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Just In Time in Maintenance – a Case Study

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Abstract - Now a day's in all manufacturing industries there should be reduce in wastages and increase in productivity. Just In Time (JIT) is the same technique to increase productivity by reducing the wastages. In this research, an efforts has been made to synthesize JIT in maintenance, to reduce the wastages of maintenance and to increase the productivity. Overall Equipment Effectiveness (OEE) technique is used for enhancing the productivity. Problems were identified which consumes more time for maintenance and some solutions are given for those problems to decrease the downtime, with the help of those solutions OEE increased. JIT technique can be used in all type of industries.

***Key Words*:** JIT, OEE

1. INTRODUCTION

Just-in-time (JIT) is a management philosophy that relates to eliminate sources of manufacturing waste by producing the right part in the right place at the right time.Waste results from any activity that adds cost without adding value, such as moving and storing. JIT should improve profits and return on investment by reducing inventory levels (increasing the inventory turnover rate), reducing variability, improving product quality, reducing production and delivery lead times, and reducing over cost. In a JIT system, underutilized (excess) capacity is used instead of buffer inventories to hedge against problems that may arise.

JIT applies primarily to repetitive manufacturing processes in which the same products and components are produced over and over again. The general idea is to establish flow processes (even when the facility uses a jobbing or batch process layout) by linking work centers so that there is an even, balanced flow of material throughout the entire production process, similar to that found in an assembly line. To accomplish this, an attempt is made to reach the goals of driving all queues toward zero and achieving the ideal lot size of one unit. The goal of JIT, therefore is to minimize the presence of non-value-adding operations and non-moving inventories in the production line. This will result in shorter throughput times, better on-time delivery performance, higher equipment utilization, lesser space requirement, lower costs, and greater profits. JIT was developed as a means of meeting customer demands with minimum delays. Thus in the olden days, JIT is used not to reduce manufacturing wastage, but primarily to produce goods so that customer orders are met exactly when they need the products.

Just-in-time manufacturing is a process where suppliers deliver inventory to the factory only when it's needed for assembly. Companies are beginning to turn to Internet-based technologies to communicate with their suppliers, making the just-in-time ordering and process speedier and more flexible. Just In Time is a 'pull' system for production process. Order act as a signal for a product to be manufactured, it informs the manufacturing unit when to initiate the process of manufacturing the product. Once it gets the order, demand-pull enables it to produce only required product in the correct time. In its most basic explanation and principle JIT refers to every component in the manufacturing system arriving just in time for it to be used. In this system there is no need for stock holding facilities of any kind. The most common industry that uses JIT system is the automobile industry.

1.1 Wastes in JIT Maintenance:

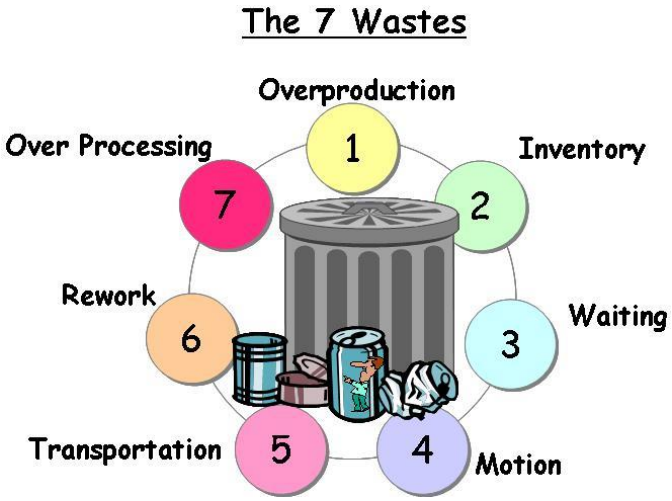

Fig 1: 7 Wastages of JIT

1.1.1 Over Production: It is a result of producing products which are not needed. So, it leads to waste of resources, time and increases cost.

1.1.2 Waiting Time: The operator, the machine or the part is either not working or not worked upon. The duration of waiting is unproductive and it may result in serious consequence.

1.1.3 Movement: Any unnecessary movement is a waste of energy. It causes blockages, disrupts movements and delays the flow of other items produced.

1.1.4 Process: There may be some steps in the process which are not necessary at a particular stage. It is waste of all the inputs that go into those steps.

1.1.5 Inventory: Excess procurement or production builds up stock of materials which are not immediately used, thus locking space and funds which carry heavy costs.

1.1.6 Efforts and Movements: People who work do not study as to how certain steps are utilized in realizing the purpose for which they are made. It is waste of resources which are not available when needed.

