Implementation of 5S to Set Up Inventory Control System with HTML Coded Spare Management System

Sandip Mane, Jay Bhuva, and Smit Patel

Abstract This research paper has brought out the importance of inventory management considering the availability of stock in absence of its data or improper accessibility of data that transforms the asset into liability. Process proposed in this paper helped in identifying over inventory and eliminating dead inventory thereby raised level of optimum inventory significantly within two months of process implementation. This process helped to maintain available spares in a systematic manner as well as handle inventory management effectively, which is an important link in supply chain. Inventory models are based on the assumptions. A number of inventory models were analyzed, but none could be implemented because of invalid assumptions. The new inventory model was proposed based on assumptions mentioned in this paper. The proposed model can be implemented effectively in a short span to control the inventory.

Keywords 5S · Optimum inventory · Dead inventory · Over inventory · Spare management system

1 Introduction

Balanced inventory helps organization with numerous benefits such as improved cash flow, high throughput, and reduction in operational expense. In this paper, inventory is further categorized as dead inventory, over inventory, and optimum inventory. Elimination of dead inventory along with effective use of over inventory improves warehouse management.

Mishra et al. [1] studied the inventory model of deteriorating items and contradicted the assumption that items preserve their physical characteristics in storage for long time and shared his thoughts of maintaining inventory of deteriorating items as a challenging and alarming issue. Harris et al. [2] examined the necessity of EOQ

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model and proposed a formula for determining economic order quantity (EOQ) way back in 1915. Later, Ghaseni et al. [3] stated that assumptions of EOQ model were unrealistic. There are market fluctuations, uncertainty in manufacturing plant, obsolete inventory, availability of disproportional inventory (over inventory and under inventory) in warehouse made it difficult to apply EOQ model in real life. Well-maintained warehouse and knowledge of using appropriate EOQ model can reduce risks associated with usage of EOQ model. Salunkhe et al. [4] investigated the core requirement of inventory management and linked it with models such as 5S, Kanban, and Kaizen. He termed 5S for inventory management as one of the best suited models to enhance efficiency and effectiveness by identifying items in warehouse and maintaining these items in more systematic order and sustenance of this new order. Seyedhoseini et al. [5] emphasized on the fact of decaying inventory and proposed method which would help in using available inventory before it decays. Zhou et al. [6] experimented on time varying demand rate and deterioration of item and designed model of using of two warehouses in minimum cost. Availability of two warehouses may somehow increase holding cost, but it would reduce dead inventory drastically which can be helpful for medium to big manufacturing plant. Arda et al. [7] analyzed the application of multi-supplier strategy which helps in reduction in inventory holding cost and also the shortage cost. Sana et al. [8] focused on imperfect production inventory model and proposed strategy which helped in satisfying demand conditions on time. Baek et al. [9] studied production inventory system and proposed effective outbound process in inventory management considering each customer draw single item from inventory at a time. Hariga et al. [10] studied multi-warehouse concept and proposed model which would provide use of multi-warehouses on the basis of fixed and flexible space leasing contracts.

Various models were studied and analyzed to develop new inventory control system proposed in this paper. 5S is considered to be the best suited aid which would help in effective inventory management. It is used in wide spectrum of industries which includes healthcare, education, and even in government. Its origin is in manufacturing, and inventory management is one of the important segments of manufacturing plant. Standardization is the fourth S of 5S model. More the standardization, less the bottlenecks in system. Inventory can be managed and sustained in much better way when 5S model collaborates with proposed computer controlled inventory management system in this paper. It has not been reported earlier of using such process to manage inventory. Henceforth, it would be discussed that how proposed method helped in eradicating dead inventory and smart use of over inventory helped to reduce large stack of unused inventory. It helped to bring inventory in warehouse at optimum level and to sustain it with simple proposed process. Many models are available to control inventory on basis of assumptions, but most of them are inapplicable because of unrealistic nature. This paper discussed inventory control of spares which was used infrequently, and only 40% of this spare was used frequently, so to maintain such inventory, proposed process is being used.

