CASE STUDY OF LEAN IMPLEMENTATION AT RAMDEVS MOTORS, COIMBATORE

BACKGROUND

Ramdevs Motors, an OE manufacturer of centrifugal pumps, started their assembly facility in 2010. At the time of project initiation, they were assembling 80 pumps per day.

An initial discussion with the managing partner of the company to understand the vision and mission of the organization, was followed by process walk through in the plant to study the processes, operations and the value stream of the components. The following were the strategic goals for Ramdevs Motors for 2011-12:

- To improve the productivity of the pumps from 80 units per day to 150 per day,
- To improve the material storage and handling processes

It was expected that these goals would be primarily addressed through the year long lean implementation exercise in turn supported by strategic investments and policy changes, where required. KIAP was appointed to guide the Light Engineering Cluster in implementing lean under the Government of India's NMCP scheme and thereby supported Ramdevs through the year 2011-12 in achieving the said goals.

Diagnostic Study

The Lean journey commenced with a current state assessment and road map setting exercise. Since, all the variants of the centrifugal pumps were manufactured at that time were having similar process steps, it was considered as one product family and the current state of the manufacturing process was defined in a Value Stream Map.

The VSM was made using actual cycle times measured for each activity involved in the manufacturing process . The inventories, number of operators involved were also physically verified on the shopfloor. The summary of the VSM is shown below.

Customer Demand Rate

		Current	Target
Customer reqmt	(Nos/month)	2000	3750
Demand rate	Nos per day	80.0	150.0
Takt time	(minutes)	**5.6**	**3.0**

Target for the line is deliver one pump every 3 minutes.

Process Data

Operation/Process	Available resources		Cycle time	C/O time	WIP	WIP	Availability	Effective capacity
	Mcs / W.Stns	Man	(min)	(min)	(Nos)	(min)	(%)	(nos / day)
Winding	1	4	6.35	2	0	0	90%	63.7
Winding Inspection	1	1	1.3	0	0	0	90%	311.5
Varnishing		1	1	0	0	0	90%	405.0
Motor Pressing		1	1	0	20	10	90%	810.0
Adoptor Assy		1	1	0		0	90%	607.5
Rotor Cleaning + bearing pressing + punching		1	5	0	40	196	90%	82.7
Motor Testing	1	1	4.0	4		0	90%	101.3
Ceramic Fixing + Impeller Fixing + Paper Gasket		2	2	0		0	90%	270.0
Pump Testing	1	1	4.0	4		0	90%	101.3
Flange Fixing		1	0.5	3	30	14.4	90%	843.8
Painting		1	2			0	90%	242.5
Finishing		2	3			0	90%	160.1
Packing		1	4.3			0	90%	94.0

Inferences

	Cycle time	C/O time	WIP
Total time per unit output (minutes)	33.2	13.0	220.4
Throughput time	626.6 minutes		
VA ratio	5.30%		
Plant capacity (bottleneck)	63.7		
Constraint	Yes		
Bottleneck process(es)	Winding		
	Motor Assy		
	Motor Testing		
	Pump Testing		
	Finishing		
	Packing		

Baseline Study

At the time of our initial observations, the plant capacity was 80 pieces per day. The Target Production agreed as 150 pieces per day with a Takt time of 3 minutes.

Productivity

18 employees were working in the shop-floor of which 4 were in the winding section. Assembly line cycle time total was 26 minutes, which meant that only 2080 minutes of employee time is utilized against the available 8100 minutes which is about 25%. This showed the huge potential to increase output with existing resource with proper line balancing itself.

VA Ratio

Value adding ratio is only 6% which also suggested a large scope for improvement.

System Potential

From the initial observations of the shop floor, we envisaged at least 150 units per day production. Winding and testing of pumps and motors are the main bottleneck activities identified. A lean roadmap was then prepared which would be a step by step guide towards the final objectives.

