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PRODUCTIVITY IMPROVEMENT IN MANUFACTURING UNIT ANALYZING PRODUCTION MACHINES AND FACILITIES

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ABSTRACT
The main aim of this analysis is to improve layout in a manufacturing unit with clear focus on improving productivity. An effort is made to study the entire layout design of production line right from raw materials stage until finished product output and redesigned layout after thorough analysis of data in line with software simulation techniques. The project study is carried out at Gears manufacturing company in Dewas. Its aim is to cater growing needs of the axle gear market for cars, trucks, and tractors. Arena software used is a simulation environment consisting of module templates, built around SIMAN language constructs and other facilities, and augmented by a visual front end.

1. General
Line performance depends on many factors. Such as: Cycle time, No of stations, Traffic problems, Station space, Transportation networks, Communication among the groups, Task complexity, Reliability. Different kinds of wastes in a process can be categorized, these wastes reduce production efficiency, quality of work as well as increase production lead time. Major wastes are: overproduction, waiting, unnecessary transport, over processing,excess raw material, unnecessary movement, defects, unused employee creativity.

2. Literature review
Korrakot Yaibuathet Tippayawong, Thitima Prapasirisulee, (2012). The objective of this study is to improve productivity of a furniture manufacturing company. Motion and time study, process analysis and plant layout design were used as tools to improve the process. Simulation was carried out to evaluate the designed layout. Initially, production process was analyzed to evaluate process operation time. **Soroor K. H. Al-Khafaji, (2012).** The aim of this research is to study the effect of the shift from the traditional style of production to the application of modern techniques of lean in one of the old Iraqi industries to improve the flow of production and demand processing by reducing line intersections with optimal usage of available facilities. Value stream mapping, (VSM) have been used to represent the production flow line. ARENA software has used to develop the simulation models, with applying pull system of lean tools for the modified status instead of the push system that has used in the traditional style of production. **Dara Schniederjans and Marc Schniederjans, (2015)** This paper seeks to address the relationship between social and technical quality management with innovation. Moreover, this paper empirically assesses contingency factors including organization size, task and managerial ethics which play roles in moderating the relationship between quality management and innovation. **Bobby John, Jenson Joseph E, (2013).** Attempt is made to simulate the factory layout using the software ARENA (student's version). Utilization of each machine is calculated.**Maniveluralidaran V, Sandeep D**, **2014**, The aim of this project is to find out most efficient arrangement of machines in the machine shop that will improve the efficiency of workflow in the shop floor allowing workers and equipment being more productive. **Kishore B. Lad, Dr. A. P. Kedar, Milind M. Urkudkar, Pooja B. Bijwal, (2014).** The objective of this study is to understand and improve the productivity by applying kaizen methodology in the industry.Research work has been carried out to evaluate the designed plant layout. Initially, production process was analyzed through time study. The new layout result was compared with existing layout result and shows an improvement of productivity. **Vivekanand Gogi , Rohith D , ShashiKiran K , Suhail M Shaikh, (2014)** This research paper aims to study and improve the current plant layout and are analysed&

designed by using string diagram. An Attempt is made to simulate the current and proposed factory layout by using ARENA software. Efficiency of the current & proposed plant layout are calculated.

3. Industrial Problems Identified

- The main problem noted while visiting industry is weak industrial study and engineering. The lead time observed is too high to handle or bear with respect to cost and resources utilized.
- Bottlenecks in plant layout and in sequence of operation are noted, Frequent and continuous basis breakdowns which are affecting productivity at high extent in present existing working culture.
- Check points in plant layout are improper and are required to control ongoing process. Machines waits for long time due to improper plant layout, raw material handling and inline inventory is poor.
- Plant layout understanding is poor and operators have no standard procedure and null awareness to new technologies and working procedures. Tools and equipment's are not well placed so that operator or maintenance person can respond immediate to online problems.
- Software skills and approach is absent among management and frontline engineers which is one of the biggest reason for fail to understand and rearrange process which is traditionally used and practicing.