Proposed model is different from other available inventor models in terms of assumptions and scale. Most of the inventory models available are based upon constant demand rate, total demand is known in advance etc., such models could be excessively used in big production plant, but for department level inventory management, it is incompatible.

The assumptions of inventory model would be as follows:

- Lead time is known
- No holding cost
- Shelf life of inventory is known.

This model facilitates perpetual inventory control system which provides real-time inventory data. Semi-skilled computer operator can easily control inventory management process. Over inventory could be depleted within couple of months of implementation. One of the major advantages is its sustainability with minimal monitoring of inventory. Availability of lead time data gives provision to keep minimal safety stock, and it also helps in costing and for material requirement planning (MRP).

2 Methodology

Dividing methodology in three phases would help to understand process in better way. The first phase started with analysis of available inventory management system and its bottlenecks. Few measures were taken before starting sorting procedure. Spares were kept in cupboards according to their weight. The lighter components were placed in higher shelves and heavier one in lower shelves. This avoided the distortion of shelves and also helped in avoiding injury to person drawing out spare from cupboards. Spares like sensors, connectors, relays, nut and bolts, small batteries, etc., were kept in higher shelves. For heavier spares like pump, motors, gears, etc., lower shelves of cupboards were preferred.

Inventory data was to be stored and maintained in form of Excel sheets. To simplify the maintenance of inventory data, with the help of HTML code, a ‘Spare Management System’ named form was generated which was attested in Excel sheet containing inventory data. This code helped in provoking form whose stand out feature was particular named UID number. Each spare was given unique six-digit number. This number helped in locating the available spare in warehouse of department. First digit of that UID number signifies the cupboard in which that spare is located. UID number would help in both inbound and outbound process of spare. With the help of this number, new spare would be added in inventory data, and existing spare’s data would be updated. In case of outbound process, UID number’s sheet would be pasted in cupboards according to shelves. For example, there are ten spares in second shelf of cupboard, and UID number of that ten spares ranges from 100,010 to 1,000,020. So, this ten numbers will get printed on sheet of paper and would be pasted against shelf 2. If a person who is unknown by the name of spare draws spare from shelf, he has to note down the range of UID numbers of spares in that shelf. In the system, he would search for that range of UID number and identify the exact UID number with the help of photograph of that spare to update inventory data.

The situation was such that untidy and disorganized store condition of department made it difficult for supervisor to keep track of inventory properly.

Figure 1 shows the department layout before implementing 5S. Here, cupboards are located at extreme ends of department. Available space was not utilized. Rack was filled with scrap and heavy spares randomly. When ordered inventory was received by department, it was kept in one of those cupboards according to space availability in shelves or else in open nearby rack area.

After analyzing few models, 5S was thought to be implemented. First step of this Japanese concept was sorting, other four stages are set in order, shine, standardize, and sustain. Figure 2 shows the changed layout of department. It helped in availability of more space for cupboards and utilizing department space in much better way. New cupboards were added in store, and storage area was concentrated at extreme left end of department. Rack was removed, and obsolete spare of that rack was disposed. Other spares of rack were shifted in new cupboards to sort it later. In case of inventory

