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Introduction to the Case Industry and Identification of Critical Product

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ABC case study has been carried in a leading food product manufacturing unit, located near Ludhiana, Punjab, India using VSM, having annual turnover approximately Rs. 15 million ($0.23 million). This organization was started in 2001 and is an ISO certified company. The company employs 400 personnel including workers, supervisors, engineers and also top management. The most valuable product of the organization is pressure type juicer machine. But the organization was not being able to complete the customer's demand. Because a lot of time being wasted in the manufacturing of pillar rod (one of the most essential parts of juicer machine). The problems faced by the selected organization are:

- Insufficient layout of the organization.
- Unnecessary movement of material from one place to another which in turn leads to the wastage of time as well as workforce.
- Production lead time & WIP inventory were very high.

The organization is manufacturing all types of commercial and domestic food processing products. But the most valuable product of ABC organization is pressure type juicer machine. Pillar rod is the most essential part of juicer machine, which was selected on the basis of excessive wastage of time in manufacturing as compared to other parts. (1) Production lead time was very high as comparison of others and (2) In-process inventory was also high.

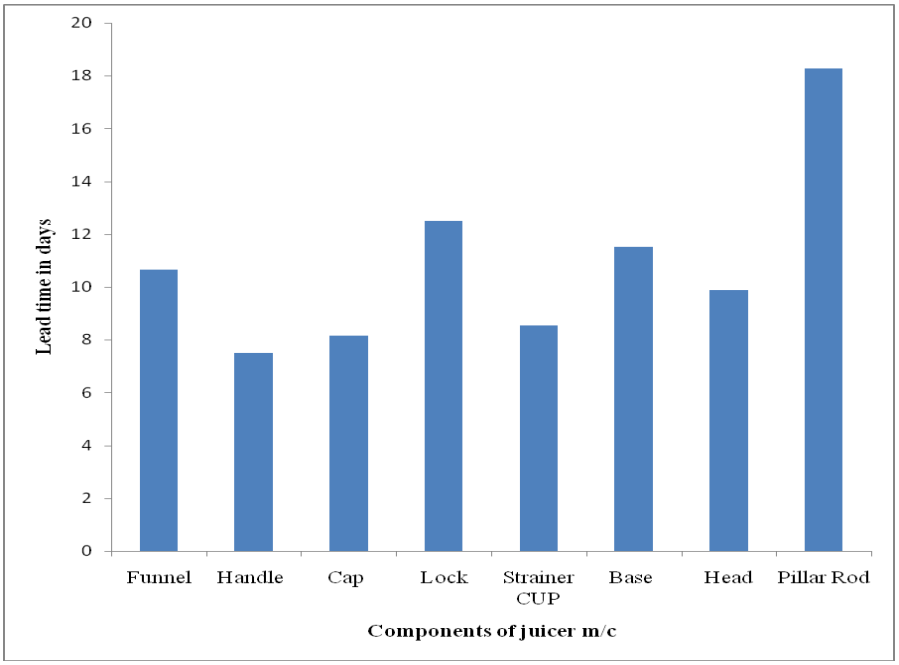

Figure 1. Comparison of Lead time of Juicer machine's Components

The products must be delivered to customer within 35 days (by truck) and 43 days (by sea) after receiving the order from the customer. The length of pillar rod is 400 mm and its respective diameter is 30 mm.

Calculation of Takt Time of Operations

In this study, the data collection was involved the time study, workforce and material movement of all processes of Pillar rod. The cycle time was noted of every operation and the time study of distance moving from one workstation to another. The data was collected by consulting the workers, foreman etc. In manufacturing of Pillar rod, the various operations used were, Cutting, Turning, Drilling, Tapping, Grinding, Assembly and Packaging. Table 1. shows the information about the cycle time of every operation and workforce involved to complete the number of operations.

Table 1. Cycle time study and workforce

S. No.	Operations	Cycle Time (In sec.)	Number of workers
1.	Cutting	154	2
2.	Turning	70	1
3.	Drilling	25	1
4.	Tapping	20	1
5.	Grinding	70	2
6.	Assembly	12	2
7.	Packaging	125	4
	Total	476	13

Confinement of the study in our current layout is restricted to material handling only. The movement of partial synthesized product is done by workforce. The total distance between all the workstations in manufacturing of pillar rod is 39.5 meters and workforce involved is 4.

Table 2. Current distance traveled by material and workforce required

Sr. No.	From	To	Distance (in meters)	Workers
1.	Raw Material Storage	Cutting	0	0
2.	Cutting	Turning	5.5	1
3.	Turning	Drilling	14	1
4.	Drilling	Tapping	0	0
5.	Tapping	Grinding	8	1
6.	Grinding	Assembly	3	0
7.	Assemble	Packaging	1	0
8.	Packaging	Storage	8	1
Total			39.5	4

TAKT time is the calculation which shows the company must be manufactured a component/machine to satisfy the customer demand on-time.