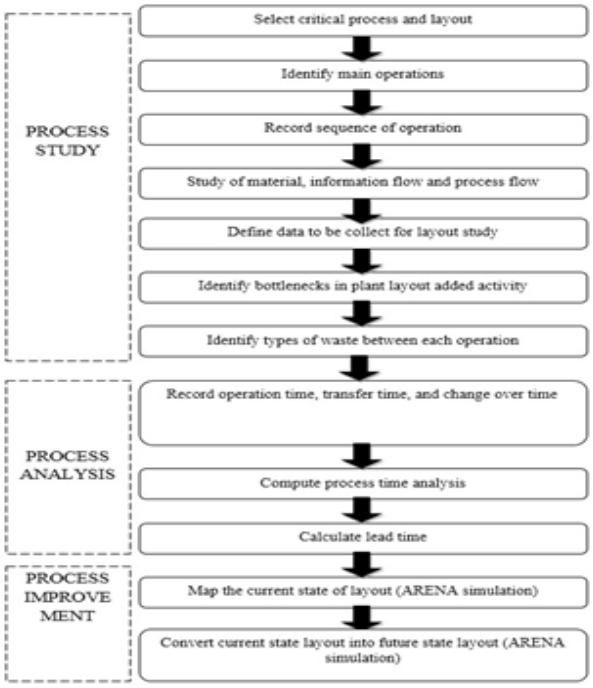

Figure 1: Flow chart of Plant layout improvement method

4. Data Collection and Analysis

The operators are interviewed for the causes of delay, they told that there is a tool room which is distinct from the shop floor and the control of tool room is in hands of separated department named as tool room. One more factor that was pointed and raised by operator is material and store problem, the operators are facing problem of issuing in time material and tools to conduct smooth, fast and continuous working to achieve higher productivity.

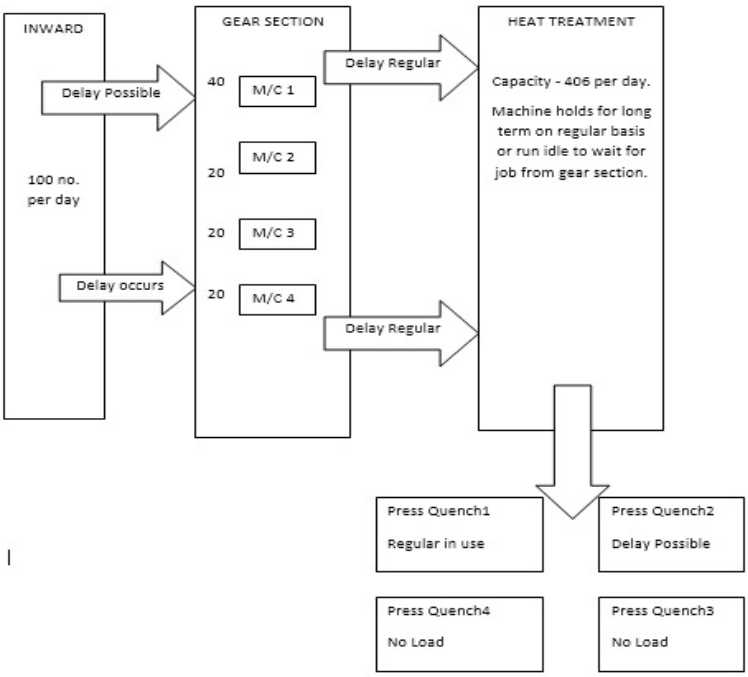

Figure 2: Material Flow in Plant

Table 1: Delay Record Table (Existing Process)

Day Sr. No.	Start time	End time	Observation time	Preventive Shutdown	Scheduled Preventive + Lunch/Tea Break Time	Tool Re-Sharpening time	Miscellaneous. Tool Shortage / Maintenance	Store delay / new tool / raw material	Unscheduled Delay
1	9AM	5PM	480 min	-	60 min	90 min	35 min	-	125 min
2	9AM	5PM	480 min	30 min	90 min	90 min	-	20 min	110 min
3	9AM	5PM	480 min	-	60 min	-	30 min	35 min	65 min
4	9AM	5PM	480 min	-	60 min	90 min	20 min	50 min	160 min
5	9AM	5PM	480 min	30 min	90 min	-	45 min	40 min	85 min
6	9AM	5PM	480 min	-	60 min	90 min	40 min	-	130 min
7	9AM	5PM	480 min	-	60 min	90 min	30 min	-	120 min
		Total	3360 min	60 min	480 min	450 min	200 min	145 min	795 min

Table 2: Productionvs Rejections (Existing Process)

Day No	Total Production	Total Defects
1	43	3
2	48	3
3	52	5
4	39	2
5	50	3
6	42	4
7	44	3

Total	318	23

4.1 Plant Performance Analysis (Existing Process)

Plant layout and performance is analyzed for its performance:

Shift length = 3360 minutes

Scheduled down time = Lunch break + Two Tea Breaks + Scheduled shutdown = 480 min

