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Thorough Elimination Of Muri, Mura And Muda To Achieve Customer Satisfaction

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Abstract:
In recent days, there is a huge competition between all the automobile industries, Supplying higher quality cars at more competitive price to much more people timely is big challenge for all the automobile industries. The study is carried out based on observations made at shop floor (Genba) of manufacturing department in a leading automotive manufacturing company. Due to percentage increase in the demand of output shaft (short/long) by 20% within a month, the company was not able to cop-up with the demand by the customer due to 3M concerns. The basic waste (MUDA) at workplace means any factor that does not contribute to the manufacturing process but only raise costs, the fluctuation (MURA) refers to the irregularities and fluctuations that happen temporarily in a production schedule and in the volume of parts and the overburden (MURI) means giving too heavy mental or physical burden to workers on production sites, for Machinery it also means giving excess workloads to equipment more than it is normally capable of. Thus the main emphasis of the study is on identifying and eliminating 3M's by performing time study, method study, motion study (Video Ethnography) to ensure safety, quality, productivity, cost, and HRD level up as well. Moreover, ergonomics study to reduce the fatigue at the machining line to improve workability, ultimately achieving customer delight by supplying 100% quality products.

Keywords: *Ergonomics, kaizen, 3M's, Standardized Work, Video ethnography.*

1.Introduction

In order to meet the customer demand stroke/fluctuation, the manufacturing environment needs to be free from unproductive conditions, such as 3M's mentioned above. The effective tool, which can be applied in order to improve the productivity of any manufacturing setup, is the main philosophy of Toyota Production System. The main objective of TPS is to eliminate non-value added activity (MUDA), overburden (MURI), fluctuation (MURA) and also reduce the fatigue at the machining line to improve workability, produce products based on takt-time (JIT), less inventory (Pull system) and less space to become highly responsive to customer demand while Supplying higher quality parts at more competitive price to much more people timely in an efficient way of production.

2.Research Methodology

The basic kaizen procedure and concepts of kaizen are used as effective methods for the study of the research work. The principles and methods of lean that are used to transform the company into high performing lean enterprise.

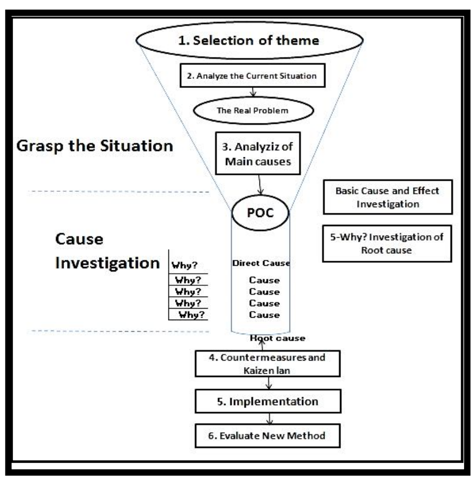


Figure 1:Basic Kaizen Procedure Flow Chart [2]

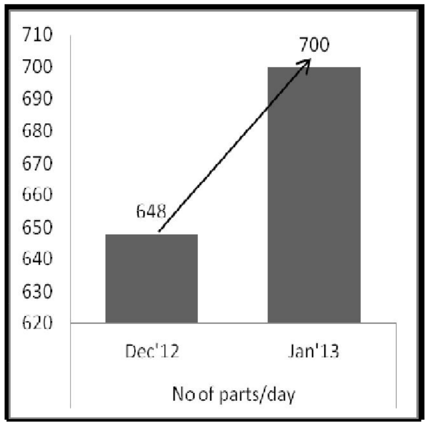


Figure 2:Customer Daily Demand

2.1.Selection Of Theme

Drastic increase in the demand of output shaft (short/long) from 648parts/day to 700parts/day has made very difficult to fulfill customer demand on time. This is due to 3M's and fatigue, which are contributing to the actual problem.

2.2. Analyze The Existing Method

To grasp the current situation of the cell, we have gone through three sheets of standardized work. Based on the three sheets of standardized work process study, time study and motion study has been carried out.

2.3.Work Element Analysis

Work element analysis has been carried out at output shaft (short/long) of soft machining to divide the main work into 8 work elements for short and long as well.

