

IMPLEMENTATION OF KANBAN SYSTEM FOR READY SUB-ASSEMBLIES IN MAINTENANCE AREA

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ABSTRACT

Uncertainties brought about by fluctuations in demand and customers' requirements have led many established companies to improve their manufacturing process by adopting the Kanban system. By doing so, they are able to manufacture and supply the right product, in the right quantity, at the right place and time. Implementation of the Kanban system resulted in reduction of inventory to minimum levels besides increasing flexibility of manufacturing. Successful implementation of the Kanban system furthermore reduces operational costs, consequently increases market competitiveness. The Kanban system is basically an inventory stock controls system that triggers production signals for product based on actual customers' requirements and demand. The system is controlled by the Kanban card which dictates the optimum production parameters. This paper concludes that implementation of the Kanban system reduced lead time, minimized inventory on floor and optimized storage area. The objective of this study is to show that Kanban system improves a manufacturing system as well as achieving Just in Time practice.

Keywords: *Just In Time, Kanban system, Manufacturing lead time reduction*

I. INTRODUCTION

PROJECT BACKGROUND:The main aim of our project is to ensure that every subassembly should be available at given point of time whenever it needed so as we can reduce the breakdown time of machine which give the continues flow of work and hence increases productivity. To solve the problem we implement a Kanban system. Much of our work has been concentrated on few main topics; initially we observed and studied the Kanban system and the subassemblies used in maintenance area.

PROBLEM STATEMENT:Non availability of subassemblies in maintenance area resulted into breakdown of machines and influencing the production.

Objectives:

The Objectives given by company is as follows:

- 1) Reduce the breakdown time of machine due to unavailability of sub assembly.
- 2) Study of Kanban system and its parameters.
- 3) To increase the production rate per day

Methodology:

Method to develop Kanban system is presented. Then evaluation of performance was carried out once the Kanban system was adopted in maintenance area. The method was structured as follow,

- i. Designing Kanban flow
- ii. Gathering relevant parameter of manufacturing and customer

II. LITERATURE SURVEY

(1) Electronic Kanban System:-M.RajuNaik(MS)*, E.Vijaya Kumar(M.Tech)**, B.UpenderGoud(MBA)***

This paper presents a case study of the use of an e-Kanban system to minimize operational and logistics issues for a parts supplier within the automotive industry. Measures of operations and logistics performance are examined both before and after the implementation of the e-Kanban system through a series of observations, in-depth interviews, and documentation reviews. The results indicated improvements in production lead times, financial costs, effective and efficient work processes, and reductions in waste. The enhancement of the e-Kanban system through radio-frequency identification (RFID) is also discussed.[1]

(2) Lean Manufacturing: Kanban and Pull Based Manufacturing:- Conrad Volkmann,Senior Program Manager,In Microsoft Dynamics AX 2012,pull is implemented based on kanban frame work to plan,track and execute based on pull signal.Lean manufacturing for Microsoft dynamics AX 2012 provides a powerful new instrument to supports the following scenarios:kanban production and replenishment based on events.[3]

(3) Review of jit-kanban system:-C.sendilkumar.R.Panneerselvam In this paper,JIT-KANBAN literature survey was carry out and presented.The recent trends in the JIT_KANBAN are discussed under the heading special cases.In this review,100 state of art research papers have been surveyed.The directions for the future works are also presented.[3]

II. INVENTORY CONTROL

An inventory consist of usable but idle resources such as men, machine, material or money. 'Inventory' and 'stock' are often used to relate to the same thing (Wild, 2002); yet when inventory management is mentioned, there is however a slight difference with stock. Stock is usually an amount of goods that is being kept at a specific place (in a warehouse for example), sometimes referred to as inventory. Conversely, inventory management is primarily about specifying the size and placement of stocked goods. Inventory management is necessary at different locations within an organisation or within multiple locations of a supply chain, to protect (the production) from running out of materials or goods.

The scope of inventory management is broader than stock. Basically inventory management can be defined as the "management of materials in motion and at rest" (Coyle et al., 2003). The following activities all fall within the range of inventory management (Wikipedia, 2009): control of lead times, carrying costs of inventory, asset management, inventory forecasting, inventory valuation, inventory visibility, future inventory price forecasting, physical inventory, available physical space for inventory, quality management, replenishment, returns and defective goods and demand forecasting. Inventory management basically serves two main goals (Reid & Sanders, 2007). First of all good inventory management is responsible for the availability of goods. It is important for running operations that the required materials are present in the right quantities, quality and at the right time in order to deliver a specific level of service. The second goal is to achieve this service level against

optimal costs. Not all items can be held in stock against every cost for example and therefore choices have to be made.