Demand = 5000 pieces per month Working days per month = 25
(Gazetted holidays and Sundays excluded)
Number of shifts per day = 1 Working hours per day = 8hrs (9:00am to 5:00pm)
Available time per day = 480min. Net working time per day = 480 - 40 = 440min.
(Excluding 30min. Lunch break and 10 min. Tea break) Total working time per day = 440*60 = 26,400sec.
TAKT time = Total working time per day / Customer demand per day = 26400/200 = 132sec.
The following figure 3.3 shows cycle time of current state at different workstations. This figure shows the cycle time of one operation (i.e. cutting) is above the TAKT time.

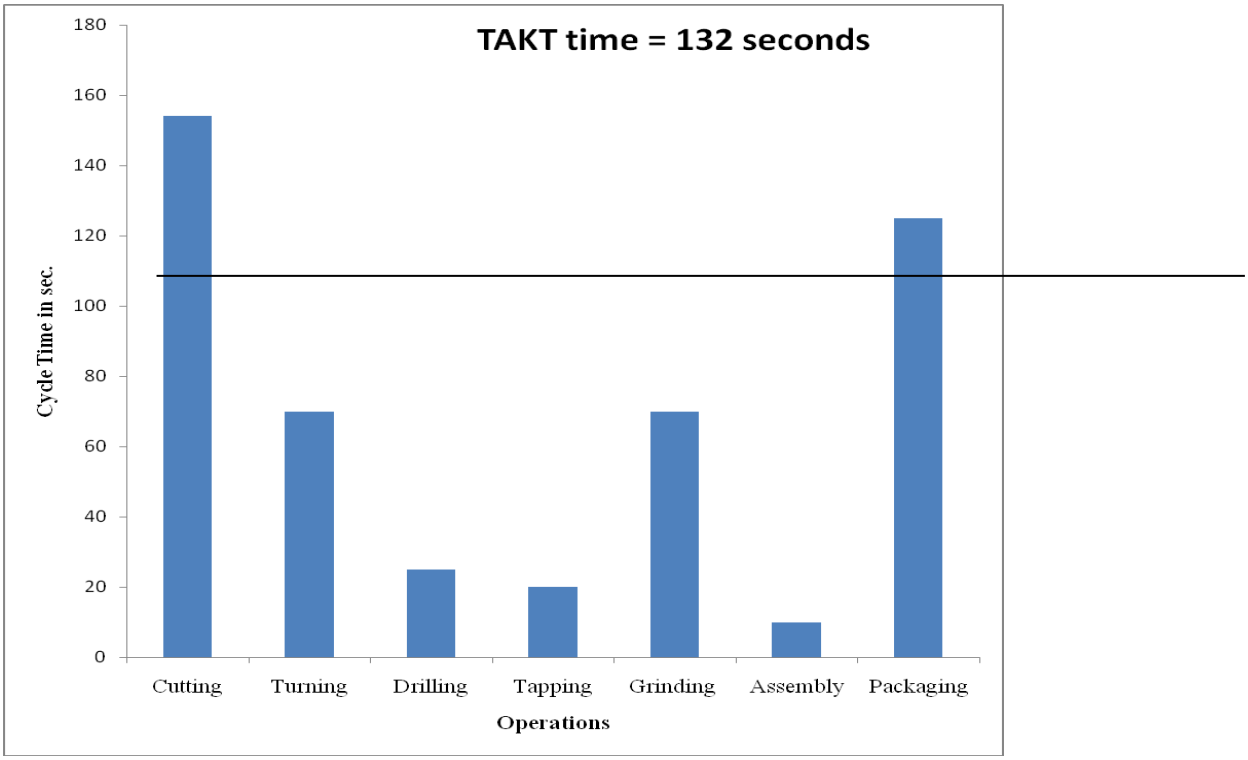

Figure 2. Current state processing time at different workstations

Current State Map

Current state map is arranged by taking the data from the selected department and also by consulting the workers, foreman etc. The order comes from the customer to marketing department of ABC organization. After forecast the exact demand, the marketing department sends this information to the production planning and control (PPC) department which further sends it to the Material requirement planning (MRP) department. MRP department sends it to different suppliers by physically or electronic media. The material starts from raw material to become a finished product through a number of operations including, Cutting, Turning, Drilling, Tapping, Grinding, Assemble, Packaging. Work in process inventory between the operations is shown with triangles. The timeline shows the lead time (in days) at the top and processing time (in sec.) at the bottom of value stream map. It contains the entire conversion process from raw material into finished product. VSM is purely a pencil and paper work which shows the information flow and material flow of a product. The major steps involved in mapping are as follows:

- An A3 size (or 12x17 inches) paper taken and draw various icons which representing customer, marketing/controlling department and supplier are being displayed with enough gap.