2.3.1.<u>Work Element Analysis For Output Shaft (Long)</u>

Pick up R/M from bin, abnormality check
And walk to M/c SMM-00024
Unload /Load ,Cycle start SMM-00024
Walk to M/c SMM-0001.
Unload /Load ,Cycle start SMM-0001
Walk to M/c SMM-0002.
Unload /Load ,Cycle start SMM-0002
Walk to M/c SMM-0003.
Unload /Load ,Cycle start SMM-0003

Walk to M/c SSP-0001.

Unload /Load ,Cycle start SSP-0001

Walk to M/c SLA-0001.

Unload /Load ,Cycle start SLA-0001

Walk to QC stage.

Quality Check, Place it in a FG Bin

And walk back to R/M Chute.

2.3.2.Work Element Analysis For Output Shaft (Short)

Pick up R/M from bin, abnormality check

And walk to M/c SMM-00024

Unload /Load ,Cycle start SMM-00024

Walk to M/c SMM-0001.

Unload /Load ,Cycle start SMM-0001

Walk to M/c SMM-0002.

Unload /Load ,Cycle start SMM-0002

Walk to M/c SMM-0004.

Unload /Load ,Cycle start SMM-0004

Walk to M/c SSP-0001.

Unload /Load ,Cycle start SSP-0001

Walk to M/c SLA-0001.

Unload /Load ,Cycle start SLA-0001

Walk to QC stage.

Quality Check, Place it in a FG Bin

And walk back to R/M Chute.

2.4.Process Study

Process study has been carried out to know what and all operations can be done at the soft machining of output shaft (Short/Long) cell.

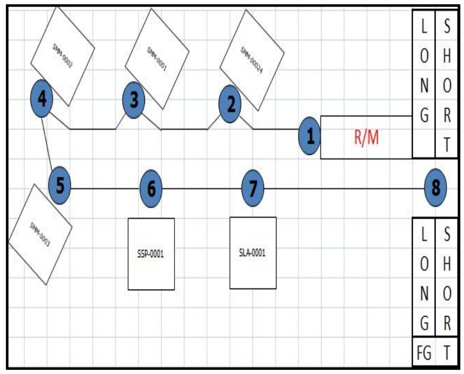


Figure 3:Process Layout (Long)

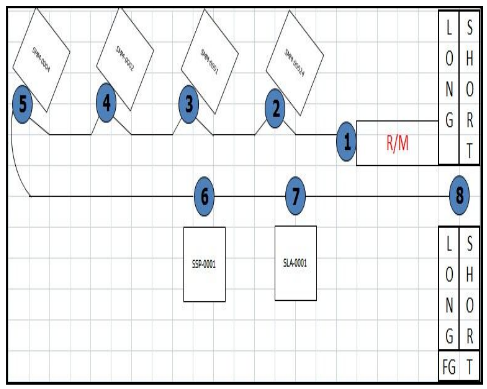


Figure 4:Process Layout (Short)

2.5.Standardized Work Type-I Activity 3 Charts

Once the work element analysis is completed, standardized work type-I activity 3 charts have been prepared.

2.5.1.<u>Standardized Production Capacity Sheet</u>

To prepare this sheet we would require the amount of time spent in manual work and the machine's automatic operation time. The time spent in "changing cutting tools" "Set-up time" "Process inspection". The main purpose of preparing this sheet is to clearly identify each machine production capacity/shift in order to take adequate actions for bottleneck machine process.

2.5.2.<u>Standard Work Study Table</u>

The standard work Study table uses takt time as a basis for allocation of work and to establish most efficient sequence of work. To prepare this sheet we would require the amount of time spent in manual work, the machine's automatic operation time and walking time. The main purpose of preparing this sheet is to identify whether there is muda of walk or muda of waiting and we can easily identify whether the man is bottleneck or machine is bottleneck.

2.5.3.Work Process Sheet

This Chart represents where exactly the process starts and where exactly the process ends. From this chart, we can easily identify the quality checkpoints and safety checkpoints. The main purpose of preparing this chart is to know how many standard-in-process stocks and buffer stocks are required to run the line without any stoppage.

2.6.Time Study

Time study has been carried out to analyze the current situation. To perform time study we use either a digital or an analog stopwatch. While many stop watches have lap and split functions, TPS normally uses continuous time measuring method to analyze work. This means we let the stop watch run continuously when measuring the time for each element work. By performing time study, we can easily identify the fluctuations in the cycle time, manual time and machine auto time.

2.6.1.Cycle Time Measurement

Cycle time has been measured for 10 continuous cycles. Fluctuation in the cycle time is the difference between minimum and maximum time taken to complete one cycle. Fluctuation check sheet has been prepared to identify cycle time fluctuation for output shaft long and short as well.

