC31911	C	VITAL	SLOW	EASY	MEDIUM
53	BEARING ROLL,22220 EK/C3	C	ESSENTIAL	SLOW	EASY	LOW
54	BEARING ROLL,22220CCK/W33	C	ESSENTIAL	SLOW	EASY	LOW
55	CROSSHEAD, 40010407, MAT	C	ESSENTIAL	FAST	EASY	MEDIUM
56	SAFETY RELAY,PILZ PNOZ-X4,3NO+1 NC	C	DESIRABLE	SLOW	EASY	MEDIUM
57	IMPACT IDLER,1200MM BELT,114MM,BTH	C	DESIRABLE	SLOW	EASY	LOW
58	IMPACT IDLER,1200MM BELT,114MM,BTH	C	DESIRABLE	SLOW	EASY	LOW
59	IMPACT IDLER,1200MM BELT,114MM,BTH	C	DESIRABLE	SLOW	EASY	LOW
60	BUCKET FOR RMT BUCKET ELEVATOR	C	VITAL	FAST	EASY	LOW
61	BUCKET FOR RMT BUCKET ELEVATOR	C	VITAL	FAST	EASY	LOW
62	BUCKET FOR RMT BUCKET ELEVATOR	C	VITAL	FAST	EASY	LOW
63	POPPET VALVE, 1/2"BSP, NC, N315N904549	C	VITAL	NON-MOVING	DIFFICULT	MEDIUM
64	VLV SLND;P/N:N315N904549,PARKER	C	ESSENTIAL	NON-MOVING	DIFFICULT	MEDIUM
65	GFL CAPACITOR,3.5 MICRO FARAD, FCAP 3080	C	VITAL	NON-MOVING	EASY	MEDIUM
66	VALVE PRESS CTRL S 665-3-1/2 D 2, SB	C	DESIRABLE	SLOW	EASY	MEDIUM
67	BEARING ROLL,22220 EK/C3	C	ESSENTIAL	SLOW	EASY	LOW
68	WHEEL RIDING DIA 338 X 130, TC	C	DESIRABLE	SLOW	EASY	LOW
69	Welding electrode CGS 680 3.15 mm	C	DESIRABLE	FAST	EASY	LOW
70	Welding electrode CGS 680 3.5 mm	C	DESIRABLE	FAST	EASY	LOW
71	ELECTRD WELDG;CGS 680,3.15MM	C	DESIRABLE	FAST	EASY	LOW
72	ROD END CYL, 06-4261-2044-03, SB	C	VITAL	NON-MOVING	SCARCE	MEDIUM
73	BEARING ROLL,22218CCK/W33	C	ESSENTIAL	SLOW	EASY	LOW
74	BEARING ROLL,22218CCK/W35	C	VITAL	SLOW	EASY	LOW
75	CHAN;C CHANNEL, MAT	C	DESIRABLE	FAST	EASY	MEDIUM
76	CHAN;C CHANNEL, MAT	C	DESIRABLE	FAST	EASY	MEDIUM
77	GAUGE PRESS, 35-1009-SW-028-XMG-600, SB	C	DESIRABLE	FAST	EASY	MEDIUM
78	GRSE;GREASE OMEGA-57	C	ESSENTIAL	FAST	EASY	LOW
79	ROD END,RH CFM 12T MAKE: SEALMASTER	C	ESSENTIAL	SLOW	EASY	LOW
80	ROD END,LH CFML12T MAKE: SEALMASTER	C	ESSENTIAL	SLOW	EASY	LOW
81	BAG-A;FFT:FOR SHOTBLAST BAG FILTER	C	DESIRABLE	SLOW	DIFFICULT	LOW
82	BAG-B;FFT:FOR SHOTBLAST BAG FILTER	C	DESIRABLE	NON-MOVING	DIFFICULT	LOW
83	BEARING (22217EK), BC31915	C	VITAL	SLOW	EASY	LOW
84	BEARING (22217XEK), BC31915	C	VITAL	SLOW	EASY	LOW
85	Welding electrode CGS 6011 3.15 mm	C	DESIRABLE	FAST	EASY	LOW
86	Welding electrode CGS 6080 3.15 mm	C	DESIRABLE	FAST	EASY	LOW
87	Welding electrode CGS 7016 3.15 mm	C	DESIRABLE	FAST	EASY	LOW
88	SEAL OIL;P/N:TSN-532G,SKF LIMITED	C	ESSENTIAL	FAST	EASY	LOW
89	SPHERICAL BEARING, SBG12 MAKE:SEALMASTER	C	VITAL	NON-MOVING	SCARCE	LOW
90	BOLT;COUNTERSHUNK BOLT M20x140,AM	C	DESIRABLE	SLOW	EASY	LOW
91	DIRECTION VALVE P01254 FOR T/P INDEXER	C	VITAL	SLOW	DIFFICULT	MEDIUM
92	DIRECTION VALVE P1784FOR T/P INDEXER	C	VITAL	SLOW	DIFFICULT	MEDIUM
93	FILTER BAGS, DEDUSTING,AM	C	DESIRABLE	SLOW	EASY	LOW
94	GUIDE;HOIST ROPE GUIDE,3T CRANE,RODDING	C	ESSENTIAL	SLOW	EASY	LOW
95	PISTON LIP KIT 5.00CSB-2HLTS47AC8.5,LUL	C	VITAL	SLOW	DIFFICULT	LOW
96	VALVE PR, EVSA315A061/RHC13/5004940, BP	C	DESIRABLE	SLOW	EASY	MEDIUM
97	BEARING HOUSING SN1 518 TC-SKF	C	VITAL	NON-MOVING	DIFFICULT	LOW
98	BEARING HOUSING SN4 518 TC-SKF	C	VITAL	NON-MOVING	DIFFICULT	LOW

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