PRODUCTIVITY IMPROVEMENT IN SMALL SCALE INDUSTRIES

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Abstract- Small scale industries play an important role in Indian economy. It has emerged as a powerful tool in providing relatively larger employment next to agriculture. It contributes more than 50% of the industrial production in value addition terms and generate one third of the export revenue. Global markets are continuously changing and demanding product of high quality and low cost. In this paper, the needs of TPM implementation in Indian SMEs and its effects on productivity, quality of product, culture of the organization, maintenance activity etc are discussed. The outcomes of literature of some case studies were kept in mind that all these show that the implementation of TPM in SMEs is still very low or negligible in India. Therefore, more effort should be given in developing a better model or there is a need to develop a proposed model for TPM implementation in SMEs. Finally, a TPM implementation methodology is proposed. The objective of this paper is to study the roll of OEE in Indian manufacturing industries either from small scale to large scale industries. Through a case study of implementing TPM in a small scale Industry for enhancing OEE of the company, assessment of performance losses in the production facilities, contributions of TPM initiatives in improving the organizational performance are discussed and analyzed. Moreover, the results of implementing TPM are also compared with previous one and find the importance of TPM implementation in Indian organizations.

Keywords- Small And Medium Enterprises, Total Productivity Management, Overall Equipment Effectiveness (OEE), etc...

I. INTRODUCTION

The Small Scale Industrial sector plays a vital role in the industrial development of any country. The importance of the Small Scale Industrial Sector is well recognized world over for its significant contribution in gratifying various socioeconomic objectives, such as higher growth of employment, output, promotion of exports and fostering entrepreneurship. The small scale industrial sector in India employs 31.25 million people and produces over 8,000 industrial items with the product range varying from very simple items produced with traditional technology to hi-tech products like electronic goods, television sets, engineering products, etc. At present, the Small Scale Industry (SSI) sector accounts for over 90% of industrial units in the country, 8 percent in the GDP and approximately 40 percent of India's exports. The SSI sector has gained special significance because of its low investment requirements. As per the census report of the year 2001-02, employment generated by SSI per Rs.1 Lakh investment was 1.39, while employment generated by large scale industry was 0.20 implying that large scale industry requires an investment of Rs. 5 lakh to generate employment for one person whereas SSI generates employment for 7 persons with same investment. Thus, the SSI provides 7 times more employment with the same level of investment in large scale industry. Further, SSI sector is a major source of raw material for some large scale industries. The spread of the SSI will prevent the concentration of economic power in a section of society. Moreover, most of these industries were characterized as being environmentally friendly. The possibility of establishing these industries in different regions is favourable because they do not need a special infrastructure, once these industries are well established then the encouragement of their spread in the rural regions will help to achieve many of the social and economic goals, such as increasing income in rural areas, controlling the migration from rural areas to cities and controlling demographic growth. Hence, the SSI sector plays a significant role in determining the growth performance of Indian economy. Thus, the Government of India took a number of steps for promoting SSI sector in India by establishing Handloom board, Handicraft board, Cottage industry board, Khadi and Village industry board, etc. to augment the performance of SSI in India. Despite these efforts of Indian government, 1,30,041 sick units in Indian small scale industry have been observed in the year 2005. A huge number of sick units, therefore, portray the gloomy picture of the health status of the Indian SSI. Therefore, any attempt to analyse the sources of growth of Indian SSI gains worth to study the health status of small scale industry of India.

