Productivity Improvement With The Help of Value Stream Mapping by Reducing Mould Changeover Time

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Abstract: The objective of this research work is to improve productivity by identifying the possible lean improvements in the plant with the help of Value Stream Mapping. The most critical issue faced by manufacturers today is how to deliver their products or materials quickly at low cost and good quality, for that several methods and approach exist such as lean Manufacturing tools for improving the productivity and efficiency by identifying the wastes in each department and Processes. Lean tools enabling a company to differentiate value from waste and facilitate to maximize customer value while minimize waste. Value Stream Mapping is to use the Kaizen activity with Single Minute Exchange of Die (SMED) or Quick Mould-changeover to effectively support future state for process improvements. As a conclusion for this paper presents that the designed Future Value Stream Map (FVSM) which helps to effectively identify wasteful activities and production processes and Implement that to improve the Productivity. VSM and Kaizen serve as an input for continuous improvement by reducing the manufacturing lead time using SMED in Plastic Injection Moulding at Spectrum Electrical Industries Limited.

Keywords: VSM, SMED, Quick Mould-changeover, Lean Manufacturing, Productivity Improvement.

I. INTRODUCTION

Value stream mapping is also known as a value stream analysis and lean process mapping, it is defined as a lean tool that employs a flow diagram which documenting every step in the process. Value stream mapping as a fundamental tool to identify wastes in the process, reduce process cycle time, and implement process improvements.
Divided in two parts: 1) Current State Mapping.
2) Future State Mapping.

1) Current State Mapping:

Value stream mapping is a representation of the flow of materials from supplier to customer through the organization as well as flow of information. This enables us to see at a glance where the delays are in the process, any restraints and excessive inventory in process. The current state mapping is the first step in working towards ideal state for organization. Value stream mapping (VSM) is a team exercise and should involve representatives from all of the departments within the process being mapped this process should be facilitated and led by an expert with experience in creating value stream mapping. A value stream mapping is best created by hand using a pencil (will need to make frequent corrections and changes) on a sheet of A3 paper. It is better to create map by hand and involve the entire team.
Firstly need to decide what it is exactly that we wish to map, in an organization or company with many products there may have to be some initial work done to identify which product or family group of products that should be mapped, we may decide to go with highest value, or take a longer term strategic look at those product ranges that we expect to do more business with in the future and we may be guided by our customers as to what to map.

2) Future State Mapping:

The problems highlighted in current state mapping could all be tackled one by one but what we really need is a vision of where we want to end up so that we can focus our efforts on achieving an agreed "Future Ideal State." The team guided by the expert should create a future ideal state value stream map which should envision the absolute best the process could be, this should then be agreed by senior management as the ultimate goal of our future value stream mapping exercise. This Future Ideal state could be a single cell rather than isolated process in different parts of the factory with daily (or more frequent) deliveries to the customer and from the supplier. Kanban systems could be

utilized to remove the need for planning and scheduling as well as many other ideas that could be considered in this activity.

Once we have our Future ideal state then we can plan to achieve our shared vision of where the process needs to be the simplest way to do this is to plan a series of improvements, each taking one or two months, and use our value stream map to communicate what we want to do for improvement. Use the kaizen burst symbol on current state map to highlight the improvements that we want to make in Future State Mapping.

OBJECTIVE

To Improve Productivity by Implementation of "Value Stream Mapping" Methodology on Process.

II. METHODOLOGY

1) Draw Current State Mapping.
2) Analyze Current State Mapping.
3) Draw Future State Mapping.
4) Implement Improvement Plan.

1) Draw Current State Mapping:

To Draw Current State Mapping we need to do a little thinking and some work, get the team to collect data regarding the performance of each step of the process typical types of date to be collect are:

A) Inventory
B) Cycle time (time taken to make one product)
C) Change over time (from last good piece to next)
D) Up-time (on-demand machine utilization)
E) Number of operators
F) Shifts worked
G) Scrap rate
H) Pack size/pallet sizes
I) Batch Size etc….