LEAN ROADMAP

SNo	Current State Observation (Muda Identification)	Action Plan									Expected Results
		Action	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
1	In Motor and pump testing, winding and packing - Material arrangements and multiple handling.	***Process study and Muda elimination*** to improve the productivity.									Improvement in throughput – 150 nos per day.
2	***Material Feeding:*** Materials stored in the ground – no material feeding systems.	Proper design of material storage and feeding.									Reduction in fatigue, throughput time and increase in people productivity.
3	Current workstations in the conveyors are located far away from each other resulting batching and consequent handling.	***Single Piece Flow***: Establishing Single Piece Flow except varnishing / curing, ***Cycle time balancing***.									Reduction in throughput time and increase in productivity.
4	Winding area – high WIP observed.	Implement flow production – Train the people.									Reduced WIP of the stators – to be quantified.
5	***Create Pull***	***Takt based production, Kaizen, 5S, Poka-Yoke***									Standardisation and Pull based production.
6	***Synchronisation***	Align support activities – SOPs, visual monitoring systems,									Sustenance of Lean Manufacturing

Implementation Methodology

KIAP has a unique intensive workshop methodology to improvement and problem solving in strategic areas. 2-3 day workshops were conducted in each stage taking up projects in accordance with the lean roadmap. During these workshops, process improvement and Problem Solving are accelerated thereby giving significant improvement.

In each workshop, cross-functional teams were formed, each team working on improvement of one strategically important area. Over a one-year period, participation was ensured from all functions including finance, stores, marketing and HR. The participants in the workshop simultaneously learn the relevant lean tools and techniques by actually implementing them. Top Management (owner) commitment is the pre-requisite for the success of any such initiative and this was obtained by their physical presence during the presentation/ experience sharing sessions at the start and end of each day of the workshop.

Standardization of the improvements made was reviewed within 3-4 weeks after each workshop. In Stage IV and V, concepts like 5S and Autonomous Maintenance/Planned Maintenance were introduced to ensure long term sustenance of all improvement made in the unit and bring in the culture of continual improvement.

Internal Kaizen Champions were identified at the outset and they coordinated with KIAP consultant as well as participated in all workshops as they would be responsible for sustaining and building upon this initiative in the long run. These champions will have therefore learned all relevant tools, techniques and concepts as well as understood from KIAP the process for bringing about and sustaining change.

A list of major improvement and sustenance projects is given below; each project is detailed out in the following section for better understanding:

1. Change from batch layout to single piece flow layout
2. Reduction in cycle time in bottleneck activities through Line Balancing and workstation design
3. Eliminating non value adding activities through kaizens
4. 5S for standard work practice

Improvement Projects

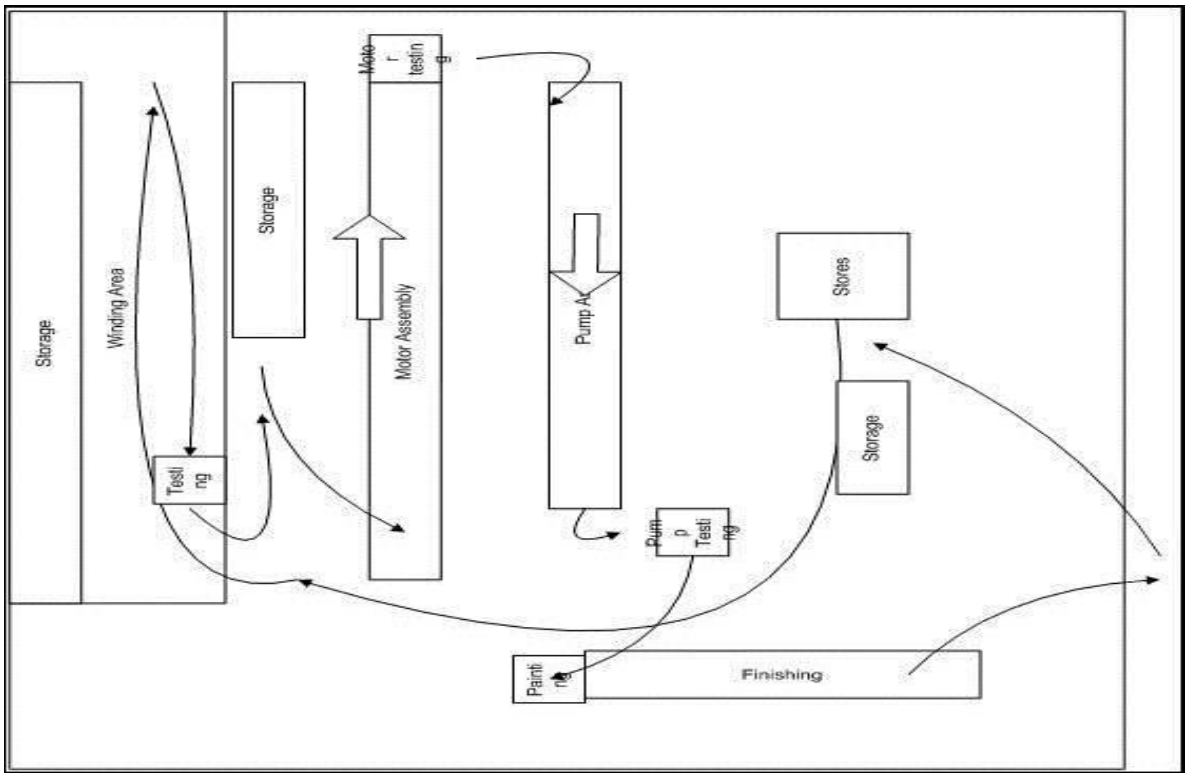
Project 1 - Change to single piece flow layout