In the present changing world scenario attributed to globalization, an organization cannot be run merely on investment and returns, but more on the quality of their products, services, human resource, productivity, timeliness, cost-reduction and its commitment to organization's goals. The quality and productivity with commitment can be achieved only when there is a real change in the mindset of people at work in the way they look at the global business, the technology and the organizations. This change can be made only by proper implementation and utilization of technology and human resource development practices. Therefore, the industrial productivity became the centre of attention as far as
the research is concerned. In the present changing world scenario, any organization has to maintain a good standard to stand in the highly competitive world of globalization and even for small continuous improvement in its quality. Small and medium enterprises (SMEs) are considered as the backbone of economic growth in all countries because they account for more than 75 percent of global economic growth. SMEs are contributing in providing job opportunities and also act as a supplier of goods and services to large organizations. SMEs can be defined by a number of factors and criteria, such as Investment, location, size, age, structure, organization, number of employees, sales volume, worth of assets, ownership through innovation and technology. In India, SMEs managers face a lot of pressures to reduce costs of product, improve product quality, and deliver goods and services on time. Moreover, Indian SMEs operate generally in an unsupportive environment (Singh et al., 2006). The India has evolved as an extensive institutional network over time for the promotion of small and medium scale enterprises (SMEs). This network extends from the national to state and district levels. Different institutions are Small Industries Development Organization (SIDO), Small Industries Service Institutes (SISIs), National Small Industries Corporation (NSIC), National Institute of Small Industries Extension Training (NISIET), Small Industries Development Corporation (SIDC) and State Financial Corporation and District Industries Centers (SFC&DIC). These institutions are helping small firms in several functions including marketing, exporting, importing, adopting technology and the like.

ABOUT TPM
Kaizen introduced the idea that employee expertise generates improvements. TPM stands for Total productive Maintenance, is first developed in Japan, it is term-basedpreventives and productive maintenance and involves every level from top executives to shop floor operators. Total employee involvement, autonomous maintenance by operators, small group activities to improve equipment reliability, maintainability, productivity, and continuous improvement (kaizen) are the principles embraced by TPM. TPM also facilitates the organizations to achieve higher levels of productivity, improved customer service, morale, and profits. TPM initiatives, as suggested by the Japan Institute of Plant Maintenance (JIPM), involve an eight pillar implementation plan that results in substantial increase in labor productivity through controlled maintenance, reduction in maintenance costs, and reduced production stoppages and downtimes.

Overall Equipment Effectiveness (OEE)
Overall Equipment Effectiveness has been developed by the JIPM. OEE is regarded as an important measurement for assessing the performance of equipment. Three key performance measurements: availability, performance rate and quality rate that combines into one consolidated metric by OEE calculation. The OEE can be used to help focus on improving the performance of machinery and associated processes by identifying those performance opportunities that will have the greatest impact to the bottom line. It is the ratio of actual equipment output to its theoretical maximum output. OEE can be viewed as the present of time that equipment would need to run at its maximum speed in order to attain the actual output of that tool or machine.

II. STUDY OBJECTIVES

- To study the roll of OEE in Indian manufacturing industries either from small scale to large scale industries.
- To analyze about implementing TPM in a small scale Industry for enhancing OEE of the company, assessment of performance losses in the production facilities, contributions of TPM initiatives in improving the organizational performance.

III. LITERATURE REVIEW

Small and medium enterprises (SMEs) play an important role in modern economies because of their flexibility and ability to innovate. In nearly every country, SMEs play a significant role in providing employment opportunities and supporting large scale manufacturing firms. However, there are not many studies reported in the literature that deal with productivity problems in SMEs. Considering the importance of SMEs, the experiences of a small company engaged in continuous improvement and a related conceptual model are discussed here to highlight how productivity can be improved with limited resources. The case study presented in this paper was conducted at Valeo; a French company located in England that produces wiper systems for the automotive industry in the UK. The wiper systems include containers, pumps, jets and hoses. Valeo produces a wide variety of low volume parts for various customers in a job shop environment. The objective of the project was to improve productivity in two cells of the company, namely the Honda/Rover cell and the headlamp cleaning cell. Next, the aim was to identify potential areas for cost savings resulting from productivity gains. Finally, implementation issues associated with productivity improvement strategies in a small company are discussed. (A. Gunasekaran, L. Forker, B. Kobu, 2000).

