ICOMS98, Adelaide, 1998

Spare Parts Optimisation in Maintenance Improvement

M. Adra
Kilpatrick Green Facility Management
6 Korio Quay Road
Geelong Victoria 3215

R.A. Platfoot
University of New South Wales
Sydney NSW 2052

The management and associated costs of inventory is an area of increasing concern. In the case study presented in this paper, considerable effort was allocated to managing the stores holdings in a cost effective way. The task remains to continually balance the investment in holdings versus avoiding costs due to not having a spare immediately available. A risk based approach was adopted to assign a level of criticality to a spare in order to determine whether or not to continue holding it. However, even after establishing a criticality system, it was proven necessary to implement an ongoing audit process which refreshed the required holding levels.

1. Introduction

A program for the improvement of the delivery of contract maintenance services has been carried out at the factory of an automotive glass manufacturer. The tasks associated with the improvement work were overheads on the current work load of the local staff. As a consequence they were designed to be distinct from each other so that the improvement process did not stall in the event that some items were not completed. The tasks were also designed to ensure that the man hours associated with them should be reasonably accommodated by the people responsible for them.

The underlying philosophy of the strategy may be summarised as improving the visibility of the maintenance effort and ensuring the accountability of the cost drivers. This paper presents one specific aspect of this program which was the improvement of the inventory management. Some of this work involved refining the information stored within the CMMS and setting out strategies within the maintenance plan for better control of inventory.

Typically the maintenance provider is responsible for the procurement, supply and handling of the spare parts associated with the maintenance of the assets. This can be the case irrespective of whether the provider is from within the company or is a contractor, [1]. However, in the case that the parts are specialist items, possibly obtained from overseas suppliers, then the operations people may undertake the purchasing and hand them over as free issue items to be managed by the maintenance provider in their stores

system. As a consequence of this, reduction in stores holdings was a key part of a total maintenance improvement program, [2].

In this work a CMMS was available for tracking inventory data, but common with older DOS-based systems, proved to be user unfriendly and difficult to use to generate meaningful reports. To introduce a new component into the existing system, a user is required to access a cataloguing module and an inventory module, which is a well established split in function, [3]. This two stage process proved to be labour intensive.

2. Inventory Improvement Strategy

The stores list should include the following information:

- Identification of the item
- (If dedicated to a sole machine) where used, otherwise identified as general spares (repairable item), consumeable, or rotable
- Cost
- Bin, rack or some other position identifier in store
- Lead time for purchase
- Status - in stock, out of stock, on order ….

	What is part availability	Does failure stop machine	Is there a backup system	Does owner demand spare	What is the downtime cost
1	½ hour delivery	No	Yes	No	< $1000/hr
2	2-4 hours delivery				< $5000/hr
3	24 hours delivery	Partial running		Negotiate assured supply	< $10000/hr
4	7 days delivery				< $20000/hr
5	>14 days delivery	Yes	No	Hold on site	> $20000/hr

The optimisation of the stores holding was based on a decision criticality matrix shown in the above table. Using this matrix requires an answer be provided for each question shown across the table. The sum of the scores for each answer is calculated and the following decision strategy is applied:

Score < 10 - do not hold spare
10 < Score < 20 - hold spare if NOT locally available
Score > 20 - hold spare in store

2.1 Auditing Inventory Information

To maintain the integrity of information, random checks were instituted on the reports generated regarding inventory control. Standard procedures were allocated to each data entry personnel to follow when entering information into the CMMS. Currently, administration personnel will generate a report which is handed to the maintenance managers for auditing the data consistency and accuracy. This information is also provided to both the purchasing officer and operations manager for their input.

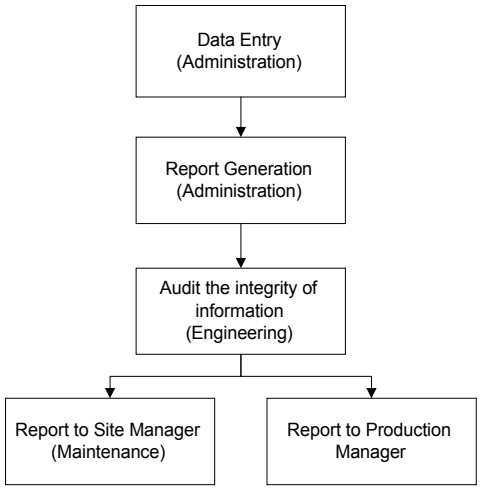

Figure 1 Information audit

2.2 Monthly Reports.

Maintenance engineers have the responsibility to produce inventory information so that on a monthly basis, reports on total inventory holdings are generated. These are currently handed to production management for their own reference. This report contains the information including Item No., Item Cost, Bin Location, Area of Use*, Status (Critical spares)*, and Lead Time. The items most frequently used have an asterisk, which means that not all spares have all of the items of information associated with them within the report. Even though the area of use has been defined for each component, there exist software limitations in the current CMMS when linking files from the cataloguing and inventory modules.

