

Capacity Utilization In Rocker Shaft Cell, Through Single Piece Flow

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Abstract— Maximization of production with zero or very less wastage is one of the main concern of lean production implementation. Batch production is one of the out dated and less productivity production type still being followed in many industries. Attempt has been made for the implementation of lean tools such as single piece flow, kaizen and layout designing, after the observation of six months in a tractor steering gearbox manufacturing industry. The primary and secondary rocker shaft assembly of the tractor steering gearbox is manufactured in this cell. The cell redesigning done is mainly concentrated on the reduction of cycle time, distance between each machine and flow of materials. This paper also discuss the multi-skill working and before and after effect of implementation of SINGLE PIECE FLOW.

Index Terms—Cell design, Single Piece Flow, Multi-skilled working, Rocker shaft, Kaizen, layout.

1. INTRODUCTION:

Flow of materials in continues manner from the initial stage to the completion of the finished goods with the maximum utilization of the available capacity. They are labor power, equipment's or machineries available, resource, capital and techniques. In this paper, the study of an automotive industry which manufactures rocker shaft rod for the tractor gearbox assembly is been carried out for six months. The various problems faced in reaching the customers demand are tracked and noted down. Switching from batch production to single piece flow production system and the different changes carried out to support the single piece flow system are put into light.

2. LITERATURE SURVEY:

Luoyan hu.et al. One piece flow or single piece flow is one of the effective tool of Lean. In this paper, a well-known garment processing enterprise is been considered and one year of tracking and research work has been carried out. Pre-production preparations like U-shaped hanging line, templates, controllers and Warning lights. Software preparations such as process monitoring software, evaluation system, required software and skilled operators. Staff preparations like expertise skills, training regarding skill of implementation and changes to be made. Management system is sound or not matters more for SPF to be benign (friendly) mechanism. Implementation of lean tools like one piece flow or single piece flow plants resulted in achieving targets, time quantitative, energy conservation, market demands etc. To achieve the one piece flow or single piece flow Pre-Productions, efficient software's, wage systems are the essentials. For standardization and implementation, training regarding lean system, multifunctional skills and rhythmic working, friendly environment, mutual assistance, encouragement for suggestions and innovations are very supportive. The culture of lean implementation and single piece flow will surely result in increase in productivity, good social environment

and high quality products at the same time.

Mohammad NorzaimiCheAni. The paper highlights the case study of a newly constructed one piece flow technique implemented by an electronic assembly factory as the assembly process. Production of required units in the required quantities at the required time is described as Just-In-Time (JIT). The aim of implementation of single piece flow is nothing but JIT. That is to meet the customers demand at required time with required quantity and quality. In this paper we can see the clear difference between batch production and one piece flow with respect to time and One piece flow or single piece flow has achieved in decreasing manufacturing lead time, less inventory and improve the customer satisfaction.

Michael Marton.et al. Single piece flow also commonly known as continuous flow manufacturing is a method used in a cellular manufacturing environment. The difference between the “batch and queue manufacturing” and “single or one piece flow manufacturing” in clearly shown in this paper. The other requirements to achieve single piece flow like consistently working machines, repeatability in process time, availability of equipment and other time limitations are been put into light. Practical and theoretical knowledge about one-piece flow is described in this research. Advantages and disadvantages of the single piece flow and how increase in efficiency can be achieved are clearly shown. This will reduce inventory levels, reduce manufacturing lead time, and improve customer service levels.

M. Mat Salleh.et al. The term “lean” was the Japanese concept and had been used in avoiding or reducing the different types of wastes in the industrial sector. In this case study of automotive company, U-shaped layout design for single piece flow has been implemented which encourages good visibility of flow of materials and decreases

non value adding works like rework, motion, processing, inventory, overproduction and transportation.Reduction in motion of the operators with in the cell has been observed after implementation of U-shaped layout compared to old layout design. As the result, it will decrease the tiredness of the workers, multi working can be implemented and company gains more profits in the future.

Vladimír Modrák. The case study is on the methodological aspects of cell design for transformation production process. Redesigning of the cell is mainly focused on optimization of material flow and the techniques were focused on methodological procedures on the aim to build single piece flow production. Case study was conducted at a bicycle components manufacturing company and concentrated on conversion of batch production to cellular manufacturing. This paper deal with the application of SPF or One Piece Flow by applying principles of product/ quantity (P-Q) analysis and production flow analysis. Presented change in production process is viewed as one of the way of optimization of material flows by changing production layout. Transforming of the production layout to 6 lines led to improvement in economic conditions of the company.

