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Productivity Improvement of an Industry by Implementing Lean Manufacturing Principles

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ABSTRACT— The competitive dynamic business environment has forced large and small scale firms to reexamine their methods of doing business. For the last decades the large scale industries have implemented lean in order to sustain in a dynamic environment. But the small scale industries have ignored to implement lean due to economic factor. The benefits of lean implementation in large scale sector now realize the small sector to implement lean. . This article addresses a case study of small scale industries. The study considers Single Piece Demand driven system – may be implemented for the semi- process industry. The case study is extensively described to be able to judge how the context of the changes and the intervention process contribute to the results of the intervention. And also this case study illustrates the existing hidden potential in small scale industry as well as a selection of suitable methods for productivity improvements and its ultimate goal is to eliminate waste and non-value-added activities at every production or service process in order to give the most satisfaction to the customer..

KEYWORDS— single piece demand, non value added activities, intervention process.

I. INTRODUCTION

Lean manufacturing is one that meets high throughput or service demands with very little inventory.In order to remain competitive in global competition and to be able to meet unprecedented market changes,organizations must not only design and offer better products and services; but need to improve theirmanufacturing operations. One of the strategies is by deploying lean manufacturing practices that can be usedto improve the operational performances. After World War II,Toyoda family in Japan decided to change their automatic loom manufacturing business to the automobile business. But they had few problems to overcome. They could not compete with the giants like Ford in the foreign markets. Therefore Toyota had to depend upon the small local markets. They also had to bring down the raw materials from outside. Also they had to produce in small batches. They haven't had much of capital to work with. With these constrains TaiichiOhno took over the challenge of achieving the impossible. With his right hand man Dr. Sheigo Shingo for next three decades he built the Toyota production system or the Just In Time system.

Eli Whitney's concept of interchangeable parts said to be the very initial beginning of this concept. But first or at least famous implementation of something similar to JIT happened a century later in manufacturing of Ford Model T (in 1910) automobile design.

Various pioneered work from people like Deming and Juran in the field of quality improvement was used in this system. This bought built in quality to the system. More importantly Ohno and Shingo understood the drawbacks in the push system and understood the role played by the inventory. This led to pull system rather than the push system. This system developed in Toyota from 1949 to 1975 virtually unnoticed by the others even within Japan.The complete elimination waste is the target of the system. This concept is vitally important today since in today's highly competitive world there is nothing we can waste.

II.LITERATURE SURVEY

Ben Naylor et al.., [1] has compared the lean and agile manufacturing paradigms, highlighting the similarities and their differences. Total supply chain perspective is essential and companies should be striving for leagility, which is attained by carefully combining both lean and agile paradigms which shows the elimination of waste. Another author John

Miltenburg et al .., [2] describes the U-line as the special type of cellular manufacturing used in JIT production systems. The purpose of JIT is to improve product quality and cost by eliminating all waste in a production system.

Sullivan et al.., [3] describes the large fixed costs of production are depreciation intensive because of huge capital investments made in high-volume operations.These fixed costs are spread over large production batch sizes in an effort to minimize the total unit costs of owning and operating the manufacturing system.

Rachna Shah et al.., [4] examines the effects of three contextual factors, plant size, plant age and unionization status, on the likelihood of implementing various manufacturing practices that are key facts of lean production systems which eliminates the MUDA ,Japanese term for waste.Paez et al.., [5] represents a change in production system paradigm that calls for integration of the human and technological practices.

Christian Becker et al.., [6] shows that assembly line balancing research which traditionally was focused upon simple problems has evolved towards formulating and solving generalized problems with different additional characteristics such as cost functions, equipment selection, and paralleling, U-shaped line layout and mixed-model production.

Abdulmaleket al.., [7] describes where lean principles were adapted for the process sector for application with VSM as a main toolwhich is used to identify the opportunities for various lean techniques.

Rubio et al.., [8] analyses a production-management model that considers the possibility of implementing a reverse-logistics system for remanufacturing end-of-life products in a lean production environment.Browning et al .., [9] shows the implementation of lean principles and practices will reduce production costs.

Rong et al.., [10] propose the formation of one-piece flow production system based on FACO method. They target on the just-in-time aspect of the production system and provide a multi-objective evaluation model whose aim is to minimize cycle time, changeover count, cell load variation, number of cells, and maximize the extent to which items are completed in a cell.

Pattanaik et al.., [11] exercise an applied methodology for scientific, objective techniques that cause work tasks in a process to be performed with a minimum of non-value adding activities resulting in greatly reduced wait time, queue time, move time, administrative time, and other delays.

Mustafa FatihYegul et al.., [12] propose a multi-pass random assignment line balancing algorithm aiming at minimizing the number of stations.

Guneri et al.., [13]shows that the cells are balanced in themselves, but they are redesigned as u-shaped cell to increase the production efficiency and effectiveness.

Aomaret al.., [14] presents an approach for optimizing multi-lean measures using simulation and Simulated Annealing (SA). Simulation is used as a platform for deploying lean techniques, estimating lean measures, and value mapping of lean measures. Yang et al.., [15] explores relationship between lean manufacturing practices, environmental management and business performance outcomes.

