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Lean Manufacturing Implementation Using One Piece Flow System For Productivity Improvementin Baritori Process

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Abstract :*Baritori is a process of debris or non-needed parts removal in aluminum diecasting product. The baritori process that is carried out today uses a manual process by relying on the capabilities and reliability of the operator. This study aims to analyze the baritori production process to get maximum output. In order to increase these productivities, lean manufacturing approach with One Piece Flow system is applied. One piece flow system implemented to achieve a short Cycle Time so that maximum output is obtained. This is done considering that the BRKT RR (DC) product every month has a high demand. Therefore, manufacturer need a system that is effective in achieving maximum output with high quality according to customer demand.Before the application of One Piece Flow, the output was 902 pieces, while after the application of One Piece Flow was 1332 pieces.*

Keywords - *lean manufacturing, one piece flow, productivity, baritori*

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I. INTRODUCTION

Productivity is a term in production activities, which means a comparison between the output and input. Productivity is a measure that states how well resources are regulated and utilized to achieve optimal results. Productivity can be used as a benchmark for the success of an industry in producing products. So that higher of the comparison means higher the product produced. Productivity measures vary depending on the aspects of output or input used as basic aggregates. Productivity measures include labor productivity index, direct cost productivity, total cost productivity, energy productivity, raw material productivity, and others.Productivity calculated only for good products. If a work center has a lot of defective items, the work center is not productive. These four steps in productivity (Measurement, Evaluation, Planning, and Improvement) have become the basis for increasing productivity.The productivity cycle is used as a basis for improving production problems, especially on an industrial scale.Some problems that cause a decrease in company productivity are; there is no productivity evaluation,delays in decision making by management, low motivation in employment, and the company is not able to compete and adapt to technological and information progress.Efforts to increase productivity require several indicators as an evaluation. One of them is Overall Equipment Effectiveness. The problem identification is done by Lean Manufacturingapproach.One approach of Lean Production is One Piece Flow. One Piece Flow is a production system or work done by completing one production process one after another. The opposite of One Piece Flow is a Batch system. Batch is to collect similar products which are then done in groups and after the group is finished the next group is run.Based on product sales data, it is known that the request for BRKT RR (DC) is quite high. Therefore, it is necessary to control the production output in order to maintain the supply of deliveries to customers. So that, its necessary to have an appropriate lean manufacturing process using the One Piece Flow method.The expected goals of this research areanalyzing the baritori production process to get maximumoutput.In order not to expand the problem to be studied, the following restrictions are made:

1. The assessment is intended as a proposed improvement in the production process.
2. Data processed is sales data for January 2017 - October 2017.
3. Daily production amount for BRKT RR (DC)

II. LITERATURE REVIEW

According to A. Heider & J Mirza in their paper, lean thinking originated from the Toyota Production System and inherited its concepts and methodology. In contrast to the Toyota Production System, the implementation of lean has been proposed in almost every domain of life. In the manufacturing domain, it is a common misconceptionthat lean is suitable for mass production only. S. D. Gobinath, S. Elangovan, and S.

Dharmalingam in their studies state that lean manufacturing is about eliminating waste and non-value added tasks. Examples of waste in manufacturing include overproduction, over-processing, waiting, unnecessary part movement, excess inventory, and defects, as applied to hardware production lean manufacturing focuses on eliminating all sources of waste by applying the following strategies such as One piece workflow, take time, and pull system. Lean identifies the bottlenecks in design and development processes that add unnecessary delays and cost. It can help create a more efficient system that reduces time to market without compromising on quality. According toP. Puvanasvaran, H. Megat, T. S. Hong, M. M. Razali, and H. A. Magid, Lean Process Management has proven to aid organizations in developing manufacturing and administrative management solutions and make the organization a leaner at the same time a 'fitter' one, achieving World Class standards in terms of production, quality, marketing, etc. R. B. Lopes, F. Freitas, and I. Sous explain that recent years have shown an increasing use of lean manufacturing (LM) principles and tools in several industrial sectors. Already a well-established management philosophy, it has shown numerous successful applications even outside production environments. M. E. Nenni, L. Giustiniano, and L. Pirolo research conclude that it is now widely accepted that Lean Management is of considerable benefit in manufacturing, so there is a growing interest in it among companies in the pharmaceutical industry. In their research, M. Manzouri, M. N. Ab-Rahman, C. R. C. M. Zain, and E. A. Jamsar found that large businesses around the world have been trying to reduce the total cost and wastes across their supply chain to remain competitiveness. Manytechniques and tools are important for reducing costs and wastes and for providing effective services for customer. V. Dave, A. Dixit, and A. Singh say that Lean Manufacturing was developed by Toyota Japan and is now widely practiced by many manufacturers in the world. Lean manufacturing is a systemfor identifying and decreasing waste through continuous improvement. Lean Manufacturing is done by flowing the product at the pull of the customer in pursuit of perfection. LM is important, especially because of waste reduction and decreasing in lead time. According to S. Neha, M. G. Singh, K. Simran, and G. Pramod, Lean manufacturing is a plethora of principles that focus on cost reduction by identifying and eliminating non-value added activities. The fiercely globalized and competitive markets of 21^{st}-century demand for increasing high variety of products at reducing cost, lesser lead time and perfect quality. This changing scenario calls for a new manufacturing that would enable them to compete in this competitive globalization market. According to K. Dharma Reddy, M. Bhupal, G. Chiranjeevi Naidu, one of lean manufacturing tool, line balancing, can be used to improve productivity. This tools worked by reducing non added value activity in assembling line.