Component Name: Arc Shield Size 3

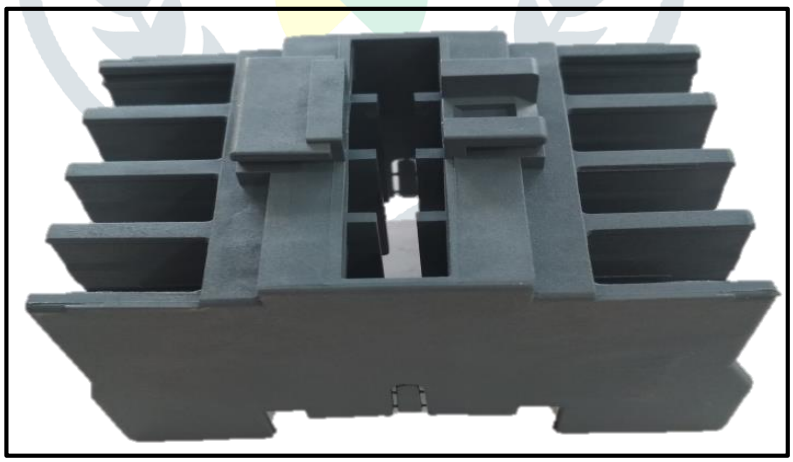

Fig. 1 Arc Shield Size 3

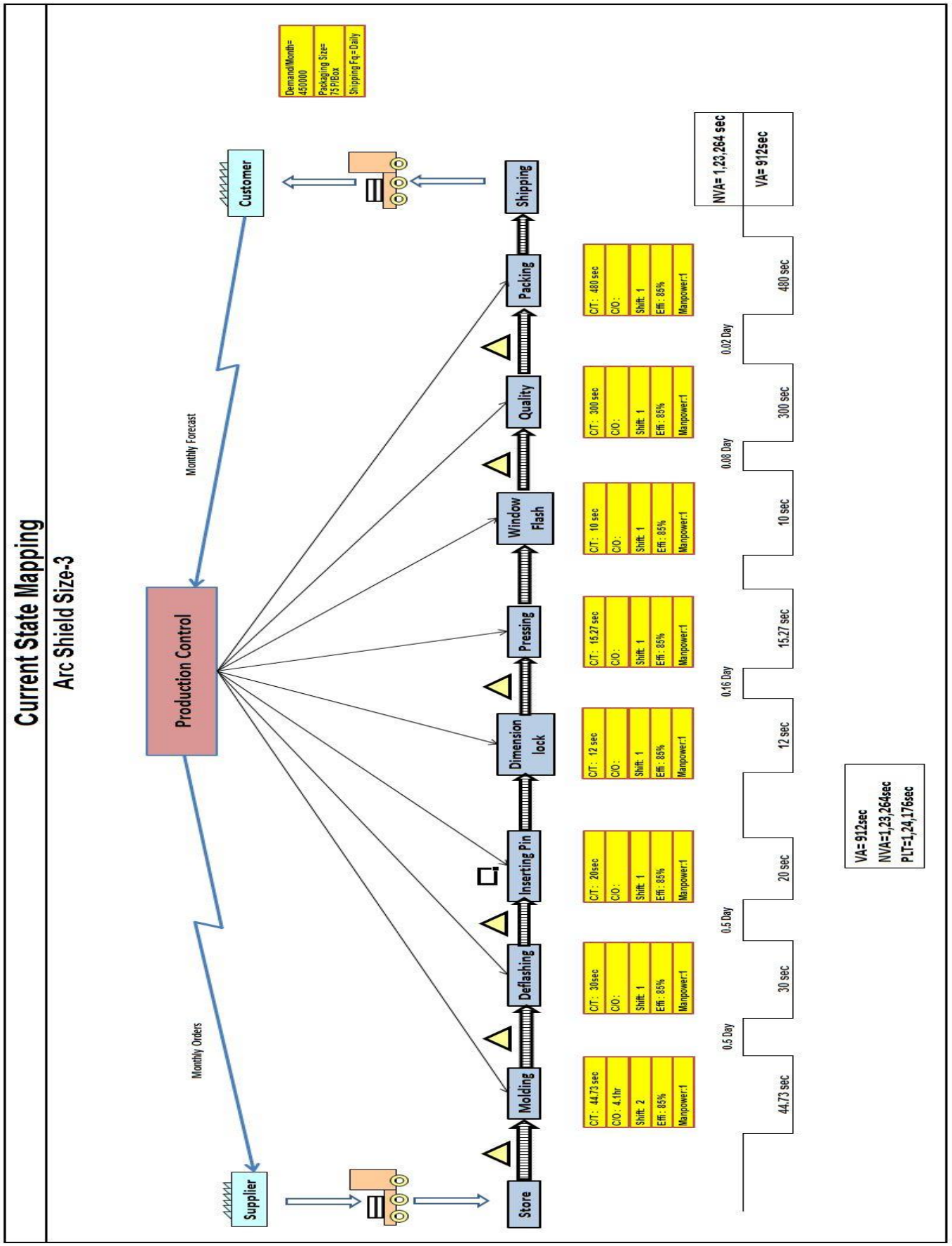

Fig. 2 Current State Mapping**.**

2) Analyze Current State Mapping.

The data boxes and the timeline contain much information about our process, we can now see in one document where the problem areas within our process lie, issues such as:

a) Excessive Inventory
b) Long cycle times
c) Low uptime
d) Excessive Setup Times
e) Poor Quality / Rework
f) Poor one piece flow

Molding CT = 44.73 sec

De-flashing CT = 30 sec

Inserting Pin CT = 20 sec

Dimension Lock CT = 12 sec

Pressing CT = 15.27 sec

Window Flash CT = 10 sec

Quality CT = 300 sec

Packing CT = 480 sec

VA= 912sec

NVA=1, 23,264sec

PLT=1, 24,176sec

PCE=VA/PLT=0.73%

3) Draw Future State Mapping.