1.1.7 Defective Product: A defective product is one that is not fit for it intended use. Defective products consume the same time, resources, and equipment that can be used to make defect-free products. Thus defective products use up resources and result in losses.

1.2 Overall Equipment Effectiveness:-

JIT employs overall equipment effectiveness (OEE) as a quantitative metric for measuring the performance of a productive system. OEE is the core metric for measuring the success of JIT implementation program. This metric has become widely accepted as a quantitative tool essential for measurement of productivity in manufacturing operations. The role of OEE goes far beyond the task of just monitoring and controlling the manufacturing system performance. The OEE measure is central to the formulation and execution of a JIT improvement strategy. It provides a systematic method for establishing production targets, and incorporates practical management tools and techniques in order to achieve a balanced view of process availability, performance efficiency and rate of quality. OEE is calculated by obtaining the product of availability of the equipment, performance efficiency of the process and rate of quality product.

OEE =Availability (A)*Performance Efficiency (P)* Rate of Quality

Where,

$$\text{Availability (A)} = \frac{\text{Available Time} - \text{Down Time}}{\text{Available Time}}$$

Available Time = Total Time – Planned Downtime

Downtime is related to time associated with breakdown, setup, changeover, repairs, waiting time etc.

$$\text{Performance (P)} = \frac{\text{Std. Cycle Time} * \text{Qty. Products produce}}{\text{Operating Time}}$$

Operating Time = Total Time – (Planned Production Time + Down Time)

$$\text{Rate of Quantity} = \frac{\text{Good Unit Produce}}{\text{Total Unit Produces}}$$

JIT seeks to improve the OEE, which is an important indicator, deployed to measure success of JIT program in an organization. JIT has the standards of 90 percent availability, 95 percent performance efficiency and 99percent rate of quality. An overall 85 percent benchmark OEE is considered as world-class performance.

2. LITERATURE REVIEW

The Technologies are developing fast now a days but the problems regarding the downtime and segregation of wastages in JIT seven wastages in small and medium scale industries are not done properly.(Sandeep Phogat, 2000), designed questionnaire survey method was used to pull together the responses from the different industries regarding relevance of JIT practices in maintenance. The survey methodology included questionnaires design and development, data collection, data compilation, data presentation and data analysis. Waste of inventory in terms of spare parts storage and obsolesce, etc. waste of reject/rework/scrap in case of poor maintenance, waste of processing that leads to increases in maintenance and waste of overproduction/excessive maintenance activity has a high level of presence in the maintenance of Indian organizations and gets the top ranks in all the seven types of maintenance waste.(A.S. Aradhye & S.P. Kallukar, GCMM 2014), Evaluation of JIT in Indian manufacturing enterprise (By I.P.S. Ahuja & J.S. Khamba). The JIT approach enables to achieve high product quality with optimum resources in manufacturing industry. JIT approach is based on lean manufacturing system which develops to improve and optimize manufacturing efficiency by reducing lead time through waste elimination and kanban. Kanban system achieves minimum level of inventory. It ensures the supply of right part, at the right time, in the right place and in right quantity. Kanban system is system to manage and control flow of material in manufacturing industry. Cards are used to regulate material flow throughout process. JIT concepts are originally developed in the manufacturing domain. It can be identified, analysed and altered to fit and benefit service organizations. If the service organizations apply JIT techniques to reduce non-value-added activities, they will have more time to focus on value added activities, which will improve service to their customers and provide better operating environment for the organization. JIT focuses on the process, not on product. Therefore it can be applied to every process within manufacturing or service industry. The main objective of this research is to make use of a case study to present various issues regarding implementation of JIT for a service industry.(G. Abdennour & M.L. Smith, 2007), This research focuses on the operational control problem presented by the variability of processing time and machine breakdown. Since poorer process reliability results in a pronounced lower level of system utilization and higher level of work-in process inventory, a good preventive maintenance program and a suitable maintenance policy are necessary to maintain high productivity, to have a high quality product, and to allow the production people to maintain minimal inventory. Under different situations, different maintenance policies do not have the same effect on the production line performance. To illustrate the use of the models, the user must have some prior information relevant to the production line parameters. To determine

which maintenance policy to use, the manufacturer also must have an idea about the variations concerning the different independent variables used in this study.

The industries like Japan and Germany are far advance due to such practices, and as citizens and engineering student its is decided to implement this technique in India too, so because of this, the selection of this topic has done which is definitely going to help and strengthen the nation's economy.

3. RESEARCH METHODOLOGY

In this study, the company is selected for the study. The information from various literature also be used for the accomplishment of the project.

