A REVIEW PAPER ON LEAD TIME REDUCTION TOOL AND TECHNIQUES

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ABSTRACT:-

In today's scenario every business grows very fast and customers wants item in minimum duration time. So if production and services are not in pace with customer demand then the product will be out of race. Hence it is very crucial for every business to keep lead time at minimum. To bring lead time at minimum level, organization must have efficient Standard Operating Procedure (SOP). Also continues improvement should be pursued to sustain in the market. To reduce the lead time study is necessary, also detailed information is required to understand the flow of the product. Various production wastes should be identified and reduced to make system more efficient. Various tools and techniques are available for reducing the waste and lead time of production system. To select appropriate tool or technique for waste minimization, they are classified in the 3 groups. This study is a review on various lead time selection tools and techniques for several applications.

Keyword: Lead time, Lean Manufacturing, VSM, Kaizen, Basic Industrial Engineering Tool.

I. INTRODUCTION:

Customer satisfaction is prime objective of most of the industries. Lead Time is an important factor for customer satisfaction. Lead Time is the amount of time between process initiation and completion. For our customers Lead Time is the time between a confirmed customer order and its scheduled pick up or delivery based on our terms and conditions. The lead time varies according to type of product and market condition. Basically Lead times evaluation includes some parameters like work order start dates, operation start and due dates, overlapping operations, overlapping and concurrent operations, and calculating lead times.
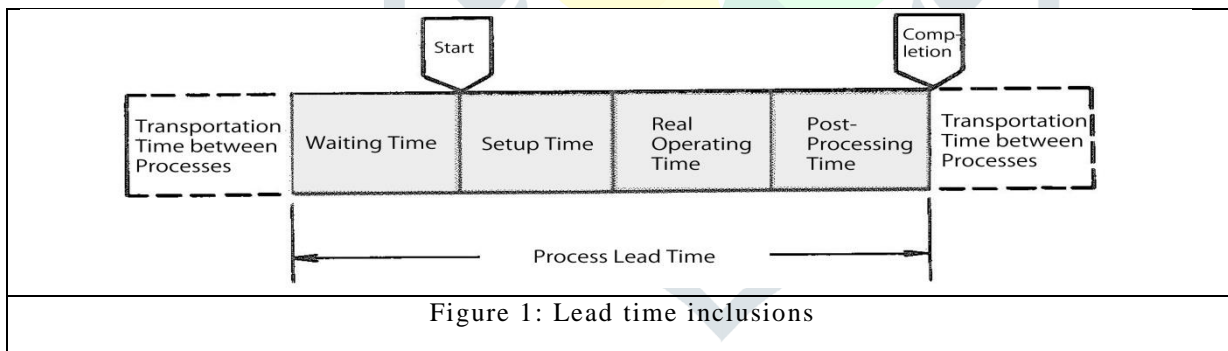

Figure 1: Lead time inclusions

Figure 1 shows various inclusions like waiting time, set up time, post processing time, inspection time, etc. in lead time. The real operating time is always less as compared to total lead time. If extra time is reduced or eliminated, production system will become more efficient and productive.

There are many factors which can influence company's lead time policy, including manufacturing environment (assemble-to-order, make-to-order), fixed or variable quantities, serial or overlap operations, fixed or variable time, number of shifts and operators, factoring by efficiency, and protection.

Lead time is applicable manufacturing as well as service organizations. It is concerned to each and every process like business plan development, painting process, tool & die manufacturing, stamping operation, building a house, income tax refund, servicing your car, receiving materials and building customer products, banking process, grocery shopping ,etc.

Lead Time Analysis should be carried out for following reasons.

- To document all steps in a process.

- To quantify the time and distance of each step in a process.

- To identify where value is being added to the process.

- To understand how non-value added activities drive cost in a process.

- To learn that reducing Lead Time contributes directly to improving Q,T, P and Customer Satisfaction..

II. CRITERIA FOR CLASSIFICATION OF LEAN TOOLS AND TECHNIQUES:

There are many tools and techniques used for lead time reduction. There are two ways to reduce lead time like through reducing setup time and other is reducing processing time. (Figure 2) Set-up time can be reduced by either SMED or Method study approach. While processing time can be reduced by work study, lean tools, appropriate PPC, etc.