- All the entries are done to make a record of monthly/daily requirements of each product along with the amount of containers.
- Dispatching and receiving data are shown with the truck using direction arrow for movement of material.
- The bottom of the map is being displayed with the manufactured/assembly operations with the upstream operation on the left side and downstream operation on the right side.
- Work in process inventory between the processes displayed with the help of triangles.

Figure 3 shows the current state map of Piller Rod and Figure 4 shows the present Layout of the organization.

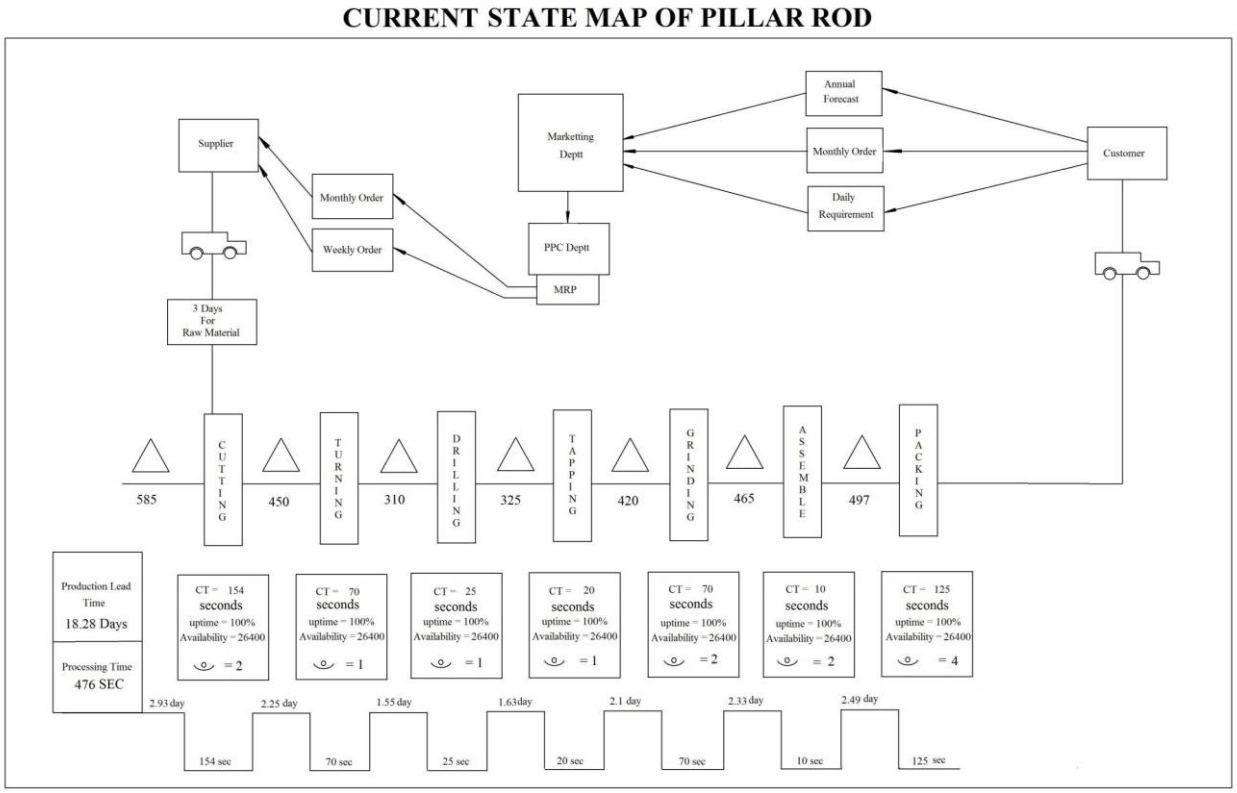

Figure 3. Current state map of pillar rod

Analysis of Current State Map

After studying the current state map, it was found that there is lot of wastage of time in manufacturing of pillar rod product. The wastages shown below:

- The production lead time was very high 18.28 days & Work in process inventory 3052 in b/w processes.
- Wastage of time in movement of material from turning process to drilling process. The distance between both the processes is 14m and it was covered in 1.30 min. physically by a worker.
- Total processing time was 476 seconds & total worker involved was 17.
- There were one process (i.e. Cutting) having processing time more than the TAKT time.

Apart from the process explained above, the production of pillar rod process involves one operation that was covered in TAKT time very well but that was particular contributing towards waste and improvements to be carried on in area.