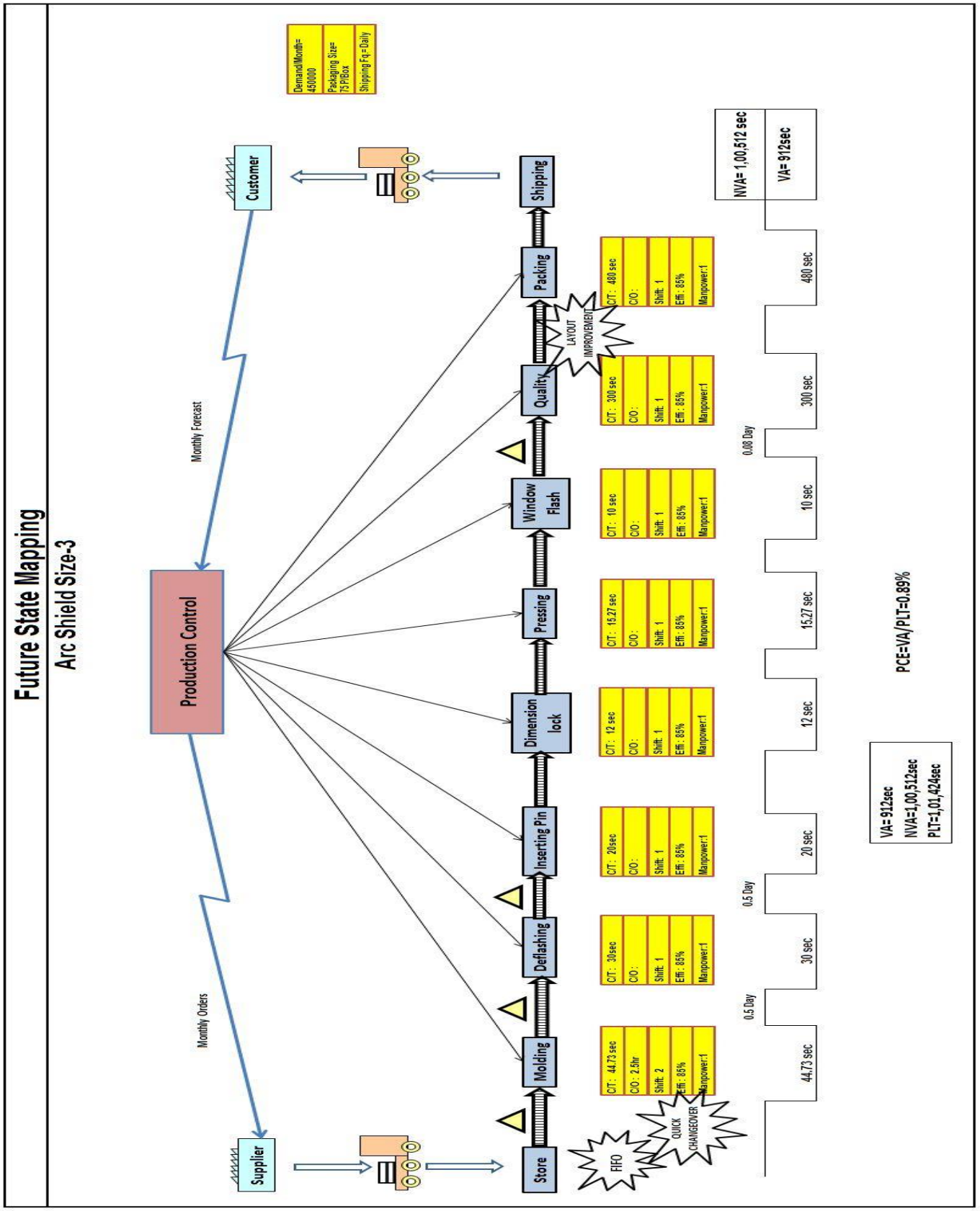

Fig. 3 Future State Mapping

4) Implement Improvement Plan.

Reducing Changeover tine or setup time is a vital part of most Lean implementations if you we to be able to reduce batch sizes and improve process efficiency. Quick Changeover as the name suggests allows us to reduce setup time if implemented well. Quick Changeover is used to record the activities required for changeover of tool. Quick Changeover classifies the activities in VA /NVA, Internal and external activities.

Steps followed during Quick Changeover:

a) Study the current changeover process. (Time study, observe and study the activities.)
b) Note down the activities.
c) Classify the external and internal activities. And also into VA and NVA
d) Separate Internal and External activities.

Mould Changeover Analysis

MACHINE:	Moulding Machine	IMM14											
DATE:	19-Dec-18					PAGE 1 OF 1							
Tools	Mould :	Arc Shield size 3											
	Setter :	GANESH AND VIJAY	Tools :	WAX COATING, IBOLT, D CLAMP, BELT, SPANNER, ALLEN KEY									
									Analysis				
SEQ #	START TIME	ACTIVITY / EVENT	Duration TIME	VA	NVA	INT	EXT	INTERNAL to EXTRNAL	Eliminate	Combine	Rearrange	Simplyfy	Investigate
1	00:00	Shut down machine.	0	1.0		1							
