Application of Performance Improvement by using Single piece Flow

Prof. P.V. Dhopte¹, Prof S.W. Sajjanwar², Prof G.M. Palatkar³

Department of Mechanical Engineering, Jhulelal Institute of Technology, Nagpur, INDIA
¹E-mail: parkashdhopte@gmail.com
²E-mail: sanjay18270@rediffmail.com
³E-mail: gplatkar@gmail.com

Abstract — In the present scenario of the globalization, where every company wants to be a world class manufacturer or to improve its organizational performance, it is quite essential to adopt proper improvement techniques which suits it. Every organization needs to be more productive and efficient in order to survive in the market. In the era of the globalization, the requirements of manufacturing or services firms are needs innovative approaches and ideas, replacing the conventional ones; need to improve quality, reducing cost, proper utilization of the resources, and increase in productivity, reduction in all types of waste etc. Depending on the various factors, how to choose the best for an Organization? What methodology or system fits the particular type of organization? Many process improvement methodologies appear to conflict with each other or at least one down play the contribution of other methodologies. As Title indicates, an attempt is made to implement some methodologies in various sections. The case study has been conducted in one of the reputed manufacturing company of India. Due to variety of products, a huge scope of improvement can be made in present system. Efforts have been taken in this direction, for the selection of project. The main objective of this project is to improve production capacity, to minimize inventory, cost, space utilization, Labour cost and rejection and defects by implementing performance improvement techniques like single piece flow, line balancing, etc.

I. INTRODUCTION

Since the early 1990s, globalization has driven business towards more rapid change as competition became ‘border-less’[1]. In an attempt to manage this change, organizations have pursued formalized change programmers. The most popular initiatives employed by manufacturing organizations as organizational performance improvement techniques [2]. Now day’s shorter products life cycle and increased demand for customization make it difficult to produce some products or traditional production lines. Often the best that can be done is to produce them in batch flow system that has been improved through the incorporation of line flow principals. This is one piece flow manufacturing. Traditional cells with irregular material flows are replaced by U-shape production lines within which flow is regular and paced by a cycle time and between which flow is controlled by pull signals[3]. This piece of research work addresses the selected number of the quality improvement programs. Amongst the montage of tools and philosophies it is essential to find the nectar of methodologies, their comparison or similarities with other powerful once. The section II of research paper highlights literature review of research on various methodologies. Section III tries to explain the some of the drawbacks of current system. Section IV mainly focuses on the methodologies such as single piece flow with their analysis. Section V gives the comparative study of analysis, whereas the section VI and VII gives the result discussion and conclusion.

II. LITERATURE

Single piece flow can be described as an ideal state of efficient operations, where batch sizes and lot production are replaced by working on one product at a time [3]. While not practical for operations which very low processing times and correspondingly high change-over times (both values defined by taken time), it is nevertheless a Lean Manufacturing goal to achieve single piece flow in every operation possible. Achieving one-piece flow requires the elimination of waste. We remind the reader of the seven wastes [4, 5]:

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As a company reduces these wastes and strives for single piece flow, many other benefits follow. Some of these benefits include (i) improved quality and fewer defects (ii) reduced inventory (iii) less space required, (iv) enhancement of overall manufacturing flexibility, (v) makes the identification of future kaizens simpler, (vi) ensures a safer work environment, (vii) improves employee morale. We will review each of these benefits in more detail:

(i) Improved quality and fewer defects: When batches and production is eliminated, there is less opportunity to manufacture defects. Since the batch size will essentially be one, there will not be mountains of inventory to count, move, store and eventually pick. Furthermore, single piece flow ensures that if there is a quality problem with a particular part, we are sure that the defect has affected just one part. We do not need to dedicate hours isolating and testing the parts in the production run to determine if they meet quality standards. Of course, if a defect is caught in a single piece flow environment, this should not mean that we do not take the appropriate corrective actions to ensure that the problem is not ongoing as it may reoccur. At a high level, these steps include determining if standard work was followed and if so, what changes need to be made to the standard work document to ensure that the problem will never resurface again. Kaizen!

(ii) Reduced Inventory: Implementing single piece flow will require each operation to only produce what is needed by the next operation (the surgeon). When followed properly, the process will eliminate any opportunity to build ahead. Consequently, inventories will not be allowed to build up.

(iii) Requires less space: As inventory levels are reduced (see above), less space and manpower will be required to manage (receive, count, stock, store, pick and deliver) them. In addition, single piece flow usually requires creating manufacturing cells that squeeze machines as close together as possible so that a single operator can oversee many machines with the least amount of walking motion [3].

(iv) Enhances overall manufacturing flexibility: We know from our value steam maps that the less inventory in a value steam, the shorter the lead-time will be from customer order to product delivery. In a single piece flow environment, since we operate with less inventory, lead-times will also drop which will give us more time to react to customer orders (unless we pass off the lead-time gains to the customer).