Unscheduled down time= 795 min, Ideal run time = 0.22 piece per minute, Total pieces produced = 318, Rejection numbers = 23, Good Pieces = 318 – 23 = 295 Numbers,

Planned production time = Total shift time – (Break + Schedule shutdown) = 3360 – 480= 2880 minutes

Total Operating time = Planned production time – Downtime

= 2880 – 795= 2085 minutes

Availability = Operating time/Planned production time

= 2085/2880= 0.7239 = 72.39%

Performance = (Total production/Operating time)/Ideal run time

= (318/2085)/0.22 = 0.6932 = 69.32%

Quality rate = Good pieces/Total pieces

= 295/318= 0.9276 = 92.76%

This is observed from delay table that the down time is having largest contribution of the tool re-sharpening, one more second largest contribution is from material delay from store, but some more maintenance delays are there which can be listed in delay contribution table.

Table 3: Delay contribution table (Existing Process)

Day No.	Tool re-sharpening	Store delay	Hydraulic/Pneumatic leakages	Lubrication	Machine Setting	Tool Adjustments	Oil level
1	90	-	20	-	10	5	-
2	90	20	-	-	-	-	-
3	-	35	-	5	10	10	5
4	90	50	10	-	10	-	-
5	-	40	15	5	10	10	5
6	90	-	10	10	5	10	5
7	90	-	-	15	0	10	5

4.2 Post Analysis Discussions and Implementation

- Plant is working almost with half of its capacity, there is scope of research and engineering implementations to improve productivity.
- Gear machining section is bottleneck of the industry which is playing role to lower productivity of overall plant.
- Regular delay is occurring from inward section or store issuing raw material, tools and equipment's.
- Machine 1 is producing approx. 40 gear machining per day and rest of three machines are having productivity of approx. 20 gear machining per day. Labor electricity, maintenance and running cost are same as machine 1.
- Heat treatment is one of the costlier process which costs high to start, to run and to maintain each time, it is noticed that heat treatment section feels lack of inventory each day and is required to off frequently and cannot be utilized with its highest productivity rate.
- Tool re-sharpening is biggest delay noted during delay analysis and data collection which is need to resolve immediately.
- Some more major delays are due to store operations, leakage repairing delays, lubrication, machine setting and tool adjustments which are noticed from existing plant layout and process study.
- The store room is located outside the flow process layout of process which is causing delays.

- The tool room is also located far from operations performed to produce gears.

4.3 Arena Simulation for Post Implementation Production

The post implementation modal is prepared with arena to simulate possible production with the improved machine availability.

The modal with arena is shown below:

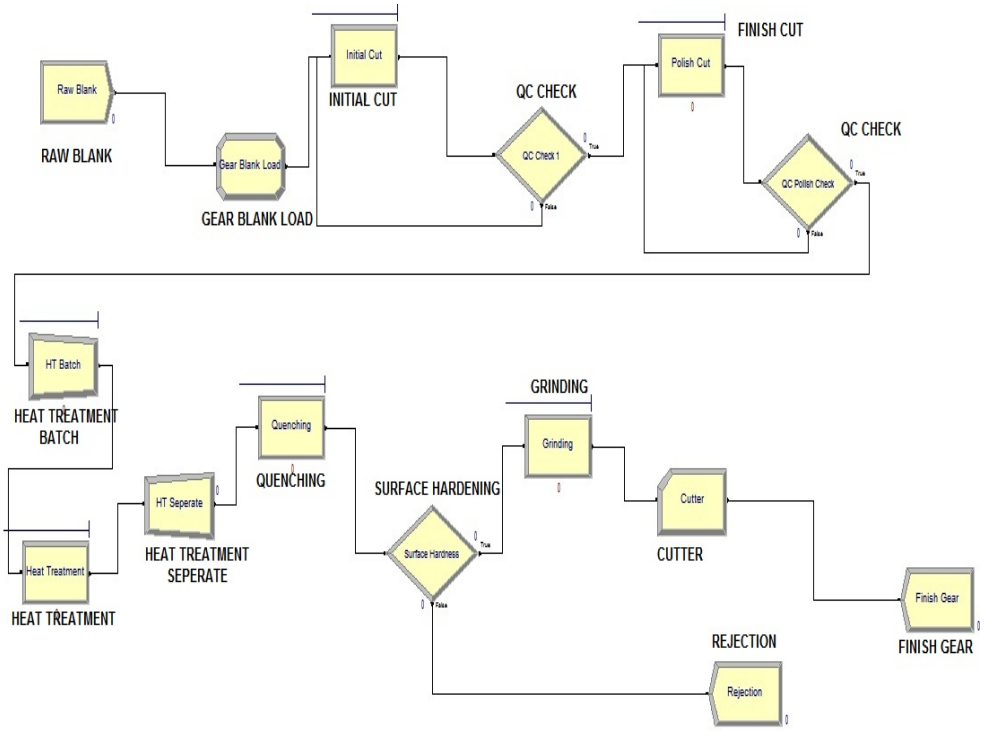

Figure 3: ARENA model and simulation of industry

All activities and steps of gear manufacturing in company are considered and modal is prepared with the input of 100 gear blanks per day in the plant.

Quality checks are also considered to find possible rejections in proposed simulated production rate. The production which can be achieved with present facilities is simulated 76 numbers per day by ARENA. It means there is lots of scope to work scientifically to increase production out of present facilities.

