Analysis and Optimization of Cycle Time for Instrumentation Valve to Improve Manufacturing

A.R Pawar[1] Prof V.S Jadhav[2]
[1]PG Scholar [2]Professor
Department of Mechanical Engineering
Government College of Engineering Karad, Maharashtra, India

Abstract— Cycle Time Optimization is identifying and implementing more efficient ways to do things. Reducing cycle time requires eliminating or reducing non-value-added activity, which is defined as any activity that does not add value to the product. Examples of non-value- added activity in which cycle time can be reduced or eliminated include repair due to defects, machine set-up, inspection, test and schedule delays. Reducing cycle time will have a significant impact on a company's bottom line when implemented. Cycle time reduction is provides tremendous benefit to a company. From the cycle time reduction the non-value added activity will be reduce or eliminated. The benefit from this reduction is following below: 1) Reduced cost 2) Increase throughput 3) Streamlined processes 4) Improved communications. 5) Reduced process variability 6) Schedule integrity 7) Improve on-time delivery
Therefore following work will be carried out:
1. Study of manufacturing, quality assembly and testing of instrumentation valves. 3. Implementation of value stream map (VSM). JIT for manufacturing and assembly line. 4. Comparative analysis of existing with VSM implemented line. 5. Optimization of cycle time for instrumentation valves.

Key words: Cycle Time Optimization, Instrumentation Valve

I. INTRODUCTION

A. Value Stream Mapping

Value Steam Mapping is a powerful lean tool for identifying the waste. Lean means identifying and eliminating waste. This required a detailed understanding of all the processes involved so that waste can be identified and eliminated. Value Stream Mapping has the reputation of uncovering waste in manufacturing, production and business processes by identifying and removing or streamlining non-value-adding steps. A flow diagram showing the process is drawn to reflect the current state of the operation. The non-value actions are identified in each step and between each step by their waste of time and resources.

B. Cycle Time

Cycle Time Optimization (CTO) is an operating philosophy of maximizing the efficiency of suboptimal value-added activities while minimizing non-value-added activities and time for the best quality, cost and responsiveness to customer needs. Using these tools helped company to develop process with cycle time within the take time associated with building the product. Having a good understanding of these lean tools allowed for a better understanding of the waste associated with walk and wait that was in the production line and the importance of eliminating it. Manufacturing practices covers all aspects of production from the starting materials, premises and equipment to the training and personal hygiene of staff. Detailed, written procedures are essential for each process that could affect the quality of the finished product. There must be systems to provide documented proof that correct procedures are consistently followed at each step in the manufacturing process - every time a product is made. The goal of these lean manufacturing. Methods is to reduce waste in manpower, inventory, time to market, to become highly responsive to customer demand while producing quality products

C. Instrumentation Valves

1) Needle Valve

A compact needle type valve for isolation of lines, sampling, throttling and similar application. The valve has screwed ends to be used with pipes and tubes.

- Test Pressure: 25 c Room Temperature.
- Material: A105, A479SS304, A 479SS316,A182Gr F316SS Monel, Hastelloy.
- Finish: CS zinc plated and dichromated Natural.

II. METHODOLOGY

A. Time Study

1) Continuous method:

Here the stop watch is started at the beginning of the first element. The watch runs continuously throughout the study. At the end of each element the watch readings are recorded on the study sheet. The time for each element is calculated by successive subtraction. The final reading of the stop watch gives the total time known as observed time. In this research, this method is used to find out time required for each operation on each workstation.

Elements- Each workstation are divided into elements.

Sr No.	Elements									
	T	R	T	R	T	R	T	R	T	R
1										
2										
3										
4										
5										
6										

R- At the end of each element, in turn, the particular reading of the watch is recorded for the corresponding element. The watch continued to run so that at the end of first element of the second piece of work is starts. Each reading is recorded in the column of 'R'.

