Exercise 1

- In an Automotive Manufacturing Study for a new product:

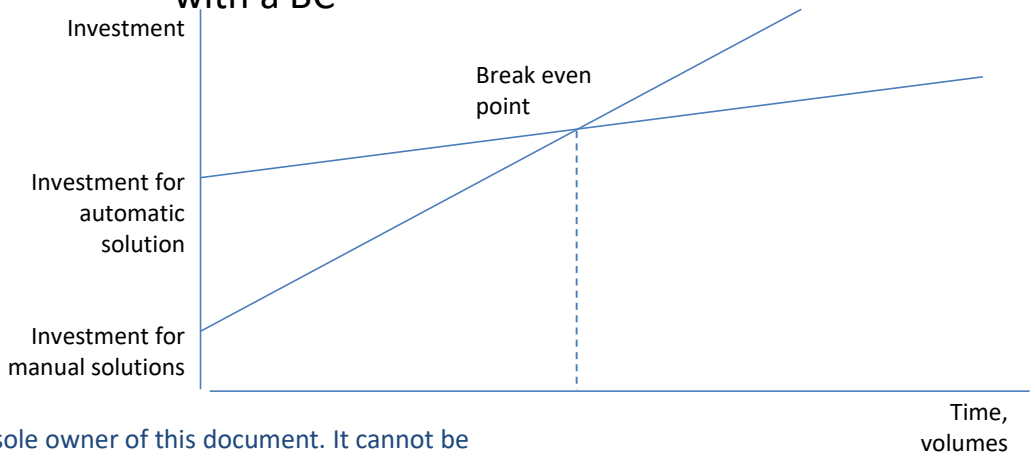
1. Which are the main phases?
2. According to which criteria the level of automation is defined?
3. How are compared the different scenarios?

Solution

1. Main phases: Product and Demand analysis,Process cycle development, Layout, Building and Utility design, Economical evaluation: investment and cost