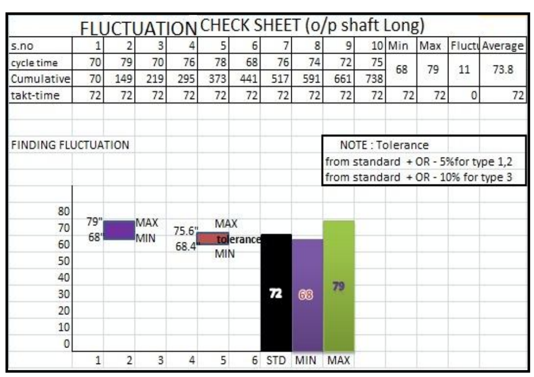
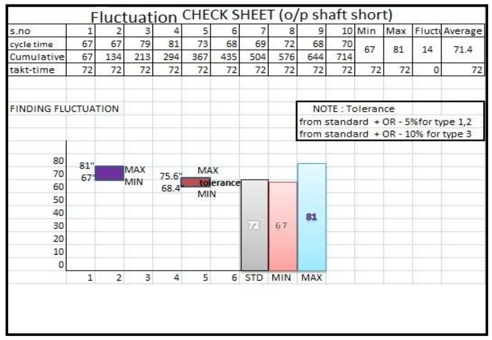


Figure 5:Fluctuation Check Sheet(Short)



Fluctuation CHECK SHEET (o/p shaft short)														
s.no	1	2	3	4	5	6	7	8	9	10	Min	Max	Fluctu	Average
cycle time	67	67	79	81	73	68	69	72	68	70	67	81	14	71.4
Cumulative	67	134	213	294	367	435	504	576	644	714				
takt-time	72	72	72	72	72	72	72	72	72	72	72	72	0	72

Figure 6:Fluctuation Check Sheet (Long)

2.6.2.<u>Human Fluctuation</u>

To identify fluctuation in the human work, the manual time has been measured for 10 cycles for each identified work element.

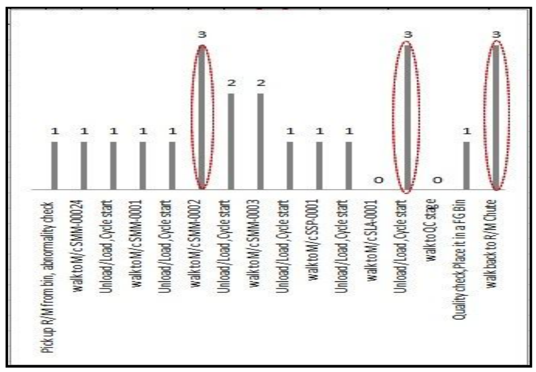


Figure 7:Human Fluctuation (Long)

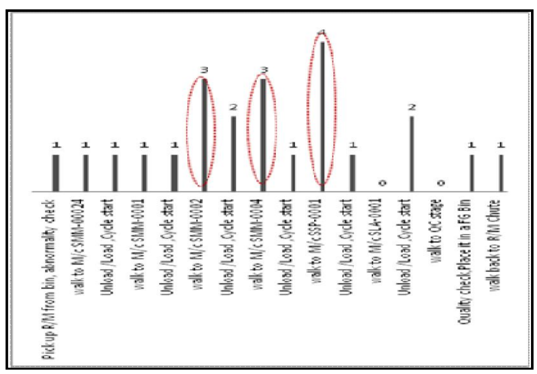


Figure 8:Human Fluctuation (Short)

2.6.3.<u>Machine's Automatic Operation Time Fluctuation</u>

The machine auto times has been measured for 10 times for each machine to identify the fluctuation in the machine's automatic operation time.

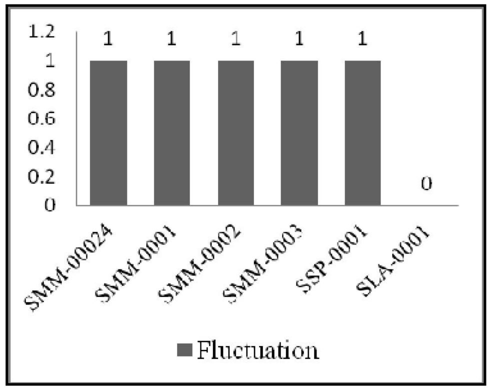


Figure 9:Auto Time Fluctuation (Long)

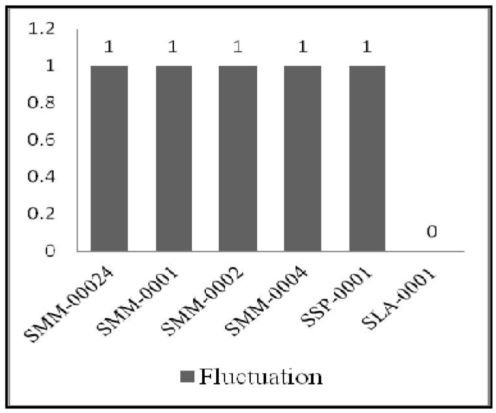


Figure 10:Auto Time Fluctuation (Short)

2.6.4.<u>Motion Study</u>

Motion study has been carried out to identify the 3M's using Video Ethnography method. The optimal work procedure must be determined to complete work efficiently. By performing Video IE where slow stop motion is available and motion can be analyzed in detail by replaying the video, muda, mura and muri of motions were identified.

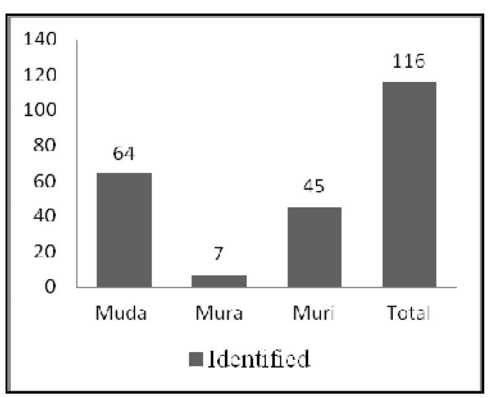


Figure 11:No Of 3m's

2.6.5.Ergonomics Study

Motion Movement Evaluation Sheet has been prepared to identify the posture burden points(Ergonomics standard burden score).

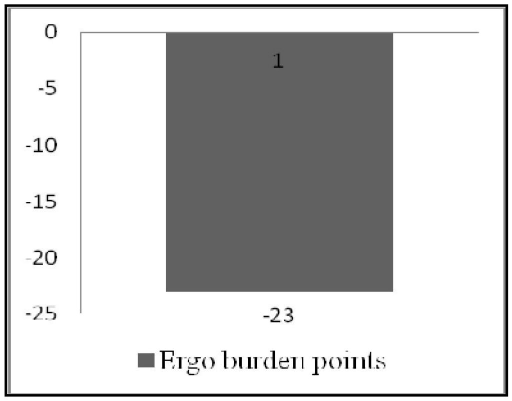


Figure 12:Ergonomics Burden Points

2.7.Analysis Of Main Causes

We now felt we had sufficient data to move to step3. Cause and effect diagram have been constructed to analyze the main cause for the 3M's and fluctuation in the cycle time, manual time. At output cell of soft machining 3M's and fatigue are the main causes to the fluctuation in the cycle time,manual time. So it has become very difficult to fullfil customer demand on time. The root cause for the 3M's and fatigue have been identified by performing root cause analysis.[3]

2.8.Setup Countermeasures And Kaizen Plan

Work analysis observation has been carried out and kaizen problem list is prepared on the basis of TPS standards. Proper kaizen ideas are generated and countermeasures are taken for all the 80 kaizen problems which are listed.

Rank A	Rank B	Rank C
Can do kaizen immediately.	Require small equipment and m/c setup or layout change, need more time.	High cost,more techniques, new equipment,will take long time.

Table 1: Kaizen Rank Criteria[3]

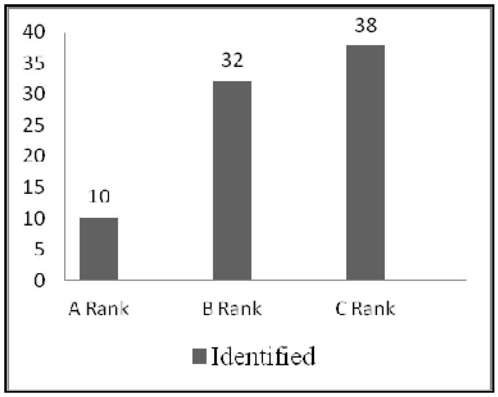


Figure 13:Category Wise Kaizen Points Identified

2.9.*Implementation Of Kaizen Plan*

To implement best kaizen plan, we need a close ties and co-operation between a boss,subordinates &co-workers in the following and preceding processes. By convincing subordinates who are forced to change how to work through explaination of reasons and goals of kaizen.