The existing process was observed by a cross functional team right from raw material receipt to finished good storage. A *Muda* walk was done where the team followed the material as it moved through various stages in the plant.

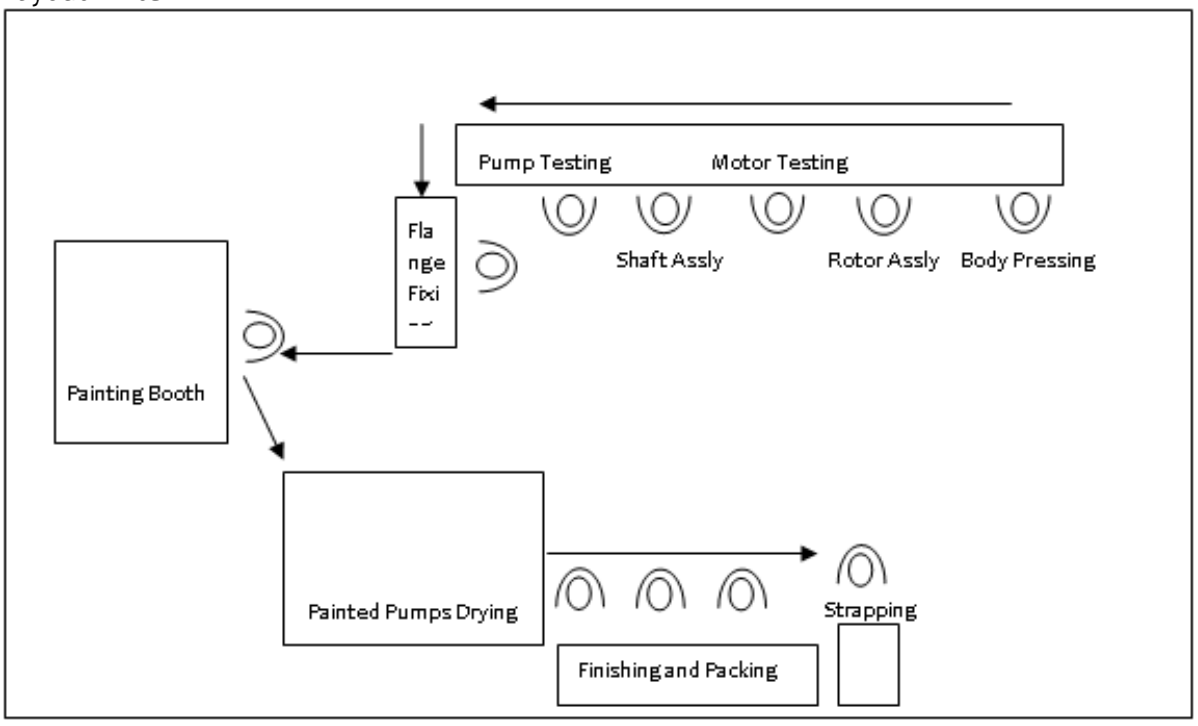
The layout was made to support batch processing; Larger tables occupying the assembly area both for storage and working. The production area was filled with WIP material blocking the way for material feeding to the assembly stations. Some materials were stored on the ground.

Layout was then changed to establish one piece flow in the assembly. The area was cleared off and a feeding system established. Mobile multi-stage opening bins were provided for material movement and storage near the point of use. The lay outs of before and after implementing Second stage are shown below.

