PRODUCTION & QUALITY MEASURES THROUGH KANBAN STUDY

Rahul Rana
Dronacharya College Of Engineering

ABSTRACT Globalization has changed the concept of quality & customer satisfaction, and has established new benchmarks. Customer’s choices and perceptions have also been changing rapidly. This leads to high variability and short product life cycle. An industrial and manufacturing enterprise have to struggle to gain the competitive edge and meet or exceeds the aspirations of customer. In this context, adoption of proper tools & techniques leading to higher productivity and quality becomes the key issue. Changing over to Just-in-time (JIT) manufacturing philosophy has a lion’s share in most Japanese success stories. There are various tools to realize JIT. A pull way comprising Kanban can be implemented in large country like India with the help of “Milk Run way”, which establishes a supply chain. This paper deals in brief the case of implementation of Kanban way in a Tractor Manufacturing Company and its cost analysis for gaining the productivity advantage. The issues like quality & high inventory levels are addressed by designing and implementing a Simple (single card) Kanban way in a warehouse of the Tractor Assembly Plant. After implementing & operating the way for a pilot batch of components, its implications on the productivity and quality are assessed.

INTRODUCTION

Today world economy tends to become one global village driven by the incessant market forces and consideration of efficiency. Globalization, privatization and liberalization override the norms of political compulsions and become instrument for achieving competitive efficiencies and resource optimization. Global competition, thrust on quality, and demand for higher productivity are some of the challenges before present industrial units. It is need of time that every organization should find innovative ways to meet these challenges to gain a competitive advantage. Seeking effective factory scheduling & control way provides the competitive advantage. A competitive advantage can be gained by studying and adoption of the proper and effective tool to eliminate the wasteful elements. This paper discusses the design, development and implementation of the Kanban way intended to address the issues of the higher inventory levels due to push way. The Kanban way was implemented and operated for the pilot batch of components in a tractor assembly plant warehouse and its effectively has been evaluated.

EXISTING PROCESS

This study has been concentrated on factory scheduling control policy for a tractor assembly plant, which produces 3000-3500 tractors per month with a daily capacity of 140 tractors. Daily 15 to 20 different types of models are assembled, which can be broadly classified as “old model” and “new model”. These models are produced for different range of horsepower varying from 20HP to 40 HP. After studying demand pattern, it is observed that, in general 50% of old model and 50% of new models are scheduled daily. The plant has a U shape layout & it can be categorized as Pre-paint assembly workstations, paint booth and post paint assembly station. In the factory premises four plants are located that are Tractor Assembly Plant, Engine Assembly Plant, Transmission Assembly Plant and VTU ( Very Touch Unit ) Assembly Plant. Engine and transmission from neighboring plants are supplied to tractor assembly plant and assembly is carried out in tractor assembly plant. Components required for assembly are purchased from vendors located all over India. These components are stored in the warehouse and are supplied at the various assembly workstations. The warehouse also supplies the components to its satellite plants located in other states.

Need for Kanban Way

In case of the existing factory scheduling method, Material Requirement Planning (MRP) based on the monthly forecast creates schedules on every 25th of the month for the material required in next month.
Once schedules are communicated & allocated, vendors are allowed to supply components and can dump the material in the warehouse. Vendors, and again components are procured and issuing of components. Even sometimes the actual inventory levels do not match with the inventory records in the computer way creating chaos.

Hence it was decided that these drawbacks can be overcome by an establishing an effective visual control way through Kanban. Kanban establishes a pull control policy, which is based on the consumption-based replenishment Kanban is a Japanese term where ‘Kan’ means card and ‘Ban’ means signal. Cards are used as a medium of information communication and limit WIP by authorizing the movement and production of components. There are two types of Kanban cards i.e. withdrawal and production Kanban. Withdrawal Kanban authorizes the movement of material from one stage to another, while production Kanban authorizes the production at the upstream workstation. When single card is used then way is called as Simple Kanban way & when both the cards are used then way is called as Integrated Kanban way.

DESIGN OF KANBAN WAY.

To design the Kanban way, the upstream and downstream workstations need to be identified. In case of tractor assembly plant the assembly workstation is the downstream workstation for warehouse and warehouse is the downstream workstation for vendors located outside the premises of the factory. As in-house production facility does not exist, Simple Kanban way with Withdrawal Kanban is designed and implemented for the pilot batch of components.

2.2.1 Total number of Kanban Cards.

Deciding the total number of Kanban cards for a component is a key issue. If the excess cards come into circulation then it encourages sloppy schedule and high stock levels. Insufficient cards will adversely affect the throughput. Out of several methodologies to decide the total number of Kanban cards, the use of predetermined formula (Koregaonkar M.G. 2002) and heuristic approach has been made. The constraints identified which restricts the use of any standard methodology are

- Responsiveness of each vendor to supply in a specified time.
- Uncertain supply of components to the satellite plant.
- Purchase officers risk taking ability, experience & prejudices about vendor.
- Kanban way should not hamper share of business for multi-sourced components.