To examine the need to develop, practice and implement such maintenance practices, which not only reduce sudden sporadic failures in
semi-automated cells but also reduce both operation and maintenance (O&M) costs. A case based approach in conjunction with standard tools, techniques and practices is used to discuss various issues related with TPM implementation in a semi-automated cell. The findings indicate that TPM not only leads to increase in efficiency and effectiveness of manufacturing systems, measured in terms of OEE index, by reducing the wastages but also prepares the plant to meet the challenges put forward by globally competing economies to achieve world class manufacturing (WCM) status. The paper presents an interesting investigation of TPM implementation issues which may help the managers/practitioners to prepare their plants/units to meet the challenges of competitive manufacturing in twenty first century by adopting and implementing TPM. (Rajiv Kumar Sharma, Dinesh Kumar, Pradeep Kumar, 2006)

IV. METHODOLOGY

- The COMPANY A was observed for continuous two month working hours. Time measurement for various losses was setup and adjustment; changes in process, Transportation, Inventory Management were suggested.
- Analytical interpretation and comparison of data.
- Identification & Quantification of significant losses.
- Frequent Maintenance and breakdown-prevention measures implemented.
- The value of OEE was b/w 40% to 50% which is very less. It should be b/w 60% to 80% for a company which is in better condition.
- During Lunch time of 30 min, Maintenance personals must do preventive maintenance of each line so that
- Down time of lines can reduce.
- Run the machines even during lunch. (Lunch is for operators and not for machines.
- Visual display of maintenance chart at suitable locations in the shop floor.
- Prepare a proper maintenance schedule by maintenance department and always focus on preventive maintenance. OEE Calculation before Improvement Availability = Valuable Operating Time/Available Operating Time

V. CASE STUDY

Company A is a small scale industry. He has installed a unit of irrigation pipe and Triple Sheet of Capacity of 120 MT irrigation pipe and 120 MT Triple Sheet in a single shift. Finished product of irrigation pipe and triple sheet of the unit will be sold to the traders in nearby areas Company A promoter of the unit always thinks to enhance our business as well as providing jobs to local manpower. The Total Cost of unit was about Rs.60.00 lakhs. It is a small scale industry. The raw material is LDHHD granules of Petroleum which is easily available in bulk quantity. The promoter of the unit had done quick market survey to estimate the demand position of the product in surrounding districts.

Process of the company

The process start with mixing of granules with colors in a mixer which is operated with the help of electrical motor which provides required RPM to rotate the mixture blades to reduce the size of granules for further operation. After that the raw material is poured into funnel which is fitted with the burners. There are two funnels from which one is of larger size than the other. In larger size funnel, we pour material of low quality and in smaller of high quality. The ratio is maintained according to the quality required by the customer to satisfy the customer’s requirement which is based on cost. As the heating of granules takes place with the help of burner the heated up material flow through a pipe in which a spiral shaped shaft is moving to help the material flow further. As the material reaches the end of the pipe it passes through a die which is used for providing the required diameter of the pipe. The die is arranged with the help of four bolts to maintain the wall thickness of the pipe. After that the manufactured product goes through a long water tank where the coating of pipe takes place and the shape of the pipe is maintained. After that the pipe is rolled and sends for the packing.

Process Oriented Losses: Following losses have observed during this research-

- **Equipment failure loss:** In the COMPANY A, the main loss which account for the relatively smaller efficiency of the plant is because of the equipment failure. It occurs when the machineries unexpectedly fail. This Losses also includes loses due to equipment function deterioration
- **Setup and adjustment loss:** In COMPANY A, this loss occurs mainly at the starting of shift and rest time of the operators. There are some operators who don’t start to operate the machine at the scheduled time.
- **Start-up loss:** The start-up loss is the one that occurs until the startup. In the industry at the beginning of the machine there is small time loss to warm up the machine.
- **Minor stoppage and idling loss:** The minor stoppage loss is the one in which minor trouble causes the machine to refrain from operation. When breakage occurs during operation in company A, unplanned stoppage for cleaning and lubrication is one
of the minor stoppage and idling loss occur on the factory.