T- The time required for each element for operation. The time for each element is secured by subtracting successive readings.

a) Needle valve Assembly:

1) Needle Valve Internal bonnet Screwed Ends

Sr No.	Elements													
	Set Screw		Handle		Gland Nut		packing		Valve Bonnet		Stem		Valve Body	
	T	R	T	R	T	R	T	R	T	R	T	R	T	R
1	13	13	4	17	4	21	13	34	6	40	14	54	3	57
2	11	70	5	75	5	80	8	88	5	93	10	103	5	108
3	13	123	5	128	3	131	3	134	8	142	15	157	5	162
4	16	180	2	182	5	187	10	197	4	201	10	211	4	215
5	13	233	3	236	5	241	9	250	4	254	10	264	4	268

Total Time	66	19	22	43	27	59	21
No. of Observations	5	5	5	5	5	5	5
Observed Time	13.2	3.8	4.4	8.6	5.4	11.8	4.2

Total time = 51.4sec

2) Needle Valve Internal bonnet female ends

Sr No.	Elements							
	Handle		Gland		Valve Body		Valve Body	
	T	R	T	R	T	R	T	R
1	6	6	10	16	10	26	6	32
2	7	41	11	52	9	61	6	67
3	7	78	10	88	8	96	6	102
4	6	111	14	125	10	135	6	141
5	7	151	11	162	8	170	6	176

Total Time	29	20	23	27	36
No. of Observations	5	5	5	5	5
Observed Time	5.8	4	4.6	5.4	7.2

Total Time=32.8sec

3) Needle Valve Internal bonnet design double ferrule tube ends

Sr No.	Elements							
	Handle		Gland		Valve Body		Tube fitting male/female	
	T	R	T	R	T	R	T	R
1	7	7	10	17	21	38	9	47
2	10	10	8	18	16	34	8	42
3	7	7	10	17	14	31	8	39
4	7	7	7	14	12	26	9	35
5	11	11	8	19	12	31	10	41

Total Time	42	43	75	44
No. of Observations	5	5	5	5
Observed Time	8.4	8.6	15	8.8

Total Time=40.8sec

4) Angle Needle Valves screwed bonnet design

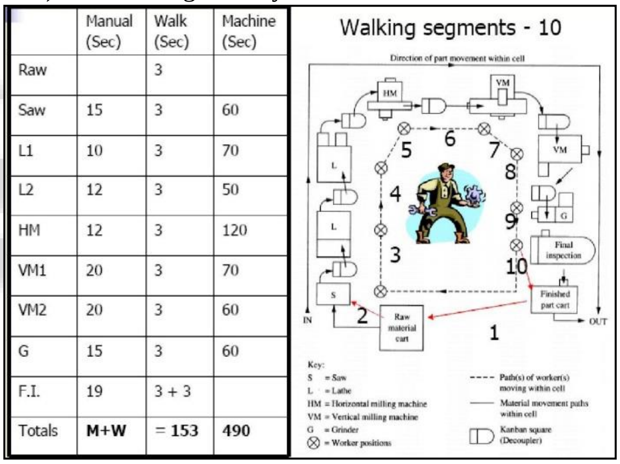
Sr No.	Elements					
	Handle		Gland		Valve body	
	T	R	T	R	T	R
1	10	10	13	23	10	33
2	9	45	8	53	8	61
3	7	73	6	79	12	91
4	9	101	6	107	12	119
5	12	144	9	153	11	164

Total Time	47	42	53
No. of Observations	5	5	5
Observed Time	9.4	8.4	10.6

Total Time=28.4sec

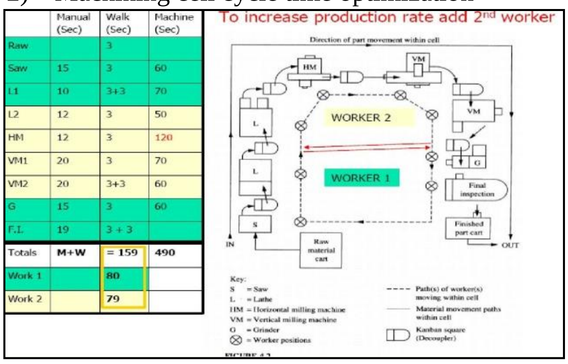
b) Cycle time calculation and observing bottlenecks