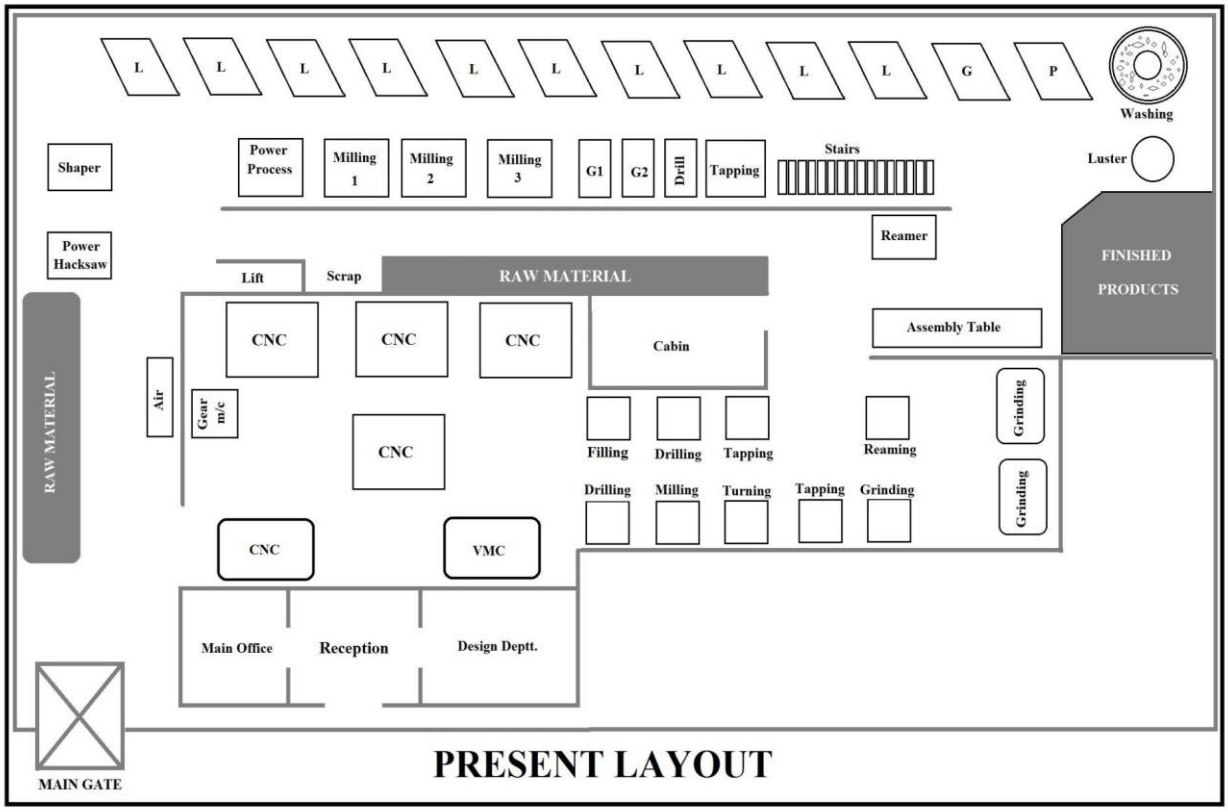

Figure 4. Present layout of the organization

Reason behind the wastages is due to lack of communication between the operator and supervisor. Secondary reason is that mostly the labour is working on the contract basis. Tertiary reason is that much similar kind of products in process. As the labour is working on contract basis therefore their daily wages are set by the management itself on the basis of the kind of operation and the quantity of products to be manufactured. The quantity varies inversely with the cost of operation. If the quantity is then the cost of per unit operation is reduced and if the quantity is less than the price of per unit operation is increased considerably. All the above-mentioned operations needs a keen observation but along with those operations of pillar rod production. We also need to lay great emphasis on the TAKT time which was contributing towards wastage and a sincere effort has been carried out to prevent the wastage.

Table 3. Analysis of current state map of pillar rod

Operations	Cycle time (in sec.)	Work in process inventory	Lead time (in days)
Material Arrangement	0	0	03.00
Cutting	154	585	02.93
Turning	70	450	02.25
Drilling	25	310	01.55
Tapping	20	325	01.63
Grinding	70	420	02.10
Assemble	12	465	02.33
Packaging	125	497	02.49
Total	476	3052	18.28

Proposed Changes for future state Map

Some of the alterations were suggested for future state map which are as follows:

1. Cutting Operation

Cutting of pillar rod was done with power hacksaw machine. It involves 154 sec. of cycle time having;

Product loaded = 6 sec. Cutting period = 145 sec Product unloaded = 3 sec.

