A CASE STUDY OF VALUE STREAM MAPPING

Niharika Choubey[1], Ashish Gabel[2], Jaideep Verma[3], Neha Verma[4]
Department Of Mechanical Engineering
Shri Shankaracharya Institute of Professional Management And Technology

I. VALUE STREAM MAPPING

Value-stream mapping is a lean-management method for analyzing the current state and designing a future state for the series of events that take a product or service from its beginning through to the customer. Value-stream mapping has supporting methods that are often used in Lean environments to analyze and design flows at the system level (across multiple processes).

CASE STUDY

- Complete Address: Kalpataru Power Transmission Limited, Old Dhamtari Road, Khorpa, Raipur, Chhattisgarh, Pin: 493661
- Established in the year 2012.
- It is located at a distance of 24 Km from the Raipur city.
- It is an ISO certified company.
- It is a large scale industry with the turnover of 6000 crores.
- The products that are manufactured in the manufacturing plant in Raipur are angle, cleat and plates.
- Number of workers : 700
- Number of shifts : 3

DESCRIPTION OF THE INDUSTRY

- The raw materials are kept in raw yard. Raw materials that are used for manufacturing process in Kalpataru are angle sections that the company purchases from the companies like Jindal, SAIL etc.

- If bend is present in the raw material, then it undergoes through straightening process.

Two products are manufactured in Kalpataru Power Transmission Limited :-

- Plates
- Angles and cleat

For the production of these two products there are two separate process lines in the industry.

PROCESS LINE OF PLATE

- As visible in the layout, the first process line is for manufacturing plates. Following are the process for the manufacturing of plates :

II. DRILLING OR PUNCHING

Drilling is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials whereas Punching is a forming process that uses a punch press to force a tool, called a punch, through the work piece to create a hole via shearing. Depending on the cross section of the plate one of the operation is applied. If the cross section is large then drilling is applied and if the cross section is less then punching is applied.

BENDING:

Bending is a manufacturing process that produces a V-shape, U-shape, or channel shape along a straight axis in ductile materials, most commonly sheet metal.

AFTER BEND DRILL:

The drilling operation is performed on the bend produced, as per the requirement of the product.

STRAIGHTENING:-

- Machine:- Straightening machine
- Cycle Time = 1.15 min
- Change over time = 6 min
- Lot = 40 pc
- Number of operators = 3
- Available Time = 27,000 sec
- Energy = 22 KW
- Horse Power = 30.8

CNC:-

- Machine:-CNCVP-942
- CYCLE TIME = 4 min
- CHANGE OVER TIME = 5 min
- Lot = 40 pc
- Number of operators = 3
- Available Time = 27,000 sec
- Energy = 20 HP, 1470 rpm

NOTCHING:-

- Machine:- NOTCH 3
- CYCLE TIME = 27 sec
- CHANGE OVER TIME = 6 min
- Lot = 80 pc
- Number of operators = 3
- Available Time = 27,000 sec
- Energy = 22 KW
- Working pressure = 21 Mpa
- Flow rate = 91 L/min

GALVANIZATION

- CYCLE TIME = 10 min
- CHANGE OVER TIME = 6 min
- Lot = 80 pc
- Number of operators = 12
- Available Time = 27,000 sec
- LPG consumption = 13 Kg / MT

PACKING

- CYCLE TIME = 60 min

- CHANGE OVER TIME = 6 min
- Lot = 80 pc
- Number of Workers = 4
- Available Time = 27,000 sec

