

INVENTORY MANAGEMENT FOR INDEPENDENT DEMAND ITEMS
IN ESCOM.

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A dissertation submitted to the Faculty of Engineering,
University of the Witwatersrand, Johannesburg, in partial
fulfilment of the degree of Master of Science in Engineering.

Johannesburg, 1987.

DECLARATION

I declare that this dissertation is my own, unaided work.
It is being submitted for the Degree of Master of Science
in Engineering in the University of the Witwatersrand,
Johannesburg. It has not been submitted before for any degree
or examination in any other University.

De J. J. J. J. J.
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...1st...day of June.....1987.

SYNOPSIS

The aim of the project was to provide users with a means of reducing their inventories in the short term, until a fully integrated materials management system could be implemented. Since the users had very little knowledge of inventory management concepts and relatively primitive tools, a grass roots approach was taken. Firstly, users were educated in some of the basics of inventory management and then, when they had reached an adequate level of understanding, given a personal computer (p.c) based "inventory optimisation package" to enable them to more easily and speedily control their inventory. An analysis was undertaken by the author at two pilot site stores so as to prove the effectiveness of the inventory models chosen and presented in the education, as well as to demonstrate the working of the p.c. based computer program developed. The analysis shows that inventory reductions of several millions of rand are possible at the pilot stores. Since the stock turn ratios for the stores in question are higher than the Escom average it can be concluded that similar savings can be made at most Escom stores, with a marginal implementation cost.

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To my project supervisor, Keith Sandroek, thank you for your guidance and assistance. Also to Ehud Matya, thank you for being my "soundboard" and for your moral support.

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1. AIM

The aim of the project was to provide users with a means of reducing their inventories in the short term, until a fully integrated materials management system could be implemented.

2. INTRODUCTION

In January 1986 Escom's Organisation and Business Analysis department was given the responsibility to investigate materials management in Escom. The request for the investigation came from the Senior General Manager after he became aware that Escom's stock holding would exceed R1 billion by 1990, while customer service levels were still unacceptably low.

A project team consisting of industrial engineers, business analysts and external consultants was formed to investigate materials management in Escom. The project team began the investigation by examining the present inventory procurement life-cycle so as to gain a good understanding of the systems (manual or computer) being used and a qualitative measure of their effectiveness.

The next phase was the development of the user's requirements which was followed by drawing up a comprehensive system definition (and data flow diagrams). Once these steps are complete, computer software will be evaluated, chosen and implemented.

During the 1st phase of the project (evaluating the present systems) it soon became evident that the present systems were grossly inadequate, especially as regards inventory management. It was also found that the general level of awareness and understanding of even basic inventory management concepts was extremely poor. This, together with a lack of the appropriate tools, had contributed to the present unsatisfactory situation of high stock levels and poor customer service levels.

Because any computerised integrated materials management system would only be implemented throughout Escom 3-4 years into the future, it was decided that the present state of affairs could not be allowed to continue until that date and that some form of intervention was essential.

It was thus decided that a short term action plan should be developed in the interim, to enable users to begin to gain control of their inventories.

In short, the immediate action plan was to:-

- (1) Identify the role of inventory management in Escom and establish the function organisationally.
- (2) Educate all inventory management/optimisation personnel with some of the basic techniques, as soon as possible.
- (3) Make inventory management aids (such as personal computer programmes etc) available to personnel once an adequate level of understanding of inventory management concepts had been realised.
- (4) Give further educational seminars on other related areas such as Material Requirements Planning (MRP), Master Scheduling (MS), etc.

The author was given the responsibility for steps 2 and 3 of the above plan and the work done in this regard forms the basis of this dissertation.

Step 1 of the action plan was undertaken by the Organisational Department in Escom while the responsibility for step 4 was given to external consultants, although this can be seen as part of the overall implementation process of the proposed MRP II system.

3. BACKGROUND INFORMATION

3.1 Inventory Breakdown - Escom.

Escom's business can roughly be divided into two major areas: Generation and Distribution. The Generation business is essentially concerned with generating power and erecting power stations while the Distribution business concerns itself with transmitting the power to individual users via the distribution network, as well as the construction of the network.