3. CASE STUDY:

Batch production is one of the widely used production technique, where number of materials or in batches are processed at intermittent time intervals. Achieving of just in time is one of the main reason for one piece flow production system. Production of required units in the required quantities at the required time is known as just in time. The rocker shaft cell of tractor steering gearbox manufacturing company, running the batch production is being considered for the case study. Primary rocker shaft and secondary rocker shaft are been manufactured, which are later fitted inside the steering gear box. These two individual rocker shaft parts go through different mechanism or machines to become individual finished products. The primary rocker shaft as an raw cast moulded material go through the facing and centering initially, later long barrel turning, short barrel turning, thread rolling, U-boring, reaming, drilling, tapping and ball peg operation, spline hobbing and the gear shaping operation is being done. The below figure show the flow of primary rocker shafts.

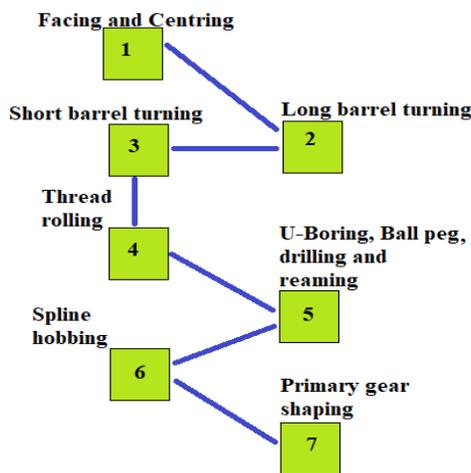


Figure 3.1: Flow of Primary Rocker Shaft

Likewise, secondary rocker shaft also pass through facing and centering, long barrel turning, short barrel turning, thread rolling, spline hobbing and at the last the gear shaping operation is carried out. The flow of Secondary rocker shafts are as shown in the below figure.

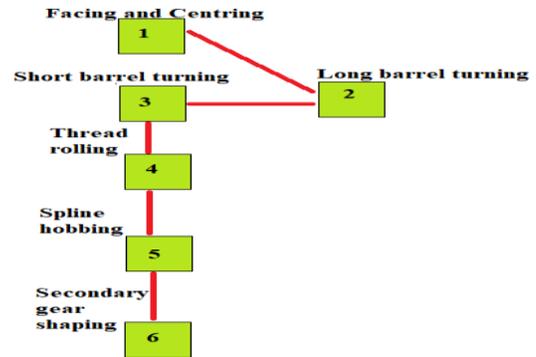


Figure 3.2: Flow of Secondary Rocker Shaft

3.1 Batch production:Batch production is a widely used type of production system in manufacturing industries. Batch production has its own drawbacks such as building up of inventories, large amount of non-value added works involved and more work space occupying for storage and fluctuating cycle time.

The below figure show the work sequence and layout of rocker shaft cell. Each machine has individual operators and therefore totally 8 operators are engaged. The blue line shows the flow of primary rocker shaft from first operation to last operation. The red line indicates the flow of secondary rocker shaft in its sequence of operations. Primary and secondary rocker shafts both pass through five same operations; they are facing and centering, long barrel turning, short barrel turning, thread rolling and spline hobbing. We can see in the below figure, that the primary rocker shaft is moved for another operation after thread rolling and later it comes back to spline hobbing in a batch and waits for its turn. Till then the shaping machine is left idle. The overall cycle time taken for the completion of 114 rocker shafts (57 pieces primary and 57 secondary) are 32 hours 30 minutes. After completion of each operation, batch of 114 rocker shafts wait for 1hour before going to the next operation, also occupying extra storage space between each machines and inventory is built up.

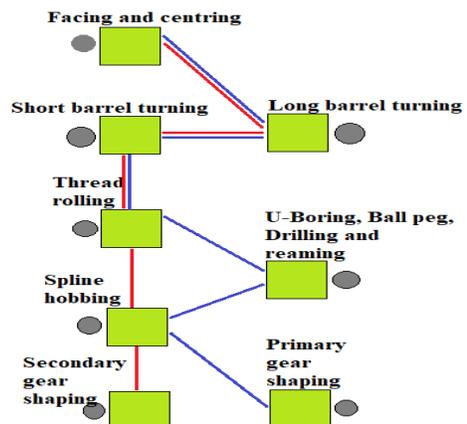


Figure 3.3: Batch production layout

3.2 Single Piece Flow production:Lean manufacturing is one among the on trending topics in the field of production industries. It has always been helpful in overall growth of a company by making changes in the production lines. Flow of semi-finished materials or raw materials through different processes in a continuous manner till they become finished products are known as single piece flow. Single piece flow production is more advantages compared to batch production and it clearly shows the difference between the batch production and single piece flow production system in the case study carried out. Single piece flow results in decreasing the non-value added works like un-necessary movement of workers, excess manpower and to meet the customers demand and zero inventory.