Figure 2: Lead time reduction tools and techniques (Afzal H.Alad 2014).[23]
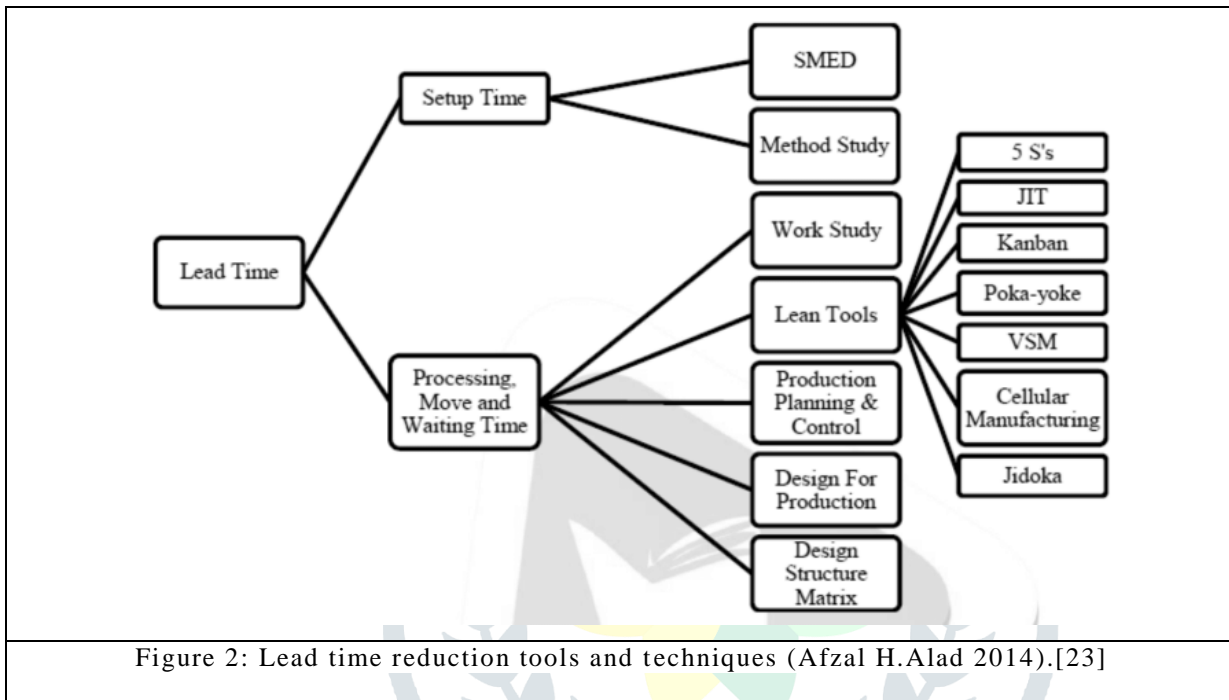
III. LITERATURE REVIEW:-

There are many tools and techniques used for lead time reduction. These tools are selected according to the need like type of industry, data availability, diagnosis of extra time etc. There are 3 levels classified for tools and techniques as shown in figure 3. In order to simplify the lead time reduction tool selection process, logically 3 levels can be categorized. Literature review is carried out in such 3 groups.