1) Machining Cell Cycle Times



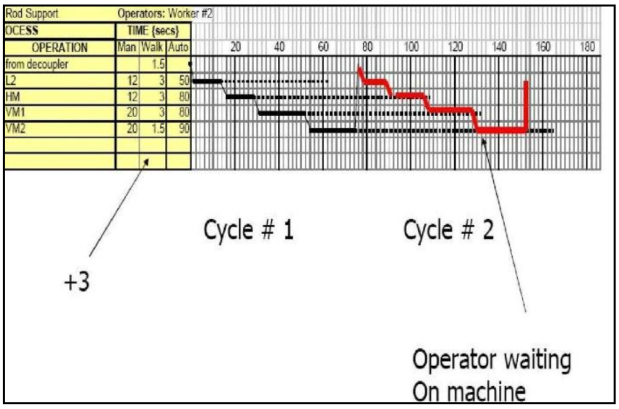
	Manual (Sec)	Walk (Sec)	Machine (Sec)
Raw		3	
Saw	15	3	60
L1	10	3	70
L2	12	3	50
HM	12	3	120
VM1	20	3	70
VM2	20	3	60
G	15	3	60
F.I.	19	3 + 3	
Totals	M+W	= 153	490

2) Machining cell cycle time optimization



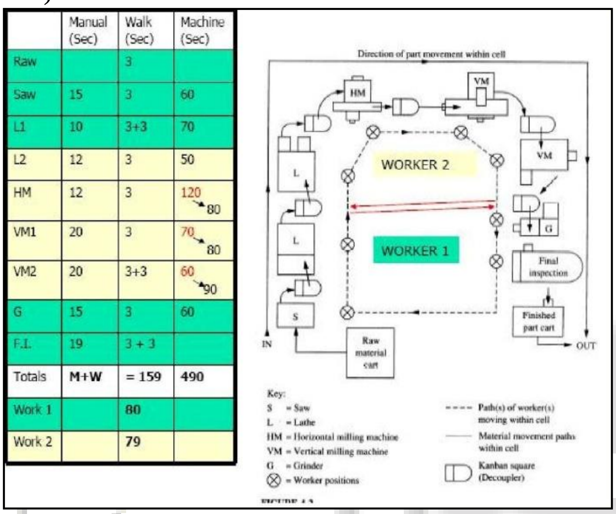
	Manual (Sec)	Walk (Sec)	Machine (Sec)
Raw		3	
Saw	15	3	60
L1	10	3+3	70
L2	12	3	50
HM	12	3	120
VM1	20	3	70
VM2	20	3+3	60
G	15	3	60
F.I.	19	3 + 3	
Totals	M+W	= 159	490
Work 1		80	
Work 2		79	

3) Limitation



Check max (MTj)< CT
Worker 1,80=80
Worker 2 ,12+120 > 79
One part every 132 sec

4) Balance load



5) Reduced cycle time
Check max(MTj)<CT
Worker 1, 80=80
Worker 2, 110>79
Hence worker 2 will need to wait for vertical mill 2
New production rate is
1 part/110sec

c) Value stream Map

VSM Plots by using VSM Smart Draw Tool

1) Current State Map of CR Upper Line

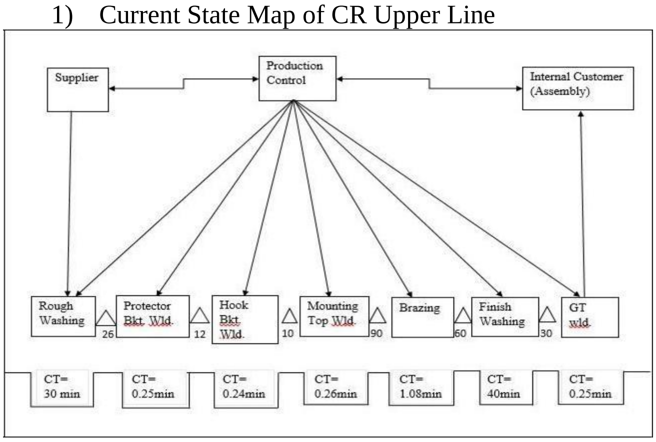


Fig. 1.1: Current State Map of CR Upper Line

Fig.1.1 shows the current state map of CR upper line. Current state of CR upper line shows the process flow which shows that how value is getting added into the bare upper shells. Process starts from the bare shells to come to the store from supplier.