The value added time was very high. So, the main point of view was to reduce the value added time. The operation was being done by using power hacksaw machine. But if the organization used metal cutting band saw machine. Then it will lead to the reduction of value added time.

2. Movement of material

The distance travelled by the material from turning station to drilling station is 14m and this distance is covered in 1.30 min. physically by a worker. It leads to the wastage of time, workforce and useless movement of material.

By allocating the new respective position of the machines (i.e. Drilling and Tapping) and it will reduce the above mentioned wastages moreover the movement of material will not need any kind of worker.

3. Packing Department

In recent years packing operation was accomplished under four steps by four individual workers with their own respective operations. These were as follows:-

- Lifting and hanging over the juicer machine.
- Covering the juicer machine in polyethylene pack one after the other.
- Placing the covered juicer machine in the container.
- Sealing the container.

On careful observations we find that second and third operation can be merged together in order to reduce the number of operations and the manpower.

Future State Map

Few alternations have been done in the current state map and a future state map has been developed. All the changes have been introduced in the future state map in the manufacturing process of pillar rod. Future state map looks entirely different from the current state map. It has been shown below. The salient features of the future state map are as follows

- By allocating the new positions of the machines (i.e. Drilling and Tapping), the movement of material has been reduced from 14m to 1m.
- Manpower has been reduced from 17 to 14.
- Operating time has been reduced from 476 sec. to 406 sec.

- WIP has reduced from 3052 to 2510.
- Lead time is reduced from 18.28 days to 15.56 days

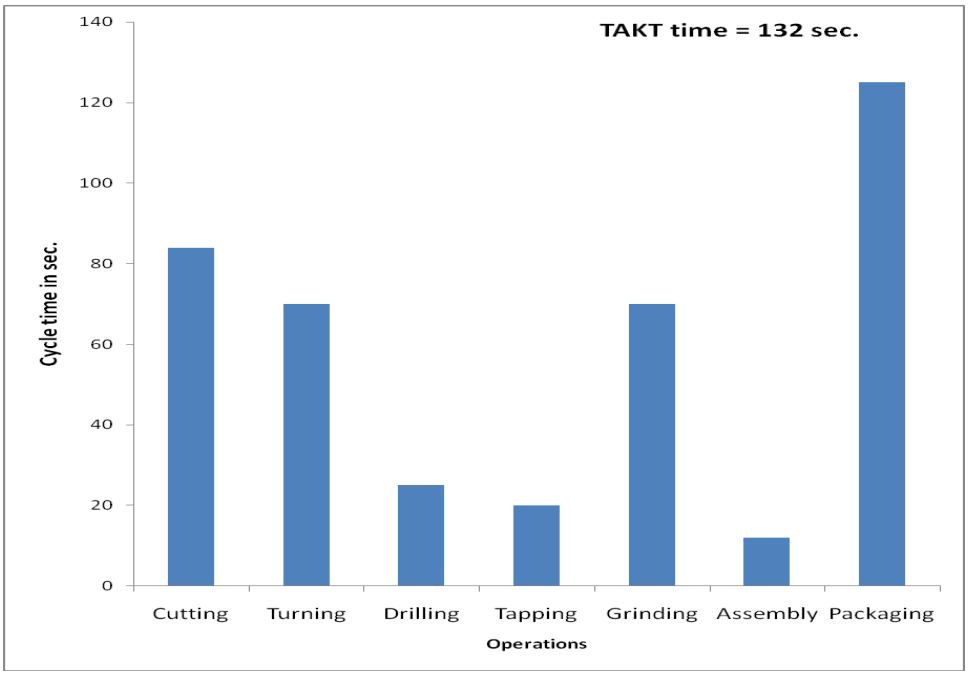

Figure 5. Future state processing time at different workstations

The following figure 5. shows cycle time of future state at different workstations. This figure shows the cycle time of all operations below than the TAKT time.

Analysis of current state map helps to identify waste such as path distance between theworkstations and extra laboue applied as th`e current layout is not a line assembly and is restricted to some of the parameters. Hence new layout is reduced the path between the workstations and manpower to the greater extent i.e. reduction of the distance between workstation came upto 24.5 meter and workforce are reduced to 3 from 4.