2	00:00	M/c idle (Serching Equipments)	12:00		1.0		1		Y				
3	12:00	Take Off Ejector Coupler	00:30	1.0		1							
4	12:30	Ejector Position Zero.	00:30	1.0		1							
5	13:00	Oil Remove.	03:17	0.7	0.3	1							
6	16:17	Apply protection spray on mold from Inside.	01:17	0.8	0.2	1							
7	17:34	Closing of Mold.	00:18	1.0		1							
8	17:52	Remove Ejector Connection.	02:38	0.9	0.1	1							
9	20:30	Fitting ibolt into Tie Bar.	00:30	0.1	0.9		1			Y			
10	21:00	Fitting of Tie bar into mold	06:30	0.8	0.2	1							
11	27:30	Searching	09:20		1.0		1		Y				
12	36:50	Wait For Crane	11:52		1.0		1		Y				
13	48:42	Water Removing	01:14	1.0		1				Y			
14	49:56	Move Crane to molding Machine	01:14		1.0		1			Y			
15	51:10	Fit Dclamp , Ibolt and Belt	03:30	1.0		1							
16	54:40	Untide of Clamp one side	03:00	1.0		1							
17	57:40	Untide of Clamp second side	01:40	1.0		1				Y			
18	59:20	Back Pattern	00:30	1.0		1							
19	59:50	Remove Ejector Rod	01:20	1.0		1							
20	01:10	Match ejector rod threads	02:00	0.2	0.8		1		Y			Y	
21	03:10	Put Hook on next mold	00:30	1.0			1			Y			
22	03:40	Carry Mold to Molding machine	02:40		1.0		1		Y				
23	06:20	NVA bring pallet	01:05		1.0		1		Y				
24	07:25	remove nipple of mold by spanner	05:39	0.6	0.4		1						
25	13:04	clamp ibolt and belt on loaded mould	03:00	1.0			1						