Layout - Before

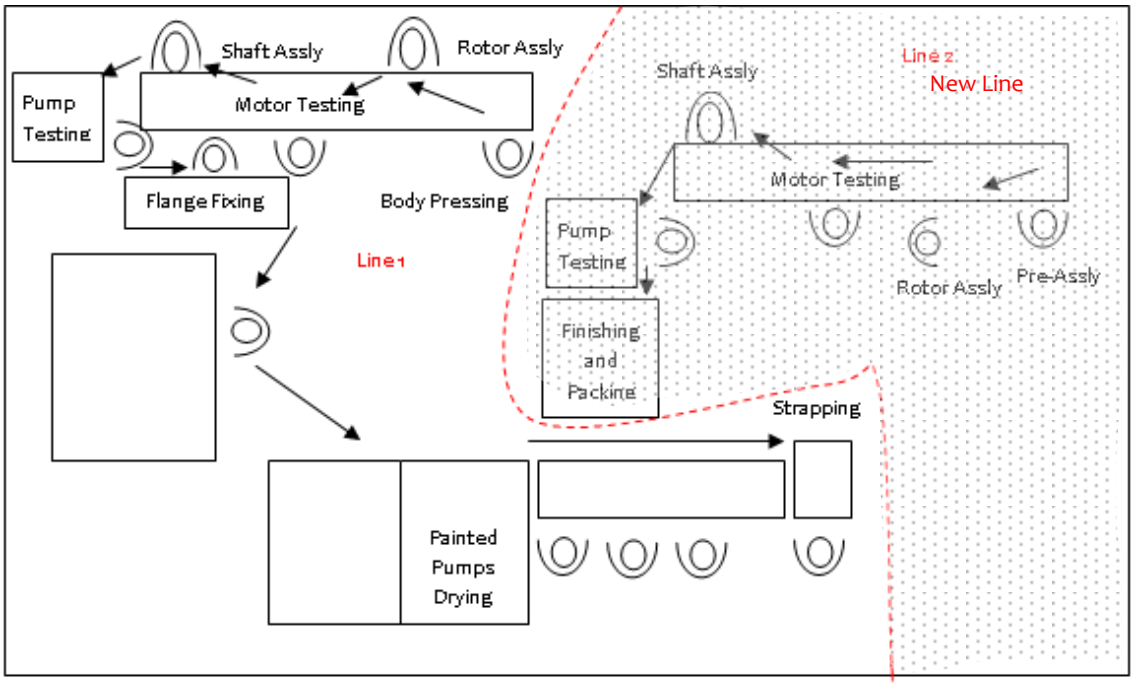


Layout - After



During the project, the demand for a new product (mini pump) increased considerably again doubling the requirement from the unit. There were significant differences between the process and sequence of new model and the regular ones resulting in the need for a new assembly and packing line. During the final stage of implementation, it was also decided to reduce the length of the existing line so that the strain for the

operators to pull and push the pumps gets further reduced and the entire space requirement for the line gets reduced by 40%. The layout made for the two lines is given below.



Project Results

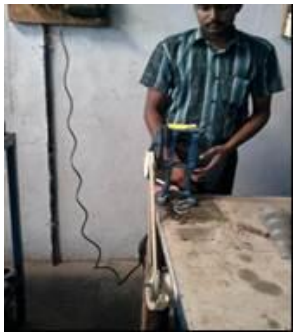
- Assembly Throughput time got reduced to 23 minutes from 37 minutes
- Assembly throughput increased from 80 pumps per day to 200 pumps per day for one line. With second line, capacity has further increased to 400 pumps per day.

Project2 - Reduction in cycle time in bottleneck activities

From the VSM, it was clear that the cycle times of operations were not equal and the accumulation of WIP between the operations after changing the layout as per flow suggested the same. Hence, the team was assigned with the task of balancing the cycle times using the concepts of Heijunga and workstation design. The improvements done are as below.

Before	**After**
The motor assembly was found to be the bottleneck with a cycle time of 496 sec (8.3 min). Preceding operation body pressing had cycle time of 170 seconds and succeeding operation motor testing 114 seconds.	Load leveling (heijunka) was done – wiring activities are shared with body pressing operation and numbering is shared with motor testing and a leveled cycle times of 150, 130 and 125 seconds were achieved for the three operations.

Before	**After**
The next higher cycle time was for pump testing, which was also carried out in as an off line activity batchwise.	Pump testing was integrated into the assembly line, giving immediate feedback on defects to the preceding operators. The duration of running test was reduced to 2 mins from 3 mins (value based on the requirement).

