Productivity Increase on Manufacturing Line A

Maria Victoria Grant Tejada
Advisor: Dr. Héctor J. Cruzado
Master of Engineering Management Program

Abstract

In a company that shall remain anonymous, Manufacturing Line A was underperforming, often falling back in orders. The company decided to put in place a project to look at increasing productivity in this high-mix low volume assembly line. After conducting an analysis of historical data, the high runners were selected for the redesign of the assembly line. Time studies were conducted to identify areas of opportunity, and employee interviews took place. Besides increasing productivity, reducing any potential risks was also considered while evaluating the assembly line. The redesign took place and post-implementation time studies were conducted to validate the increase in productivity. It was demonstrated that the daily output will increase by 47% if the proper mix of designs are in the schedule. In addition, three risk reduction projects were implemented.

Introduction

The area under study will be referred to as Manufacturing Line A, where various designs of motor manual starters are produced. Every operation is manual and there are no machines involved. This line is constituted by one press and four different riveters. Manufacturing Line A was evaluated because it was a very inefficient line, with no clear labeling of components. When employees were working in batch production, if a mistake was made at one step of the process multiple units needed to be reworked. This line was often found to be in back order and safety concerns were also present. This line needed to be evaluated to be able to increase the daily output, meet demand, and ensure profit.

Background

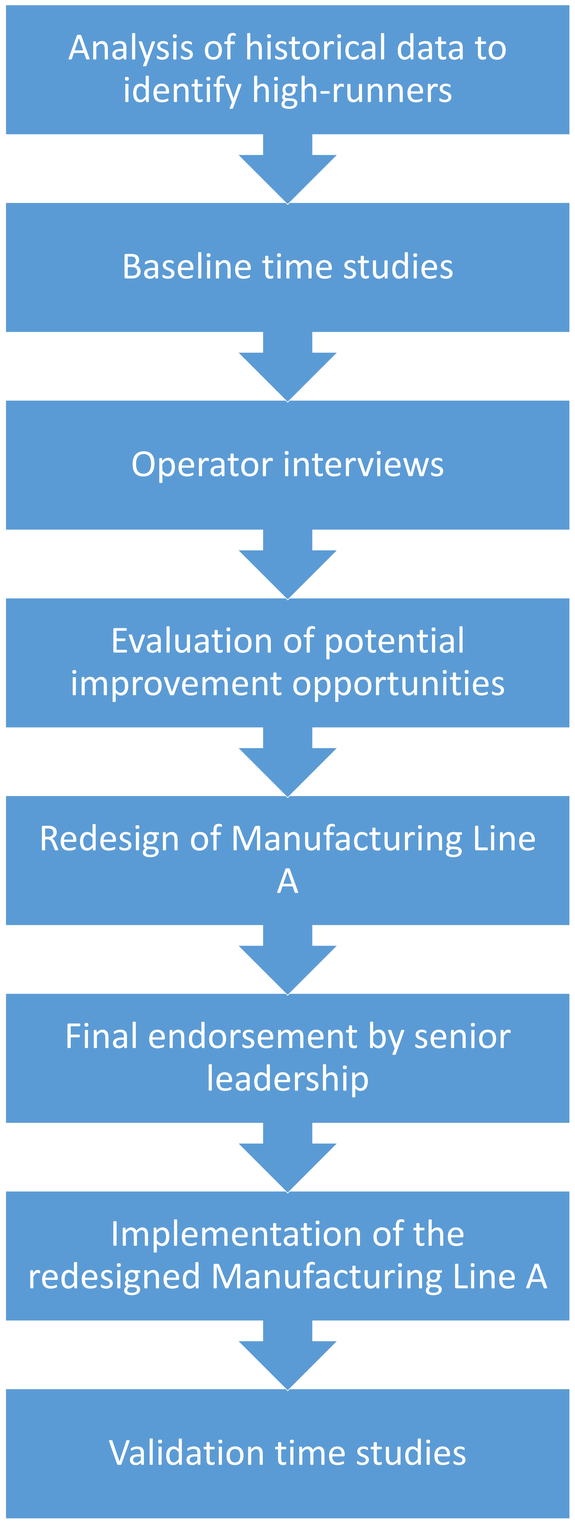
Many companies look at increasing productivity to reduce manufacturing costs, increase revenues, and ensure customer satisfaction. There are often key players that sell similar products and companies need to be creative to remain relevant in the field and maintain market share against competitors. Once concept that is often utilized in different industries is Lean Manufacturing. This concept has as a main purpose the creation of value in the manufacturing process by eliminating those activities that customers are not willing to pay for. When evaluating the manufacturing process, it is important to understand what activities add value and what activities don't add value. Time studies are often performed to determine what the process cycle time is, from these time studies, activities can be classified under value added vs non-value added.