Table 4. Future distance travelled by material and workforce required

Sr. No.	**From**	**To**	**Distance (in meters)**	**Workers**
1.	Raw Material Storage	Cutting	0	0
2.	Cutting	Turning	5.5	1
3.	Turning	Drilling	1	0
4.	Drilling	Tapping	0	0
5.	Tapping	Grinding	6	1
6.	Grinding	Assembly	3	0
7.	Assemble	Packaging	1	0
8.	Packaging	Storage	8	1
Total			24.5	3

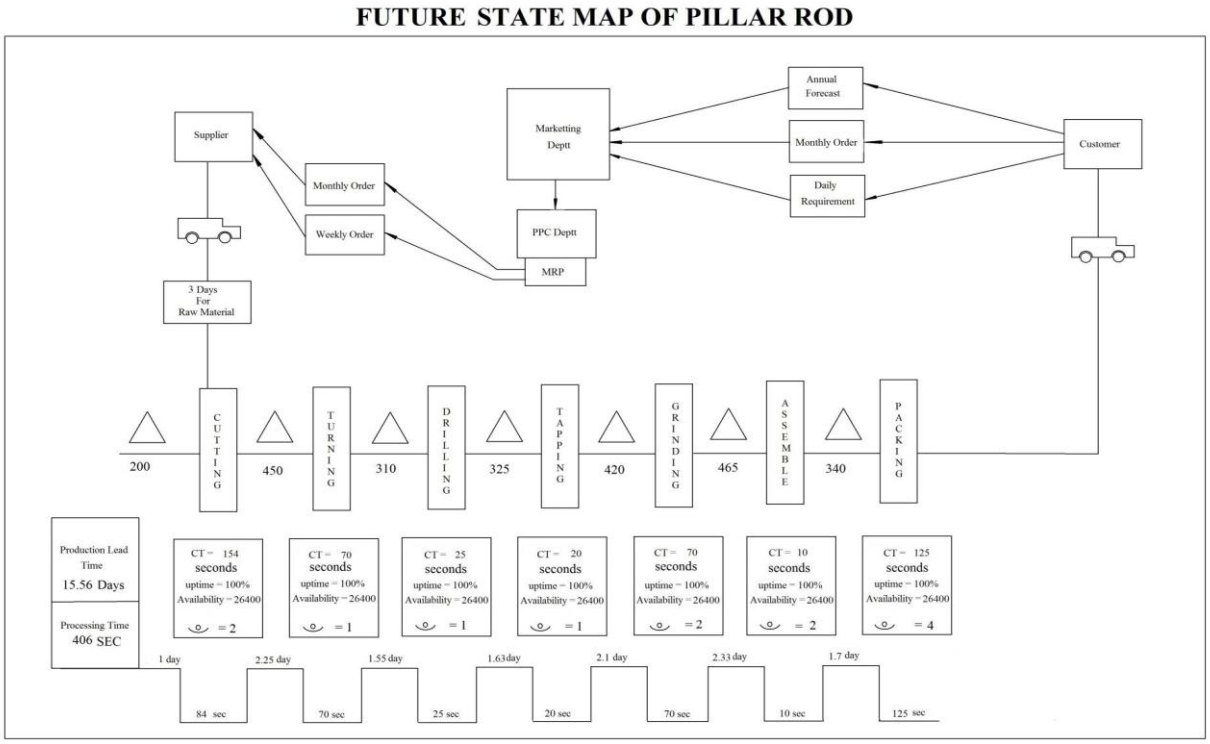

Figure 6. Future state map of pillar rod

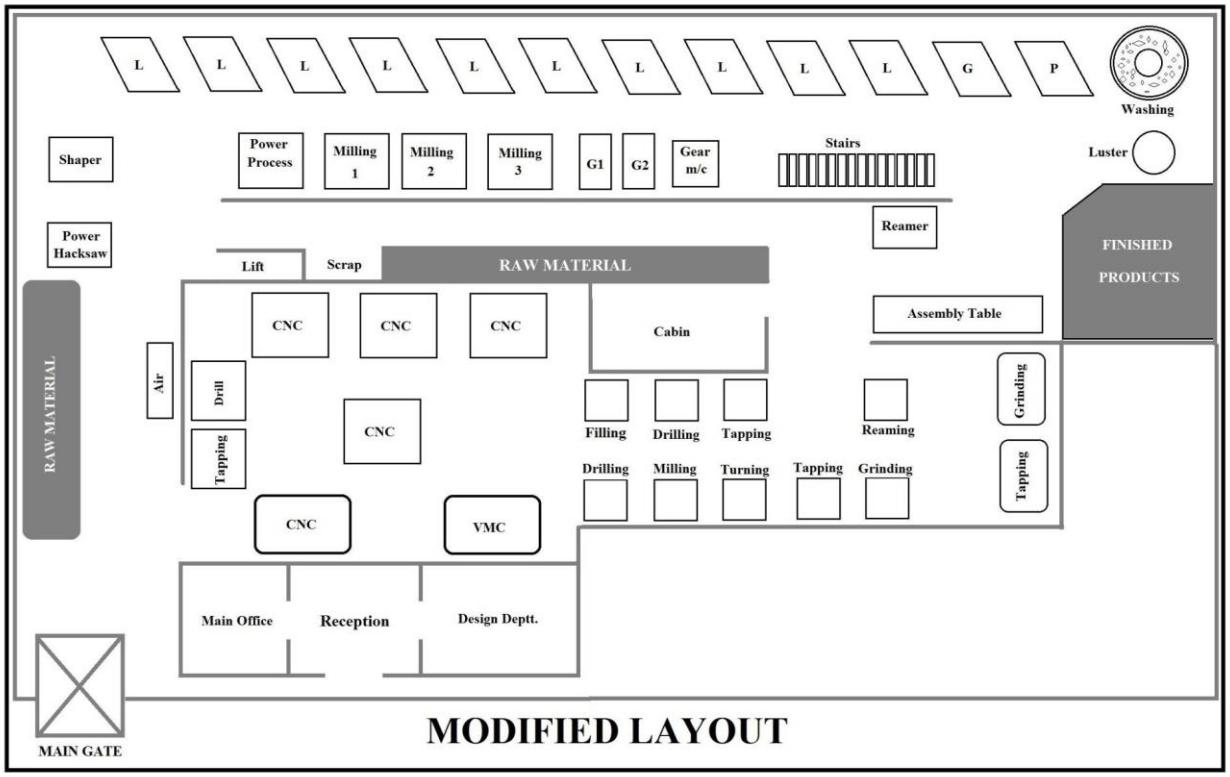

Figure 7. Modified layout of the organization

Comparison of current and future state

The table 5. shows the comparison b/w the current state map and future state map of pillar rod. There are as follows:

Table 5. Comparison between the current state and future state

S. No.	Performance	Current state	Future state	Reduction (In %)
1.	Cycle time	476 sec.	406 sec.	14.71
2.	Production lead time	18.28 days	15.56 days	14.88
3.	Work in process inventory	3052	2510	17.76
4.	Workforce (Operator + Process shifter)	17	14	17.64
5.	Movement of material (distance)	39.5m	24.5m	37.97

The comparison between the current state and future state shows that the cycle time of the pillar rod was reduced by 14.71%, Production lead time was reduced by 14.88%, WIP inventory was reduced by 17,76%, Workforce was also reduced by 17.64% and total movement of material from one place to another was reduced by 37.97%.

The following figure 8. shows the comparison of all operation which is used in manufacturing of pillar rod.