There is no stable means for measuring the amount of stock holdings over a time span. Usually, this is produced when requested by maintenance management after a stock take. Hence, there is a need to establish a measuring method of inventory holdings, which would be generated on the monthly basis. A typical example would be looking at the inventory costs of holdings on a monthly basis. This would be a key indicator for determining the question "Are store holdings increasing or decreasing?" This can be achieved by totalling the inventory holdings in the CMMS through a summary report.

More thought will be required to implement this issue.

2.3 Non-Moving Stock

The current CMMS has the capability for generating report on the last issue date of each component. In other words, for any stock movements, issue, return and stock adjustment a record is written to the CMMS transaction file that looks at the following.

- Item Number
- Transaction date
- Transaction quantity
- Cost of the transaction
- Some or other data which is not important for this case.

A report has currently been generated for our slow moving stock. It is searched through the last date each component was issued. This report has been created to serve two purposes. Firstly, to reduce the current level of store holdings which maintenance needs to achieve. Secondly, it helps determine the maximum and minimum quantities kept in stock.

The report created was based on non-moving store items over the past 18 months. Critical spares classed as 1A to 1E were excluded from this report and only dealt with those items considered non-critical. Over 1000 items were printed and handed to the operations manager for interrogation. Many of these items were either consumables or redundant items. They have been highlighted and will be removed from the information system, once a formalised method has been established.

Because consumable items are directly booked to general plants, there is no need to hold them in the general store. Rather, they could be positioned in satellite stores or the compressor room where other consumables are kept. A KPI has been established that indicated trends in the inventory holdings. This indicates the amount of store holdings before and after these non-moving stock items are tackled.

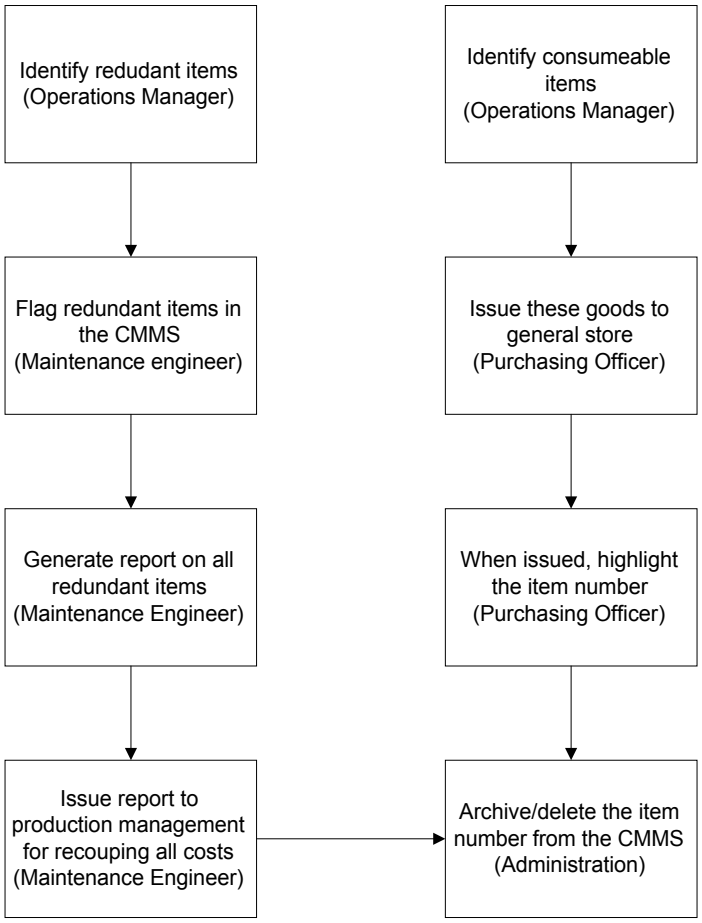

Figure 2 Procedure for removing inventory items from the CMMS.

2.4 Random Audits and Stock-Takes

The Purchasing Officer is responsible for conducting both the random audits and stock-takes. This new method of controlling inventory holdings is indicated in the flow chart in Figure 3. It also allocates the appropriate personnel to the task.