Mould Changeover Analysis

MACHINE:	Moulding Machine	IMM14												
DATE:	19-Dec-18													
Tools	Mould :	Arc Shield size 3												
	Setter :	GANESH AND VIJAY	Tools :	WAX COATING, IBOLT, D CLAMP, BELT, SPANNER, ALLEN KEY										
											Analysis			
SEQ #	START TIME	ACTIVITY / EVENT	Duration TIME	VA	NVA	INT	EXT	INTERNAL to EXTRNAL	Eliminate	Combine	Rearrange	Simplyfy	Investigate	
26	16:04	mould centring	03:39	1.0		1								
27	19:43	clamp fitting (A) side	01:18	1.0		1						Y		
28	21:01	clamp fitting (B) side	00:39	1.0		1				Y		Y		
29	21:40	clamp fitting (C) side	01:57	1.0		1						Y		
30	23:37	clamp fitting (D) side	00:53	1.0		1				Y		Y		
31	24:30	Serching Allen key	01:05		1.0		1		Y					
32	25:35	Remove mold Tie bar and take out the crane	03:32	0.7	0.3	1								
33	29:07	connections	02:25	1.0		1								
34	31:32	mould open	01:02	1.0		1								
35	32:34	Waiting For Side Core Setter	30:16		1.0		1		Y					
36	02:50	Fitting The Side Core	18:05	1.0		1								
37	20:55	Waiting for Skilled Oprator	03:49		1.0		1		Y					
38	24:44	Cleaning	02:13	1.0		1								
39	26:57	Cooling pipe connection	13:36	0.6	0.4	1								
40	40:33	Ajusting Air Supply	02:00	1.0			1			Y				
41	42:33	HRS Connectin	09:18	0.7	0.3	1								
42	51:51	Mold Cleaning and Setting	06:49	1.0		1								
43	58:40	cooling pipe connection proplem	02:14		1.0	1						Y		
44	00:54	Barrel Heating & Predrying of material	23:41	1.0		1						Y		
45	24:35	Again cooling pipe connection problem	05:00		1.0	1						Y		
46	29:35	HRS Heating	01:17	1.0		1								
47	30:52	change cooling pipes	25:00	0.2	0.8		1					Y		
48	55:52	Mold Cleaning	02:00	1.0		1								
49	57:52	Purgining + Machine setting	01:33	1.0		1								
50	59:25	1st Sample from Mold	01:35	1.0		1								
51	01:00	2nd sample	00:53	1.0		1								
52	01:53	10th sample	10:00	1.0		1								
53	11:53	OK Sample	01:00	1.0		1								
54	12:53	Mass production												
			Total	02:15	01:56	02:20	01:52							
			04:12											

Mould Changeover

MACHINE:	Moulding Machine	IMM14		
DATE:	19-Dec-18			
Tools	Mould :	Arc Shield size 3		
	Setter :	GANESH AND VIJAY		
				R1
SEQ #	START TIME	ACTIVITY / EVENT	Improvement action	Revised Time
1	00:00	Shut down machine.		
2	00:00	M/c idle (Serching Equipments)	Moulding Change Over Trolley	00:00
3	12:00	Take Off Ejector Coupler		00:34
4	12:30	Ejector Position Zero.		00:32
5	13:00	Oil Remove.		01:17
6	16:17	Apply protection spray on mold from Inside.		01:12
7	17:34	Closing of Mold.		00:01
8	17:52	Remove Ejector Connection.		02:32
9	20:30	Fitting ibolt into Tie Bar.	Make this Activity External	00:32
10	21:00	Fitting of Tie bar into mold		06:28
11	27:30	Searching	Moulding Change Over Trolley	00:00
12	36:50	Wait For Crane	Proper change over mold planning	00:00
13	48:42	Water Removing	This activity combine with other activity	00:00
14	49:56	Move Crane to molding Machine	To be done by other Helping Operator	00:00
15	51:10	Fit Dclamp , Ibolt and Belt		03:29
16	54:40	Untide of Clamp one side		03:04
17	57:40	Untide of Clamp second side	To be done by other Helping Operator	01:49
18	59:20	Back Pattern		00:32
19	59:50	Remove Ejector Rod		01:18
20	01:10	Match ejector rod threads	Make this Activity External (Done at mold m	02:15
21	03:10	Put Hook on next mold	Make this Activity External	00:30
22	03:40	Carry Mold to Molding machine	Make this Activity External	02:40
23	06:20	NVA bring pallet	Make this Activity External	01:07
24	07:25	remove nipple of mold by spanner		05:31
25	13:04	clamp ibolt and belt on loaded mould		03:16