A concept that companies often evaluate when looking at increasing productivity is how their manufacturing processes are built. The two major options are batch production and one-piece-flow. Depending on the duration of each step of the process, and how complex the manufacturing process is, companies may benefit from one or the other. When going into a productivity increase project, it is important to also include the human aspect to the process. Typically, employees show resistance to change because they are afraid of the unknown and there might be misunderstanding of why things need to change and what the potential repercussions are.

Problem

The intention of this project was to increase productivity of Manufacturing Line A to fulfil late orders and ensure new orders can be fulfilled on time. In addition to this, risk reduction projects were to be implemented if risks were present in the assembly line.

Methodology



Analysis

The first step in the analysis phase was to analyze historical data. This analysis would be the baseline to determine the high runners of Manufacturing Line A since this is a high-mix low-volume assembly line. Table 1 demonstrates that the high runners for this assembly line are Design 1, Design 2, and Design 3.

Table 1
Analysis of historical production data

Product Mix	Quantity	Daily	Production %	Cumulative %
Design 1	1991	8	38.95%	38.95%
Design 2	1984	8	38.81%	77.76%
Design 3	431	2	8.43%	86.19%
Design 2A	414	2	8.10%	94.29%
Design 4	292	1	5.71%	100.00%

Based on the analysis of historical data, time studies were conducted for assembly designs 1, 2, and 3 for which activities were categorized as value added (VA) and non-value added (NVA). The results from this time studies are shown in Table 2. It can be noted that the percentage of time spent on NVA activities is greater than the percentage of time spent on VA activities.

Table 2
Time studies results (NVA vs VA activities)

Product	Total Time	NVA	%NVA	VA	%VA
Design 1	1425.2	978.3	69%	446.8	31%
Design 2	1673.1	1128.2	67%	544.9	33%
Design 3	1794.3	1180.6	66%	613.7	34%

Results and Discussion

The new proposed design showcases a cell style assembly line where production will be done utilizing one-piece flow, standing operations, and having parts of the process done in each of the stations. The process will flow from station 1 to station 7 and can be executed by one or two operators. For one operator, this person will complete the full manufacturing process. For two operators, the second operator will start processing when the first operator is on station 5 and both operators will complete the full process for each unit. The rational for this is based on the standard time it would take for the operators to complete the process for each station.

This design also allows for a reduction of inventory present in the manufacturing line, where only components required will be present in each of the stations, with a 2-bin Kanban system to trigger when the warehouse replenishes without ever having to wait for components.

After implementing the new design for Manufacturing Line A, a post-implementation time study took place to validate the increase in productivity. Table 3 shows the results of these time studies. With this new design of assembly line, for all designs the operators will be spending more time on VA than NVA activities. The output per day is expected to increase to 40 units per day when the line operates with two employees following the suggested mix per day.

Table 3
Post-implementation time studies results

Product	Total Time	NVA	% NVA	VA	% VA	New Daily Output
Design 1	764.9	318.1	42%	446.8	58%	15
Design 2	957.3	412.4	43%	544.9	57%	15
Design 3	1058.8	445.1	42%	613.7	58%	4

Conclusions

The redesign of Manufacturing Line A was proposed because this line was often in backorder and often rework was being performed. There was a need to increase productivity in addition to reduce safety risks. With the implementation of this project, productivity of Manufacturing Line A has been increased by 47% and three risk reduction projects have been implemented to avoid ergonomic concerns and potential injuries.

During this project, it was instrumental to include the operators in the process of the redesign of Manufacturing Line A. Including the operators in the process helped with ensuring they were aligned with the new design of the assembly line, and they felt valued. At the end of the day, they are the ones that must perform the operations daily and need to feel comfortable with the process. For this project to be successful, it was required that multiple departments aligned on the timelines an ensured the required support was available, everyone made this a priority and the weekly meetings that were held to share progress and upcoming activities were a good way to ensure the project would not get delayed.

Acknowledgements

- Dr. Hector J. Cruzado
- Process Improvement Department
- Manufacturing Managers
- Operators
- Site Leadership

References

1. Tanasic, Z.; Janjic, G.; Sokovic, M.; Kusar, J. *International Journal of Simulation Modelling (IJSIMM).* Mar2022, Vol. 21 Issue 1, p77-88. 12p. DOI: 10.2507/IJSIMM21-1-589.
2. Bon, Abdul Talib; Samsudin, Siti Nor Aini. *Proceedings of the International Conference on Industrial Engineering & Operations Management*, 3/6/2018, p284-291, 8p
3. Lee, Quarterman. *ISE: Industrial & Systems Engineering at Work.* Aug2020, Vol. 52 Issue 8, p44-47. 4p.
4. Metz, Maria. *Ovidius University Annals, Series Economic Sciences.* 2021, Vol. 21 Issue 1, p611-620. 10p.