The Generation business consists of power generating utilities (power stations) falling into the following categories:

- Coal fired - (25)
- Gas turbine - (2)
- Hydro electric (2)
- Pump storage - (2)
- Nuclear - (1)
- Total = 32

These power stations are distributed throughout South Africa, with a high concentration of coal fired stations in the Eastern Transvaal.

The distribution business is divided into the following geographical areas:

- Southern Cape
- Western Cape
- Eastern Cape
- Northern Cape
- Orange Free State
- Western Natal
- Eastern Natal
- Southern Transvaal
- Eastern Transvaal
- Western Transvaal
- Central Transvaal
- North Eastern Transvaal

The stores configuration or network is different for the two business areas. In Generation each utility is served by a major store, which may or may not consist of substores. In Distribution however, each Region is served by a main store which feeds a varying number (3-8) of smaller stores. These stores then, in turn supply the so called camp site stores, situated at the construction sites.

Escom's total stockholding is ± R792 million with the generation and distribution businesses holding roughly equal quantities of stock. Approximately R856 million of inventory is purchased annually.

The value of this inventory is distributed in the following categories.
(See tables 3.1 and 3.2 below and figures 3.1 and 3.2 over)

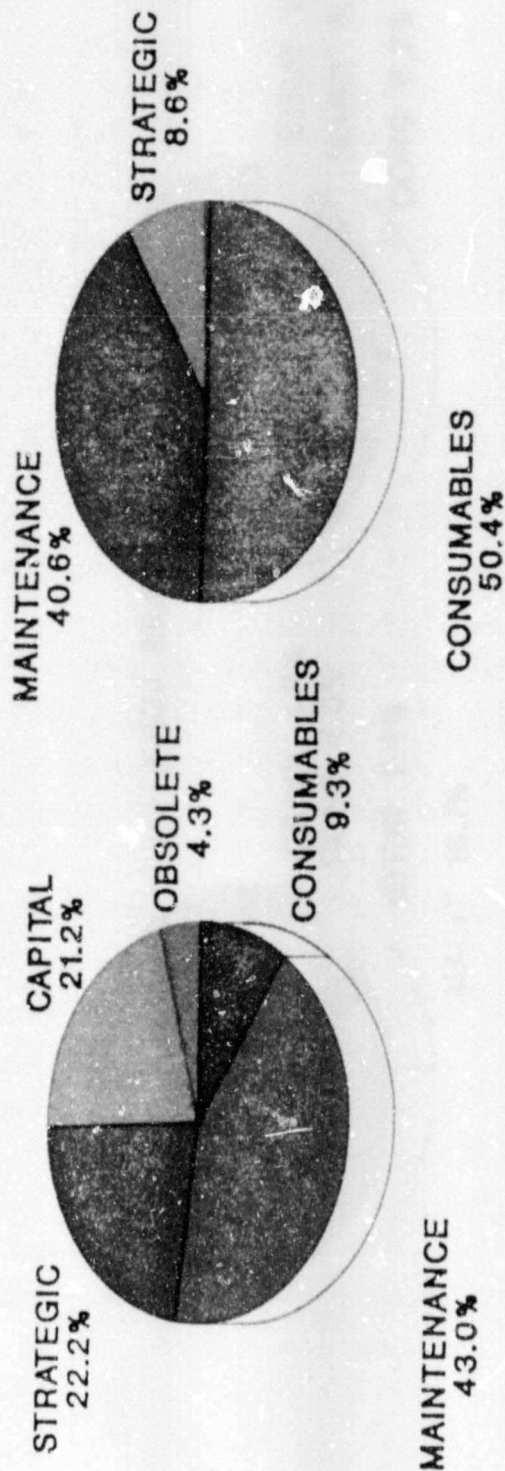
CATEGORY	GENERATION		DISTRIBUTION	
	ON HAND VALUE		ON HAND VALUE	
10/20 - Obsolete	R18 756 564	4,3%	R6 895 632	1,9%
11/21 - Capital, nuclear	R91 618 867	21,2%	R4 344	0%
12/22 - Key, strategic	R96 349 373	22,2%	R27 778 133	7,7%
13/23 - Construction projects	R43 372	0,1%	R273 386 989	76,3%
14/24 - Maintenance stock	R186 306 297	43,0%	R36 348 555	10,1%
15/25 - Consumables	R40 412 833	9,3%	R14 142 573	4,0%
TOTAL	R433 487 300	100%	R358 555 000	100%