5. Results, Discussion and Conclusion

5.1 Existing Process Study Results:

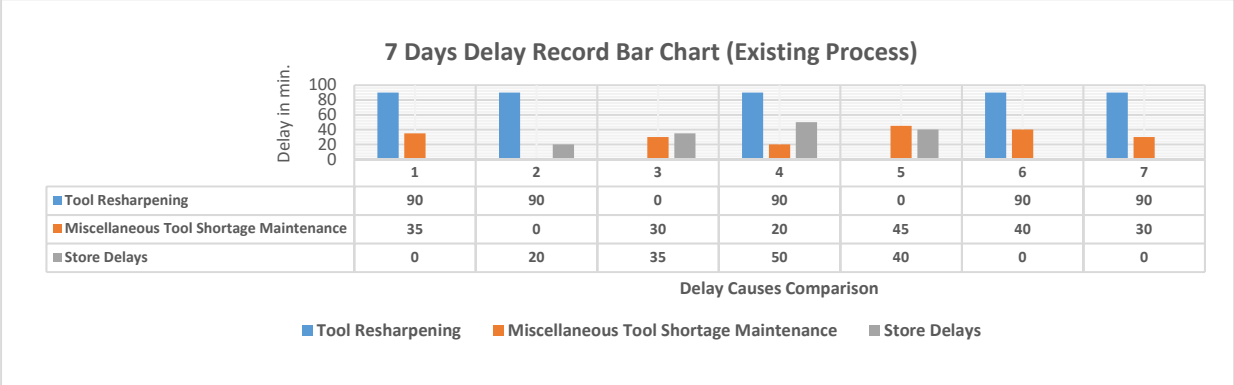

Figure 4: Delay Comparison for Existing process and layouts

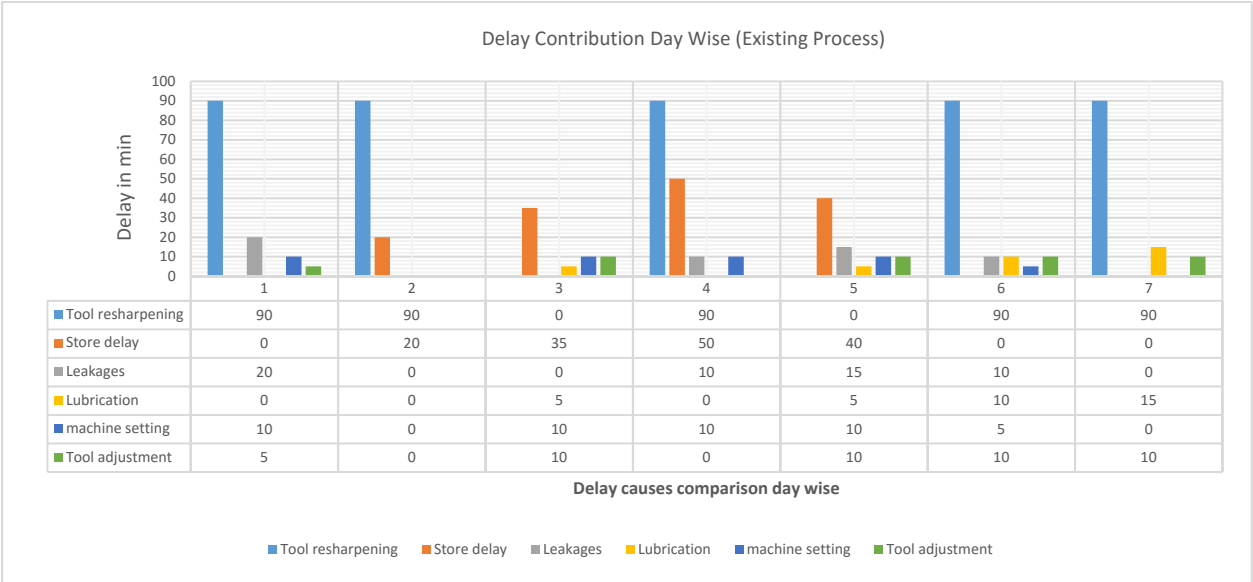

Figure5: Delay Contribution Comparison for Existing process and layouts

5.1.1 Result Graphs for existing process concluded that:

Tool re-sharpening, tool and raw material shortage and store problems are the major issues which contributes with great percentage to the availability of the machines.

The three causes are noted as most influencing problems and are required to kill immediately with suggested implementations and methods.