2.5 Standardising Spares.

As production designers utilise different types of equipment for common purposes, not only are inventory holdings increasing, but other parameters also need to be considered. In the case of PLC's, for example, these include:

- Training and diagnostics
- Local support
- Software

- Racks, processors, input/output cards or other items of equipment that interface with the primary item

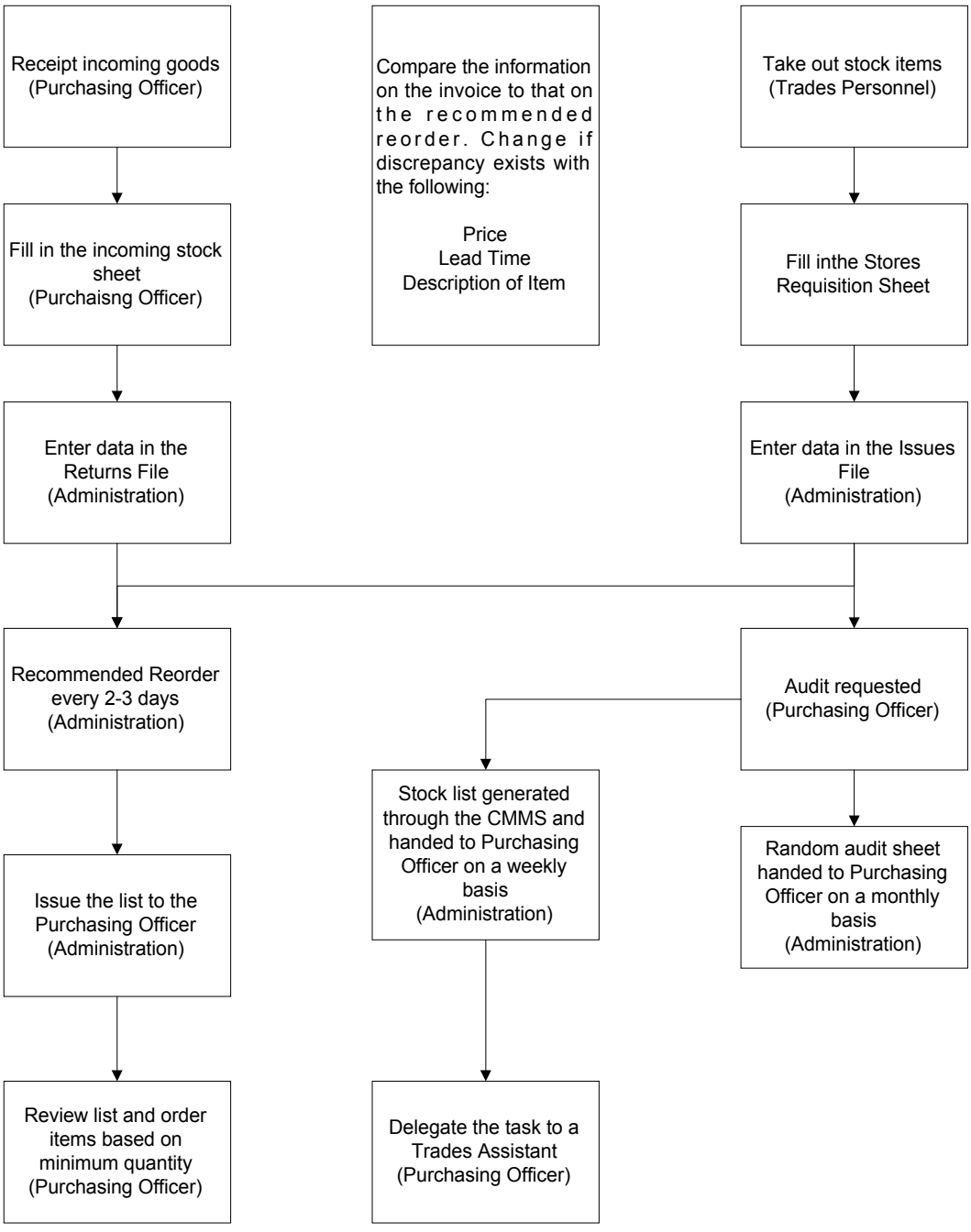

Figure 3 The stock audit process

Hence, there are the additional costs associated with the different brands of PLC's. On the

site in question there are approximately 5 different brands, which are utilised all over the plants. More recently, newer equipment is featured with Allen Bradley PLC's, that are based on specifications forwarded by the production management to their suppliers.

The parts within each of the PLC's brands are completely different and thus cannot be interchanged. However, further investigation will be required to determine if duplicate parts are utilised on other brands of components. A genuine issue would be pneumatic components.