TABLE 3.1 Escom's on hand inventory per category

CATEGORY	GENERATION		DISTRIBUTION	
	USAGE VALUE		USAGE VALUE	
10/20 - Obsolete	R653 120	0,4%	R1 781 204	0,3%
11/21 - Capital, nuclear	R0	0%	R0	0%
12/22 - Key, strategic	R14 598 987	8,6%	R15 142 322	2,2%
13/23 - Construction projects	R 142	0%	R584 525 593	85,3%
14/24 - Maintenance stock	R69 359 083	40,6%	R41 358 393	6,0%
15/25 - Consumables	R86 051 803	50,4%	R42 370 046	6,2%
TOTAL	R170 666 137	100%	R685 178 5607	100%

TABLE 3.2 Escom's annual inventory usage per category

GENERATION INVENTORY ANALYSIS



ON HAND VALUE ANNUAL USAGE VALUE

FIGURE 3.1

GENERATION INVENTORY ANALYSIS

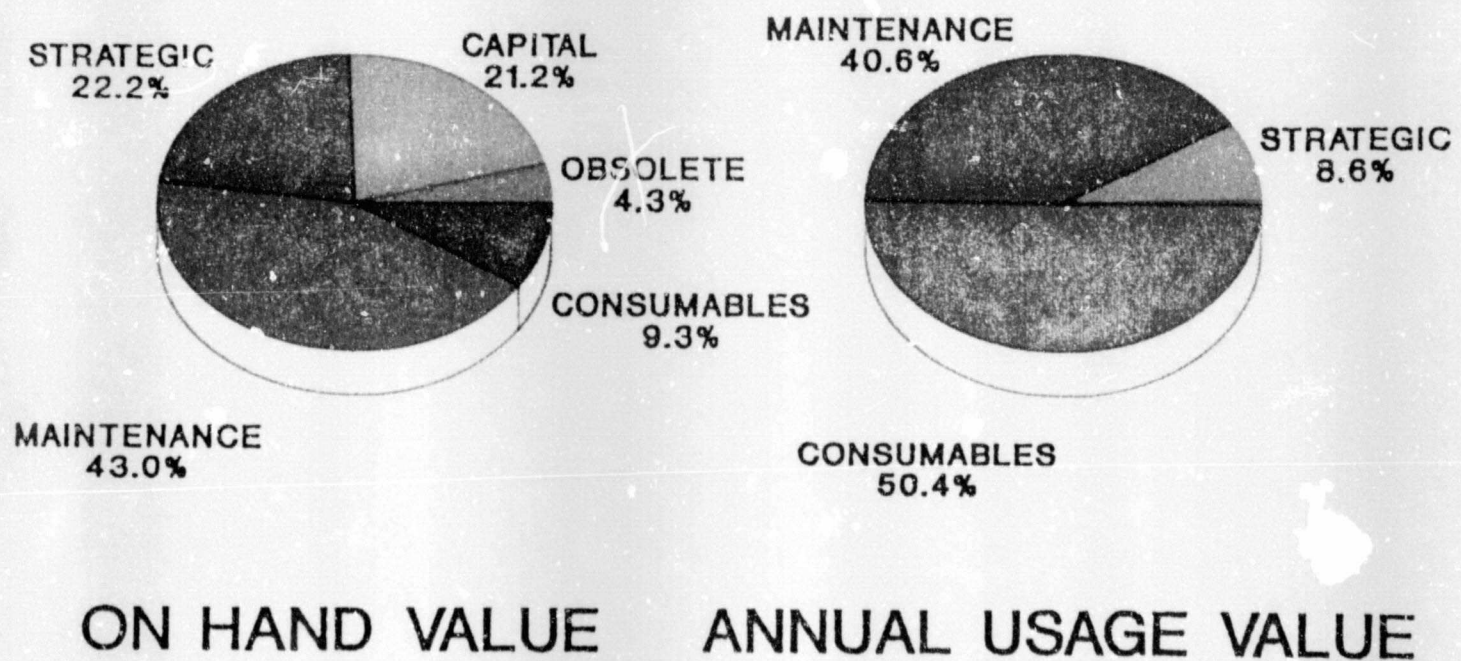


FIGURE 3.1

DISTRIBUTION INVENTORY ANALYSIS

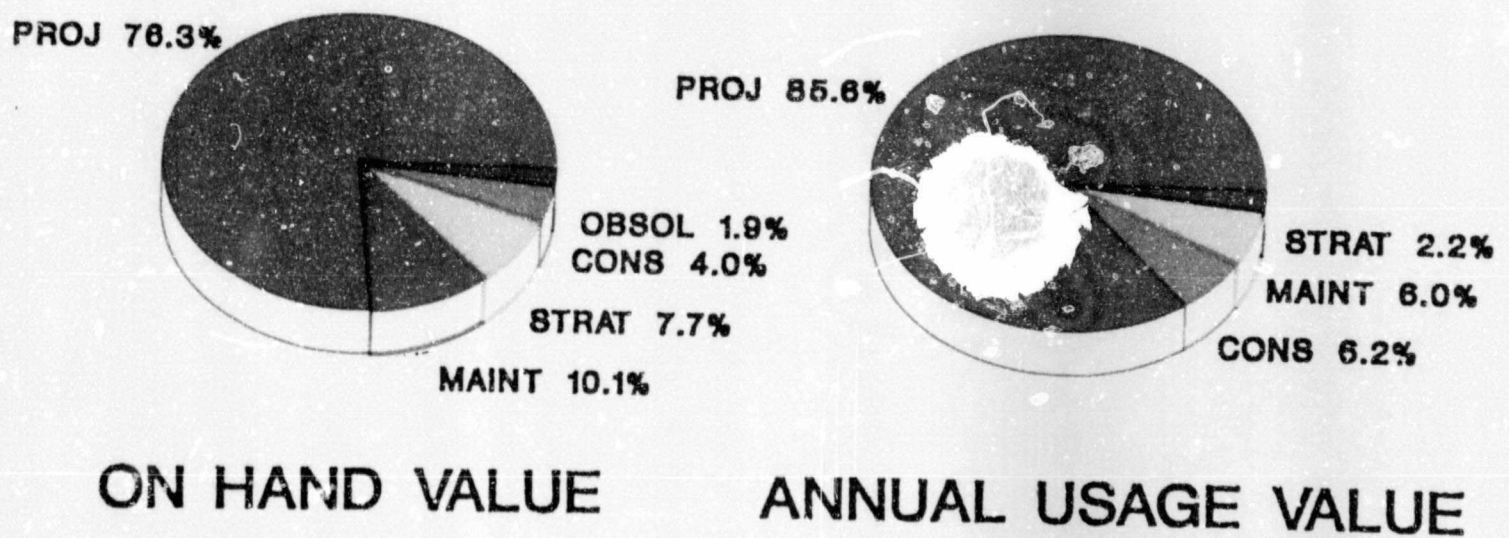


FIGURE 3.2

From tables 3.1 and 3.2 we can calculate the stock turn ratios shown below in table 3.3

GENERATION	CATEGORY	DISTRIBUTION
0,035	Obsolete	0,258
0,000	Capital, nuclear	0,000
0,150	Key, strategic etc	0,545
0,067	Construction projects	2,138
0,370	Maintenance stock	1,138
2,130	Consumables	2,996
0,358	TOTAL	0,955

TABLE 3.3

The following can be concluded from the stock holding, usage value and stock turnover tables of the previous pages:

- the nature of demand for Generation is predominantly independent in nature while for Distribution it is predominantly dependent in nature. (This in turn (loosely) implies that Generation is suited to statistical inventory control, whereas Distribution is more suited to MRP.)
- a major (potential) saving can be made if the material to be used in Distribution construction projects (+R585 million used per annum or 68% of the total used in Escom) is effectively planned for, purchased timeously and controlled properly.
- a huge (potential) saving can be made if category 14/24 and 15/25 items are purchased in economic lot sizes. Presently purchases in these categories amount to ± R240 million per annum, or 28% of the total purchased in Escom).
- the stock turnover ratios are, in all categories, extremely low.
- the combined stock turn ratio of Gen. and Dist. for category 14/24 and 15/25 is 0,86 turns p.a.
- the combined stock turnover ratio for Dist. and Gen. for category 11/21 and 12/22 is 0,137 turns p.a.