5.2 Post Implementation Study Results:

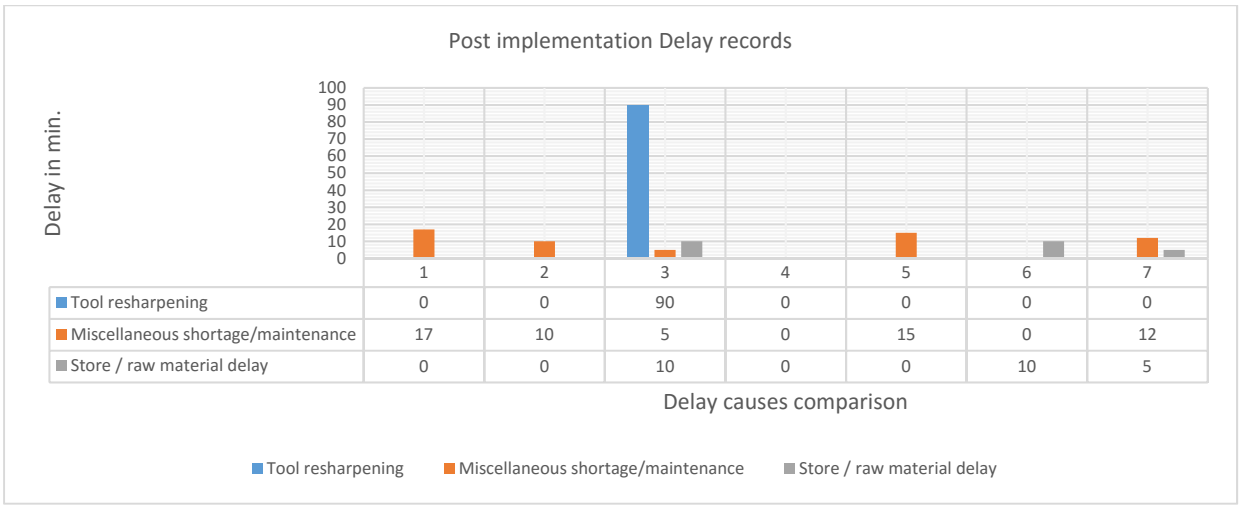

Figure 6: Delay Comparison for Post implementation process and layouts

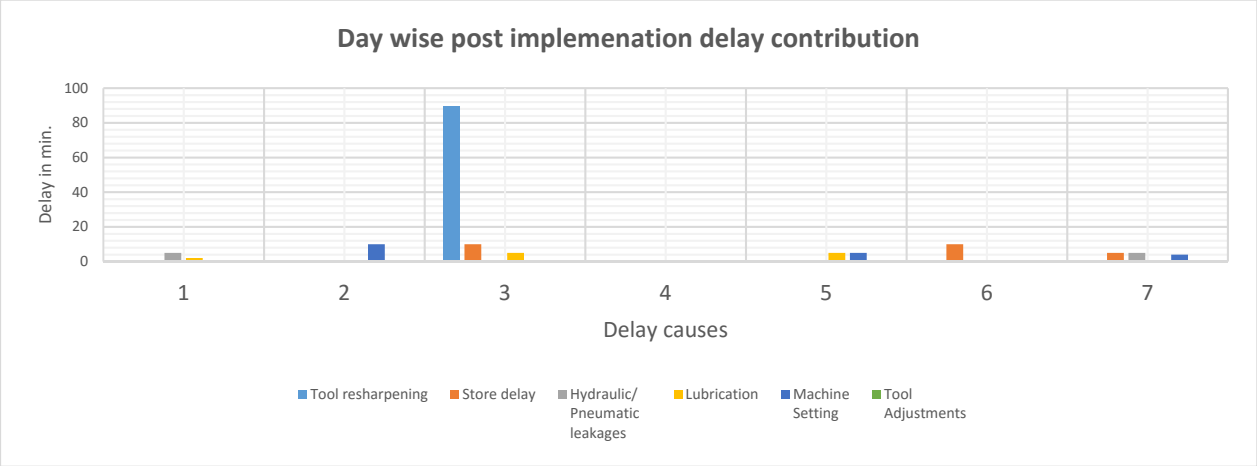

Figure 7: Delay Contribution Comparison for Post implementation process and layouts

5.2.1 Result Graphs for post implementation process concluded that:

Major delay issues and caused can be eliminated with remarkable ratio compared to existing process study. Most of the problems and delay causes are noticed for less times in post implementation process study, when preventive is performed, check lists and log books are followed and tool is make available in case of need of tool re-sharpening. The implementations are thus successfully implemented and proposed to the organization to adopt implementations in regular practice.

5.3 Performance parameters comparison (Existing vs Post implementation)

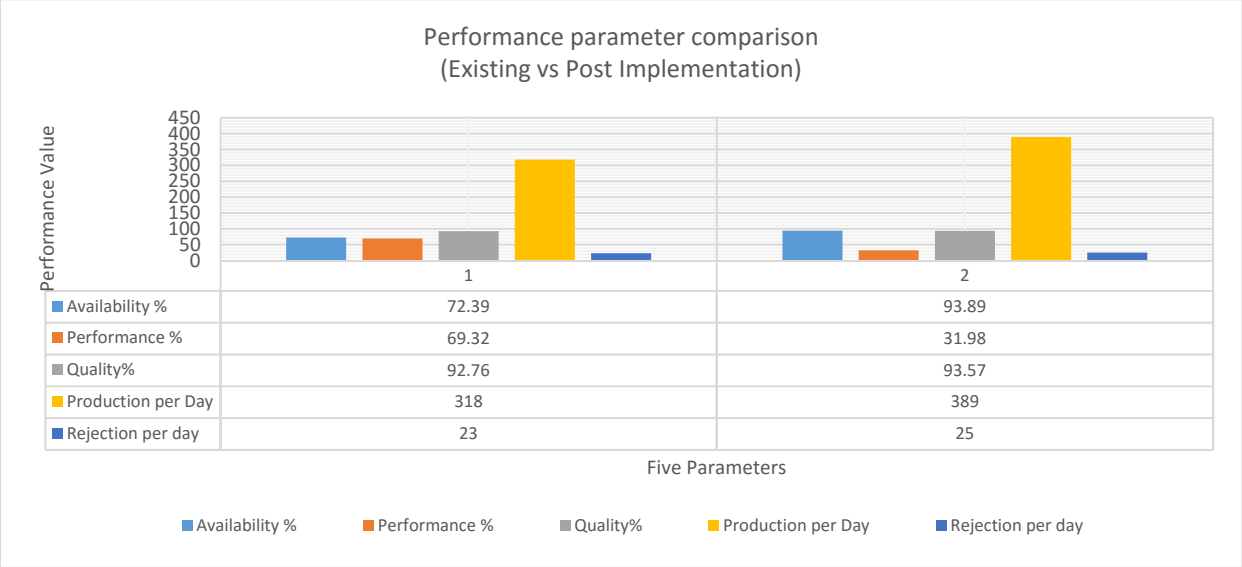

Figure 8: Overall results comparison for Availability, Performance, Quality, Production and rejection.

6 Conclusion

- Availability of the machine increases from 72.39% to 93.89% i.e. availability increases by 21.5%.. More availability will produce more number of products for company.
- Performance parameter is decreased by 37.34%, this is because delays are reduced with very high percentage and performance will increase with time when company increases loading machine with increased input and when workers will adopt the implementations with high commitment. It is importantly required to involve production zeal among workers with high motivation.
- Quality also improves by 0.81%. It is a continuous process and will continue improve with new implemented process with time.
- Production quantity in very first week increases from 318 to 389, which is 71 numbers higher in proposed implemented system. It is because availability is increased and downtimes are reduced with very high percentage. There is scope of producing more with this much availability of machine, but it requires involvement of all from top to bottom in company.
- Rejection in quantity are increases to 25 from 23, but it is because production numbers are increased. It can be controlled implementing and installing industrial engineering department in company.

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