Container Size

The containers fabricated and used to store the components in accordance with the rack way of warehouse involve a major investment. While designing the Kanban cards, the optimum use of existing containers has been made. Containers are selected depending on the size of components, lot sizes and capacity of container. The container type specified on the Kanban card has only to be used forever for storing the particular quantity specified for particular component.

IMPLEMENTATION OF KANBAN WAY

It was decided to implement the Kanban way in three phases. In first phase, to procure the components supplied by local vendors only. In second phase, to procure the components supplied by third party logistics and at last, to procure components from the vendors located outside that are not covered by established supply chain. Efforts were concentrated to design, develop and implement Kanban way for a pilot batch of components procured from the local vendors. Implementation has been accomplished by deciding the flow of Kanban way and standard operating procedure to be followed by all workmen of warehouse. Implementation was a time-consuming activity. The various activities carried out while implementing Kanban way are summarized in brief as follows

- The components, which are to be procured by Kanban way, have been identified.
- The Kanban cards have been designed for each and every identified component by studying related data i.e. demand rate, lead time etc and arranging meeting with the vendor’s representative and concerned purchase officers.
• After deciding the total number of Kanban cards, the next step was the priming of the way i.e. to build a buffer to start the way in a balanced state. For this, components against all the Kanban cards have been procured and stored in specified containers. Kanban cycle starts procuring components after the priming of the way is over.

• For effective communication i.e. to trigger the production at vendors end, simple e-mail signaling mechanism was developed and implemented. An excel sheet was programmed to operate so that operator has to simply click the card number for that particular component & respective vendor. All the information on Kanban card to be triggered gets communicated to the vendor against which vendor has to supply the material.

• The flow and operation of Kanban card was decided which was important to avoid the congestion and misplacement of the Kanban cards.

Standard Operating Procedure

The operators and workers in the plant have been trained and asked to follow a standard procedure. Vendor representatives had also been trained and asked to cooperate to make the way successful. The various activities identified and standardized are as follows -

A) Receiving of Components

(i) Material should be received only if a free Kanban card is available for that component. (ii) Vendor is asked to write the Kanban card number against which the material has been dispatched by him. This number on invoice has to be checked with the free Kanban card available. (iii) The quantity on invoice should match with the Kanban card quantity (iv) The Container type specified on the Kanban card should only be used to store the components (v) The Kanban card should be attached to the container and both should move together till container becomes empty. (vi) The material should be stored on the location specified on Kanban card only

B) Issuing of Components and follow up

(i) Once the container on assembly line becomes empty, the container and card should be taken back to the stores (ii) The Kanban card has to be removed and the number of Kanban card should be noted. The Kanban card should be placed in the first box (Kanban post) (iii) The Container with Kanban card number, subsequent to the removed one should be issued. (iv) The vendors have to be informed to dispatch material against the removed Kanban cards placed in first Kanban post. (v)

OPERATION OF KANBAN WAY

A wayatic procedure was developed to deal with the circulation of Kanban cards, which is shown, in Figure 2. After removing the cards from empty container on assembly line, feeder has to place this card in Kanban post and then he has to replenish the material on assembly line with a filled container with a Kanban having subsequent number. The Kanban placed in the first box, is collected by the person communicating & intimating vendors to produce and dispatch the components. The cards then have to be kept as per the expected arrival day (column) and against the name of purchase officer (row) in a pigeonhole rack specially fabricated. A standard operating procedure was established to receive, store and issue the material on assembly line so that Kanban card should have proper circulation in plant. The way was operated for six months and enforced to overcome inertia of the old way.

After intimating vendor, the Kanban card should placed in a pigeon-hole rack, at the location named after the purchase officer (buyer) and the day of receipt of material as per lead-time. (vi) The vendor intimation box has to be checked daily to identify which material is expected to arrive (vii) If the material is not received on the expected day, then the card should be shifted to defaulter’s box and follow up should be taken for the cards in this box.

RESULT AND ANALYSIS

Comparative Analysis

After implementing and operating the Kanban way to procure the components for six months, the comparative and effectivity analysis have been performed. Data was collected for a sample of 20 components from the records of SAP (Way and Process) i.e. ERP (Enterprise Resource Planning) package and compared for the inventory levels
before and after the implementation of Kanban way which is graphically presented in Figure 3. Significant average inventory reduction of 43.77% has been observed. The data of 20 components have been classified as per A, B & C category, and the savings against the overstocking have been evaluated considering minimum lending interest rates of 8.5% per annum with which the company raises its funds. The average inventory existing with Kanban way is taken as a reference while evaluating savings against the overstocking. This means if the Kanban cards or lot sizes increase, then the savings will decrease and vice-versa. Hence the average inventory existing with Kanban way is taken as reference to evaluate the savings against the overstocking existing with the old push way, which is as shown in Table 1.

