ISEN 645 - LEAN ENGINEERING

ASSIGNMENT -2 | VALUE STREAM MAPPING

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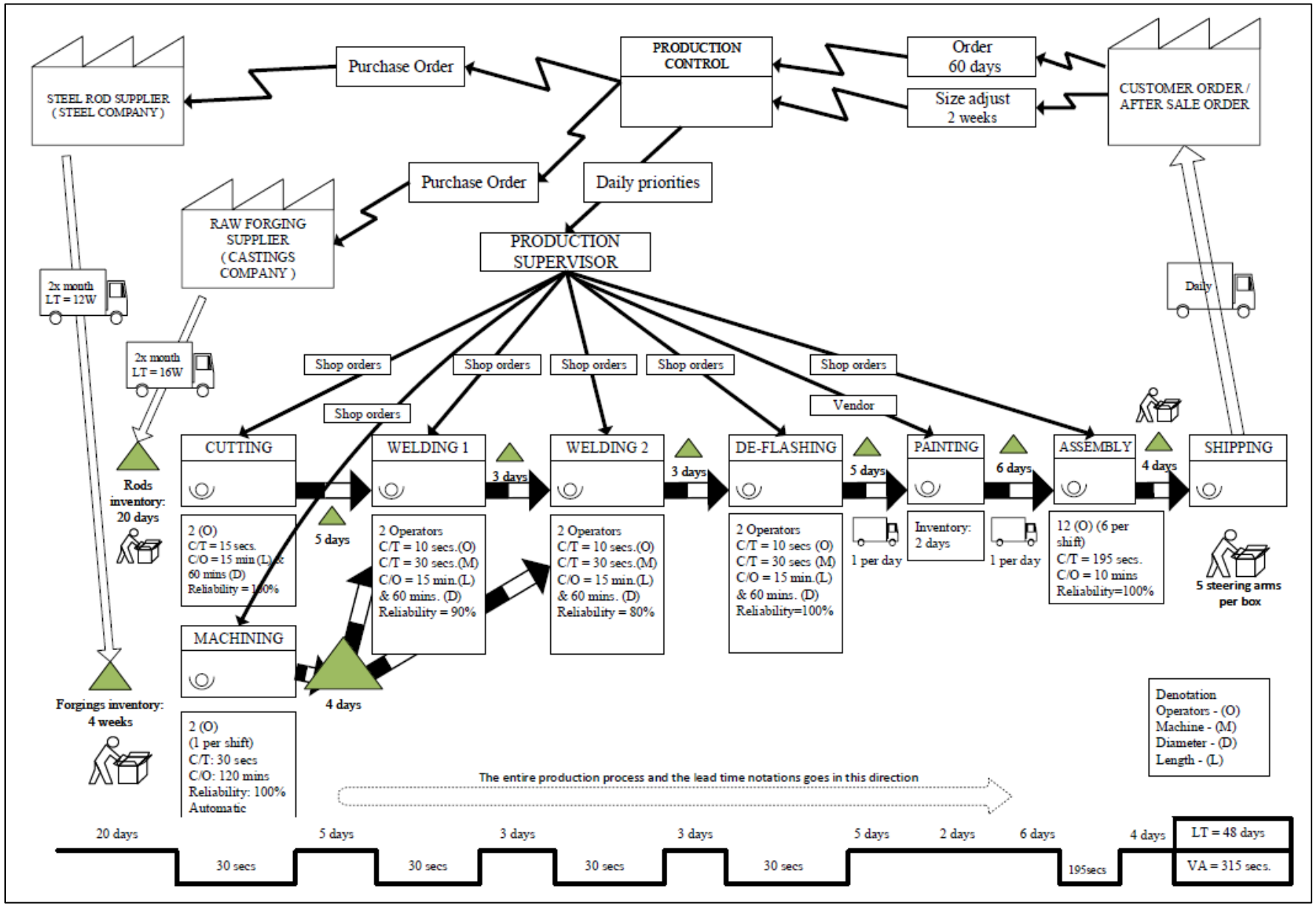
1) WASTE AUDIT OF THE AS-IS

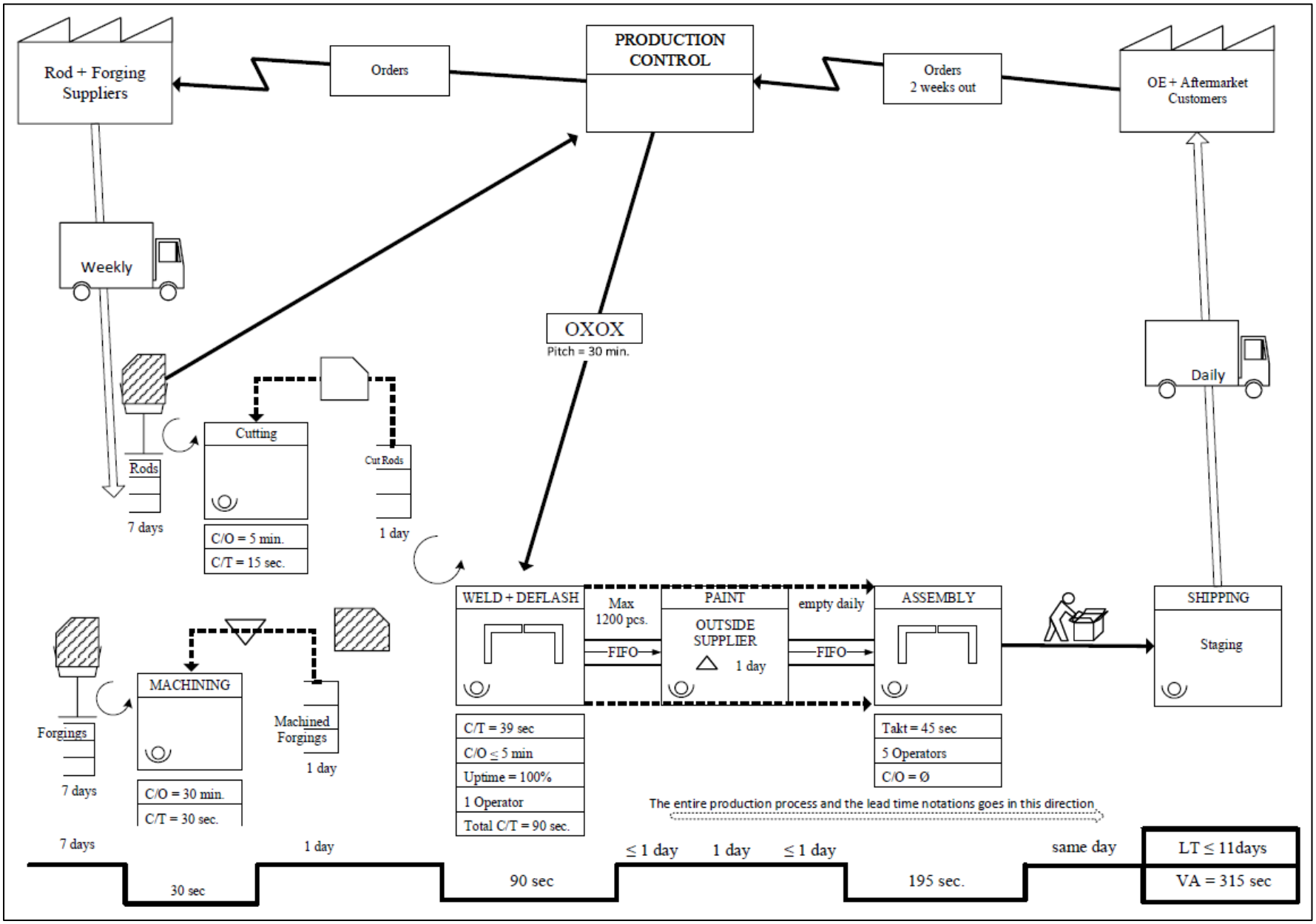
Waste type	Needs from the ASIS	Ways to mitigate/eliminate (countermeasures)	Requirements for the TO-BE
Overproduction	Once the production of the steering arm proceeds halfway customers are making changes to the initial order before 2 weeks of shipping this led to overproduction of a certain type of steering arm which is for any customer, and further these semi-finished goods should be scraped or reallocated to other orders for which additional manpower, inventory, shipping, and management is required.	To reduce the cycle time of the FG to less than 2 weeks so that we can start the production of the customer order after the final iteration of the order by the customer.	Reduced cycle time, so that we can fulfill the customer's demand on a short notice
Waiting	There are a total of 8 production processes, and about 9 incidents where there is non-value-added waiting, and this needs to be reduced drastically as it contributed to much of the lead time of the steering arm. The major wait times are 4 weeks of inventory for raw forging and 4 days for machining that forging from the before the saw and 5 days after the cut. 3 days of welded arm inventory for each side, 5 days for the de-flashed arm, 2 days during the painting process and 6 days after painting in TWI, 4 days of finished steering arms	Instead of overloading the production system with a lot of simultaneous orders, we can opt to use the "kanban" pull which would reduce the unwanted chaos in the system and thus opt towards continuous improvement of the existing order in WIP	A much-optimized Lean production system with reduced wait time and tool change layover.
Unnecessary motion	After the assembling of the final FG, the steering arm is routed to the warehouse stored for 4 days and then it is taken out and for shipment to the customer for the delivery	To eliminate the inventory after the final assembly which makes JIT for the FG to be shipped to the customer	Finished goods of steering arms are to be instantaneously shipped once it is produced
Transporting	The constant movement of machines, tools, operators, and semi-finished goods within various production units.	By using Kaikaku and designing the production system in such a way as to reduce the transportation of materials and goods	A well-designed production system to reduce unwanted movement on the shop floor
Over-processing	The order usually changes as it approached the delivery date since there may be a final iteration on the order specification from the customers. This may end up making some minor	To reduce the cycle time of the FG to less than 2 weeks so that we can start the production of the	Reduced cycle time, so that we can fulfill the customer's demand on a short notice

	changes to the existing order which leads to the over-processing of the finished goods.	customer order after the final iteration of the order by the customer.	
Inventory	The uncut rod is held for 20 days before the saw and 5 days after the saw and this is simultaneously covered by 4 weeks of raw and 4 days of machined forging Welded arm for 3 days at each end, (i.e., there are two ends) De-flashing for 5 days, painting has a total inventory of 8 days, End fitting assembly of 4 days	Elimination of the warehouse and inventory in the industry. And to initiate single-piece flow for continuous flow cells for the production process.	To convert the entire production system into a JIT model thereby eliminating the entire need for inventory and warehouse facility
Defects	The defect is some kind of error which we get that deviates the reliability process of welding station I to 90%, Welding station II to 80%	Automation of the welding process in the industry to eliminate the deviation from the expected quality	An Automated system in which the quality we can rely on is 100%

2) A VSM DEPICTION OF THE AS-IS TWI (USING VISIO)



3) A TOBE VSM


Rod + Forging Suppliers
Orders
PRODUCTION CONTROL
Orders 2 weeks out
OE + Aftermarket Customers
Weekly
OXOX
Pitch = 30 min.
Daily
Rods
7 days
Cutting
C/O = 5 min.
C/T = 15 sec.
Cut Rods
1 day
WELD + DEFLASH
Max 1200 pcs.
FIFO
PAINT
OUTSIDE SUPPLIER
1 day
empty daily
FIFO
ASSEMBLY
SHIPPING
Staging
C/T = 39 sec
C/O ≤ 5 min
Uptime = 100%
1 Operator
Total C/T = 90 sec.
Takt = 45 sec
5 Operators
C/O = Ø
Forgings
7 days
MACHINING
C/O = 30 min.
C/T = 30 sec.
Machined Forgings
1 day
The entire production process and the lead time notations goes in this direction
7 days
30 sec
1 day
90 sec
≤ 1 day
1 day
≤ 1 day
195 sec.
same day
LT ≤ 11days
VA = 315 sec

4) A FULL DESCRIPTION OF THE LOGIC APPLIED FOR EACH OF THE 8 STEPS

Question No.1: What is the takt time for the steering arm?

The total no. working days in the month in TWI industries are 20 days. And for each day there are 15 hours of paid manpower and there is a 1-hour unpaid lunch break. So, keeping this in the calculation in a month there are 20*15 = 300 hours per month of productive manpower.

So, converting it into minutes = 300*60 = 18000 minutes of manpower.

And converting this into seconds = 18000*60 = 1080000 seconds of manpower.

No. of pieces of steering arm in demand is 24,000 per month.

Therefore = 1080000 / 24000 = 45 seconds per piece.

Question No.2: Should TWI build steering arms to a finished goods supermarket or directly ship it?

Currently, in AS-IS, there are 4 days of inventory of the finished goods. And total there are 20 different variants of length, 2 different diameters, and 3 different types of end fitting for 2 ends.

So, calculating the total no. of possible variants = 20 x 2 x 3 x 2 = 240 variants.

So, for storing 240 variants of steering arm, we would require about 240 divisions or compartments within the warehouse, which would end up with the unproductive effort of loading and unloading the FG into and out of the warehouse. So thereby reducing the lead time of the project we could implement the just-in-time model which would reduce a lot of time and unproductive effort.

So, as a result, we should aim to directly ship the finished goods.

Question No.3: Where can we introduce continuous flow production?

Based on the data observed in the AS-IS system we have a takt time of 195 seconds. This is split between all the 6 operators in the six processes in the production system so as an average we have a cycle time of 195/6 = 32.5 seconds. This will be within the Takt time. The cutting and forging processes will work in parallel with each other and the resultant part is pushed to the welding station 1, welding station 2, and de-flashing station all of these are automated processes with a single operator and their individual cycle times are 40, 30, 30 seconds. And their individually takt time is less than the takt time which is 45 seconds.

So, we can combine welding station 1, welding station 2, and de-flashing station into a single continuous flow and run with a single operator.

Question No.4: How many Supermarkets and where will we need to use the supermarket pull system?

From the previous question, we can interfere that the Cutting process cannot be included in the continuous flow as it is not dedicated to the product family, and it has much less cycle time when compared to the takt time. So, in this case, we will need an inventory to withhold a buffer to the continuous flow system which will flow as welding station 1, welding station 2, and de-flashing station. And the same kind of setup is required between the continuous flow line and the painting process and for the final shipping of FG we use an instantaneous shipping model for shipping it to the customer.

In a nutshell, we would need a supermarket system between the cutting and the continuous flow system, and a second one between the continuous flow system and the painting process.

Question No.5: At what single point (the pacemaker process) should TWI schedule production?

The pacemaker of the production system is located between the first continuous flow system (consider cell 1) and the painting. Which is followed by final assembly and shipping.

Here the Pacemaker between cell 1 and painting acts as a pull system to extract the raw material from the beginning and create the necessary cavity of pull and driving the system.

Question No.6: Leveling production mix at the pacemaker process?

Heijunka (Leveling of the production load) should be used in cell 1. And at the end, the FG steering arms are packed as 5 in the box. So, a Kanban quantity should be 5 for the shipping process.

Question No.7: What work Increment is to be released consistently?

With an assumption of releasing One Kanban process 5 times 45 seconds which should be equal to 225 seconds

So, to release a Kanban, the smallest customer order is for twenty-five pieces (25). So, with this as an assumption, the pitch would be 5 times 3.75 minutes which would be around 18.75 minutes. This seems to be more viable so we can release up to 10 Kanban cards.

Question No.8: What process improvements will be necessary for the value stream to flow as the future state design?

So, with the assumption of implementing Heijunka, Kaizen, and Kaikaku in the future state, there is a potential for

- Reduction of change over time in cutting, machining, assembly, and the 3 operations in cell 1.
- And the two welding stations 1, and 2 can be improved by decreasing the welding time by employing one more operator.
- In the final assembly current cycle time (195 seconds) can be reduced by introducing automated systems rather than using 6 operators working simultaneously on a single task.
- And to increase the frequency of delivery from the supplier which could reduce the chaos in the production system.