3. Progress in Improvements

3.1 Recommended Reorder

When a critical spare is classified as critical, it is tagged with a "1" before its class code which in turn ranges from A to E. This method of identifying critical spares has helped distinguish them from other spares classed as non-critical. The table below sets out the method of identification employed:

Price	Critical Spare	Non-critical spare
$0-500	1A	A
$500-1000	1B	B
$1000-2000	1C	C
$2000-4000	1D	D
>$4000	1E	E

The recommended reordering system is currently been utilised by the purchasing department. The generation of recommended items is performed every 2 to 3 days. This system is one of the tools for controlling inventory. It should be noted that only the class codes with 1A to 1E (critical items) and PIL (items that are issued to production at zero value) are identified in the recommended reordering system. The intentions of this method were to manage the critical spares and then begin with managing the other non-critical spares. The spares with class codes of 2A to 2E will be implemented into this system. However, they will be taken from a different report to segregate the critical from the non-critical spares.

3.2 Information Refinement

The Auslang Language for identifying spares is a tedious process. This nine digit meaningless number can be replaced by a seven digit alphanumeric. The first three digits would identify the type of component and the other four digits would either define a sequential number or part number. This will depend on the type of equipment considered. Because cataloguing is a labour intensive exercise, the most informative data about a spare can be entered within the inventory module of the CMMS. This eliminates the need for additional data entry in cataloguing which is based on the Auslang method for identifying spares.

Refining the data is the ongoing responsibility of the maintenance department. Numerous suppliers have been provided with component information that is stored in the CMMS. Feedback on the information integrity has been requested from these sources.

3.3 Satellite Spares

Currently two systems are used to control inventory. The CMMS controls the main store as described above and a spreadsheet is used for satellite stores. It is argued that all information should be entered into the one information system. The CMMS has the capability for storing additional items under warehouses. Such a warehouse may represent one satellite store and therefore allow it to be managed independently of the main store, while still allowing consistency in information storage.

Another improvement is to remove all redundant items from such stores. These are typically superseded items which are a waste of storage space. If these redundant items are not detected and acted upon, the new approach in managing the satellite stores will not be fully beneficial in assisting in reducing holdings.

4. Conclusion

Inventory management is an ongoing process for improvement, [4]. It involves a driver behind the implementation of these strategies and the review of their progress. Some of these issues have been reviewed in this paper.

The review of the current CMMS has lead to the feasibility study of more modern systems. The key features which are sought here include a more user-friendly environment and the ease of generating tailored reports. The traditional method of performing a two step cataloguing and inventory recording process needs to be eliminated and thus reduce the amount of labour required to enter parts into the system.

Some of the achievements for inventory management included:

1. Inventory control through recommended reorder listing, random audits and periodic stock-takes
2. Refining inventory information where the compilation of about 1000 critical spares has been refined based on a controlled format.
3. Identifying slow moving stock such that many items have been identified through a report that searched through those that had not been utilised for the past 18 months. These items have been highlighted based on their criticality. In addition, many of these items were redundant which are flagged under the class code "R" for redundant items.

An example of the achievement rate using these techniques is that within a two week period using random audits, 178 catalogued items were deleted which represents 5% of original holdings. This translates into an investment reduction of about 1%, indicating that it is easier to rationalise low cost consumeable items.

Based on the weekly stock-takes that have been conducted by the Purchasing Officer, a great amount of discrepancies between the stock levels on hand to those recorded within the information system were identified. It should be noted that only 6 to 7 months ago, a full stock-take was conducted. Typical levels of variance which are identified by the random audits is typically about 30% over 200 items checked. This level of variance will be reduced through the adoption of the strategy outlined in this paper.

It may then be understood that not all store items issued are recorded when a component is taken from store. A better method for recording inventory that is issued is now required. This will be the subject of further investigation. The usual reason for the problem would be a trades person attending to a breakdown and only focusing on repairing the plant stoppage. Even with the original intent of filling in the stores requisition form, completing the paperwork can slip their mind.

Acknowledgments

The authors acknowledge the support of Kilpatrick Green Facility Management for this work.

References

1. E.A. Silver & R. Peterson, Decision Systems for Inventory Management and Production Planning, 2ed, John Wiley & Sons, 1985.
2. J.D. Blackburn, Time Based Competition - The Next Battle Ground in American Manufacturing, Business One Irwin, ISBN 1-55623-321-3, 1991.
3. P. Gilmour, Logistics Management, Longman, Australia, 1993.
4. J. York, Qualitivity - The Simultaneous Improvement of Quality and Productivity, Longman Professional, Australia, 1992.