<table>
<thead>
<tr>
<th>Category</th>
<th>Savings / month (Rs)</th>
<th>Initial condition</th>
<th>Avg. Inventory (Rs)</th>
<th>% Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>19,424.43</td>
<td>3,30,221.20</td>
<td>1,751.00</td>
<td>11.05</td>
</tr>
<tr>
<td>B</td>
<td>36,846.49</td>
<td>2,61,451.00</td>
<td>1,30,728.00</td>
<td>11.00</td>
</tr>
<tr>
<td>C</td>
<td>24,796.27</td>
<td>1,16,591.00</td>
<td>1,58,396.00</td>
<td>15.66</td>
</tr>
</tbody>
</table>

The effectivity of the way can be evaluated statistically by hypotheses testing. The objective is to prove statistically that significant inventory reduction and percentage savings could be obtained against overstocking by implementation of Kanban way and extending it to remaining components. The hypothesis statement is

Null Hypothesis:

"The difference between the conditions before and after Kanban is negligible" Ho : $\mu_1 - \mu_2 = 0$

where Ho is a null hypothesis statement, which comprises the meaning that the difference between the means is not significant and approaching to zero. Proving null hypothesis false is an appropriate way to prove the difference between the means is significant and substantial. Related to number of samples involved in the experiment decides the degree of freedom. The t-statistics value, which is to be verified, is depending on the significance level $\alpha$ and degree of freedom. (Montogomery D C. 2011).

In this experiment, degree of freedom is known and t-value is evaluated. With the data, particular significance level is checked for the calculated t-value. It proves that the difference between the two means will be significant if the same experiment is implemented for the longer period for similar situation

The t-value can be found out as

Checking t- statistics B and C category component evaluate the effectivity of Kanban way. ‘A’ category components are less in number from all total components & hence t-statistics need not be evaluated. The mean $\mu$, and standard deviation $\sigma$ and various other parameter evaluated from the data collected is shown in Table 2.

<table>
<thead>
<tr>
<th>Category</th>
<th>Sample size</th>
<th>Mean $\mu_1$</th>
<th>$\sigma$</th>
<th>Mean $\mu_2$</th>
<th>$\sigma_2$</th>
<th>t-statistics</th>
<th>Degree of freedom</th>
<th>Significance level (a) from t-table for two tailed t-test</th>
<th>Confidence level $\alpha$</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>9</td>
<td>399.33</td>
<td>317.88</td>
<td>360.17</td>
<td>44.232</td>
<td>2.175</td>
<td>3</td>
<td>0.055</td>
<td>93.3%</td>
</tr>
<tr>
<td>C</td>
<td>8</td>
<td>1893.25</td>
<td>793.75</td>
<td>1918.79</td>
<td>360.20</td>
<td>1.554</td>
<td>7</td>
<td>0.18</td>
<td>82%</td>
</tr>
</tbody>
</table>

% that for B-Components and with confidence level of 82% for C-components.

Therefore from the t-test, savings and effectiveness would be ascertained with a confidence level of 93.5.
CONCLUSIONS

The Kanban ways have been designed, developed and implemented for tractor assembly plant for a pilot batch of 88 different types of components procured from the vendors located in the vicinity of factory. The way can be extended for other components. A significant average inventory reduction of 43.77% has been obtained. The effectivity of the Kanban way was evaluated statistically and inferred that the success of the way can be assured with a confidence level of 93.5% for B components & with 82.5% for C components against over stocking. Apart from this the various benefits obtained are

• Visual control has been established, reducing variance and eliminating the reconciliation problem

• Optimum utilization of pallets and containers, factory space is possible with Kanban way.

• Production ordering and follow up with vendors have been subordinated from purchase officer to the operator of warehouse.

• Improved Quality as the way with a shorter queue cannot tolerate high level of yield loss and rework because there will be quick shut down of the line. The short queue reduces the operation and detection of defect time. As a result a Kanban has applied a pressure for quality. Thus Kanban had brought total discipline in all the activities of material handling and warehousing. It has released the capital blocked due to overstocking. The Kanban way evaluated for the pilot batch of the components ascertains that it is having a potential to reduce the inventory levels. Hence the Kanban way can be extended to procure the other components. With this way, waste in all forms will be eliminated, and turnover ratio of capital will increase. Thereby the net worth productivity of the company as a whole will be improved. The Kanban is one of the proactive steps to gain the competitive advantage by productivity and quality improvement.

REFERENCES


• Charles Standard & Dale Davis (2011) “Pull way : Implementation Experience In American Manufacturing” Proceedings of twelfth annual conference of the production and process management society, Orlando

• Claudine Chaouï, George Liberopoulos And Yves Dallery (2010), “The extended Kanban control way for production coordination of assembly manufacturing way” IIE Transactions V.32


• M.S. Akturf & F. Erhunf (2009), ” An overview of design and operational issue of Kanban way” International Journal of Production Research, V. 37, No 17 pp 3859-3881.