Figure 3: Classification of tools and techniques
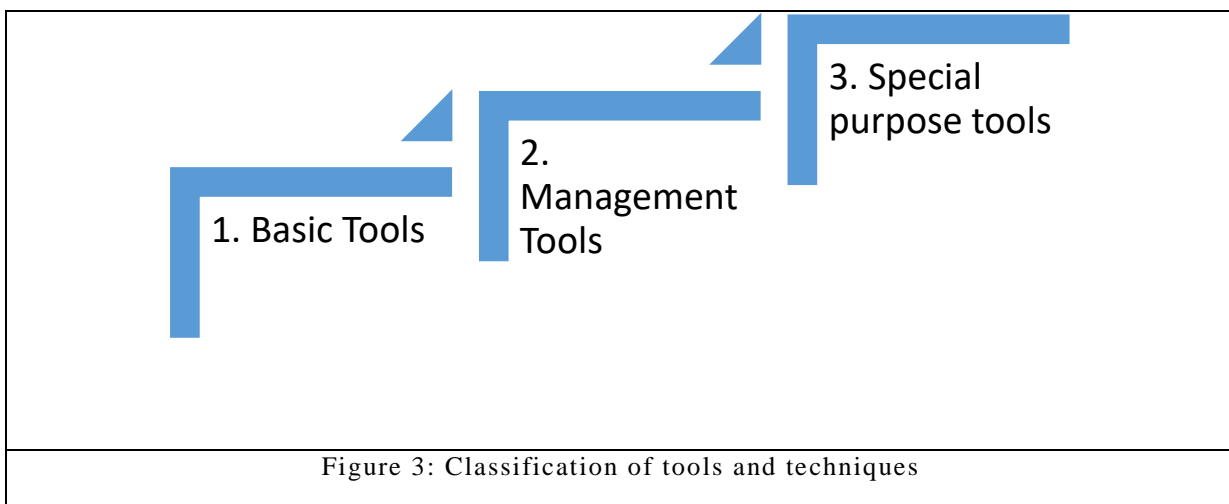
In level 1 basic tool and techniques use for data collection and analysis. Also some basic information regarding production flow can be collected to get more understanding of the process flow. The data analysis will lead to find the scope of improvement. This type of tools and techniques are used at preliminary analysis for lead time reduction.

IV. BASIC INDUSTRIAL ENGINEERING TOOL:-

Flow chart: This diagrammatic representation illustrates a solution model to a given problem. Flowcharts are used in analyzing, designing, documenting or managing a process or program in various fields. It's also use for basic flow data for VSM which shown by Peter Hines1997. if any industries are not aware about that component flow then it result increased lead time. [1]

Operations process chart (OPC): Operation Process chart records the overall picture of process and sequence wise steps of operations. (Jadav dhanpal 2017) The operation chart illustrates only the value-adding activities in the manufacturing process; therefore, material handling and storage are not illustrated in this chart. [2]

String diagram: String diagram is one of the useful and simplest techniques of method study. It can be defined as a scale model on which a thread is used to trace the path or movements of man and materials during a specified sequence of events. It is used for plan layout optimization in production time and machine cost. (Akil Jariya 2017) The use of string diagram reduced 42% of travel time and traveling distance by 30%. [3]

Time and motion study: A case study of automotive industry of using time & motion study and lean concept to reduce motion waste and improving productivity. The time study is based on with reference to existing time. It is concluded that as an important tool for lead time reduction. Time Study measures the time necessary for a job or task to be completed using the best method. (Patange 2013).[4 & 5]

7 Quality Control Tools: Nowadays, most companies attempt to improve quality management by reducing the opportunities for work to be damaged and shortening the time between manufacturing and defect detection. The researchers have identified the key methods for reducing lead time towards zero defect management. (Tawana Jaff and Atanas Ivanov 2014).[6]
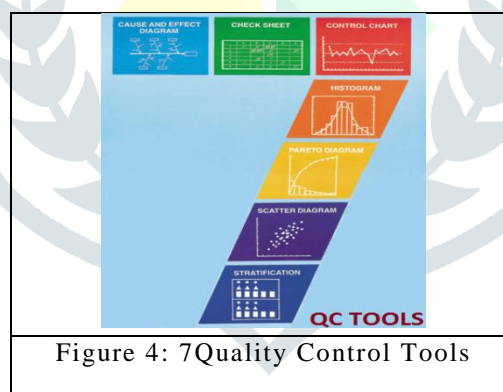

Figure 4: 7Quality Control Tools

To gather actual data concerning the efficiency of processes and the flows among processes, the process and work analysis of IE (Industrial Engineering) methods is conducted, and also interviews with peoples in production floor are conducted. To understand the way and situation of production planning and control, interviews with planning staff, and the data collection of actual production planning and control performance are conducted. To know about actual contents of customer order, interviews with sales people and data collection of received order are conducted. By conducting the above data collection in many aspects, we try to do objective judgments and not get into subjective judgments which shown by (Kazuto Ohata 2013).[7]

The tools and techniques should be selected according to type of product and diagnosis of problem. The data collection and data analysis are important steps of 7 quality control tools.