The methodology is explained in the following figure:

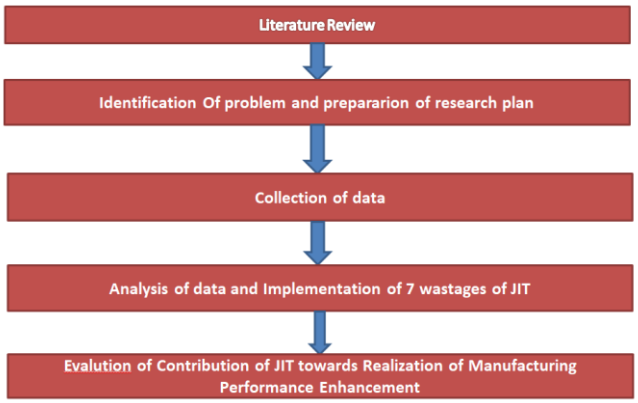

Fig 2: Methodology of Project

For the effectiveness of the project various extensive plant visits, interviews/discussion with the company persons, investigation of JIT initiatives by data collection, data analysis using OEE is to be made for proper implementation and further for proper results.

3.1 Case Study

For Execution of Project Just In Time in Maintenance, the manufacturing industry was selected. The Process chart for the line which was selected for the study:

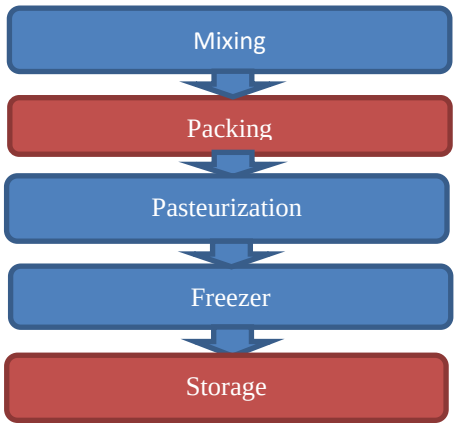

Fig 3: Line Layout

3.2 JIT Implementation:

Problem Identification & Recommended possible solution:

3.2.1 Waiting time:-

1. ICE Machine: When ice machines will having problem, then other ice machine should be arranged from other plant of same company or there should have centralized provision of Ice plant which can full fill the requirement of ice for both plants.

2. Manpower: When many machine related problems came at same time, available maintenance people are not enough to attain these problems which are leading towards increase in downtime period. So at least 4 mechanical people needed in every shift to reduce breakdown period.

3. PC Shortage: There are many technical departments like electrical, electronics, boiler, refrigeration & mechanical in maintenance room which are have to store some data regarding maintenance; but there is only 1PC available in maintenance department which is insufficient. At least 1 more PC is required to reduce waiting time related to process material purchase requisition.

4. Store location: Machine spares & General Purchase Store location is far away from store. The location of store should be nearer to the plant so that machine spare parts should be getting easily during break down period.

5. SAP Process: During breakdown problems, effective pre-planning must be followed by maintenance & production supervisor through condition monitoring. After machine problem identification, they need to arrange required spare parts or spare machines as fast as possible which will decreasing SAP processing time & inventory purchase time from store.

6. Requirement of Multi-skill: In the maintenance department, there is a need of multi-skill maintenance persons which can solve all department problems. Training should be given to maintenance persons about Multi-skill problem solving which is beneficial for company point of view. This will definitely decrease machine breakdown.

7. Refrigeration Compressors lines: Refrigeration Compressors are connected to their respective freezers. Compressors lines are not connected to each other and there is no spare compressor available in the system. So Refrigeration Compressor system lines require interconnection and spare compressor is needed in the system which can be used during compressor break down period.

8. Air Compressor requirement: Currently they are using two air compressors in the system one of which is having 60 HP capacity and other is 30 HP. Most of the machines are pneumatic based so 60 HP breakdown will lead towards total system failure. So another 60 HP air compressor is needed in the system instead of 30 HP for back up purpose.

3.2.2 Inventory:-

1. Need of Whatsapp: Whenever new or repaired part of machine is coming in department, for easy identification of part location, whatsapp group should have been preferred for convenience of maintenance person.

2. Spare part location: The Machine spare parts which required repeatedly should have been present in maintenance room.

3. Racking system modification: The Materials racking system need to extend for easy part sorting as per machine names which should be present in maintenance room.

4. Toolbox: The maintenance persons are having separate toolbox with each of them and hence the separate toolbox in the Process hall is not required.

5. Gearbox requirement: In this stick lines there are same types of machines are having same types of gearboxes. So machines like coloring impeller, coloring+ pump, arraying machines & boiling cooling machines requires at least 1 spare gearbox in case of emergency breakdown since gearbox gear repairing process is time consuming.