- the low stock turnover ratios imply that, in most instances, either excess quantities are being purchased or excess safety stocks are being held, or both.
- although it is realised that the stock turn ratios will never be as high as in some industries (especially category 11/21 and 12/22), there appears to be a lot of room for improvement.

3.2 Inventory Breakdown - Generation Store

The following statistics apply to a typical Escom Generation store. (Duvha Power Station store in this instance).

Number of different items (lines) : 21500
 Annual usage value (total) : R20 million
 On hand value (total) : R42 million
 Pareto analysis : (see table 3.4 and figure 3.3)

PERCENTAGE OF TOTAL NUMBERS OF ITEMS	ANNUAL USAGE VALUE		ON HAND VALUE	
	(R MILLION)	(%)	(R MILLION)	(%)
0,5%	R15,0M	75%	R16,4M	39%
1,0%	R16,6M	83%	R21,0M	50%
2,5%	R18,6M	93%	R27,3M	65%
5,0%	R19,4M	97%	R31,9M	76%
10,0%	R20,0M	100%	R36,5M	87%
20,0%	R20,0M	100%	R39,5M	94%
80,0%	R20,0M	100%	R41,9M	100%
95,0%	R20,0M	100%	R42,0M	100%

TABLE 3.4 Pareto analysis - Generation store

The categories of stock are distributed as follows within the top 80% on hand and usage value items:

CATEGORY	ON HAND VALUE	USAGE VALUE
10 - OBSOLETE	0,0%	3,5%
11 - NUCLEAR, CAPITAL	0,0%	0,0%
12 - KEY, SAFETY	13,4%	6,4%
13 - CONSTR. PROJ.	0,0%	0,0%
14 - MAINTENANCE	79,5%	70,9%
15 - CONSUMABLES	7,1%	19,2%
TOTAL	100%	100%