III. NECESSITY FOR MAINTAINING INVENTORY

Though inventory of material is an idle resource, almost every organization must maintain it for efficient and smooth running of its operations. Without it no business activity can be performed, whether it is a service organization like a hospital or a bank or it is a manufacturing or trading organization. If an enterprise has no inventory of material at all, on receiving a sales order it will have to place order for purchase of raw materials, wait for receipt and then start production. The customer will thus have to wait for a long time for the delivery of the goods and may turn to other suppliers resulting in loss of business for enterprise.

Maintaining an inventory is necessary because of following reasons:

- 1) It helps in smooth and efficient running of enterprise.
- 2) It provides service to customer at the customer at a short notice. Timely deliveries can fetch more goodwill and orders.
- 3) In the absence of inventory, the enterprise may have to pay high prices because of piecemeal purchasing. Maintaining of inventory may earn price discount because of bulk purchasing. It also takes advantage of favourable market.
- 4) It reduce product costs since there is an added advantage of batching and long, uninterrupted production run.
- 5) It acts as a buffer stock when raw material are received late and shop rejection are too much.
- 6) Process and movement inventories (pipeline stocks) are quite necessary in big enterprises when significant amount of times are required to transship items from one location to another.
- 7) Bulk purchases will entail less orders and therefore less clerical cost.
- 8) It helps in maintaining economy by absorbing some of the fluctuations when the demand for an item fluctuates or is seasonal.

However, too often inventories are wrongly used as a substitute for management. For example, if there are large finished goods inventories, inaccurate sales forecasting by marketing department may never be apparent. Similarly, a production foreman who has large in process inventories may be able to hide his poor planning since there is always something to manufacture. Furthermore, inventory means unproductive 'tied up' capital of the enterprise the capital could be usefully utilized in other ventures as well. With large inventories, there is always likelihood of obsolescence too. Also maintenance of inventories costs additional money to be spent on personnel, equipment, insurance, etc. Thus excess inventories are not at all desirable. This necessitate controlling the inventories in the most useful ways.

IV. CAUSES OF POOR INVENTORY CONTROL

- 1) Overbuying without regards to the forecast or proper estimate of demand to take advantage of favourable conditions.
- 2) Overproduction or production of goods much before the customer requires them.

- 3) Overstocking may also result from the desire to provide better service to the customer. Bulk production to cut down production costs will also results in large inventories.
- 4) Cancellation of orders and minimum quantity stipulations by the suppliers may also give rise to large inventories.

The inventory control consist of determination of three basic factor:

1. When to order (produce or purchase)?
2. How much to order?
3. How much safety stock be kept?

When to order (produce or purchase)?: This is related to lead time (also called delivery lag) of an item. Lead time may be defined as the time interval between the placement of an order for an item and its receipt in stock.it may be replenishment order on an outside firm or within the works. There should be enough stock for each time so that customers' orders can be reasonably met from this stock until replenishment. This stock level, known as reorder level, therefore to be determined for each item. It is determined by balancing the cost of maintenance these stocks and the disservice to the customer if his orders are not filled in time.

How much to order: As already discussed, each order has associated with it the ordering cost or acquisition cost. To keep it low, the number of orders should be as few as possible i.e. the order size should be large. But large order size would imply high inventory carrying cost. Thus the problem of how much to order is solved by compromising between the acquisition costs and inventory carrying costs.

How much should be the safety stock: This is important to avoid overstocking while ensuring that no stock-outs take place.

The inventory control policy of an organization depends upon the demand characteristics. The demand for an item may be independent or dependent. For instant, the demand for different models of television sets manufactured by a company does not depend upon the demand of any other item, while the demand of its various components will depend upon the demand (and hence sales) of the television sets and may be arithmetically computed from the latter. The independent demand is usually ascertained by extrapolating the past demand history i.e. by forecasting. The order level can be fixed from the demand forecasts and lead time. Thus while in the case of dependent demand, simple arithmetic consumptions are enough to ascertain requirements of the component; in the case of independent demand items, statistical forecasting techniques have to be employed.

V. OVERVIEW OF KANBAN SYSTEM

We rest provide a comparative review of Kanban literature on determining the design parameters using a tabular format, then discuss the studies on determining the Kanban sequences to show the impact of operational issues on the design parameters.