In his research, Marton conclude that one piece flow is a system used to manufacture components in a cellular layout. The cell is an area where everything that is needed to process the component is within easy reach, and no component is allowed to go to the next process until the previous process has been finished. The aims of onepiece flow are: to make one component at a correct time all without unplanned interruptions and without long queue times. E. Wołowiec-korecka, M. Korecki, W. Stachurski, and P. Zgórniak conclude that the majority of limitations and shortcomings of traditional heat treatment can be related to its batch nature. In order to open new perspectives it is necessary to remove this factor and replace it with the opposite one, that is, the one-piece flow model. P. Bagal, S. Sane, and V. Karandikar found that a comprehensive methodology is adapted to analyze and improve productivity systematically. A line survey was conducted to estimate the line imbalance. This is followed by the identification and removal of rubbish and barriers to balance the line and optimize the use of resources. Modifications in the layout are implemented to switch from batch system and queue to single-piece flow. B. G. Rüttimann and M. T. Stöckli inform that in addition to the ideal Lean interpretation boiled into the limited concept of Muda and Kaizen, the classic representation of the "temples" Toyota Production System (TPS) often leads to the interpretation that Lean is a toolbox who can choose what is called a free tool. By choosing some tools, however, it is full Potential polling stations certainly cannot be exploited and in the worst case - can even lead to spending nuisance. R. Parthipan, A. Jenith, and V. Nirmalkannan say that Lean Manufacturing is based on continuous improvement philosophy. A method is adapted to analyze and influence productivity. Layout changing, from batch to single flow, are effectively reduce queue. It is necessary that the next generations of production lines, especially the assembling devices, have to be designed more adaptable. According to H. Tokola, E. Niemi, and V. Vaisto, the philosophy of making skinny includes several methods that aim to eliminate waste. The general method in this paper is the type of flow value mapping and work model in different processes. Exploration analysis is carried out to reveal the relationship between methods and types of results. This is done using analytical analysis.

S. Lee, C. P. Liu, T. J. Fan, and Y. Chen conclude that burrs are thin ridges, usually triangular, that develop along the edge of a workpiece during various manufacturing operations such as machining, trimming, forging, and casting. Burrs can lead to noise, unsafe operation of a machine, produce friction and wear in the moving parts, and may reduce the fatigue life of components. Although deburring technology is used in precision manufacturing and high-quality machining, deburring is still considered a difficult problem. Precision parts require care to achieve precise dimensions and surface quality and in subsequent finishing operations. Deburring and edge finishing typically receive little attention from designers and manufacturing engineers.

According to A. Okada, H. Yonehara, and Y. Okamoto, in the manufacturing site of industrial products, burr often generates at the edge of parts by metal removal processes, such as cutting, milling, grinding, EDM, laser machining, as a result of plastic resolidification or deformation of the material. The burr would lead to bad influence on the subsequent process, or the deterioration in product quality, function, and appearance. H. Puga, J. Barbosa, D. Soares, F. Silva, and S. Ribeiro informed that presently most of the aluminum castings are sold as ready to use components and functional parts, with high added value, after severalmachining operations, which are usually carried out inmachine shops inside the foundry companies themselves. Machining operations usually generate considerable amounts of waste in the form of chips (usually 3–5% of the casting weight). According to P. K. Rai, A. Mohammad, and H. Z. Jafri, burr formation is a common metal sheet defect and Burr/deburring control is an important problem for industry and engineers. It is manufactured in all cutting & cutting operations. In the sheet metal section of the thorn is usually but after a certain limit is needed a damaged form. This leads to repeated work and part quality problems.