Before High level of WIP observed in the winding area, due to mismatch in cycle times. 	**After** The cycle times were balanced (hijunka) workstations were designed. Strained operations like wire rolling and coil pressing were assisted with autonomation.  
Before  In winding, operator found searching for tools like soldering rod etc., each time.	**After**  Workstations were designed.
Before  In winding, operation 2, often there is confusion between two coils as they are kept together after winding.	**After**  Introduced clamping of different rolls of coils at winding itself – making it easy for winding by eliminate tying with thread and eliminating mix up, confusion and resulting delay.
Before  Finishing, Final inspection and Packing are done in batch process.	After  The Finishing, Inspection and Packing brought into the flow with appropriate workstation design.

Project Result:

- Winding capacity increased from 25 numbers to 125 per day
- Packing capacity increased from 80 pumps to 150 per day.

Project 3 - Eliminating non value adding activities through kaizen

The team spent a day in observing the entire process from raw material stage. The major observations were analyzed in detail and kaizen based solutions were implemented.

Observation (before)
Operators searched for Tools and accessories were stored under the table resulting in fatigue to the operators.

After Kaizen
Work stations were designed to support the operators eliminating the need for searching and bending.

Before
A torch light is used to see the stator number under the thermal box.

After
Illumination is improved and the number is visible without torch light.

Before : In the motor testing, all the capacitors are stored in a bin. The inspector had to pick the required capacitor each time for testing.

After: Required work instructions at pump assembly made visual work instruction and displayed. The assembly work station improved by storing the components in the sequence of use and left and right hand side differentiation.

The capacitors are placed on the tool board. The inspector can pick the required capacitor for the model and place it on the stand provided. So that picking up and keeping back the capacitor each time for testing is eliminated. The capacitor could be readily connected without handling it.

Project Result :

Cycle time per pump got reduced from 6 minutes to 2 minutes.

Project 4 - 5S for Standard Work Practice

Once the layout was changed and non value adding activities minimized the process was ready to be standardized and sustained. At this stage 5S was implemented by the team keeping in mind the arrangements required for the lean flow manufacturing. 5S is a cultural change issue and hence all parts of the unit including office was included and the concerned people trained. Two 5S audits were done by KIAP consultants to review and support the implementation after which the initiative was handed over to the internal kaizen champion.

Observation (Before 5S)	**After 5S**
	
The pumps require a drying time of minimum 2 hours. So, we need to store atleast 60 pumps on a table. After drying, pupms are stored in a stationery table. Handlng of pumps created muda and muri to operators. When the volume got increase, space for keeping painted cpmponents became a constraint.	Multi-Layer storage provide with wheels (movable racks) saving space and eliminating the movement of operators'.
	Workstations designed all the tools were arranged in the sequence of their use and to ease the pickup and use.

Before

Materials are stored in the bins as received. Counnting, Searching, stock taking to reconcile materials were frequent occurences.

After

All the racks are identified with rack numbers along with shelf numbers. Frequently used items are stored in the easy to access areas. Count free storage system was implemented.

Visual Management

Management Information made visual at shop floor

In Incoming Inspection, Master Samples of Incoming Components are (approved samples) displayed as ready reckoner.

Info board system started for displaying the trend of incoming material defects.

Visual Work insturctions were made and displayed at prominent locations –

At Inward Inspection

In Assembly

Results : The unit got a 5S score of 48% in first audit which went upto 60% in second audit.

SUMMARY OF RESULTS OBTAINED

Process Level Results

The improvement projects done had a direct impact at the process level since the focus was on improving methods of work through eliminating and minimizing Muda and Muri across the value stream. A summary of the main results is given below:

Parameter	Before	After lean	Improvement	Impact on business
Cycle Time per pump (mins)	6	2	66% reduction	Increased productivity
5S Score	48%	60%	12% increase (against 100%)	Increased safety and Morale and reduced strain

Business Level Benefits

The process level results in turn combined to benefit Ramdevs' business as a whole in the following aspects:

Parameter	Before	After lean	Improvement	Business Impact
Production Rate (Nos/Day)	80	200	250% increase	Turnover goes up by fulfilling more orders
Space Utilisation	1 Assly line	2 Lines	100 % more production in the same space	Space utilisation

The benefits obtained have spurred Ramdevs to start taking in more orders and increased their focus on business development. An internal lean champion is now carrying on the lean initiative to sustain the gains made in year one.