The characteristics considered in this review are classified as follows,

1. Model structure: Mathematical programming, Simulation, Markov Chains, Others
2. Solution approach:
 - 2.1. Heuristic
 - 2.2. Exact: Dynamic programming, Integer programming, Linear programming,

3. Decision variables:

3. 1. Number of Kanban

3. 2. Order interval

3. 3. Safety stock level

3. 4. Kanban size

4. Performance measures:

4. 1. Number of Kanbans

4. 2. Utilization

4. 3. Measures: Inventory holding cost, Shortage cost, Fill rate

5. Objective:

5. 1. Minimize cost: Inventory holding cost, Operating costs, Shortage cost, Setup cost.

5. 2. Minimize inventory

5. 3. Maximize throughput

6. Setting:

6. 1. Layout: Assembly-tree, Serial, Network without backtracking

6. 2. Time period: Multi-period, Single-period

6. 3. Item: Multi-item, Single-item

7. Kanban type: Single-card Kanban, Dual-card Kanban

8. Assumptions:

8. 1. Kanban sizes: Known, Unit

8. 2. Stochasticity: Demand, Lead time, Processing time, Setup time

8. 3. Production cycle: Fixed production intervals, Continuous production

8. 4. Material handling: Fixed withdrawal cycle, Instantaneous

VI. PRINCIPLE

1. ELIMINATION OF WASTES BY PROCESS IMPROVEMENTS

Introduction to Kanban System
The word Kanban has come to stand for a variety of items ranging from shelves, bins, electronic messages and order slips to the entire reorder point system. Kanban system guides everyone in an industry from machine operator to trolley driver to know what the next process to be carried out
Kanban Technique

- It provides pick up or transport information.
- It provides production information.

2. Criteria to select Kanban items

- There must be a continuous flow of work.
- There must be a one piece manufacturing at a time.
- System must be stable.

3. Six Kanban rules:

- Downstream process should get right parts at right time from upstream.
- Upstream process should produce parts or products in quantity of downstream process.

- Defective products should never be passed on to downstream process
- Number of Kanban should be minimized.
- Kanban can be utilized to adapt to very small variations in production volume. 10%.
- The actual number of parts in box must equal to number on Kanban.

VII. TYPES OF KANBAN

The Kanban system is based on use of cards called 'Kanban'. The card is put in a rectangular vinyl slack. The following three kinds of cards are normally used:

- Move Kanban
- Production Kanban
- Supplier Kanban
- Job order-Kanban -Issued for each job order
- Through-Kanban - When two processes are very close, it doesn't make sense to issue two Kanban. Used where one process directly feeds (conveyor) the next process.
- Common-Kanban-Where a withdrawal Kanban is used as a production ordering Kanban if the distance between two processes is very short and share the same supervisor.
- Emergency-Kanban- Temporary, when there is a defect or problem, can be withdrawal or production

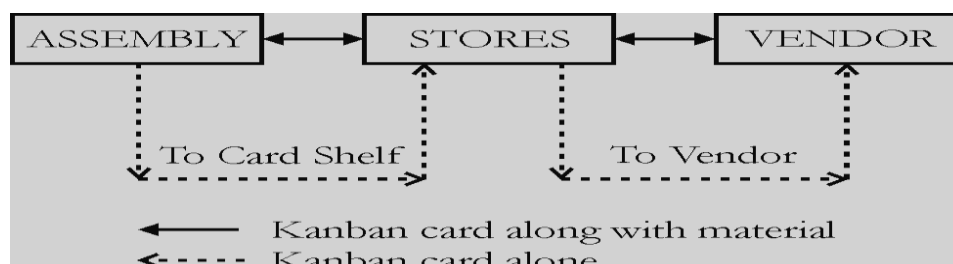


Fig. 3.1.1 Kanban flow diagram

To make Kanban system work, manufacturing processes are designated as preceding process and subsequent process. The withdrawal Kanban details the quantity that the subsequent process should withdraw, while the production ordering Kanban shows the quantity preceding process should produce. Kanban system is an information system to harmoniously control the production quantities in every process. The Kanban system is based on the use of cards called "Kanban". The card is put in rectangular vinyl slack. The following are the two kinds of cards normally used.