- **Defect and rework loss:** The defects in the Company A are not discarded but reworked. In the final inspection if any pipe was found defective then they are reworked. Sometimes less defective are also sold at lower price. In general the defects are likely to be considered as waste which should be disposed of. Returning the customer require more cost which is a double loss to the company. The goal should be zero defects to provide better product right the first time and every time.

- **Ergonomics or Human Oriented Losses:** During our visit we have observed that most of the machines are not designed in accordance with the human capacity, limitations and comfort. It has marked influence on the morale, psychology and working efficiency of the operator. Moreover, plant layout needs to be redesigned in order to increase accessibility and compatibility. Man-machine relationship is of vital significance and one of the deterministic variable in deciding production and productivity of a firm. Prolonged working hours for an operator may cause fatigue and stress if machine is not comfortable for the operators. Therefore researcher feels that there is an urgent need to make suitable modification and changes in the existing machines and equipments to make them for functional and enhance the available time.

In this case study, a small TPM concept in industry is used i.e. overall equipment effectiveness. Try to improve OEE of all the machines and reduce the break down time and increase the production of the company. Collected some data’s and calculated OEE of the machines which are running there:

### OEE CALCULATION BEFORE IMPROVEMENT

**Availability** = Valuable Operating Time/Available Operating Time

**OEE Calculation**

**Availability, Performance, and Quality Rate**

- Shift duration = 12hrs,
- Lunch = 30x2 = 60min
- Tea Time= 15x2 = 30min,
- Shift Change = 30min
- Available Time = 22hrs/day
- Capacity = 100kg/hr.
- Cycle Time = .01hr/kg

#### 2inch Machine for January

- Total production = 27566kg
- Rejection = 1000kg
- Available Operating Time = 31x22 = 682hrs
- Break downtime = 98hrs
- Operating Time = 27566/100 = 275.66
- Valuable Operating Time = 275.66+98 = 373.66
- Availability = (373.66/682)x100 = 54.7%
- Performance=([.01x26566]/373.66)x100 = 71%
- Quality = (26566/27566)x100 = 96.3%

**OEE = 54.7% x 71% x 96.3% = 40%**

#### 3inch Machine for January

- Total production = 27666
- Rejection=1000
- Available Operating Time = 30x22
- Break downtime = 99hr.
- Operating Time = 27666/100 = 276.6
- Valuable Operating Time = 276.6+99 = 375.6
- Availability = (375.6/682)x100 = 55.07%
- Performance = (.01x26666)/375.6 = 70.9%
- Quality = (26666/27666)x100 = 96.6%

**OEE = 55.07% x 70.9% x 96.6% = 40.1%**

#### 4inch Machine for January

- Total production = 29554kg
- Rejection = 2000kg
- Available Operating Time = 31x22 = 682hr.
- Break downtime = 97hr.
- Operating Time = 29554/100 = 295.5 hr.
- Valuable Operating Time = 295.54+97 = 392.54hr.
- Availability = (392.54/682)x100 = 57.55%
- Performance = [(0.01x27554)/392.54] x100 = 70.1%
- Quality= (27554/29554)x100 = 93.23%

**OEE = 57.55% x 70.1% x 93.23% = 40.1%**

#### 5inch Machine for January

- Total production = 34560kg
- Rejection = 1450kg
- Available Operating Time=31x22 = 682hrs.
- Break downtime = 100hrs.
- Operating Time = 34560/100 = 345.60hrs.
- Valuable Operating Time = 345.6+100 = 445.6hrs.
- Availability = (445.6/682)x100 = 65.3%
- Performance = [(0.01x33110)/445.6] = 74.3%
- Quality = (33110/34560)x100 = 95.8%