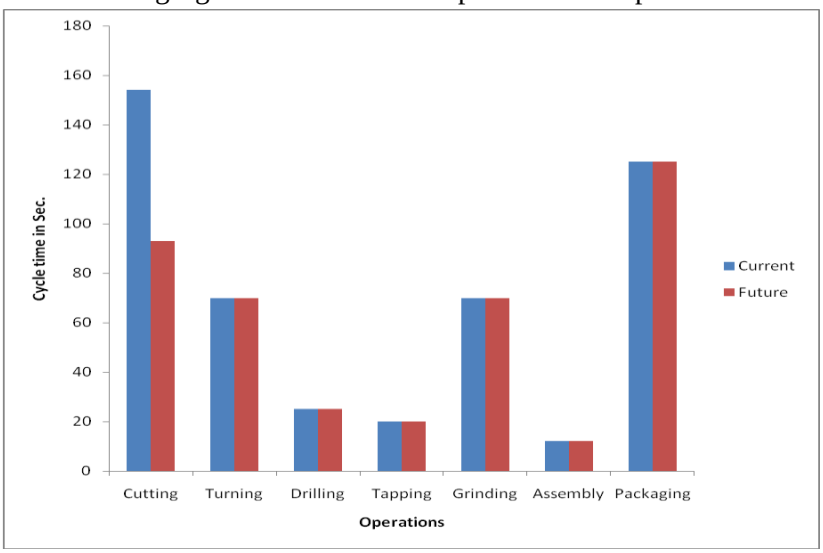

Figure 8. Comparison between the operations of current and future state

The following table 6. shows that the comparison between the current and future states of distance travelled by material from one workstation to other workstation and workforce required for material handling.

Table 6. Comparison b/w current and future distance travelled and workforce required

Sr. No.	From	To	Distance (in meters)		Workers	
			Current	Future	Current	Future
1.	Raw Material Storage	Cutting	0	0	0	0
2.	Cutting	Turning	5.5	5.5	1	1
3.	Turning	Drilling	14	1	1	0
4.	Drilling	Tapping	0	0	0	0
5.	Tapping	Grinding	8	6	1	1
6.	Grinding	Assembly	3	3	0	0
7.	Assemble	Packaging	1	1	0	0
8.	Packaging	Storage	8	8	1	1
Total			39.5	24.5	4	3

Results and Discussion

1) Cutting Operation

Earlier cutting operation was done by two workers and this operation was done by Power hacksaw machine. The main drawback of this process was that the value added time was quite high and the main point of view was to reduce this value added time. The introduction of metal cutting band saw machine leaded to the reduction in value added time. The table 3.4 given below shows the difference between current state and future state of cutting operation and it includes value added and non value added activities. Value added time is defined as the time required to provide actual value to the product whereas non value added time is defined as the time which doesn't enhance any value of the product.