2) Current State Map of CR lower Line

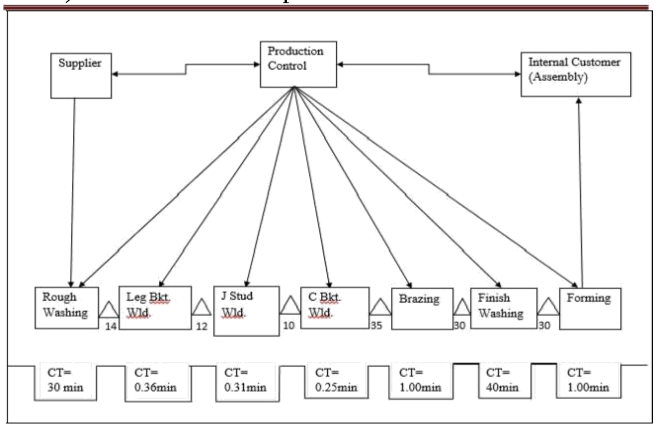


Fig. 2.1: Current State Map of CR Lower Line

3) Future State Map of CR Upper Line

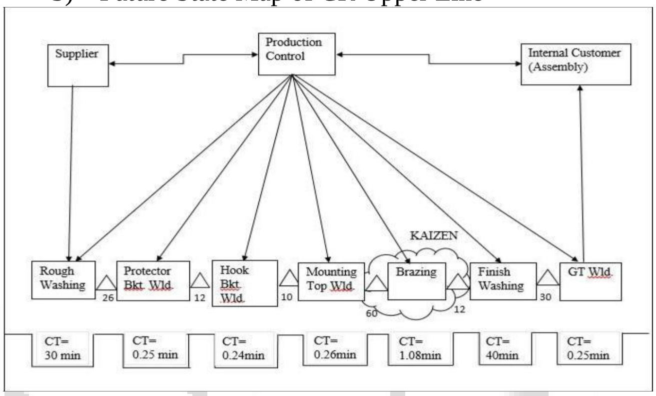


Fig. 3.1: Future State Map of CR Upper Line

4) Future State Map of CR Lower Line

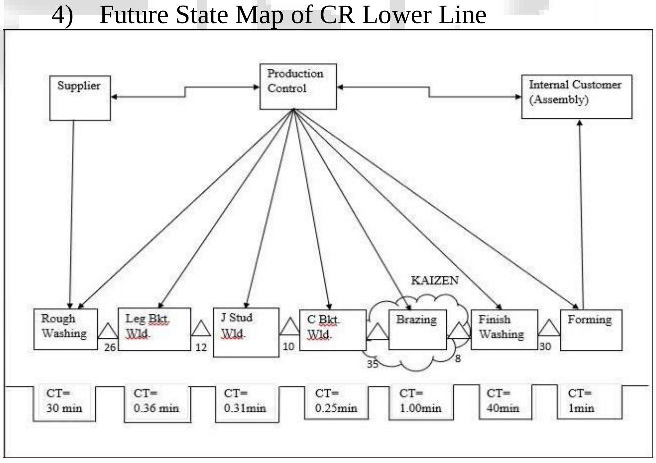


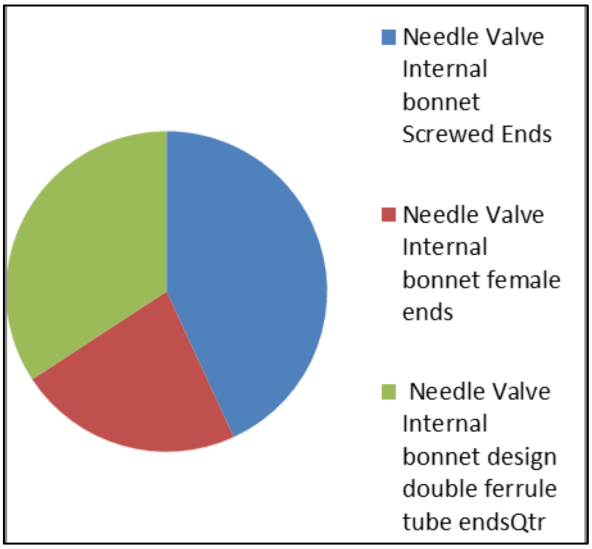
Fig. 4.1: Future State Map of CR Lower Line

III. ANALYSIS OF DATA

Data analysis deals with analysis whole data collected through various techniques. The study is mainly concerned with the time study for each workstation on assembly line

A. Needle valve Assembly

Time(sec)		
Needle Valve Internal bonnet Screwed Ends	Needle Valve Internal bonnet female ends	Needle Valve Internal bonnet design double ferrule tube ends
51.4	27	40.8



Interpretation: Time required for Needle Valve Internal bonnet Screwed Ends assembly is 51.4sec, for Needle Valve Internal bonnet female ends assembly is 27sec and for Needle Valve Internal bonnet design double ferrule tube ends assembly is 40.8.Time required for this operation varies by operator.