Fig2.3: Straightening machine

Fig2.4: CNC

Fig2.5: Notching machine

Fig 2.6: Zinc bath cattle in galvanization

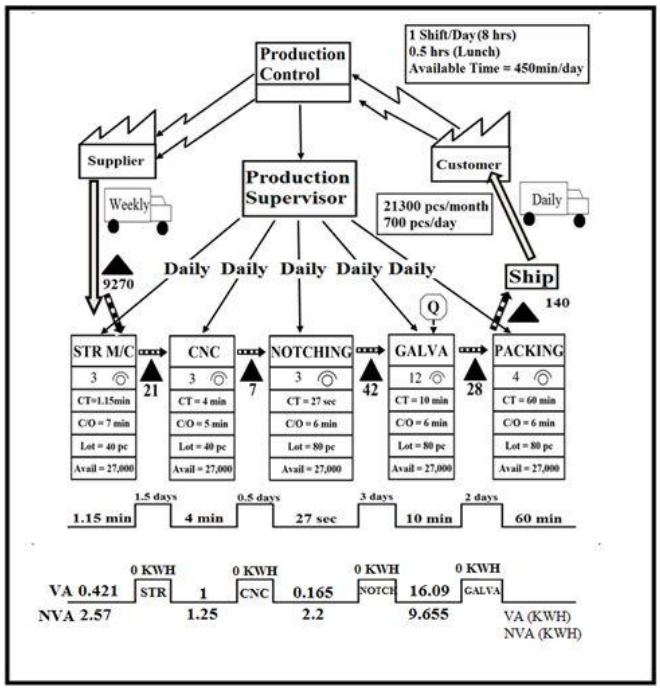
Fig2.7: packing of end products

In this step we have added working hours and number of shifts.

We have added lead time and cycle time.

We have plotted and calculated the time line symbol, which shows waiting time and processing time. It is used to calculate lead time and total cycle time.

III. CURRENT STATE ENERGY VALUE STREAM MAP



A future state map bridges the difference between the current and ideal states. It highlights the realities of technical limits, budgets and time. The purpose of value stream mapping is to highlight sources of waste and eliminate them and implementation of the future state value stream makes it feasible.The main aim of the future state map is to build a chain of production where the individual processes are linked to their customers either by continuous flow or pull and each process gets as close as possible to producing only what its customer needs when they need

STEPS INVOLVED IN MAKING A FUTURE STATE VALUE STREAM MAP

- In the first step we will decide the limits of our map. Our future state value stream map limits from Supplier to the customer. So in order to bind our map we will make these symbols first in our map as shown above.
- In the initial view of future state map, we can see on the left there is a supplier and on the right side there is a customer.
- In the center above is the production control.
- The vehicles denote the external shipment.
- The arrows drawn along with vehicles indicate the shipment arrows.

Following information are further added in our future state VSM:

- Number of hours in a shift
- Lunch break timing
- Available time of production per day
- Takt time: synchronizes the pace of production to match the pace of sales.

$$\text{TAKT TIME} = \frac{\text{Available work time per shift}}{\text{Customer demand rate per shift}}$$

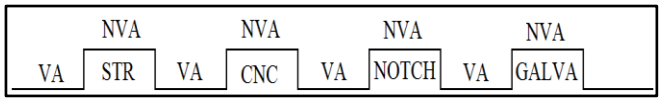
- After we have our process boundaries established we need to define our process steps for our map. The process steps are the various operations that are performed on the product, where inventory enters from one side and leave from the other end.
- Supplier supplies the raw materials require making the products to the inventory. A production Kanban is applied between supplier and the inventory in order to ensure supply of raw materials on time.
- From inventory, the raw material enters the process line. Again production Kanban and material pull symbol is applied between the inventory and process line.
- In galvanization process, problem in the quality exists and it is indicated by quality problem symbol

DELAY BETWEEN OPERATIONS	DELAY TIME OF CURRENT VSM (DAYS)	DELAY TIME OF FUTURE VSM (DAYS)
STRAIGHTENING - CNC	1.5	0.25
CNC - NOTCHING	0.5	0.12
NOTCHING - GALVANIZATION	3	0.1
GALVANIZATION - PACKING	2	0.6

- Now we will add the data(like cycle time, change-over time, lot size, no. of workers, available time etc.)on process data box. In VSM flow of information takes place.

Finally timeline is made that shows waiting times and processing times. This can be used to calculate Lead Time and Total Cycle Time

IV. CALCULATION



Here, VA = Value added
NVA = Non Value added

Formula for Energy consumption by value added activity(EVA) and Energy consumption by non-value added activity (ENVA) in terms of KWH:

EVA = KW×C/T (Cycle time in hrs)

ENVA= KW×C/O (Changeover time in hrs.)

Steps of Energy Calculation:-

- Defining all the considered process.
- Find all the calculation related data.
- i.e. - Energy, Cycle Time (C/T), Changeover Time (C/O)

To find Energy of Galva. Process:

In GALVA Process energy is used in the form of LPG so we have to change this energy in the form of Kilowatt (KW) for calculation, which is described below:-

- LPG Consumption = 13kg/MT
- Weight of one angle = 20kg

So in One MT (i.e. 1000kg), no. of angle = $\frac{1000}{20}$ = 50 Angle

Total Angle produced in one day = 700

For 50 Angle = 13kg LPG used

So for 700 Angle = $\frac{13}{50} \times 700$ = 182kg LPG per day.