(v) Makes identifying future kaizens simpler: We have already discussed that in a single piece flow environment, defects and WIP inventories fall. As a result of this reduction, it will become easier to see production problems. After all, if a particular process can not keep up, if defective inventories build up next to a particular machine or if overall customer demand cannot be met, this becomes obvious almost the minute it happens. These problems will dictate where to focus the next improvement activity.

Excel Control linkage Pvt. Ltd. was established in 1994 as an authorized assembler of cables and control levers under license from Tuthill Controls Group. Mechanical cables are a mechanical means of transmitting effort from one position to another by linear movement. They can be employed as a simple mechanical linkage or in conjunction with a control head or a lever control to make a complete remote control system. Some of the clients of this company is Bharat Earth Movers Ltd. (BEML), Eicher Motors Ltd., Escorts Construction Equipment Ltd., Hindustan Motors Ltd, L & T Case Equipment Ltd., Mahindra & Mahindra Ltd. Etc.

**III. SOME DRAWBACKS IN CURRENT SYSTEM**

In the past 50 years, people have struggled to develop approaches to good management practices that would help companies become more profitable. Unfortunately, over the years a number of factors generally caused every one of these initiatives to fail. The various factors identified as possible reasons for the failure of the
approaches to meet the expectations are cultural readiness, knowledge sharing capability and relationship balancing, learning capacity, performance management [6] and ineffective prioritization of the system. Here are some of the lacunas where current system launches complaints such as lack of consideration for human factors, lack of strategic perspective, relative inability to cope with variability, improper material handling, lack of planning, excessive labor for repetitive work etc. [8]. The various methodologies used to recover these problems are Single piece flow, Just in time, Kanban, SMED, Kaizen etc. Among all methodology we are focusing on the single piece flow techniques to sort out the above problems.

IV. ANALYSIS OF CURRENT APPROACHES:
The overall effects of the production system clearly improves production performance but the improvements is limited to certain areas. Table no.1-A provides a brief information about the production capacity of the present system which is improved by implementing single piece flow technique and the improved results are noted in the Table no.A1. The comparison of cost associates before and after implementation is discussed in point B. The Table no.2-C and C1 shows the reduction in inventory lies in shop floor. Table no.3 D and D1 shows the difference between the number of labors required for the operations.

TABLE NO.1: A) PRODUCTION CAPACITY

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly customer order</td>
<td>8000</td>
<td>8500</td>
<td>8000</td>
<td>8400</td>
<td>8500</td>
</tr>
<tr>
<td>Monthly production</td>
<td>6500</td>
<td>6600</td>
<td>6500</td>
<td>6700</td>
<td>6600</td>
</tr>
<tr>
<td>Qty. Balance to produce</td>
<td>1500</td>
<td>1900</td>
<td>1500</td>
<td>1700</td>
<td>1900</td>
</tr>
<tr>
<td>Per day production (NO/DAY)</td>
<td>250</td>
<td>254</td>
<td>250</td>
<td>258</td>
<td>254</td>
</tr>
</tbody>
</table>

Current status reveals that company produces 250 no. of cable in one shift. And our goal is to produce 320-330 cables/shift. To achieve this we design cell in such a way that it can save time by 20-30 sec for making one cable. by making single line flow of cable to reduce flow of cable from 4 station to 1 station. This can save approximately 28 sec per cable, which means approximately adding 80 cable in a shift).

Initially = 8hr x 60min x 60sec = 28800 sec/250 cable = 115 sec for one cable
Plan = 8 x 60 x 60 = 28800 sec/330 cable = 87 sec for one cable
Saving in one cable is 28 sec.

Because of single line flow it is very easy to decide production target which is very difficult in batch production. As well as installing automatic outer and inner cutting machine, which require one manpower instead of two. This will save cost of one manpower in a day. Cost implication of automatic outer cutting machine is Rs. 600000

Cost of automatic outer cutting machine can be covered in 6 month. (Rs 60000/ 200 (cost of one manpower) x 26 days) = 11.5 which is approximate 12 month

Following improved results obtained after implementation of Single piece flow.

TABLE NO. A1) PRODUCTION CAPACITY - (AFTER IMPLEMENTATION OF SPF)

<table>
<thead>
<tr>
<th>Month</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly customer order</td>
<td>8400</td>
<td>8300</td>
<td>8600</td>
<td>8400</td>
<td>8500</td>
</tr>
<tr>
<td>Monthly production</td>
<td>8300</td>
<td>8400</td>
<td>8300</td>
<td>8300</td>
<td>8300</td>
</tr>
<tr>
<td>Qty. Balance to produce</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Per day production (NO/DAY)</td>
<td>320</td>
<td>324</td>
<td>320</td>
<td>320</td>
<td>324</td>
</tr>
</tbody>
</table>

B) COST ASSOCIATE (250 CABLE/DAY)

a) Man power cost 10 man/shift=200*10 = Rs.2000/shift
b) Machine cost 50,0000/(2year*12month*26days) Rs. 802/shift
c) Overhead cost = Rs.1538/ Shift (standard company cost)
d) Running cost of automatic outer cutting machine - 100.