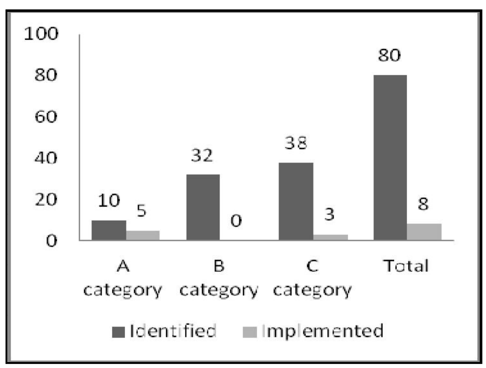


Figure 14: Kaizen Implementation Status

3.Results And Discussions

After kaizen plans are implemented,improvement results are evaluated and overall achievement of kaizen plan implementation is confirmed.

Evaluation points:

Compared the expected results to the actual results.

Found out if a new a problem exists.

Improved work conditions.

Fluctuation in the cycle time and manual time have been reduced.

Cycle Time is reduced from 77seconds to 72seconds for Short and 75seconds to 70seconds for long.

Fatigue is reduced.

3M's are eliminated.

Workability is improved.

Daily Production is increased by 648 to 700.

HRD is leveled up.

Critical eye for observation level up.

Kaizen ability & problem identification skill improved.

Motivation to the worker.

Total KPI Improvement is done (SQPC).

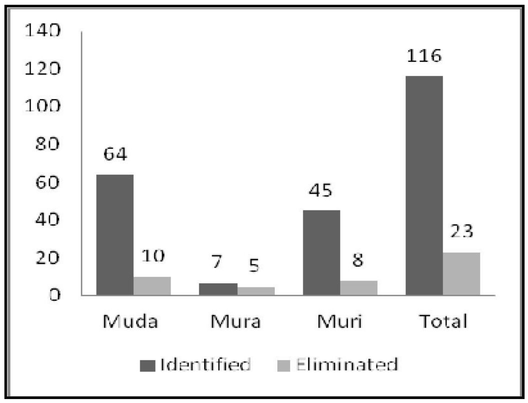


Figure15:3M's Status

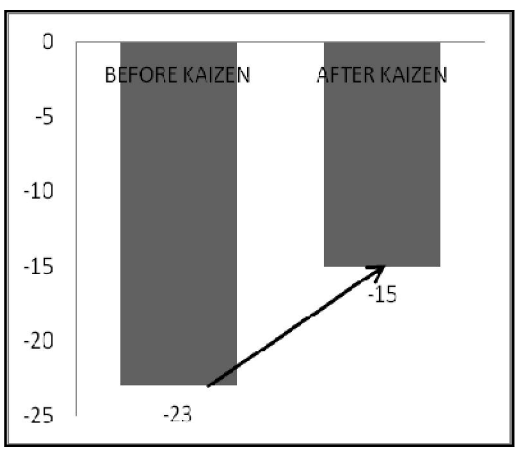


Figure 16:Ergonomics Burden Points Status

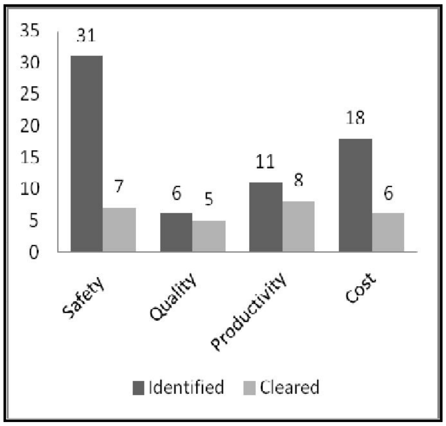


Figure 17: Total Key Performance Indicator

As a result now they are able to cop-up with the demand made by the customer.

4.Conclusion

The study of the project work has helped a lot in achieving customer delight at the output shaft cell of soft machining by identifying and eliminating 3M's. And also ensured safety, quality, productivity, cost and HRD level up as well.And ergonomics study has helped us to reduce the fatigue at the machining line. As a result the workability is improved,ultimately the customer satisfaction is done.

5.Aknowledgement

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