**OEE = 65.3% x 74.3% x 95.8% = 50%**
Productivity Improvement In Small Scale Industries

6inch Machine for January

- Total production = 35556kg
- Rejection = 1091kg
- Available Operating Time = 31×22 = 682hrs.
- Break downtime = 96hrs.
- Operating Time = 35556/100 = 355.56kg
- Valuable Operating Time = 355.56×96 = 451.56hrs.
- Availability = (451.56/682)×100 = 66.21%
- Performance = [(0.01×34465)/451.56]×100 = 76.30%
- Quality = (34465/35556)×100 = 96.9%
- OEE = 66.21%×76.30%×96.9% = 50%

OEE Calculation for January in tabular form:

<table>
<thead>
<tr>
<th>Machine Factors</th>
<th>JANUARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production (kg)</td>
<td>27568kg</td>
</tr>
<tr>
<td>Rejection (kg)</td>
<td>1001kg</td>
</tr>
<tr>
<td>Final Goods (kg)</td>
<td>37556kg</td>
</tr>
<tr>
<td>Break Down Time</td>
<td>9hrs.</td>
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<tr>
<td>Availability</td>
<td>54.70%</td>
</tr>
<tr>
<td>Performance Rate</td>
<td>7%</td>
</tr>
<tr>
<td>Quality Rate</td>
<td>96.33%</td>
</tr>
<tr>
<td>OEE in %</td>
<td>49%</td>
</tr>
</tbody>
</table>

MODEL CONSTRUCTION AND SOLUTION

Value of Overall Equipment Effectiveness of two months show poor availability, poor performance rate and poor quality rate of each line due to mismanagement and improper maintenance policy. Now, to find the causes of the rejections which inhibit the overall equipment effectiveness. After implementation of some suggestions in that particular section and record production, rejections and down time for 15th march to 15 April and calculate OEE.

OEE after Suggestion from 15 March to 15 April

2inch Machine

- Total production = 44467kg
- Rejection = 1101kg
- Available Operating Time = 30×22 = 660kg
- Break downtime = 89hrs.
- Operating Time = 44467/100 = 444.67hrs.
- Valuable Operating Time = 444.67×89 = 533.67hrs.
- Availability = (444.67/533.67) × 100 = 81.2%
- Performance = [(0.01×43366)/533.67]×100 = 81.2%
- Quality = (43366/44467)×100 = 97.4%
- OEE = 64.7%×81.2%×97.4% = 72%

3inch Machine

- Total production = 55332kg
- Rejection = 2000kg
- Available Operating Time = 30×22 = 660hrs.
- Break downtime = 80hrs.
- Operating Time = 55332/100 = 491.08hrs.
- Valuable Operating Time = 553.32×80 = 633.32hrs.
- Availability = (633.32/660)×100 = 95.9%
- Performance = [(0.01×53332)/633.32]×100 = 84.3%
- Quality = (53332/55332)×100 = 96.38%
- OEE = 95.9%×84.3%×96.38% = 71.1%

4inch machine

- Total production = 49108kg
- Rejection = 1001kg
- Available Operating Time = 30×22 = 660hrs.
- Break downtime = 85hrs.
- Operating Time = 49108/100 = 491.08hrs.
- Valuable Operating Time = 491.08×85 = 576.08hrs.
- Availability = (576.08/660)×100 = 87.2%
- Performance = [(0.01×53332)/633.32]×100 = 83.3%
- Quality = (53332/55332)×100 = 97.7%
- OEE = 87.2%×83.3%×97.7% = 71.1%

5inch machine

- Total production = 49970kg
- Rejection = 1110kg
- Available Operating Time = 30×22 = 660hrs.
- Break downtime = 89hrs.
- Operating Time = 49970/100 = 499.7hrs.
- Valuable Operating Time = 499.7×89 = 588.7hrs.
- Availability = (588.7/660)×100 = 89.1%
- Performance = [(0.01×48860)/588.7]×100 = 82.9%
- Quality = (48860/49970)×100 = 97.7%
- OEE = 89.1%×82.9%×97.7% = 72.1%