- Withdrawal Kanban (WK)

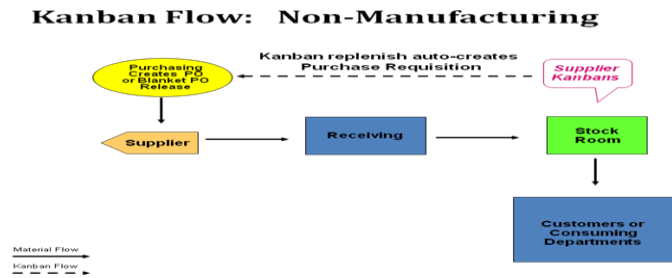
- Production Ordering Kanban (POK)

To make Kanban system work, manufacturing processes are designated as preceding process (PP) and subsequent process (SP). The Withdrawal Kanban (WK) details the quantity that the subsequent process should withdraw, while the Production Ordering Kanban (POK) shows the quantity which the preceding process should produce. These cards circulate within the factory (Pre-machining section)

VIII. WORKING

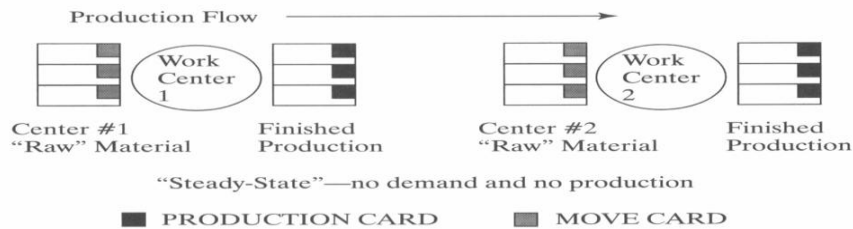
1. Kanban flow:

The Kanban flow for non-manufacturing processes is as shown in fig

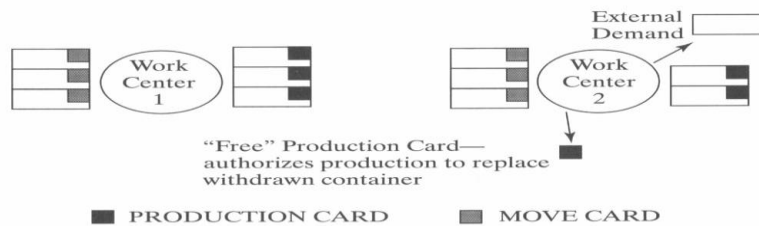


2. How does Kanban works? :

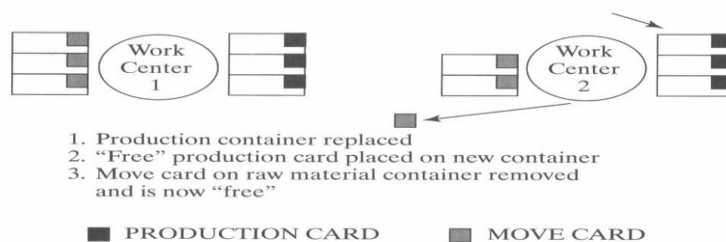
STEP- 1:At the start of the process there is no movement, since all the cards are attached to full containers or bins.



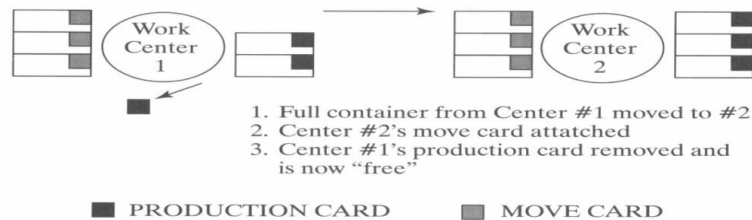
STEP-2: At some point, a down station needs some of the parts produced by work center 2 (in its “finished product” bin at the right side of this center). The material handler will take a bin of the part from work center 2, at the same time, post the production Kanban (PK) in the card post of this center. (Moment ago, the PK is attached to the full finished product bin).



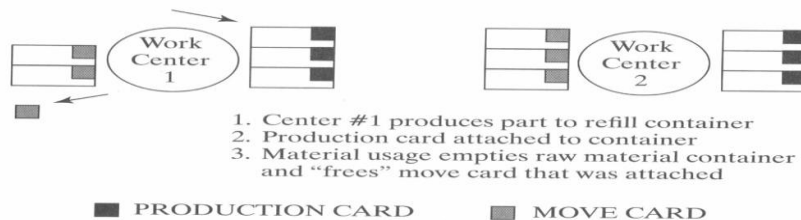
STEP-3:The posted PK is the signal to start production at the work center 2 to replace the empty finished product bin. To do that work the operator needs raw material, which is in the raw materials bin at the left side of the work center with the withdrawal Kanban (WK) attached. When that material is used up, the WK will be posted by the operator



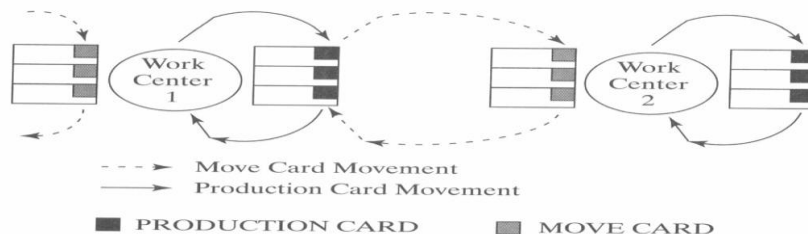
STEP-4: The posted WK authorized movement of material that usually is found in the “finished product” bin of work center 1. The material handler will now collect the WK and deliver the material to down station (work center 2).



STEP-5: Now, there is an PK posted at work center 1 which calls the operator to start production, using its raw material at the left side bins. Of course, the operator will refill his/her finished product bin and post the WK when his raw material bin is empty.



STEP-6: This process continues upstream even to the suppliers. There are no schedules with this system. Production is pulled by down station's demand. The movement of material is only authorized purely to the amount of down station's production.



IX. METHOD TO DEVELOP KANBAN SYSTEM:-

In this section, method to develop Kanban system is presented. The method for this case study consist of

- i. Gathering relevant parameter
- ii. Calculating Kanban quantity
- iii. Establishing pull mechanism and rule.

As a started, relevant production parameter was gathered such as cycle time, withdrawn time, time for waiting Kanban, time to replenish, part variant, safety stock and container capacity. All the parameters were taken directly from production floor and history record. Another important parameter was customer demand. Basically, 3 consecutives of customer forecast demand was collected to determine the highest volume within the period. This to ensure that Kanban system is capable to cater the highest demand from customer. Gathering of

accurate and appropriate parameter must be done prior to Kanban calculation to ensure that numbers is optimum and sufficient to cater customer need.

Next, Kanban calculation was carried out to determine optimum number of Kanban in system. Toyota formula (derived by UMW Toyota) was used to determine Kanban numbers. Due to current manufacturing system, two Kanban cards system was suggested to suit with current condition. The cards are Production Instruction Kanban (PIK) and Production Withdrawal Kanban (PWK). The calculation was carried out by:

$$K= RE+LS+WI+SA$$

Where,

K= number of Kanban

RE = Replenishment time coverage

LS= Lot size coverage

WI= Withdraw peak coverage

SA= Safety coverage

The total numbers of Kanban must be tally with inventory to achieve smooth circulation of Kanban card in the system. For the start, Kanban tools were fabricated to visualize Kanban flow then Kanban rule was established to assist production personnel regarding Kanban system. Finally analysis would be carried out to measure the effectiveness of the Kanban system.

X. LIMITATIONS OF KANBAN

Kanban is feasible in just about any plant that makes goods in whole (discrete) units (but not in the process industries). It is beneficial only in certain circumstances:

1. Kanban should be an element of a JIT system. It makes little sense to use a pull system if it takes interminably long to pull the necessary parts from the producing work centre, as it would if setup times took hours and lot sizes were large. The central feature of JIT is cutting setup times and lot sizes, which allows for fast 'pulls' of parts from producing work centres.
2. The parts included in the Kanban system should be used every day. Kanban provides for at least one full container of a given part number to be on hand all the time, which is not much inventory idleness if the full container is used up the same day it is produced. Therefore, companies with a Kanban system generally apply it to the high-use part numbers, but replenish low-use times by means of conventional Western techniques (e.g. MRP or reorder point).

XI. CONCLUSION

In this project, we are implementing kanban system in maintenance area. Due to this, the machine leadtime is reduced and also inventory level is controlled. It also helps the worker to choose the defective part he has to repair firstly. So due to this, the part which critically needed on particular machine is repaired, so there is continuous work on machine is possible.

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“Implementation of kanban system for ready sub-assemblies in maintenance area” had been a wonderful subject to research upon, which leads one's mind to explore new heights in the field of Mechanical Engineering. We wish to express our senior thanks and deep sense of gratitude to respected guide PROF.A.V.DHUMAL department of mechanical engineering of BVCOE&RI, NASHIK for technical advice, encouragement and constructive criticism, which motivated us to strive harder for excellence.

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