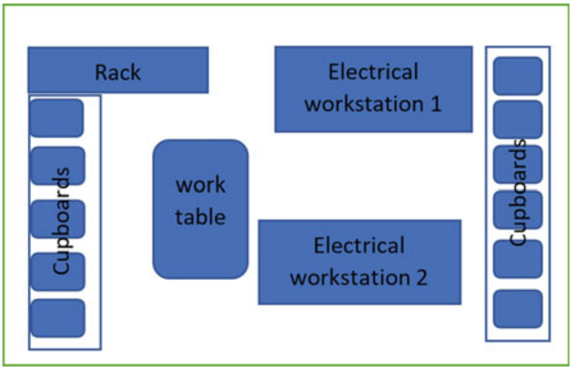


Fig. 1 Before implementing 5S

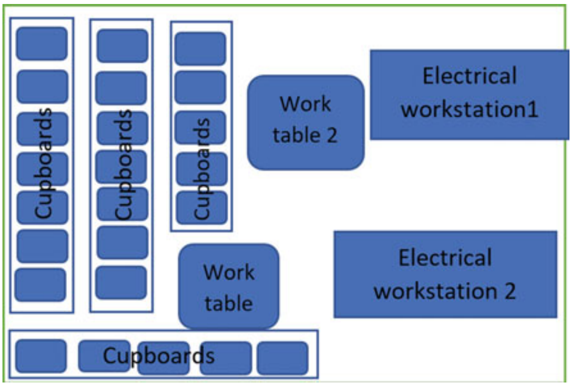


Fig. 2 After 5S implementation

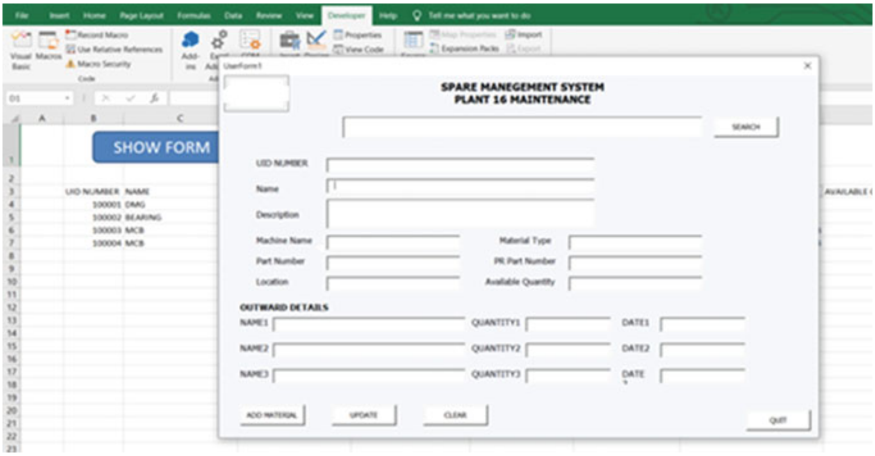


Fig. 3 ‘Spare Management System’ HTML coded form to manage inventory data

management, standardization and sustenance play a major role. Sorting was easier because availability of more cupboards to distribute available spare make it easier to implement 5S in convenient way.

Figure 3 shows ‘Spare Management System’ form attested in Excel sheet of inventory data in upper left corner. Clicking ‘Show Form’ tab pop ups form. Particulars of this form are UID number, Name, Description, Machine name, Material Type, Part Number, PR Part Number, Location, and Available Quantity. Another part of form is named ‘Outward details,’ and it consists of Name, Quantity, and Date. It stored last three entries of outward details at time. There were five tabs named Search, Add Material, Update, Clear, and Quit. ‘Search’ tab is used to view inventory condition.

The six digits UID number should be input of this search box. Whenever new spare which was not there in available inventory data, ‘Add’ tab was used and new UID number was allocated and rest of the data was filled in form. When changing data of available inventory, like adding or subtracting quantity of spare during outbound and inbound process or when location or other available data was changed, it was updated in system through Update tab. Again for update, UID number was used to search that spare, and data was edited according to spare status in warehouse. To clear wrong data filled during adding or updating spare data, Clear tab was used to refill data of that spare again from start. Quit tab helped to disappear form after its data was updated or viewed. In Excel sheet, there will be nine columns as per particulars of form to manage inventory data. In this way, inventory was managed in Excel sheet in proper order, and required data was available within few clicks in spare management system form. This system gave provision to keep track of outward details. When the material was drawn by clicking the ‘Show Form’ tab, the ‘Spare Management System’ form appeared on the screen. Here, reference number of the spares was entered in search box. Data of that spare was available on screen according to last updated data. Now, outward details that are name, quantity, and date were entered to update. Form was stored in D drive of computer system.

Phase 1—Implementation of 5S

Step 1 of 5S model, i.e., 'Sort,' after Spare Management System was coded, available spares were divided into two categories, and they are mechanical spares and electrical spares. Sorting procedure was started with inventory of mechanical components. Mechanical spares were further divided into bearings, belts, CNC machine named HAAS, CNC machine named DMG, vertical turret lathe, milling machine, lathe machine, drilling machine, pneumatic tools, grinding machine, cranes and hoists, and gas cutting machine. In a similar way, spares were sorted and were placed machinewise in cupboards. Mechanical spares that were used in two or more machines were sorted and kept in separate cupboard named general mechanical spare. Electrical spares were few in numbers compared to mechanical spares. Most of the electrical spares were general in nature. Many spares' configuration was such that they can be used in more than one machine. They were divided in numbers proportional to usability of those spares by those machines. Past transactions were referred to do so.

Phase 2—Feeding Inventory data in system

To act upon second step of 5S that is 'set in order,' spares of individual cupboards were further sorted out according to weight, and they were placed in shelves accordingly. Bins were used to avoid disordering of spares in shelf. Inventory data was now started to being noted down.

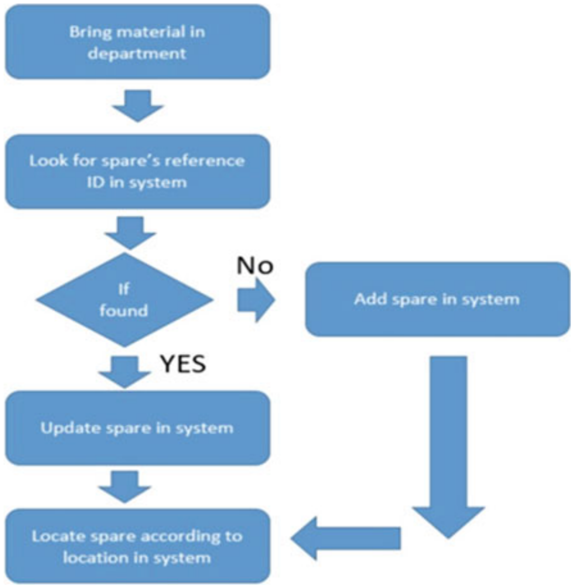
Inventory calculation started with bearing and belt. Data like bearing number, available quantity, and location was jotted down. Other required data as per spare management system form were noted from ERP software. After bearing, inventory of belts was carried out. All the collected data were added in system through 'Add' tab of the system. Now, inventory data of other machines were noted down. Photographs of each spare were captured to attest it into inventory data in computer system for easy identification for person who is unfamiliar with UID number and with even name of spare. Pictures also helped in avoiding confusion due to identical technical names.

It happened multiple times that spare of other machines were found in cupboard of other machines. In such case, that machine spare was shifted to its respective machine's cupboard, and that spare is entered in inventory data sheet of that machine through add of spare management system. Other thing which happened frequently during set in order procedure was that many times few quantities of X machine's spare were found in Y machine's spare cupboard. In such case, that spare is placed in X machine's spare cupboard and same was updated in system. In similar way, the other 3 S of 5S that is set in order, shine, and standardize were done simultaneously.

Phase 3—Setting up Inventory control process

Figure 4 shows flowchart which was proposed for inbound process of spares, i.e., when spare was received by department:

Fig. 4 Inbound process



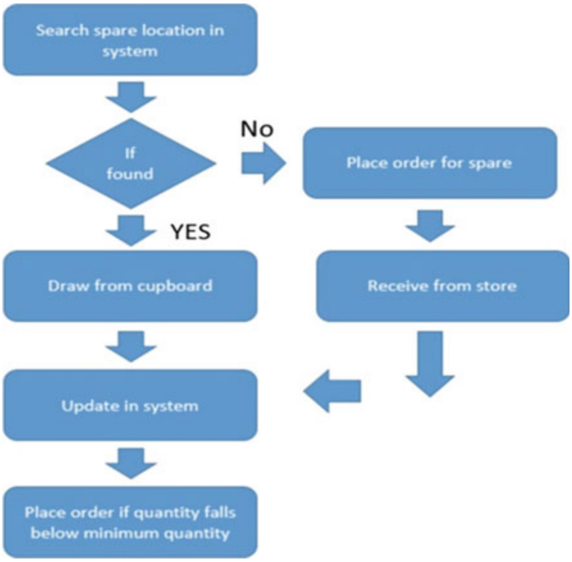
1. Bringing the spare in department and adding the inventory detail as per requirement in spare management system if particular material is received first time and no data of that spare is available. Else update data according to requirement.
2. Place the spare in cupboard according to location in system.
3. Paste the reference number in cupboard against the spare's shelf, if spare is received first time and no data of that spare was available previously.

Figure 5 shows flowchart which was proposed for outbound process of spares, i.e., when spare was drawn out for use:

1. Required spare was searched through reference number through system or else through name, and in worst case, picture is searched in excel sheet and reference number available in that row is copied to search for spare's location.
2. Spare was drawn from cupboard.
3. Update quantity in system and fill outward details.

After process set up, spares which were critical without which production rate can be hampered were identified. Spares which were more frequently used were also identified in order to keep those spares in optimum quantity in department. Optimum quantity of such spares and critical spares were determined through past transaction data available for this spares in ERP system of company. Accordingly, minimum quantity of this spares were determined. Optimum quantity was 3–5 times of minimum Inventory size of respective spares. Ordering quantity was dependent on criticality of spare, frequent use, cost of spare, and lead time. The spare's whose minimum size was to be maintained were shaded in excel sheet for easy identification

Fig. 5 Outbound process



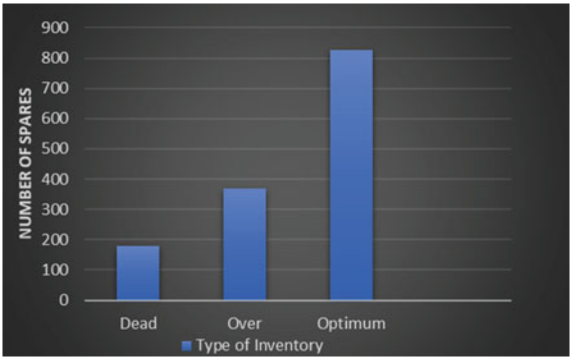
to keep track during outbound process. Other spares whose minimum size was not mentioned should be available in at least 1–2 unit of quantity.

3 Results and Discussion

There were 180 types of spares which were declared to be dead inventory because of obsolete spares, deterioration, and loss of shelf life. This was disposed which resulted in increase of spaces in store, and at the same time, data reduction was noticed which helped to avail benefits of handling less data. 13% inventory reduction was recorded.

Figure 6 shows the graph of inventory condition before 5S implementation. After

Fig. 6 Effect of dead and over inventory



dead inventory was eliminated, over inventory was targeted. Simple technique was used to tackle over inventory which was to use this inventory spare until it falls below minimum bin size and use of process where refilling up to optimum size helped in tackling over inventory problem. Now, optimum inventory level rose from 59 to 88% within 42 days of implementation. Productivity of workers also improved, and earlier, it used to take around 20–25 min to search for spare. Now, time has been reduced to 3–5 min, and also availability of spare avoids long breakdown hours of critical machines which frequently occur within every 40 days on an average.

Few limitations of this inventory model are as follows:

- More than 2000 spares' inventory control could be complicated.
- Tight monitoring is required sometimes when demand fluctuation is more.
- Technician's discipline is vital to keep track Inbound and outbound process.

With time, staff gets habitual of process, and errors can be reduced considerably within couple of weeks of implementation. Also, carrying out physical inventory twice or thrice within span of one month after implementation can help to adopt inventory model in better way.

4 Conclusion

Dead inventory and over inventory spares were available in the stores for the last 8–12 years costing 164,568 rupees. At 5% of simple interest rate, it costed 49,370 rupees and loss of production at many instances within this period. This can be avoided easily now with the use of new inventory control process. Proposed process helped purchasing department in converting purchase requisition into purchase order easily and quickly, because of availability of PR part number during placing purchase requisitions. This methodology could be proved useful for inventory management of up to 2000 types of spare conveniently. It can be implemented within short span, and inventory data can be improved further without disturbing ongoing process of inventory control. Spares management system can be helpful for managing inventory that are less frequently used and whose availability is important. There are very few models to help such type of inventory management. One computer system and 'Spare Management System' form is sufficient to handle this type of inventory condition conveniently.

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