3.2.3 Process Flow:-

1. Gear pump problem: Sometimes Gear pump related machine's gears are not getting identified after cleaning, so numbering should be done on gears which will sort gears & their respective gearbox. Or else cleaning of gear pumps should have been done separately to avoid mixing of gears.

2. Process tub identification: Processing Tubs naming should have been done for easy identification of which product is in tub.

3. Requirement of training: Machine operating trainings for production supervisor and workers are required for increasing the working efficiency. If some problem comes when the line is running, this problem can be solved by the supervisor or worker.

4. Freezer loading pattern: Loading pattern of pouches at the inlet of freezer should be proper to increase the efficiency of line. (I.e. the pouches should be 5 in each line). Excessive unpattern loading will throw pouches from spiral freezer conveyor rail.

5. Filtration System: Filtration system should be provided for chilling process. For the water in chilling conveyor there should be filtration system to avoid water wastage.

6. Communication level: Level of communication need to increase in between maintenance persons & production persons. Group discussion is needed to minimize problems which are coming on the process areas during breakdown & operating of machines.

3.2.4 Transportation:-

1. Need of Substitute materials: Some machines Import material should be converted into Indian material. Because of transportation cost from other countries to India is very high to reduce this transportation cost and time we have to convert some spare parts materials into the Indian material. This will reduce transportation and materials cost.

2. Local vendor requirement: Most of the machine related spares are coming from Mumbai, Kolhapur & Pune. Spares ordering process is time consuming. Local vendor development is required in order to reduce time consuming maintenance process.

3. Plants Interconnection: During breakdown period machine transportation from one plant to another plant is time consuming process and it is depended on availability of tempo. So, interconnection in between two plants is required, this is under development.

3.2.5 Rework / Defects:-

1. Bearing replacement: Existing SKF bearing should be replaced into the Japanese bearing like EZO NSK & Asahi. From the observations it has been concluded that life of existing SKF bearing is very less as compared with Japanese bearing. SKF bearing wears very fast as compared with the Japanese bearing.

2. Dehumidifier requirement: Dehumidifier should be present in high risk area to maintain the temperature. Dehumidifier removes moisture from air and thus for maintaining the temperature at the outlet of freezer.

3. Wedge V belt requirement: Conversion of V shape belt into the wedge type of belt for V belt application machine. By converting v belt into wedge shape belt, the life of belt will increase.

4. Line speed: Speed of line should be moderate. By keeping line speed moderate, problem regarding low weight and high weight will be decreased, so that the wastage & rework of product can be minimized.

5. O ring operating procedure: O-ring of Cut Master machine should be pressed lightly inside bowl surface which will increase life of O ring.

4. RESULT

Table 1: Comparison of OEE current and after

OEE calculation (Current)	OEE calculation (After)
Availability = 88.68 % Performance Efficiency = 93 % Quality = 89 % OEE = Availability * Performance Efficiency * Quality OEE = 0.8868*0.93*0.89 **OEE = 73.40%**	Availability = 91.37 % Performance Efficiency =98.50% Quality = 97.14 % OEE = Availability * Performance Efficiency * Quality OEE = 0.9137*0.9850*0.9714 **OEE = 87.42%**

6. Need of corner Guides: For all Boiling Cooling machine, Corner guards should be provided to avoid tearing of Pouches.

7. Cooling conveyor chain quality issue: Quality of existing cooling conveyor machine chain is not up to the required level. Conveyor chain length is increasing in large amount over a period of time. This leads towards breakdown. So this conveyor chain needs to develop or need to replace with Japanese or Korean makes chain which are having good results in the other machines of same types.

8. Need of SS Plummer block bearings: In existing boiling cooling machine, MS Plummer block bearing are used which are having low life and having rusting problem. So these bearings need to replace with SS casting Plummer block SS Bearings which are having 3 to 4 times longer life than existing bearings.

5. CONCLUSION & REFERENCES

5.1 CONCLUSION

Implementing JIT in maintenance in the **manufacturing industry which had selected for the study purpose**; as JIT works from managing the inventory by reducing the waste so in industry there was some problems regarding down time that means the down time was more which should have to reduce so for that the solutions like WhatsApp group forming, providing multiskills for the supervisors & workers, Increase in the manpower of the workers, the segregation of gear box during cleaning and applying corner guides in pasteurization process; this type of solutions were given to the company and hence the downtime and defects decreased. Because of the decrease in downtime and defects the Overall Equipment Effectiveness (OEE) increased, by this way successfully implementing JIT in maintenance in selected industry, the OEE increased from 73.40 to 87.42.

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