Christian Hofer et al.., [16] investigate the relationship between lean production implementation and financial performance. Rahani et al.., [17] shows the use of VSM improves the approach in LP initiatives as it reveals obvious and hidden waste that affects the productivity.

Stump and Badurdeenet al.., [18] explains that process requires high flexibility to respond to customer needs in a timely manner. Lean manufacturing principles can be easily applied to situations with low levels of Manufacturing Capacity. Rahul et al.., [19] shows the successes of distributed integrated manufacturing enterprises depend upon the adaptation of appropriate manufacturing technologies like computer integrated manufacturing (CIM) under the global collaborative environment along with the principles of lean manufacturing. It is observed that by implementing lean manufacturing principles the productivity of the company is greatly improved. By eliminating or reducing the non value added activities, the main categories of waste are identified and removed. Most of the researchers concentrate on lean manufacturing. Based on the above, this case study concentrates on implementing Line Balancing and Cellular Manufacturing.

III. CASE STUDY

A.Company and Process Background

Lean Manufacturing tool is planned to implement in a small scale industry for manufacturing paint brushes. This manufacturing process includes various processes like Mixing, Handle Making, Painting, Bristle Making, Assembling of Handle & Bristle and Packing Process. Among these various process it is identified that employee retainment is very less in the handle making process when compared to other process, and also based on safety and ergonomics of the product. Handle Making Process which includes various operations like Planning, Fitting, Polishing, Necking and Painting. Time study is conducted in the various operations in handle making process and the bottleneck cycle time and bottle neck machine was found.

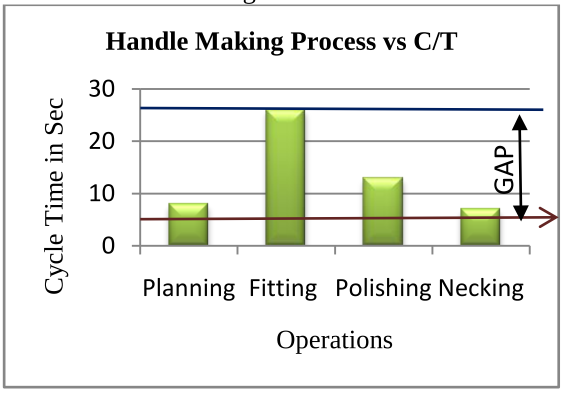
S No	Process	C/T	Bottle Neck C/T	Bottle Neck M/C	Demand	Capacity
1	Planning	8	26	Fitting	3800	3150
2	Fitting	26			3800	2008
3	Polishing	13			3800	969
4	Necking	7			3800	3729

The work is mainly concentrated to work on the gap between the demand and capacity. Line balancing and Cellular Layouts are the tools identified to improve the productivity in accordance to the literature survey.

B. Line Balancing

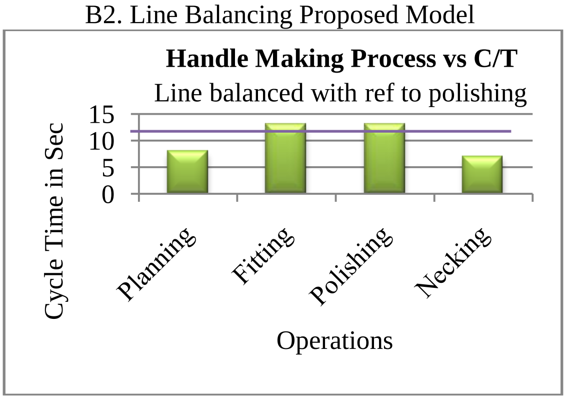
The line balancing tool is used to arrange the individual processing and assembly tasks at the workstations sothat the total time required at each workstation is approximately the same.If the work elements can be grouped so that all the station times are exactly equal, we have perfect balanceon the line and we can expect the production to flow smoothly.In most practical situations it is very difficult to achieve perfect balance. When workstation times areunequal, the slowest station determines the overall production rate of the line.

B1. Existing Model ProcessTime



In the above processes the maximum cycle time is occurred in the fitting operation. In order to balance the cycle time of fitting operation in the handle making process, Polishing operation cycle time 13 seconds is considered as a line for balancing other operations. This is achieved through step by step modification in the cellular layout of the process.

B2. Line Balancing Proposed Model



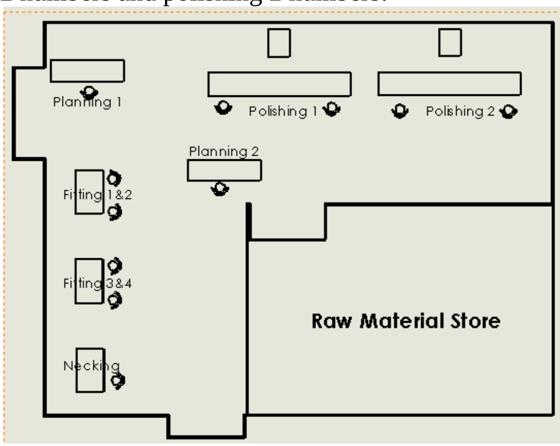
In the manufacturing process line it is balanced according to the cycle time of Polishing operation which greatly depends on the Number of operators, Number of machines, Available Space, Inventory, Operator Movement and cost. In this approach line balancing is achieved through modifying the current process layout.