4. PROBLEM IDENTIFICATION:

- Less productivity due to batch production and not able to meet the customer demand on time.
- Utilization of more man power leading to different types wastes.
- Utilization of more work space due to inventory building up.
- Overall productivity improvement.

5. ACTION PLAN:

- Conversion of batch production into single piece flow production by Layout redesigning.
- Achieving multifunction working in labours.
- Working on lean tools like kaizen, 5s, poka yoke to support the smooth working of the single piece flow assembly line.

5.1 Improvements carried out:

The new U-shape assembly line designed has reduced the excess manpower with multitasking. The flow of materials is continuous till all the operations are carried out. The spline hobbing operation which has to be carried out for both primary and secondary rocker shafts is relocated. The idle time and other waste of time during the production are minimized. In single piece flow assembly lines, the time taken to complete 144 rocker shafts is 18 hours. This helped the company to meet the customer’s demand of 114 rocker shafts per day. The below figure represent the new layout design and the flow of primary and secondary rocker shafts.

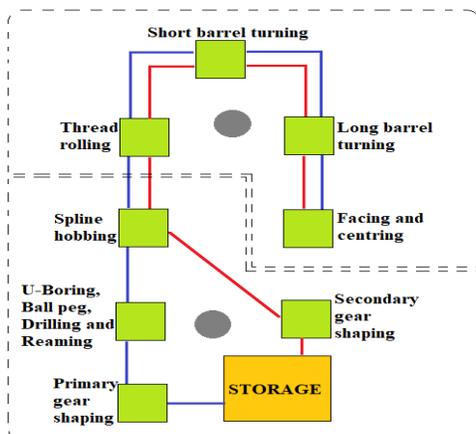


Figure 5.1: New layout redesigned for Single Piece Flow

6. RESULTS AND DISCUSSION:

The newly designed U-shaped layout has resulted in single piece flow production of rocker shafts and reduction of manpower from 8 operators to 2 operators in a cell, zero inventory and minimize other wastes like overproduction, un-necessary movement of operators, transportation. The single piece flow saved 14.5 hours during the production of 144 rocker shaft demand per day. Lean tools like kaizen and 5s to support the smooth working of single piece flow were put into light. The main advantages of U-shaped assembly line layouts are reduction of different types of wastes such as waiting time, transportation, rework, inventory, and over production.

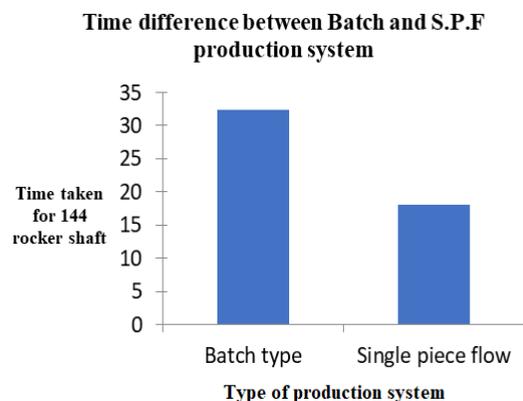


Figure 6.1: Graph for time difference between Batch and Single Piece Flow

The graph shows the time comparison between batch type production and single piece flow type production.

7. CONCLUSION:

In the research and survey carried out, most of the researchers agreed that the capacity available like man, machine, material, money and method utilization can be maximized only by single piece flow system in the industrial lines and demand can be easily fulfilled. This helps any company to compete with other companies in the market. This paper also shows the importance of single piece flow in the Production industry. The multitasking has led to reduction of excess laboring problems and other supporting systems like kanban, 5s and Standardization are put into light.

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REFERENCES

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1. Luoyan Hu 1, YaruHuo 1, Changqing Jin 2, Yan Zheng 1, QianZheng 1, YanyanXu 2. One-piece Flow Implementation Research in the Garment Enterprise. Advanced Materials Research Vols 655-657 (2013) pp 2352-2357.
2. MohdNorzaimiChe Ani¹. THE EFFECTIVENESS AND IMPACTS OF ONE PIECE FLOW MANUFACTURING TECHNIQUE INTO MANUFACTURING INDUSTRIES.3rd International Conference on Engineering and ICT (ICEI2012) Melaka, Malaysia.
3. Michal Marton, MSc. Eng., IvetaPaulová. ONE PIECE FLOW - ANOTHER VIEW ON PRODUCTION FLOW IN THE NEXT CONTINUOUS PROCESS IMPROVEMENT.
4. VladimírModrák. Case on Manufacturing Cell Formation Using Production Flow Analysis. World Academy of Science, Engineering and Technology 25 2009.
5. M. Mat Salleh¹, M.Z.M. Zain.The Study of Lean Layout in an Automotive Parts Manufacturer. 2011.