Table 7. Comparison between current state and future state of cutting operation

CUTTING OPERATION			
Operations	**Current state (In sec.)**	**Future state (In sec.)**	**Reduction (In %)**
Product loaded	6.	6	No change
Cutting period	145	84	42.06
Unloading product	3	3	No change
Total	154	93	

The given table 7. proves that the value added time has been decreased by 42.06% with the use of metal cutting band saw machine. Loading and unloading time remains unaltered. The ultimate results of using metal cutting band saw machine are given below:

- Reduction of value added time by 42.06%.
- A single skilled worker can operate this machine instead of two unskilled workers.
- The final processing time of operation was 93 sec. in place of 154 sec.

2) Movement of material

The distance travelled by the material from turning station to drilling station is 14m and this distance is covered in 1.30 min. physically by a worker. It leads to the wastage of time, workforce and useless movement of material.

By allocating the new respective position of the machines (i.e. Drilling and Tapping) and it will reduce the above mentioned wastages moreover the movement of material will not need any kind of worker.

Table 8. Comparison between current state and future state of material's movement

Elements	**Current state**	**Future state**	**Reduction (In %)**
Distance (In meter)	14	1	92.85
Time (In min.)	1.30	0	100
Workforce	1	0	100

3) Packing department

This process was also categorized under the TAKT time and also it was also taken into consideration to observe the changes. It was reckoned that whether and generating any kind of waste with context to working time and workforce.

a) Current Packing Process

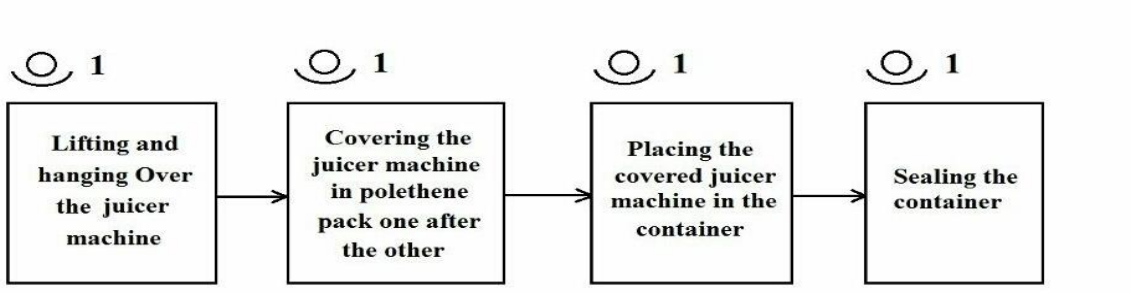

Figure 9. Current packing processes of juicer machine

Now days packing operation was accomplished under four steps by four individual workers with their own respective operations. The figure shows the present packing process of juicer machine. There are as follows:

b)Future Packing Process

On careful observations in present packing process, we find that second and third operation can be merged together into a single one and it can be performed by even e single worker in place of two workers. As a result only three workers were needed to complete the process and the steps of operations were also decreased from 4 to 3. Hence the worker will also not have to suffer from any kind of fatigue with the implementation of this new step.

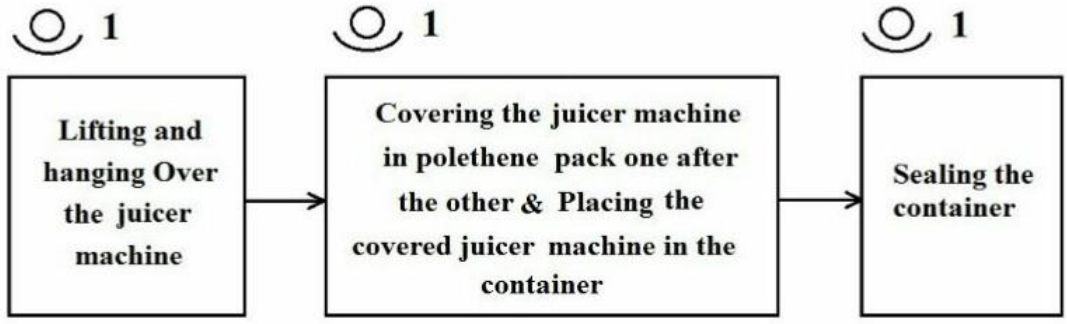

Figure 10. Future packing processes of juicer machine

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