6inch machine

- Total production = 49908kg
- Rejection = 1101kg
- Available Operating Time = 30×22 = 660hrs.
- Break downtime = 82hrs.
- Operating Time = 49908/100 = 499.08hrs.
- Valuable Operating Time = 499.08+82 = 581.08 hrs,
- Availability = (581.08/660)×100 = 88.04%
- Performance = [(0.01×48807)/581.08]×100 = 84.5%
- Quality = (48807/49908)×100 = 97.7%

OEE = 88.4%×84.5%×97.7% = 72.8%

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<tbody>
<tr>
<td>Production Rate (HP)</td>
<td>100%</td>
<td>90%</td>
<td>85%</td>
<td>100%</td>
</tr>
<tr>
<td>Efficiency (%)</td>
<td>95%</td>
<td>92%</td>
<td>88%</td>
<td>100%</td>
</tr>
<tr>
<td>Performance Rate (HP)</td>
<td>92%</td>
<td>88%</td>
<td>85%</td>
<td>100%</td>
</tr>
<tr>
<td>OEE %</td>
<td>88.4%</td>
<td>85.5%</td>
<td>82.7%</td>
<td>100%</td>
</tr>
</tbody>
</table>

VI. RESULT AND DISCUSSION

As in this research for a small scale industry by applying a most important part of TPM i.e. OEE. As before application during analysis period all the factors of OEE are below the manufacturer’s assumption i.e. 85% and the operating condition of industry is very poor. After suggestion i.e. to clean the machines during start and after working and give suggestions to change the layout to handle the material. One suggestion is to shift his inventory room to near the industry for reducing the fatigue and cost to transportation. They have some operators, not from that area they are outsiders they take leave of about 4 to 5 days to meet their families, In this case it is advised to provide training to local persons so they operate the machines in their absence and also to do the maintenance in the case of bad working of machines or to work effectively. After this during the analysis period they take actions on some from our suggestions. After this we need do calculations to calculate OEE and the results are fairly good from previous calculations. So here it is proved that if any organization whether it is small or big or global after implementation or following the golden pillars of TPM, gets guaranteed success but it is necessary that it is implementing and follow completely and with believe. Some of the suggestions and solutions are,
- Training must be given to improve the technical skills of all personnel.
- Higher effectiveness sought in newly-purchased equipments.
- Implementing cleaning of machines and shop floor area before starting their lines so that rejection or rework can reduce.
- Autonomous maintenance, which means that each operator is doing routine maintenance of his own machine like lubrication, tightening of nuts etc. One should not wait for maintenance personal for routine maintenance work. They may call maintenance personal when machine are prone to breakdown.
- Prepare a proper maintenance schedule by maintenance department and always focus on preventive maintenance.
- Motivate each employee as well as engineers to take part actively in maintenance work also, either by giving incentives or by other means.
- Audit of maintenance department must be on regular basis.

CONCLUSION

In general, high productivity can increase people’s real income and improve their ability to purchase goods and services, enjoy leisure activities, access better housing and education, and contribute to social and environmental programs. Thus the productivity improvement is essential for any Industry. In today’s world the competition in industry at an all time high, TPM may be the only thing that stands between success and total failure for some companies. It has been proven to be a program that works. It can be adapted to work not only in industrial plants, but in construction, building maintenance, transportation, and in a variety of other situations. Employees must be educated and convinced that TPM is not just another “Program of the month” and that management is totally committed to the program and the extended time frame necessary for full implementation. TPM is not merely a concept but a practical and down-to-the-earth technique for achieving significant savings and increase in profits. If everyone involved in a TPM program does his or her part, an unusually high rate of return compared to resources invested may be expected.

From the above discussion it is concluded that the process can be improved based on method study, work procedure and proper utilization of machine and material. It will improve the current process by reducing the number of workstations, transportation, combining the operations and reducing the workers fatigue. After implementing the suggested improvement ideas small scale industries can able to increase its productivity. Hence, it is concluded that all new concepts / tools / techniques / models /
incentive schemes must be tried to enhance small industrial productivity. There is a lot of potential for improvements in industrial performance of the industries by using advanced approaches to improve industrial performance in highly competitive world.

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