Fig. 4 Changeover Trial-1

Mould Changeover

MACHINE:	Moulding Machine	IMM14
DATE:	19-Dec-18	
Tools	Mould :	Arc Shield size 3
	Setter :	GANESH AND VIJAY

SEQ #	START TIME	ACTIVITY / EVENT	Improvement action	R1 Revised Time
26	16:04	mould centring	Mold Centering Guide	01:00
27	19:43	clamp fitting (A) side	Replace the thread	00:50
28	21:01	clamp fitting (B) side	To be done by other Helping Operator	00:36
29	21:40	clamp fitting (C) side	Replace the thread	01:54
30	23:37	clamp fitting (D) side	To be done by other Helping Operator	00:56
31	24:30	Serching Allen key	Moulding Change Over Trolley	01:02
32	25:35	Remove mold Tie bar and take out the crane	Make Crane removal External	00:50
33	29:07	connections		02:22
34	31:32	mould open		01:06
35	32:34	Waiting For Side Core Setter	Proper planning manpower	00:00
36	02:50	Fitting The Side Core		18:03
37	20:55	Waiting for Skilled Oprator	Proper planning manpower	00:00
38	24:44	Cleaning		02:18
39	26:57	Cooling pipe connection		13:32
40	40:33	Ajusting Air Supply	Make this Activity External	02:04
41	42:33	HRS Connectin		09:15
42	51:51	Mold Cleaning and Setting		06:42
43	58:40	cooling pipe connection proplem	Make this Activity External	02:19
44	00:54	Barrel Heating & Predrying of material	Make this Activity External	23:36
45	24:35	Again cooling pipe connection problem	Make this Activity External	05:09
46	29:35	HRS Heating		01:22
47	30:52	change cooling pipes	Make this Activity External	24:05
48	55:52	Mold Cleaning		02:09
49	57:52	Purgining + Machine setting		01:08
50	59:25	1st Sample from Mold		01:31
51	01:00	2nd sample		01:02
52	01:53	10th sample		10:05
53	11:53	OK Sample		01:07
54	12:53	Mass production		
			Internal Activity	02:11:40
			External Activirty	00:43:02
				02:54:42

Fig. 5 Changeover Trial-2

III. RESULT AND DISCUSSION

By Taking Trial-1 and Trial-2 the Changeover time is reduced which is shown in following graph:

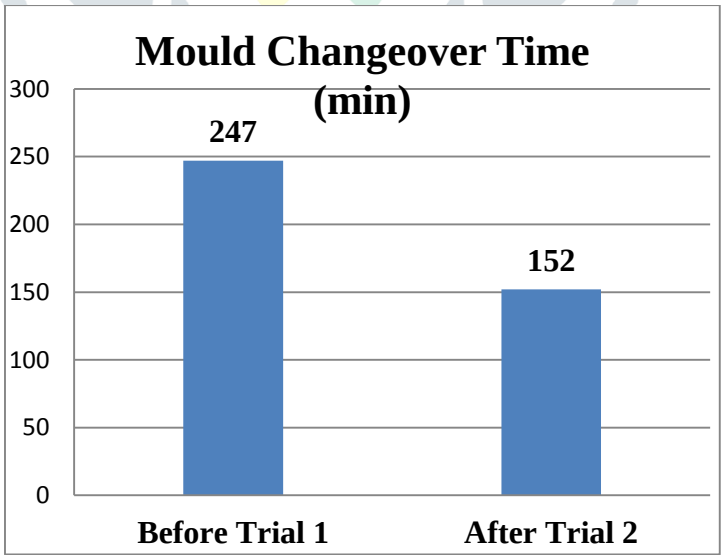

Chart. 1 Before & After Comparison of Setup Time

IV. CONCLUSION

Spectrum Electrical Industries Limited is one such industry which looked for improvement in productivity and by effective and successful implementation of VSM methodology has found increase in productivity and hence profit level increases. The Quick Changeover system was implemented at Spectrum Electrical Industries Limited successfully. The Setup Time was reduced from 247 min to 152 min. And by implementing other Lean tools the Process cycle efficiency is increased by 16%.

V. ACKNOWLEDGE

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