Or 2.106×10^{-3}kg LPG per second.

We know 1kg LPG = 10950 Kcal

$= 45834.51\frac{\text{KJ}}{Kg}$

So, KW of LPG = $45834.51\times 2.106\times 10^{-3}\ \frac{\text{KJ}}{sec.}$

= 96.549 KW

≈ 96.55 KW

Energy from KW to KWH by the given formula:

KWH = KW ×[T]

Here [T]: Process Time (hrs.)

Calculate the Value Added Energy(EVA) and Non-Value Added Energy(ENVA) by the given formula:

EVA = KW×C/T (Cycle time in hrs)

ENVA= KW×C/O (Changeover time in hrs.)
Calculate the Total Value Added Energy(Total EVA):
It can be find out by adding all the value added energy.
Calculate the Total Non-Value Added Energy(Total NVA):
It can be find out by adding all the non-value added energy.
Calculate the Per day, Per month and Per year energy of value added and non-value added energy:
Per day energy can be calculated by multiplying No. of product produced per day (i.e. 700) to the Total value added and non-value added energy.
Per month energy can be calculated by multiplying No. of product produced per day (i.e. 700), No. of days in month (i.e. 30) and Total value added and non-value added energy.
Per year energy can be calculated by multiplying No. of product produced per day (i.e. 700), No. of days in month (i.e. 30), No. of months in a year (i.e. 12) and Total value added energy and non-value added energy.

V. CONCLUSION

In our case study on a small scale industry "KALPATARU POWER TRANSMISSION LIMITED In our value stream map, we have considered following processes: straightening, CNC, notching and galvanization. After plotting current and future state value stream map, we were able to reduce delay time between stations. Also we have pointed out the problem of over-processing and solved the stacking problem existed in the inventory. We have applied FIFO method, i.e.first in first out method to maintain the material flow in the industry. The detailed improvements are indicated in the form of kaizen in future state map.

REFERENCE

[1] Rathod,C.B et.al "Critical success factors for lean implementation within SMEs" Journal of Manufacturing Technology Management. 2010
[2] Rajyalaktimi, N.et.al "JIT adoption by small manufacturers in Korea". Journal of Small Business Management. 13 No. 4, 2009, p. 514-526.2008
[3] M. H, et.al, "Problems of small Industry - A study in Andhra Pradesh," Hyderabad, SIET. 2007
[4] Sudan F.K, et.al, "Marketing Practices in small scale Industries study of Engineering Industry of Punjab", unpublished Thesis, Guru Nanak Dev University, Amritsar.2005
[5] Methew, M.C et.al "Problems and management of small scale and cottage Industries" New Delhi. Deep and Deep publication. Vol. 22 No. 5, 2011, p. 664-678, 2004
[6] Fang, N. et.al "work in Progress" An Innovative Interdisciplinary Lean Manufacturing Course, Frontiers in Education Conference, 36th Annual, 2009
[7] Achanga,P. et.al G. "Critical success factors for lean implementation within SMEs". Journal of Manufacturing Technology Management, 2006
[8] Bonavia,T et.al "An empirical study of lean production in the ceramic tile industry in Spain". International Journal of Operations &Production Management,2004
[9] Kuren M.B et.al "A lean framework for prototyping remanufacturing work cell automation"Top of FormBottom of Form (Advanced Intelligent Mechatronics, AIM 2003. Proceedings IEEE/ASME International Conference.) ,2005
[10] Billesbach,T. et.al "Applying lean production principles to a process facility". Production and Inventory Management Journal. p. 5-25, 2009
[11] Restarits,P.J et.al, "The application of lean management principles to fields other than manufacturing", Technology Management for Emerging Technologies (PICMET), 2012
[12] Rossi. M. et.al "Lean product development", 18 International ICE conferences. Vol. 22 No. 2, p. 223-240, 2011
[13] Hongliang zhang et.al "Appraisal of lean production's implementation" Management of Engineering & Technology,2009
[14] Anthony, J.et.al, "six sigma in small and medium sized UK manufacturing enterprises" International Journal of Quality and Reliability Management. 2005
[15] Chan, J.et.al "An integrative model of Japanese manufacturing techniques" International Journal of Operations and Production Management. 2004