C. Cellular Layout

Layout design and the flow of materials have asignificant impact on the performance of manufacturing system. These can help to increase productivity, reducework in process and inventory, short production lead time,streamlines the flow of materials, and reduces non valueadded activities from the production process of waiting andtransportation, which make the factory meet customers' requirement quickly. There are many types of layoutdesign in manufacturing system such as process layout,product layout and cellular layout. A cellularlayout is suggested for medium-volume and medium-varietyenvironment. This kind of layout is also appropriatefor both automated and non automated manufacturingsystems. It can be design based on Group Technology (GT).GT manufacturing offers several advantages which tendto improve productivity of a facility and reduce its operatingcosts, waiting time between process, machine setup time,distance and handling of work pieces, flow of materialsbetween workstations.

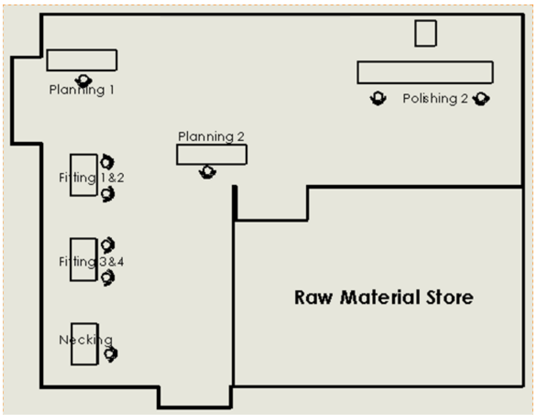
C1. Existing Cellular Layout

Manufacturing Layout shown below indicates the number of operators for the handle making process is 11 in the initial stage. And the number of machines used is fitting 2 numbers, necking 1 number, planning 2 numbers and polishing 2 numbers.



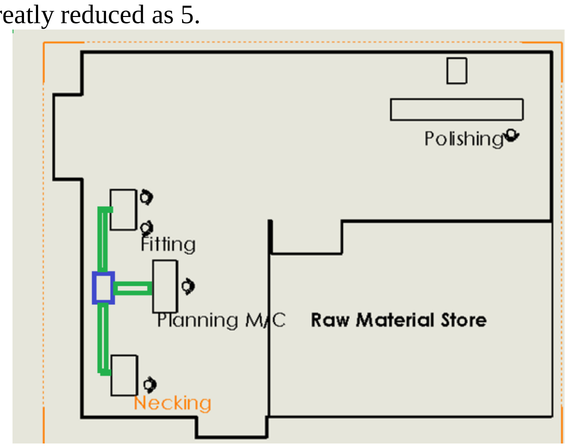
C2. Modified Layout I

First stage of modification is achieved by eliminating one polishing machine based on the time study, which also greatly reduces the inventory between the process and also effective utilization of operators. By eliminating one polishing machine the number of operators required has changed from 11to 9. This will automatically reduce the space utilization of machines.



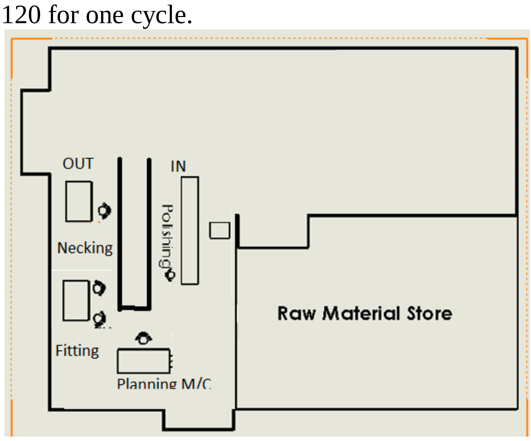
C3. Modified Layout II

In the second stage of modification a dust controller is used to prevent the employee from harmful working environment, which improve the employee retainment in the handle making process. And also a slight modification in the existing planning machine is done. In accordance to the time study on planning machine and fitting machine are eliminated further. In this modification the number of operators required is greatly reduced as 5.



C4. Proposed Layout

Proposed cellular layout is formulated by modifying the design in the planning machine which is also called as Breakthrough Machine. Also rearrangementof all the machines in the process layout in the form of U line, which greatly reduces the area utilization and also inventory in between the process as 120 for one cycle.



IV. RESULTS AND DISCUSSION

After the implementation of Cellular layout with the Breakthrough Machine it is identified that throughput of the Industry is increased with less inventory, Less Space in Material Movement,Reduction in total number of Machines, Less Number of Operators to meet the varying demand. And this implementation work is proceeded with step by step and the obtained results are satisfactory. And the future scope of the work is to implement lean principles in the other area.

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