V. LEVEL 2: SEVEN MANAGEMENT AND PLANNING TOOLS:-

7 management tools also called as new 7 QC tools. In which some tools are used to manage the relationship between components of product. The affinity diagram is a business tool used to organize ideas and data. Interrelationship diagram displays all the interrelated cause-and-effect relationships and factors involved in a complex problem and guide towards desired outcomes. A tree diagram use to break down the broad categories in to finer and finer level. Anil and Suresh 2008 have explained the production and management tool and explain the development of tree diagram.it is also used to prioritize the item and describe them in weighted criteria. Matrix diagram or quality table show the relationship between two or more sets of elements. At each intersection, a relationship is either absent or present. It then gives information about the relationship, such as its strength, the roles played by various individuals or measurements. Process Decision Program Chart (PDPC) is a technique designed to help prepare contingency plans. The emphasis of the PDPC is to identify the consequential impact of failure on activity plans, and create appropriate contingency plans to limit risks. Vikas S Jadhav and V. Vivekananda show that the project was to reduce assembly time of industrial oven, by using various industrial engineering concepts. in the current method the assembly of the machine is done in 2040 min i.e. 34.01hours and 4.3 working days. Critical path method is the proposed method to carry out the assembly operations in parallel way so that the assembly of the complete oven can be completed in 1694mins i.e.28.23hours. by allocating extra resources to crashed activity Therefore saving 5.78hours i.e. (347minutes).[8&9]

5S: Improper utilization of storage space for raw material, bins and finished products. Wastage of time in searching the raw material due to non-permanent location for storage of raw material. Low productivity due to the time wastage in searching for tools, materials due to improper workplace management. Presence of unwanted materials at the workplace which affects the moral of the worker while working. Useful storage space being acquired by the unwanted materials. More time and cost required for the inventory process of unwanted stored materials in raw material stores that all problem are reduce by implementing 5S. (Abhay R. Kobarne 2014) [10]
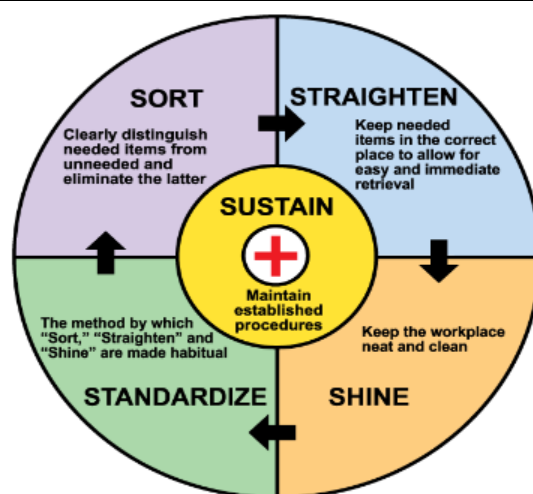

Fig.2 5S (R.S.Agrahari 2015)[11]

Kanban: Kanban (signboard or billboard in Japanese) is a scheduling system for lean manufacturing and just-in-time manufacturing (JIT).The results of this research study demonstrate that the kanban system is essential to minimize product lead time and inventory. (Nurul Hayati Abdul Halim 2013) [12]

Plant layout optimization techniques: There was the reduction by 3% in average processing time hence the increase in productivity shown by Dr. Ms. N.R. Rajhans 2016.The new layout success-fully increased the overall productivity of the facility. Results prove improvement in distance which ultimately reduces lead time and increases value addition which are shown by Muhammad Fahad 2016.This are some perfect example to optimize the layout and reduction of lead time. [13&14]

Automation: Automation is the technology by which a process or procedure is performed without human assistance. For lead time reduction we can use some automated tool in place of hand operated tool. For example; small movement of component by conveyor, hand tapping may be replaced by automatic tapping machine etc.