III. METHODOLOGY

This research was carried out in many stages. The first stage is data collection. There are two types of data used, namely primary data and secondary data. Primary data is recorded as tact time, while secondary data is sales data from January to November 2017. The second stage is data processing and analysis. Data processing is done by calculating cycle time. The cycle time calculated is the cycle time batch flow and cycle time one piece flow. Data analysis is done by comparing the cycle time batch flow and cycle time one piece flow. Furthermore, the output comparison between batch flow and one piece flow is carried out. The third stage is the implementation of One Piece Flow. The step in implementing one piece flow is to determine the product group that will enter the One Piece Flow process, calculate Tact Time, determine the equipment needed, make a slim layout according to the 5S principle, and determines the number of operators needed.

IV. RESULT AND DISCUSSION

The first step in implementing the One Piece Flow flow cell determines the product group that will enter the One Piece Flow process. In order for the process to run correctly and output optimally, the company must be able to set a high output for each individual, or a short Cycle Time. The next step is to calculate Tact Time for the product that will enter the process. Tact Time is a measure of customer demand expressed in units of time and calculated as follows:

Tact Time = Available work-time per shift / Customer demand per shift

Next, determine the equipment needed to carry out the One Piece Flow process and determine whether the equipment used meets the need to carry out the process.After determining the suitable equipment to use, the next step is to make a slim layout using the 5-S principle. The layout design of inter-process spaces in One Piece Flow flow cells must be limited. The purpose of the restrictions is to eliminate movements that are not needed and to prevent unwanted accumulation of WIP.Next step is determine how many operators will be used in the process cell with the following formula:

Number of operators = Total work content / Tact Time

For comparison, the One Piece Flow and Batch illustrations are as follows :

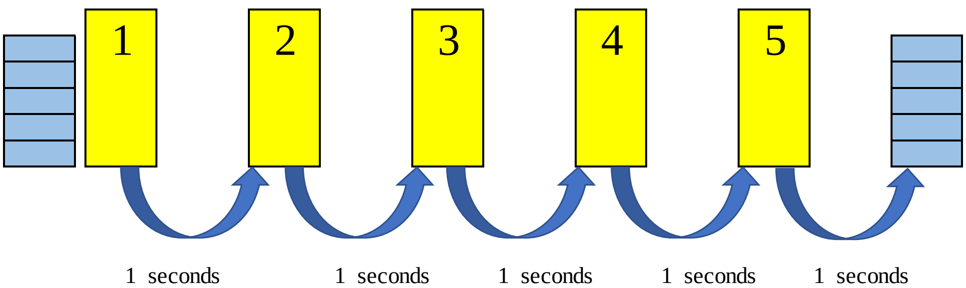

Figure 1: One Pice Flow

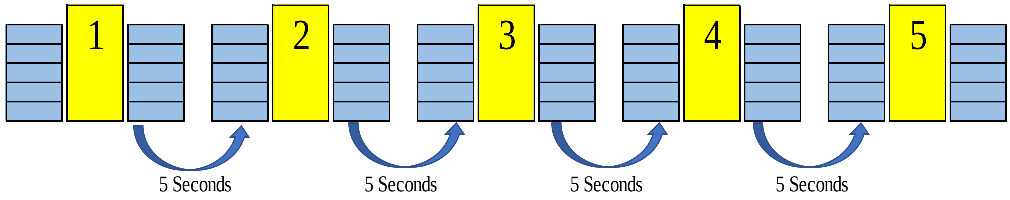

Figure 2: Batch Flow

Using One piece flow method, the first product is obtained in 5 seconds.However, using batch flow, the first product is obtained in 5 seconds. From the research, the BRKT RR (DC) product request data was obtained from January to November 2017. This data shown at following Table.