Total Cost = (A + B + C)/250 (production per day) = 17.36

Present cable cost is Rs 18. This includes man power cost, machine cost and overhead cost. We targeted benchmark of Rs 15 for one cable by installing automatic outer and inner cutting machine, which require only one manpower. This will save cost of one manpower in a day. So, Automatic machine cost per shift is = 60000/(2x12x26) = Rs 100 / shift Now machine cost will
increase by Rs. 100 new machine cost is Rs. 902. Running, maintenance and electricity cost of automatic outer cutting machine is Rs. 150

Total Cost = (A+B+C+D)/330 (production per day)
=(1800+902+1538+150)/320
=13.71 which is approximately Rs. 14.

New production cost per cable is Rs which is lower than initial cost per cable Rs 18

TABLE NO.3: C) INVENTORY LIES IN SHOP FLOOR

<table>
<thead>
<tr>
<th>Cost in Rs</th>
<th>30Sep</th>
<th>31Oct</th>
<th>30Nov</th>
<th>31Dec</th>
<th>31Jan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inner Outer</td>
<td>201000</td>
<td>302000</td>
<td>352000</td>
<td>314000</td>
<td>213000</td>
</tr>
<tr>
<td>End finished cost</td>
<td>48000</td>
<td>69800</td>
<td>78000</td>
<td>58600</td>
<td>49100</td>
</tr>
<tr>
<td>Semi finished cost</td>
<td>22000</td>
<td>40000</td>
<td>65800</td>
<td>32000</td>
<td>45000</td>
</tr>
<tr>
<td>Total cost</td>
<td>27100</td>
<td>411800</td>
<td>495800</td>
<td>404600</td>
<td>307100</td>
</tr>
</tbody>
</table>

Current inventory cost is between Rs. 2.7 lakhs to Rs. 5 lakhs. This is 1.5-3% of total turnover. (Turnover is 20 crore. (1.7 crore/ month) Out of 1.7 crore the raw material cost for one month is approx. 30% of sale value. The raw material value is Rs 5100000. So, Par day raw material consumption is = 5100000/26 = Rs 196000. We targeted that cost on shop floor inventory should not more than one day production capacity, by proper planning and insuring all parts of BOM should be ready before issue of job card for production. This will help to reduce inventory in shop floor. And not executing next production order until first order finished and packed.

TABLE NO. 3: D) LABOR UTILIZATION (AFTER IMPLEMENTATION OF SPF)

<table>
<thead>
<tr>
<th>Months</th>
<th>March</th>
<th>April</th>
<th>May</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly production</td>
<td>8300</td>
<td>8400</td>
<td>8300</td>
</tr>
<tr>
<td>Per day production</td>
<td>320</td>
<td>324</td>
<td>320</td>
</tr>
<tr>
<td>No of employee</td>
<td>9</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Man power/shift</td>
<td>35</td>
<td>32</td>
<td>35</td>
</tr>
</tbody>
</table>

Current Cable production/manpower/shift average is 24 cables in one shift by one manpower. But monthly cable requirement is about 8500 no per month. For this we require 32 Cables productions in one shift by one manpower.

TABLE NO. D1) LABOR UTILIZATION (AFTER IMPLEMENTATION OF SPF)

Production rate is increase from 250-320 cables in a day by designing a cell in such a way that it saved time by 20-30 sec for making one cable. Reduced movement of cable from 4 station to 1 station.

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</tr>
</thead>
<tbody>
<tr>
<td>Monthly production</td>
<td>6500</td>
<td>6600</td>
<td>6500</td>
<td>6700</td>
<td>6600</td>
</tr>
<tr>
<td>Per day production</td>
<td>250</td>
<td>253</td>
<td>250</td>
<td>257</td>
<td>254</td>
</tr>
<tr>
<td>No of employee</td>
<td>10</td>
<td>11</td>
<td>10</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>Man power/shift</td>
<td>25</td>
<td>23</td>
<td>25</td>
<td>21</td>
<td>26</td>
</tr>
</tbody>
</table>

V. COMPARATIVE STUDY:
The graphical representation shows that before implementing single piece flow, it was not possible to
satisfy the monthly customer order as per requirement, hence single piece flow helps to improve the production capacity of the present system.

Graph No.1: Production capacity

Graph No.2: Inventory

Graph No.3: Labor Utilization

VII. CONCLUSION

Productivity improvement
1. Inventory reduction
2. Labor utilization
3. Effective space utilization
4. Cost saving
In this paper we have tried to implement single piece flow

REFERENCES:


