

PRODUCTION FLOW ANALYSIS THROUGH VALUE STREAM MAPPING

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Abstract: This study has been undertaken to investigate about the time determinants of fabrication process in Volvo construction and equipment which is located in peenya Bangalore. Money is directly or indirectly dependent on time so for reducing time we the companies such as Volvo and Toyota have adopted the lean principles value stream mapping is one of the technique of lean manufacturing. In these techniques we consider both value adding and non-value adding topics here we mainly concentrate on the transportation, inventory, over production, man power and so on .it is important for any of the firm to look for future growth in terms of revenue and also in in terms of quality of product and service of the produced product.

Index Terms -Value stream mapping, value adding and non-value adding components, time, quality

1.INTRODUCTION

1.1 Value Stream Mapping(VSM)

Esteem stream mapping is the strategy for lean assembling standard which is utilized to kick out the undesirable or waste part from the assembling procedure by investigating the present state delineate items, benefit-based industry. It additionally gives the estimate by future state outline. Esteem stream mapping consider both esteem including and non-esteem including fields.

These is the graphical strategy which gives brief on the stream of material and furthermore data over the generation procedure and include just esteem including by heaving the non-esteem including components, for example, finished stocking, going for longer separation which isn't essential, labor and so.

1.1.1.1. Advantages of Value stream mapping

- It is the technique of lean which shows the direction for continuous improvement in any firm
- Value stream mapping gives the clear and optimum information about the production process from the current state map.
- Value stream mapping also helps in identifying the waste very easily such as waiting, transport, inventory, overproduction, motion and defects and add value to the process.
- Value stream mapping is inexpensive method which can bring profit to the firm.

1.1.1.2. Value Stream Mapping Purpose

It gives the ideal incentive to the client by expelling the waste components and by giving the best yield.

- Outline (thought to customer)
- Build (ask for to transport)
- Sustain (being utilized through life cycle to profit)

1.2 Lean assembling

Lean amassing or lean creation, as often as possible essentially "lean", is an orderly procedure for the transfer of waste ("Muda") inside a gathering system. Lean also considers misuse made through overburden ("Muri") and waste made through unevenness in workloads ("Mura"). It relies upon the contemplations of "Consistent Incremental Improvement" and "Respect for People."

2. About the organization

The name Volvo meaning "I move" in Latin, conjugated from "volvere", in reference to metal balls. The brand name Volvo was at first selected as a trademark in May 1911 with the objective to be used for another course of action of SKF metal rollers. It is a Swedish multinational gathering association headquartered in Gothenburg. The Volvo Group is one of the world's driving producers of trucks, transports, advancement apparatus and marine and mechanical engines. The Volvo Group moreover gives complete responses for financing and organization. The Volvo Group, which uses around 100,000 people, has age workplaces in 18 countries and offers of things more than 190 markets.

2.1 Business regions

Volvo gathering's activities include:

- Renault Trucks (substantial obligation trucks for territorial transportations and overwhelming obligation trucks for the development work portion)
- SDLG (Shandong Lingong Construction Machinery Co., Ltd., China)
- UD Trucks (moderate size obligation trucks)
- Volvo Busses (finish transports and transport undercarriage for city movement, line activity and vacationer activity)
- Volvo Construction Equipment (development machines)(already Volvo BM, see likewise AB Bolinder-Munktell)
- Volvo Financial Services (client financing, between assemble saving money, as land organization)
- Volvo Information Technology
- Volvo Penta (marine motor frameworks for recreation vessels and business shipping, diesel motors and drive frameworks for mechanical applications)
- Volvo Trucks (medium size obligation trucks for provincial transportation and substantial obligation trucks for long separation transportation, and in addition overwhelming obligation trucks for the development work fragment)

2.2 About Volvo Construction Equipment

Volvo Construction Equipment - Volvo CE - (initially Munktells, Bolinder-Munktell and Volvo BM) is a noteworthy worldwide organization that creates, produces and markets hardware for development and related enterprises. It is a backup and business region of the Volvo Group.

Volvo CE's items incorporate a scope of wheel loaders, pressure driven excavators, enunciated haulers, engine graders, soil and black-top compactors, pavers, excavator loaders, slip steers and processing machines. Volvo CE has creation offices in USA, Brazil, Scotland, Sweden, France, Germany, Poland, India, China, Russia and Korea. Central stations are situated in Brussels, Belgium. The organization likewise offers overall administration and a scope of reseller's exchange arrangements in financing and utilized hardware.

3. Volvo Production System (VPS)

VPS was first presented in 2007 as an approach to consistently enhance the quality, conveyance and profitability. VPS is the Volvo in activities to words. It contains useful instruments that when utilized accurately encourages the association to work towards its common objectives. VPS has 5 center standards which are to help and guide the association towards its objectives.



Figure 1

In the nick of time is a creation system to enhance the organization's arrival on venture by diminishing the in procedure stock and its conveying cost. In the nick of time alludes to the assembling and transport of just what is required. This upgrades effectiveness and empowers fast reactions to change. Volvo puts stock in the capacity of unused stock is a misuse of assets. Stock

is viewed as bringing about cost as opposed to including esteem. In Volvo without a moment to spare is based upon the five essential standards of the draw framework, constant stream handling, adaptable labor, takt time and material supply.

Flexible labour: this implies setting up a creation line so it can meet changing generation prerequisites with any number of specialists without bringing down profitability. A settled labor line is one that dependably requires a settled number of specialists. No modification can be to it at all to take care of changes underway demand.

Pull framework: one of the essential necessities of in the nick of time. The draw framework alludes to the arrangement of assembling in which following creation process pull back from continuing procedures the parts they required, when they require them, in the correct required sum.

Material Supply: is a completely incorporated application intended to close the circle amongst you and your provider by supporting the outsourcing of your assembling. The framework encourages protection of segment materials to provider in conjunction with the position of procurement arrange.

Takt Time: is the time which ought to be taken to create a segment or one finish item.

Takt time = accessible work time every day/client request every day

Continuous stream preparing: this implies dispensing with the stagnation of work in and amongst process and doing one piece at any given moment creation.

Persistent Improvement: A constant change process (shortened as CIP or CI), is an on-going push to diminish to enhance items, administrations or procedures. These endeavors look for well-ordered incremental change extra minutes or change at the some ime. Conveyance forms are always assessed and enhanced in the light of their effectiveness, effectives and adaptability. In Volvo consistent change is developed of significant worth stream mapping, critical thinking strategy, operational advancement and plan of change association.

Worked in Quality: It is a procedure that limits the requirement for examination and empowers incite critical thinking. Volvo has faith in being proactive and not responsive; it is less expensive and keeps clients and partners more joyful. In Volvo worked in quality is comprised of zero deformities, quality culture, quality affirmation and quality arranging.

Process Stability: This essentially intends to take out or diminish changeability all the while and make it proficient. Generation dependability incorporates 5s, institutionalized work, creation levelling and upkeep framework.

Cooperation: is to make a climate inside the workstation such that all representatives and staff are propelled to accomplish brilliance in their separate field towards shared objective and key targets. Cooperation in Volvo is developed of objective situated groups, cross practical work, authoritative plan and perception.

Notwithstanding this VPS includes THE VOLVO WAY. Under the Volvo path there are three fundamental parameters, those are:

- Leadership.
- Safety and Health.
- Environmental Care

4. Production Line

Under broad classification the Production line consists of,

- Fabrication Shop
- Sub Assembly-Feeders
- Main assembly – Stations
- Testing
- Paint shop

Line concept is followed in assembly, with stations and feeders

4.1. Fabrication:

In fabrication shop, rolled drums for road machinery and both top and bottom frames for excavators are produced.

Drum Rolling – Here mild steel plates are rolled in first station Long seam root welding - Then the meeting edges of plate are welded with coupons on the sides by FCAW method (Flux core arc welding) to prevent holing in case SAW method is used. A coupon is used at ends while welding to ensure uniform weld along the length, thus preventing unevenness in weld at start and ends of the weld section. And then Long seam SAW (Submerged arc welding) is done. (36V-600 amps) The filler is a steel wire with copper coating which is 4mm thick. Coupon Cutting and Grinding is done in the next stage. Rerolling is done to check for circularity of drum along its length. Then H- frame insertion is done into the drum which is welded in two stages, Circumferential root welding and Circumferential SAW. Shock mounting and welding is done in last stage and sent for painting, which would then be moved to assembly line.

Excavator - Fabrication

This section is divided into lower and upper frame fabrication. Upper frame has 10 stations and lower frame has 6 stations.

Table 1

EU1-Side frame RH(right hand)	EL1-Assembly tack
EU2-Side frame LH	EL2-1 st full welding
EU3-Assembly tack	EL3-2 nd full welding
EU4-CWT* and MCV* tack	EL4-Turning BKT & pad welding
EU5-Engine BKT tack	EL5-Inspection
EU6-1 st full welding	EL6-Heat correction & final welding
EU7-2 nd full welding	
EU8-Grinding	
EU9-Inspection	
EU10-Heat correction	

*CWT - counter weight. *MCV- Main control valve. EU-Excavator upper frame. EL-Excavator lower frame.

For upper frames in first two stations MIG (metal inert gas welding) is used, gas being CO₂. Rest all stations except 6 & 7 use, FCAW (Flux core arc welding- uses dual shield i.e gas and flux). At station 6 and 7, MAG (metal active gas) solid wire welding is used for deep penetration. In 1st full welding stitch welds are done and completed in 2nd full welding, which are further finished in welding audit. The components to be welded are procured from Korea or Apex. The variables that corely affect the weld quality are, current setting, gas ratio, weld angle, arc length, base and filler metal and other minor quantities. After welding in stations, the parts move to welding audit where all final welding is done. Here SMAW/GMAW (shielded/gas metal arc welding) is used. Class A type welding is employed i.e. TIG (Tungsten inert gas) welding. All intricate wildings are manually done and inspected at this stage and sent for painting. Usually the components (upper/lower frame) weighs about 2.6 - 3.9 tones at the end of this stage.

7.2 Paint Station:

Here frames for excavators, inside part of drum and several other small components are painted. It consists of 14 load bars for carrying components and 15 stations, viz, Loading station, wait, Machine blasting, wait, Manual blasting, wait, Masking, wait, First coat of paint, wait, Second coat, wait, Furnace(3 stages), last stage i.e. moving to next process.

The color of the paints used are yellow or grey. The paints are mixed with thinner in paint room (10-15%) and then while spraying, before the tip of the gun, the hardener is mixed with the paint being sprayed with a controllable setting(knob). Thinner keeps the paint thin from the day its mixed till it's been used. Hardener is used for quick setting of paint on the surface.

In blasting stage small pellets are shot at high speed to make the paint stick to the surface, masking is also done for same purpose. Each furnace stage lasts for 14 minutes, making 42 minutes in total for 3 stages and the furnace temperature is set to about 90-degree Celsius.

4.3 Assembly Line

Table 2

Feeders	Stations	Feeders
F8- *MCV Sub assembly and all hose connections.	S1- MCV assembly on Lower frame + horns, lights, block.	F1- Fuel, hydraulic tank, slip protection S.A*, block S. A
F9- Engine SA_pump, fan, muffler, Engine oil, filter hoses connection	S2- Engine and all tanks assembly to frame	F2- Bottom plate SA+ driver seat, AC unit, propel drive
F10- Lower frame SA1 i.e. fixing swing gear	S3-Bottomplate, boom cylinder, radiator assembly+ hoses connections.	F3- Boom cylinder and radiator SA
F11- LF SA2 T-joint+ connections, track motor+ sprocket combination fixing.	S4-Tool box, battery, cowl frames, fuse box, hood, pump room, filter connections to main frame	F4- left hand(LH) and RH cowl frame SA, ECU, Air filter, diesel filter, fuse box.

F12-LF SA3 T-joint cover plate, rollers, track guard fixing to LF	S5-Mounting Upper frame on Lower frame.	
F13- LF SA4 Putting track chain and greasing the swing gear	S6-Swing motor assembly+ hose connections, filling hydraulic oil, coolant and diesel.	F5- Swing motor SA
F14- Cylinder fixing to boom and arm+ grease rooting and hoses connection.	S7-Counter weight assembly. to lower frame	F6- Cabin SA
	S8-Cabin assembly, railings and guard light fixing. Filling oil to boom, arm cylinders.	
	S9-Boom and arm assembly docking to main frame+ bucket fixing.	F7- Boom and arm docking

The excavator assembly line has 9 Stations and 14 Feeders.

*MCV- main control valve. *S. A- sub assembly. *UF- upper frame. *LF-lower frame.

MCV, swing gear, sprocket, track motor, are main components imported from South Korea.

The block fixed at station1 has a solenoid valve that converts electric signals to hydraulic commands for operation of the machine. The track motor (hydraulically operated) with sprocket is fixed with idler which acts as tensioner for track chain due to the coil spring. The rollers and track guard support the proper action of track chain while operating.

Hydraulic oil (HLP 68), diesel and coolants for various models are filled adequately for testing purposes, after which they are all refilled before delivery to customers. Engine oil 15W is filled at feeder 2 itself. The grease used for filling into swing gear is multipack EP2.

The Counter weights are blocks of mild steel filled with concrete and other stuff to increase the weight. The counter weights are 4.2 ton and 4.6 ton for EC210D and EC300D respectively. For all bolts used Loctite 77 is used to keep the bolts fixed and hard to break, once it applied on bolts and they are fitted. For the ease of communication and material supply for stations and feeders with inventory, each of these has control box fitted at their places, called Hand on system. It has Q-Quality, S- Store, M-Maintenance and Reset buttons for respective purposes, in case there is any issue with the materials. This avoids time loss and shrinks the communication gap within the assembly line thus making hassle free continues production. This is embedded into VPS (Volvo productive system).

7.4. Testing

After Assembly TDI (Test drive inspection) is done. All route hoses and connections are checked, the machine is made to run vigorously to test to its limit and after it passes all necessary requirements, it is sent to paint shop.

5. Objectives and Methodology

5.1. Objectives

- How to overcome the present problems by plotting VSM and also plotting the future VSM using present materials.
- These method helps to reduce the waiting time in the process line.
- To check the distance travelled is worth enough to reach optimism.
- To reduce the inventory period so that the maintenance and capital spend on the stocks.
- To stop overproduction as the demand keeps fluctuating so the machine should be made only after the customer order.
- Investigate about the motion and defects and add value to the process

5.2. Methodology

We can portray the VSM strategy as an arrangement of five stages, in which the underlying four are generally paving the way to the genuine change of the procedure.

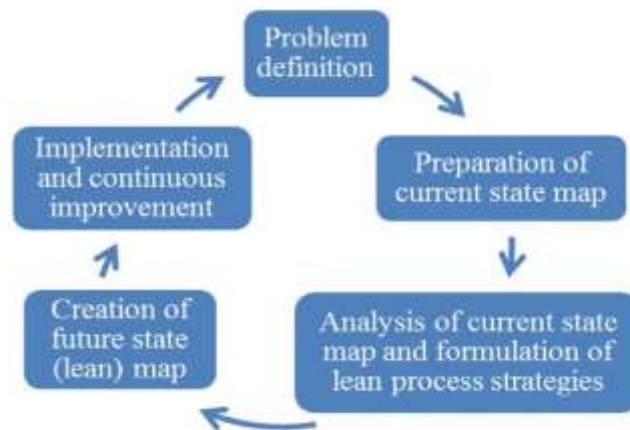


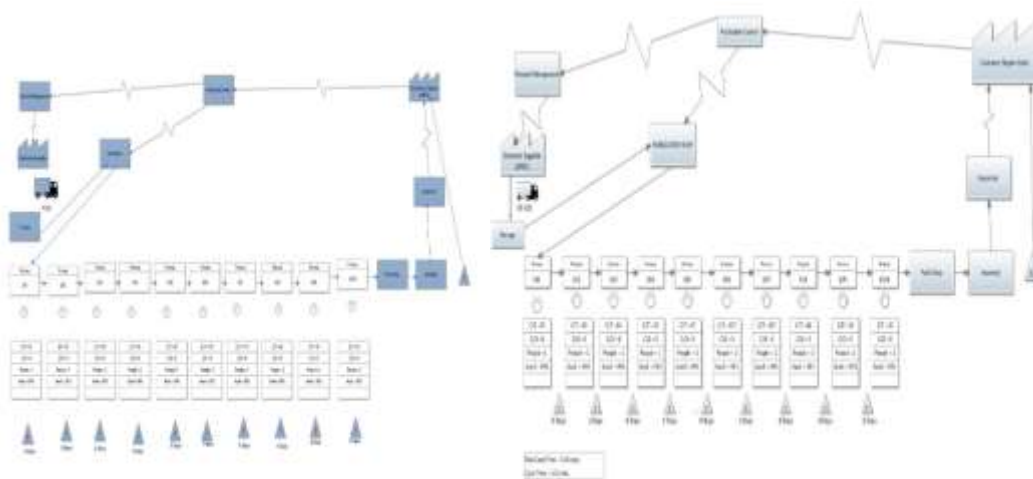
Figure 2

6. Literature survey

Santosh B. Dighe and Abhay Kakirde [1]: Lean assembling alludes to an assembling change process in light of the basic objective of Toyota generation framework (TPS). That is, to limit or wipe out waste while boosting generation stream. Numerous assembling associations understand the significance of honing lean methods. An esteem stream incorporates every one of the tasks and procedures to change crude materials into completed merchandise or administrations, including non-esteem including exercises. Esteem stream mapping is a lean assembling apparatus to design a generation process including lean activities through deliberate information catch and examination. It is a demonstrated procedure for arranging the upgrades that will enable organizations to create lean practices. This instrument has been utilized to archive current lead time, stock levels and process durations to decide the proportion of significant worth added to add up to lead time of the product offering being broke down. The initial step of significant worth stream mapping is to make a present state guide to influence a photo of the generation to stream and comprehend the organization's present cycle times, process interchanges, and machine gear limit. This gives the data expected to create a future state outline making a dream of an enhanced esteem stream. The objective is to distinguish and dispense with the waste, which is any movement that does not include esteem to the last item, in the generation procedure.

The purpose of this study was to develop a value stream map for assembly process of motor, and pump parts. The goal has been to identify and eliminate waste which is any activity that does not add value to the final product in the assembly process. It is also aimed at reducing lead time and increasing throughput rate of parts.

Mastan Singh, Er. Gurjinder Singh, and Er. Jonny Garg [2]: The An esteem stream incorporates all exercises required to change an item from crude material into the completed products. Esteem Stream Mapping investigates business forms from start to finish and a visual portrayal delineate drawn of each procedure associated with the material and data streams. At that point a future state outline attracted to demonstrate how things should function for best upper hand. Esteem Stream Mapping distinguishes the present stream of material and data in forms for a group of items, featuring the open doors for development that will most fundamentally affect the general generation framework. These days in an aggressive market, organizations require little lead time, low expenses and high client benefit levels. Accordingly, organizations pay more push to decrease lead time. Esteem Stream Mapping (VSM) is the one of the lean assembling instrument. In this investigation we will use esteem stream mapping (VSM) system to distinguish and take out various sorts of squanders in clasp industry. The present state is mapped to catch a preview of how things are done and where the change possibilities lie. Future state delineates made to demonstrate the execution activity design considering takt time. A contextual investigation did in Morning Star Industries Ludhiana, India. It is properly contending that at whatever point there is an item for a client, there is an esteem stream. This effective instrument not just features process wasteful aspects, value-based and correspondence confuses yet in addition controls about the change regions.

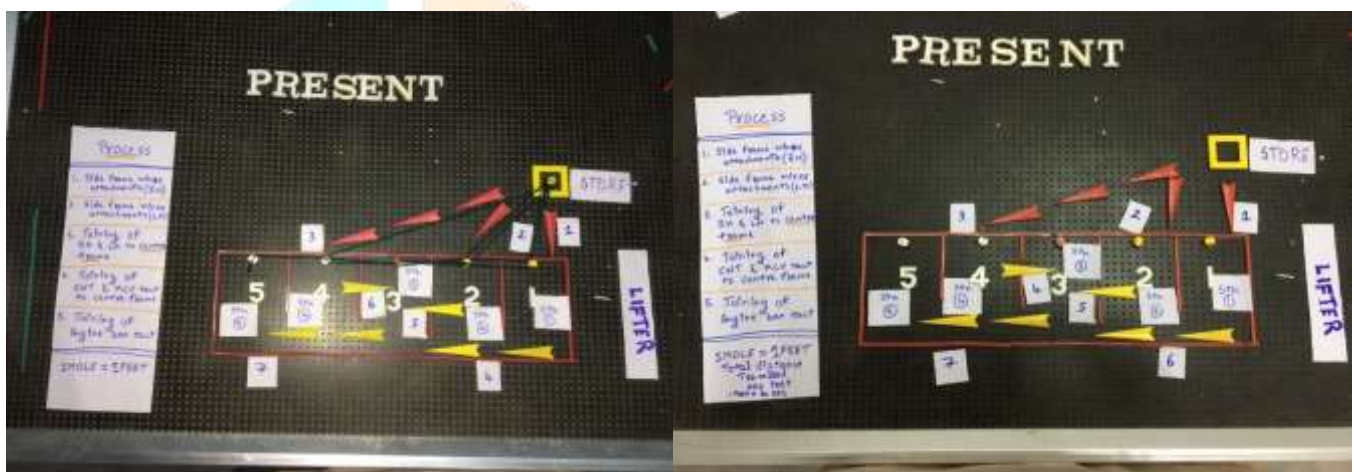


1.Future value stream mapping

2. Current Value stream mapping

Software used: Smart draw 2018

a.layout modification



String diagram method

Consider 1 hole =1 feet

- 1)Each station is 10 feet in width and 15 feet in length.
- 2)Total distance travelled= 200 feet by the lifter.
- 3)Total time consumed =200 *0 .5 mins=100 mins (time taken to travel 1 feet =30sec)



String diagram method

Consider 1 hole =1 feet

- 1)Each station is 10 feet in width and 15 feet in length.
- 2)Total distance travelled= 190 feet by the lifter.
- 3)Total time consumed =190 *0 .5 mins=95 mins (time taken to travel 1 feet =30sec)

Sl no	date	reason	Time started	Time ended	Extra time
1.	07/03/18	Tea break	2:00pm	2:25pm	15 mins
2.	07/03/18	Tea break	4:30pm	4:49pm	9 mins
3.	08/03/18	Tea break	2:00pm	2:28pm	18 mins
4.	08/03/18	Tea break	4:33pm	4:50pm	7mins
5.	09/03/18	Tea break	2:00pm	2:23pm	13 mins

Table 3

b.break time management

- on an average 12.4 mins can be saved for working by maintaining the proper tea break timings after lunch break.
- Implementation of putting music during the tea breaks so that the workers will get to know the exact break timings for 10 mins and also it refreshes the mind of employee to work effectively during working hours.

C.Figment and fouling problem in both upper and lower frame

Solution: As the figment and fouling problem is very common in all the fabrication shop and also very much difficult to avoid such problems so one of the solutions can add value to the system that is to build all the parts which is used in fabrication at once for one time with the maximum precision by using light metals like aluminum so that it will be easy to identify the defect and also to maintain the quality.

D.Distance travel

The raw materials coming from apex for the fabrication process is 50km away from the Volvo construction and equipment industry. Where the order should be placed 2 days before and once the raw materials arrive the industry it is stored for two days and then goes for the further process.

Solution:

To make the new agreement with the apex to shift its industry near to the Volvo construction and equipment's as all the equipment's for the apex is sponsored by the Volvo pvt. India.is shown in future state mapping.

7.REFERENCES

1. Rother, Mike; Shook, John (1999). Learning to See: value-stream mapping to create value and eliminate muda. Brookline, Massachusetts: Lean Enterprise Institute. ISBN 0-9667843-0-8.
2. Jump up^ Depository, Book. "34 for Quality : John Bicheno : 9780951382943". www.bookdepository.com. Retrieved 2018-03-22.
3. ^ Jump up to:^a ^b ^c ^d Hines, Peter; Rich, Nick (1997-01-01). The seven value stream mapping tools. 17.
4. Jump up^ Toyota Production System - An Integrated Approach to Just-In-Time | Y. Monden | Springer.
5. Jump up^ Graban, Mark (2011). Lean Hospitals: Improving Quality, Patient Safety, and Employee Engagement. Boca Raton, Florida: CRC Press. ISBN 9781439870433.
6. Jump up^ Graban, Mark; Swartz, Joseph (2011). Healthcare Kaizen: Engaging Front-Line Staff in Sustainable Continuous Improvements. Boca Raton, Florida: CRC Press. ISBN 9781439872963.
7. Jump up^ Plenert, Gerhard (2011). Lean Management Principles for Information Technology. Boca Raton, Florida: CRC Press. ISBN 9781420078602.
8. Jump up^ Bell, Steven; Orzen, Michael. Lean IT: Enabling and Sustaining Your Lean Transformation. Boca Raton, Florida: CRC Press. ISBN 9781439817568.
9. Jump up^ Mascitelli, Ronald (2011). Mastering lean product development: a practical, event-driven process for maximizing speed, profits and quality. Northridge, California: Technology Perspectives. ISBN 9780966269741.
10. Jump up^ Keyte, Beau; Locher, Drew (2004). The Complete Lean Enterprise: Value Stream Mapping for Administrative and Office Processes. New York: Productivity Press. ISBN 9781563273018.

8.CONCLUSION

As an assistant I could get an unmistakable photo of the Fabrication shop and its capacity. Then again, working with staffs gave us a superior comprehension of the segments, the time and the work engaged with making it the best item in its class. I was associated with the investigation of lean assembling whose segments have been generally plugged in the course of recent years and how the particular change endeavors work to shape a productive result is no mystery.

Not only the mechanical designing point of view but rather I additionally had a short understanding on Production Planning and Control, Material Management and Supply Chain, gave me a photo on how these things impact the building scene.

By and large, it was a decent chance to put by and by and create generation aptitudes and invigorate a few ideas in Science and Economy required for the administration of generation. To wrap things up, it was an awesome open door for creating individual systems administration exercises and making contacts which may demonstrate of an incentive sooner rather than later and to work with a phenomenal group of persevering individuals including administrators, engineers and furthermore floor laborers.