IV. CONCLUSION

The VSM is a necessary but not a sufficient approach to analyze production system issues. Deficiencies often arise due to its deterministic nature, which make the traditional VSM not always straightforward to describe the current state of a manufacturing process and design a desired future state. Discrete event simulation is then utilized to enhance but not replace the VSM by visualizing better dynamic features of the future state before implementation. Different simulation scenarios are developed by observing the actual processing times of activities in the manufacturing process and then characterizing their variation by statistical distributions. A roadmap is offered to show how the VSM and the discrete event simulation are combined together to provide necessary information for improvement decision problems encountered in lean manufacturing implementation.

While applying the VSM some precautions should be observed. Since it gives an illustrative view of the process at any particular instant of time, it may capture the wrong representation at that particular instance, which may mislead decision-makers. Moreover, the VSM only suggests about the area of improvement. It does not discuss any rule of thumb to achieve the improvement. Despite the inadequacy, it is a really powerful tool. It links people, tools, metrics and even reporting requirements to achieve lean manufacturing. It provides clear and concise communication between management and shop floor teams about lean expectations, along with actual material and information flow. Hence, it allows understanding and continuously improving the understanding of lean concepts.

V. FUTURE WORKS

Firstly, future studies should integrate the approach with economic measures to express both value-added and non-value-added costs sustained through the process. The primary goal of the developed simulation model is to balance throughput, WIP and production lead time. Different objectives, such as cost minimization, machine availability maximization, should be explored to examine the performance of the simulation model.

Secondly, a more substantiate simulation model should be constructed to incorporate more practical issues by relaxing some assumptions. Simulation models are developed by observing the actual processing times of activities in the process and then characterizing their variation by statistical distributions. However, these times are recorded by a portion of the manufactured product types. It is assumed that the time data of the rest products will match with the actual operation time. More product types should be input to the simulation model for further validation. Furthermore, the yield rate is assumed to be 100% with no defect happened either during or at the end of the manufacturing process, which should have a fair impact on the simulated results.

An additional field for future research might be extending the current manufacturing process to evaluate the whole supply chain. One would find that it is necessary to map both intercompany and intra-company value-added streams. It is a far more focused and contingent view of the value-added process.

ACKNOWLEDGEMENTS

The authors greatly acknowledge the editor and the reviewers for their valuable comments and suggestions that have led to a substantial improvement of the paper.

REFERENCES

[1] Mossa, F. Boenzi, S. Digiesi, G. Mummolo, V.A. Romano,"Productivity and ergonomic risk in human based production systems:A job-rotation scheduling model." International Journal of Production Economics; 2016 vol.171:471-477.
[2] Amitay, G., Malkin S., and Koren, Y., Feb., "Adaptive Control Optimization of Grinding," ASME JOURNAL OF ENGINEERING FOR INDUSTRY; 1981 Vol. 103, pp. 102-111.
[3] Manuel F. Suárez-Barraza, Juan Ramis-Pujol,“Process Standardisation and Sustainable Continuous Improvement”International Journal of Advanced Engineering Research;2010 vol.120:300-312.
[4] Buckle, P., 2011."The perfect is the enemy of the good ergonomics research and practice." Institute of ergonomics and human factors annual lecture; 2010 vol.54(1):203-215.
[5] Adler, P. S., Goldoftas, B., & Levine, D. I. "Ergonomics, employee involvement, and the Toyota Production System: A case study of NUMMI’s" Industrial and Labor Relations;1997 vol.50:416–437.
[6] Karim MA, Aljuhani M, Duplock R, YarlagaddaP "Implementation of lean manufacturing in Saudi manufacturing organisations:an empirical study." Advanced Materials Research; 2011 vol.339:250–253.
[7] Khan JG, DaluRS."Awareness of lean manufacturing in plastic pipe industries – a survey. "International Advanced Research Journal in Science, Engineering and Technology; 2016 vol.3(1):205–209.

[8] KumarA."The challenges to the implementation of lean manufacturing." International Journal of Engineering Science & Advanced Technology;2014 vol.4(4):307–312.
[9] Herron C, BraidenPM."Defining the foundation of lean manufacturing in the context of its origins defining the foundation of lean manufacturing," The IET International Conference On Agile Manufacturing; 2007 vol.85:148–157.