TABLE 3.5 Generation store inventory distribution per category

PARETO PLOTS GENERATION STORE

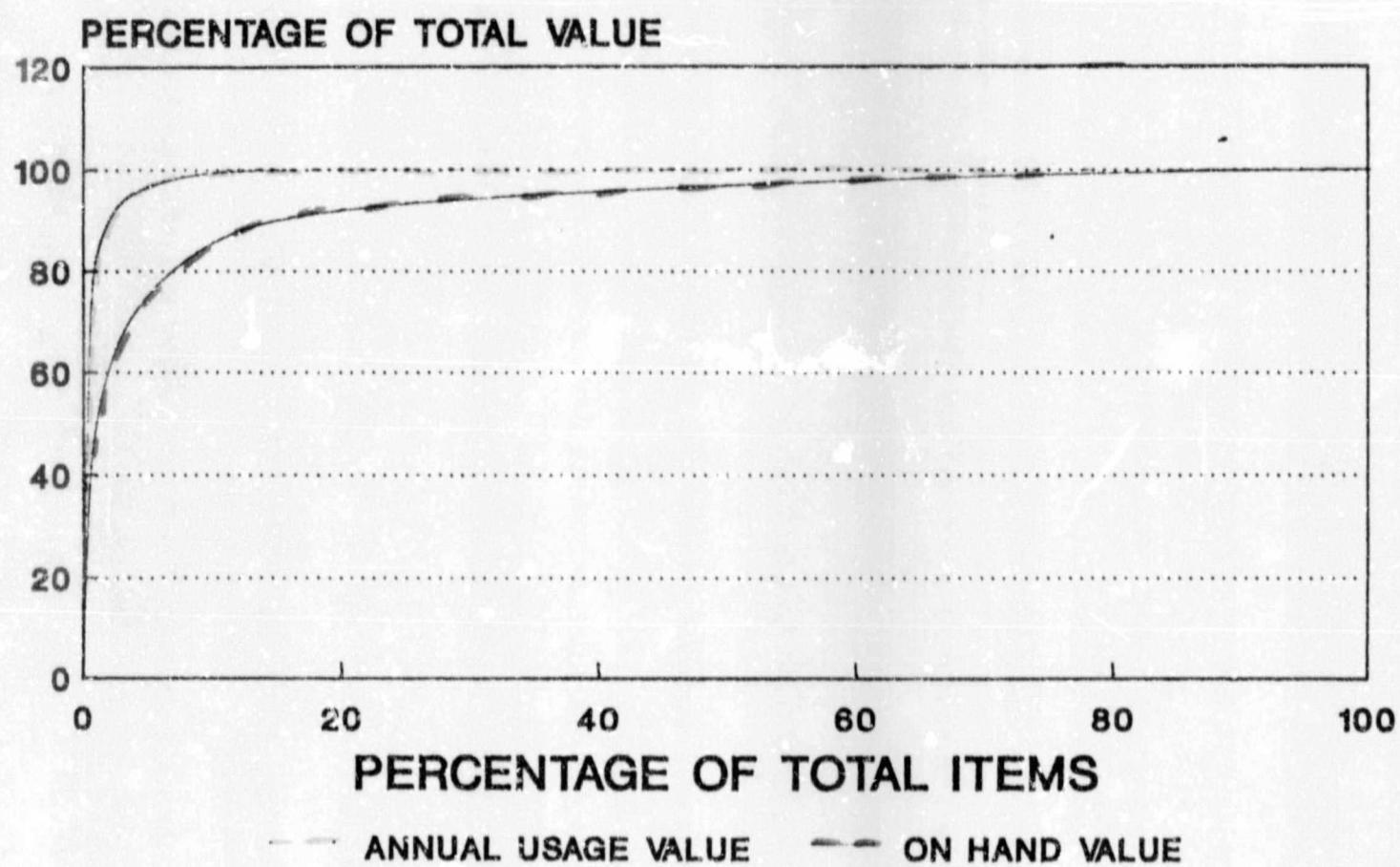


FIGURE 3.3

3.3 Inventory Breakdown - Distribution Store

(Colenso distribution store in this instance).

Number of different items (lines) : 6 500
 Annual usage value (total) : R44,8 million
 On hand value (total) : R23,9 million
 Pareto analysis : (see table 3.6 and figure 3.4)

PERCENTAGE OF TOTAL NUMBERS OF ITEMS	ANNUAL USAGE VALUE		ON HAND VALUE	
	(R MILLION)	(%)	(R MILLION)	(%)
0,5%	R22,0M	49%	R10,0M	42%
1,0%	R29,6M	66%	R13,6M	57%
2,5%	R38,1M	85%	R17,7M	74%
5,0%	R42,1M	94%	R20,3M	85%
10,0%	R43,9M	98%	R22,5M	94%
20,0%	R44,7M	100%	R23,4M	98%
80,0%	R44,8M	100%	R23,9M	100%
95,0%	R44,8M	100%	R23,9M	100%

TABLE 3.6 Pareto analysis - Distribution store

The categories of stock are distributed as follows within the top 80% on hand and usage value items:

CATEGORY	ON HAND VALUE	USAGE VALUE
20 - OBSOLETE	0,0%	0,0%
21 - NUCLEAR, CAPITAL	0,0%	0,0%
22 - KEY, SAFETY	0,0%	0,0%
23 - CONSTR. PROJ.	76,9%	86,7%
24 - MAINTENANCE	21,4%	11,4%
25 - CONSUMABLES	1,7%	1,9%
TOTAL	100%	100%