VI. LEVEL 3 SPECIAL PURPOSE TECHNIQUES:

Poka-yoke: A Poka-yoke is any mechanism in a lean manufacturing process that helps an equipment operator avoid mistakes. Its purpose is to eliminate product defects by preventing, correcting, or drawing attention to human errors as they occur. There may be some practical limitations in poka yoke but we have to overcome all that for achieving the aim of "Zero Defects, Zero Waste and Zero Delays" which are shown by Mr. Sangappa P. Parit 2013. [15]

VSM: Value-stream mapping is a lean-management method for analyzing the current state and designing a future state for the series of events that take a product or service from its beginning through to the customer with reduced lean wastes as compared to current map. A value stream focuses on areas of a firm that add value to a product or service, whereas a value chain refers to all of the activities within a company. VSM future state map shows significant improvement in the production lead time 1.02 days to 0.79 days, Which demonstrate that any delay can be analyzed through value stream mapping (Shubham Awasthi 2017).A VSM technique is introduced to control the production and raw material delivery using some processes, Value Stream Mapping (VSM) proves to be a distinguished technique which provides a company with a blueprint for strategic planning to organize the principles of

Lean Thinking for their transformation into a Lean Organization (Kaushik Chaudhari 2015).We can say that VSM is nothing but an effective integration of manpower, materials and machinery, and methods. Simplicity in terms of understanding and utilization of this tool makes is more valuable. But VSM should not end with one improvement, is should continue with a habit of continuous improvement (Umangi D. Pathak 2014).[16 to18]

Kaizen: Kaizen (改善) is the Japanese word for "improvement". In business, kaizen refers to activities that continuously improve all functions and involve all employees from the CEO to the assembly line workers. The application of the Kaizen principles involves no major expenses, but only more attention to details and practical ways to do things better and more efficiently; Problems should not be connected to people because blaming people does not solve the problem; Each approach should start with highlighting the positive parts; We should not judge or blame; we should use feed-back techniques(Mihail Aurel Titu 2010).Kaizen philosophy is applied in a small-sized custom-made furniture industry for continuous improvement and to develop the products with higher quality, lowest cost, and higher productivity in meeting the customer requirements (Kishore B. Lad 2016).The cycle time of the motor-air end assembly before implementing the kaizen was 92 min. After implementing the kaizen in LCA , the cycle time was reduced to80 min which are shown by M. Bala kumar 2013.After implementing kaizen cycle time reduce by 11% which shown by Rajenthirakumar, D 2015. [19 to 22]

VII. RELATIONSHIP OF COMPANY TYPE – TYPE OF PRODUCTION TOOLS AND TOOLS:

Following details are revealed from literature review about various types of companies and type of tools and techniques used for lead time reduction.

No.	Company Type	Tools and Techniques used for lead time reduction
1	Mass Productions Ford motor, Coca cola, iPhone	Basic IE Tools like flow chart, OPC, 7QC Tool, SMED, 5S, Automation, Poka yoke, VSM, 6sigma
2	Customize Production Rolls Royce, Furniture	Basic IE Tool (flowchart, OPC, string diagram, 7 management and planning tools, 5S, Kanban, Automation, Kaizen
3	Fixed type Production ship	Basic IE Tool like flowchart, OPC, string diagram, 7 management and planning tool, 5S, Kanban,

	manufacturing	Automation, Kaizen
4	Batch Production Bakery, Clothing. Computer chips	7 Quality Control Tools, Basic IE Tools, 7management and planning tool, 5S, Automation, VSM, 6sigma
5	Service Sector Banking, Insurance, Consultant,	7QC Tools, Basic IE Tools, 7management and planning tool, 5S, VSM, Automation, 6sigma

VIII. BENEFITS OF REDUCED LEAD TIME:

There are several advantages of reduced lead time like flexibility during rapid change of market, ability to compete with competitors, more efficient output, quicker replenishment of stock to avoid stock outs, meeting deadlines consistently and easily and increases in cash flow because of increased order fulfillment.

IX. FUTURE SCOPE AND RESEARCH GAP:-

Present days Indian small and medium scale industries are supporting big industries as well as growing. They should strive to reduce lead time and become good competitor in market. In mass production industries there is always a scope of reducing lead time by using various techniques like VSM. But, in customized and batch production company may use different tools like 7 management and planning tool at different level.

X. CONCLUSION:-

There are many tools and techniques are available for lead time reduction. The selection of appropriate tool is important in order to get reduced lead time. There is always a scope for improvement in every industry to make production system more efficient by effective resource utilization, waste minimization and lead time reducti on. This study will be useful for selection of appropriate tool or technique for lead time reduction.

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