Table 1: Sales from January to November 2017

No	Month	BRKT RR (DC)		
		QTY	Delivery/day	T. Day Delivery
1	January	64.000	5.000	13
2	February	57.000	5.000	11
3	March	60.000	5.000	12
4	April	49.000	5.000	10
5	May	66.000	5.000	13
6	June	25.000	5.000	5
7	July	35.000	5.000	7
8	August	16.000	5.000	3
9	September	77.500	5.000	16
10	October	70.000	5.000	14
11	November	32.000	5.000	6

From the data, calculate the Cycle Time using the Batch and One Piece Flow methods and obtain the following data:

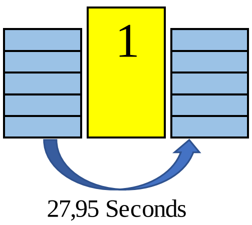

Figure 3: Batch Cycle Time

By using Batch Proces, for one product, it takes 27, 95 seconds.With simulation calculations using a batch output produced within 1 shift or 7 working hours produces the following output:

Working Hour/Shift = 7 x 60 x 60
= 25200 seconds
Production output = 25200 / 27,95
Batch = 902 pcs

Using One Piece Flow, calculate how many operators are needed to create a One Piece Flow system by knowing the Tact Time. To calculate Tact Time we use the formula below:

Tact Time = Available work-time per shift / Customer demand per shift

From the formula above, the input values are as follows:

Tact time = Available work time per day /
Customer demand per day
Tact time = (7 x 3600) / 5000
= 5,04 Sec

Next, to calculate how many operators are needed, use the following formula:
Number of operators = Total work content / Tact Time

Furthermore, to calculate the number of operators in one line based on the formula above are as follows:
Number of operators = Total work content /
Tact Time
Number Of Operator = 23,97 / 5,04
= 4,76 Operators
= 5 Roundup

So, the amount needed for one line is 5 people. One Piece Flow can be illustrated in the following line :

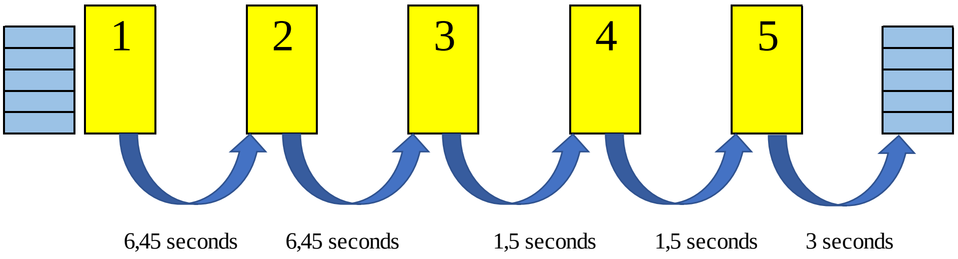

Figure 4: One Piece Flow Cycle Time

From the picture above, the time for each station is obtained as follows:
1. Station one: 6.45 seconds
2. Station two:6.45 seconds
3. Station three: 1.5 seconds
4. Station four:1.5 seconds
5. Station five (checking and packing): 3 seconds

Cycle Time needed to complete one product as a whole is 18.9 seconds, this calculation is faster than using a Batch system.Whereas for One Piece Flow when simulated the output produced within 1 shift or 7 working hours produces the following output:

Working Hour/Shift = 7 x 60 x 60
= 25200 seconds
Production output = 25.200 / 18,9
One Piece Flow = 1.333 pcs

As for the application of the layout for One Piece Flow can be seen in the picture below:

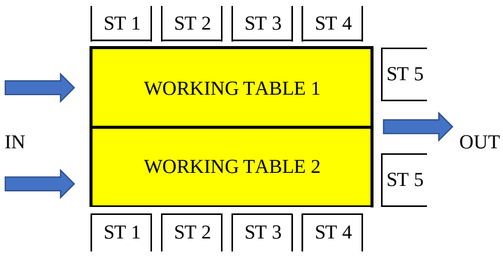

Figure 5: Layout Working Table One Piece Flow

V. CONCLUSION

One Piece Flow is one of the keys in the Lean Manufacturing concept. The main advantage when applying One Piece Flow is to increase safety, with One Piece Flow we don't need to lift heavy containers. On the contrary, in a batch system, the risks are high because the operator must lift the goods in large and heavy quantities. The next advantage is to build quality, when we make one and move one defect detected immediately and make the operator able to take corrective action immediately and the next product is no longer defective. Another advantage is increasing flexibility, increasing scalability, reducing inventory, increasing productivity, simplifying filling reset raw materials, clear the workspace, make kaizen rooted, and increase enthusiasm.

Increased productivity is achieved by applying the concept of One Piece Flow is a more cycle time so that the resulting output becomes more increased. Before the application of One Piece Flow, the output was 902 pieces, while after the application of One Piece Flow was 1332 pieces.

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