TABLE 3.7 Distribution store inventory distribution per category

PARETO PLOTS DISTRIBUTION STORE

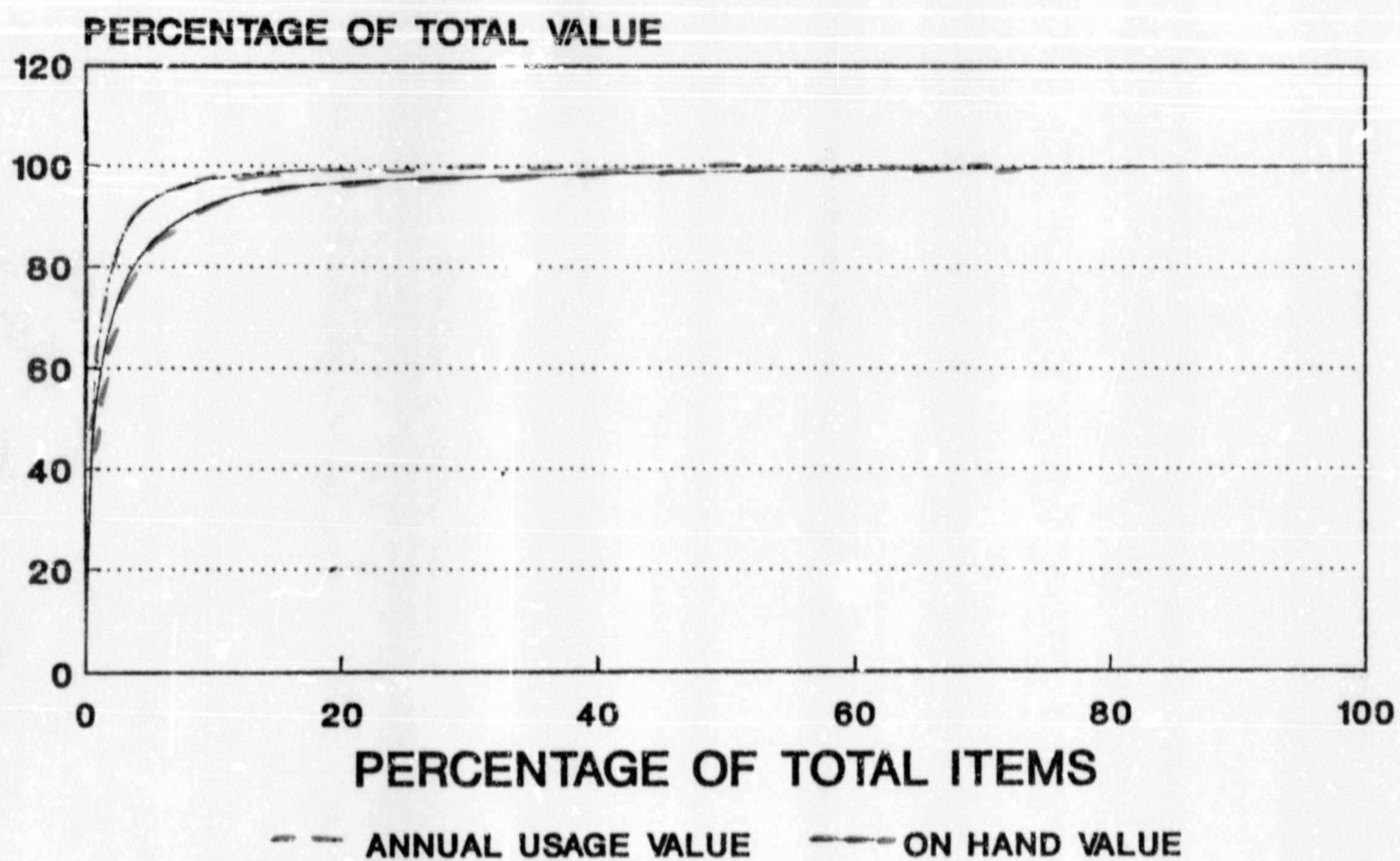


FIGURE 3.4

3.4 Present Escom Inventory Management System.

Escom has a reasonably comprehensive mainframe stock recording system. The computer carries certain item master records, for all items, and stores them against the item number, also called the NSN (National Stock Number). The following information is available per NSN per store:

- Description
- UMC (Unit of measure code)
- Quantity on Hand
- Minimum Stock
- Quantity Allocated (Firm)
- Backorder Quantity
- Available for Issue/Allocation
- Maximum Stock
- Quantity on Requisition (Total)
- Quantity on Order (Total)
- Quantity on Order (Inside lead time)
- Standard Price
- Base Price
- Locality Code
- Last Order Number
- Last Date Counted
- Class Code (ABC usage value)
- Safety Stock
- Order Point
- Order Quantity
- Average Demand
- Lead Time (Actual)
- Lead Time (Calculated)
- Lead Time (Allocation)
- Age (Months)
- Category Code
- Resource Code
- RAC (Replenishment action code)
- % Service Level Required

- Stockout Count (M-T-D)
- Stockout Quantity (M-T-D)
- Last Date Issued
- Months of Supply
 - 1 Months Issues
 - 3 Months Issues
 - 6 Months Issues
 - 12 Months Issues

Of the data stored on the system, the following fields are automatically updated:

- Quantity on Hand
- Back Order Quantity
- Available for Issue Quantity
- Quantity on Requisition (Total)
- Quantity on Order (Total)
- Quantity on Order (Inside lead time)
- Last Order Number
- Lead Time (Calculated)
- Age (Months)
- Stockout Count
- Stockout Quantity
- Last Date Issued
- Months of Supply
 - 1 Months Issues
 - 3 Months Issues
 - 6 Months Issues
 - 12 Months Issues

Values for the following fields have to be calculated outside of the system and manually entered:

- Max Stock
- Min Stock
- Class Code (A,B,C)
- Safety Stock

- Order Point
- Order Quantity
- Lead Time (Actual)
- Service Level % Required

In the past the storemen - who were responsible for the replenishment of items - entered values into these fields using the following guide lines.

- Max Stock - no guideline
- Min Stock - no guideline
- Safety Stock - no guideline
- Class Code - "A" item if it "falls" into the top 90% on the cumulative usage value report.
 - "B" item if it "falls" into the next 5%.
 - "C" item - all other items.(This field was seldom, if ever, updated and in many instances the on hand value report was used instead of the usage value report.)

- Order Point

= (average demand per month) x (lead time in months)

where average demand was generally 12 months issues /12 and where lead time was an average of the last calculated lead time (time from requisition to receipt) and the manually input estimate of the lead time.

- Order Quantity

= 3 x (average demand per month) for A items
= 6 x (average demand per month) for B items
= 12 x (average demand per month) for C items

where average demand was calculated as before and the class code assigned, also, as before.

Generally, the calculated values for the order point and quantity would be rounded to the nearest high round number such as 10, 100, 150, 1000 etc.

- Lead Time Actual - no, guideline
- Service Level Required - 95% to 100%

Generally, the system, although inadequate, was not being used to its full potential because of an inherent lack of understanding as regards inventory management in general and also the system (computer) in use.

4. INVENTORY MANAGEMENT EDUCATION

4.1 Introduction

As previously intimated, the generally inadequate level of education of Escom personnel with respect to inventory management makes the implementation of any inventory management principles or systems problematic and even dangerous.

A major emphasis of the work done by the author thus deals with improving this level of understanding of those Escom personnel in the commercial and related fields.

The inventory management education was done in the form of inventory management seminars, presented by the author. The seminars were primarily aimed at the senior inventory optimisor at each strategic business unit, but personnel in other related fields were also invited to attend. More specifically it was seen as important for people in the commercial function of the business to attend, such as buyers and storemen. The reason for this was so as to dispel problems with regard to role clarity. (Previously buyers and storemen made inventory management decisions without consulting the inventory optimisor.)

The seminars were held at the Escom Head Office and had a duration of one day. The method of presentation was informal lecturing, making extensive use of overhead projector slides, flipcharts etc.

Each seminar was opened by a senior manager so as to demonstrate the importance of the seminars as well as management's commitment to inventory reduction.

The course content followed was essentially that laid out in the handout notes entitled - "Inventory Optimisation" by C Funnell. (See Appendix A).

The handout notes were drawn up by the author after he had carried out a literature survey in the area of inventory management.

The notes were entitled "Inventory Optimisation," and not "inventory management" so as not to be confused with other stores functions (such as issuing/receiving) more widely known in Escom under the general heading of inventory management.

Once a concept had been presented, it was followed by a related example and a discussion.

In all, approximately 100 people attended the seminars, in groups of 15 people.

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