2. Comparing investment and cost of a high automation vs manual or low automation solution

3. With a break even point analysis or if more complex with a BC

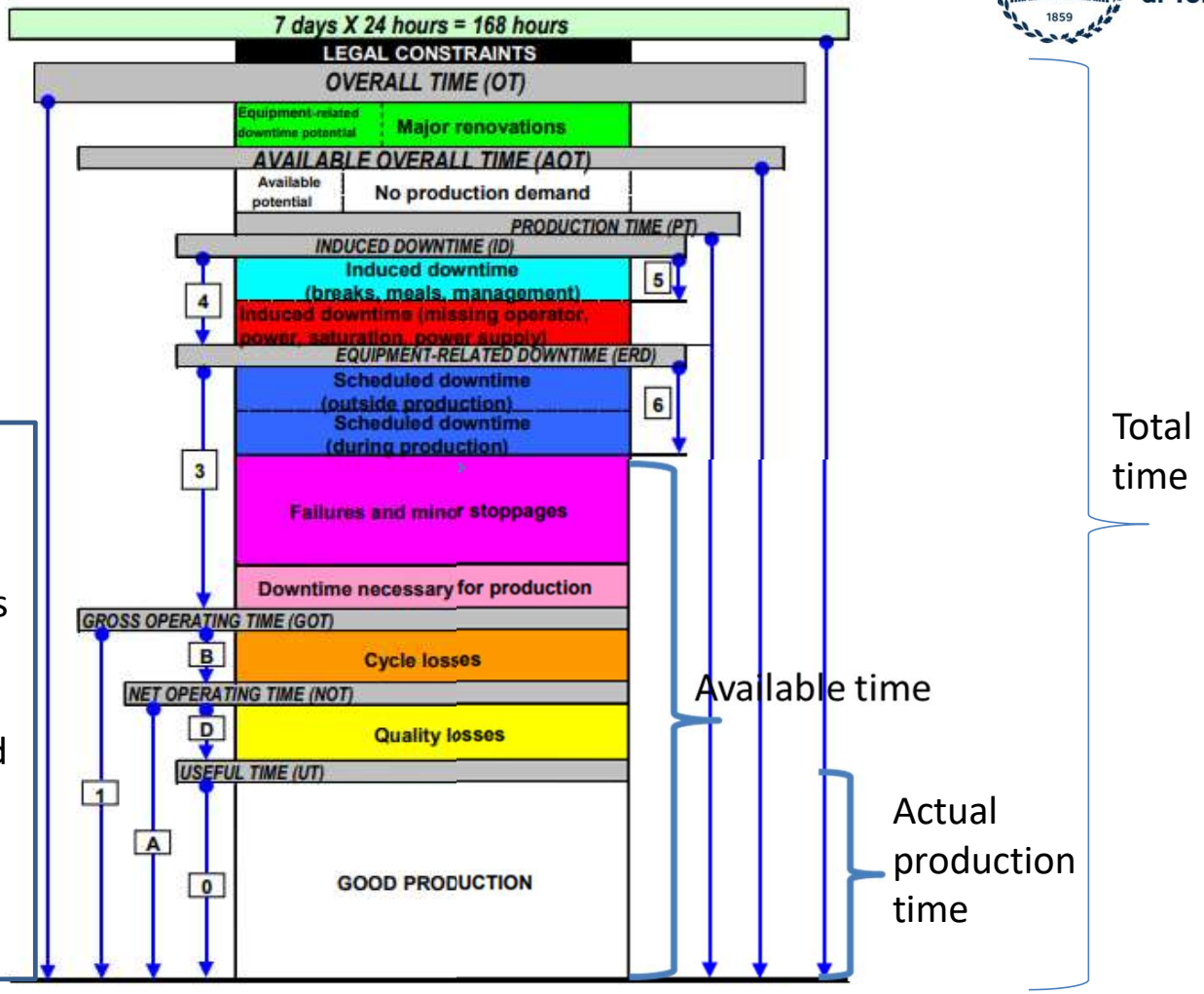


Exercise 2

- Describe the difference among:
  - Actual production time
  - Losses
  - Available time
  - Total time

Solution

- Actual production time: actual production * cycle time
- Available time = Actual production time +losses
- Losses=failures, Cycle losses (e.g. slow down), quality losses
- Total or overall time=Available time+ scheduled downtime that is necessary for production (e.g.tool change, periodical maintenance) or external events (e.g. area blackout)



Exercise 3 Solution

1. Which is the difference between a job shop and a flow layout approach?
2. Can you describe PROs and CON's?

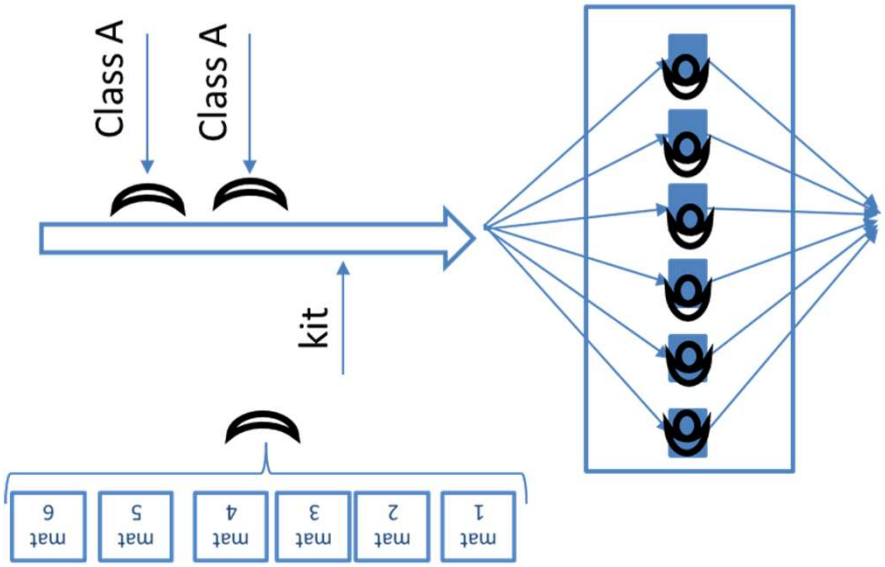
Solution

1. Job shop is aggregated by technologies- each part has a different path through the same machines
2. Flow layout: each part has its process and its machines. More parts require dedicated flows and machines
3. PROS for job shop: flexibility, no cost for conversion in case of new parts
4. CONS for job shop: longer time to complete a batch, major risks of defect since the machined are set up for every new part

Exercise 4

- Can you describe an asynchronous assembly line and the feeding system?

Solution: Workers are working in parallel. The components to be assembled are loaded onto the pallet inside an assembly kit and big parts directly on the product



Exercise 6

- How many and which are the main elements of Lean Manufacturing? Can you also describe in synthesis the background and the objective of each?

Solution

1. Batch reduction
   - It is a way to say that the setup cost is not influent and means to produce according to the final mix target and consequently with the minimum inter-operational stock,
   - Allows low volumes
   - Requires high level of standardization and short distance with the suppliers,
2. Total Quality : The target to reach a smooth flow through high efficiency and no rejection
3. Just in time: Create a pull system to reduce the stock and focus logistic to be efficient

Exercise 5

Link the period:

a. Passage from Handicraft to Series production
b. Mass production
c. Evolution of Mass production for social improvement
d. Flexibility
e. Japanese Production system

With the following production technologies:

1. Single Minute Exchange Die
2. Transfer line
3. Synchronous assembly line (chain)
4. Asynchronous assembly line (group)
5. Machining center

And give a comment for your choice.

Solution

A-3 *since at the origin (end of 1800), the split of complex operation in simple sequential ones (i.e. synchronous line) was the first step done.*

B-2 *The mass production is connected to high production machinery as transfer lines. The synchronous line was also used but not only.*

C-4 *Asynchronous groups were introduced to make less inhuman the work and major responsibility/satisfaction to the workers- at the end of '60.*

D-5 *The machining center (CNC) was introduced in 1970 and contributed to the creation of Flexible Manufacturing Systems.*

E-1 *Changeover cost is an enemy of batch reduction, that is the first element of Lean Manufacturing*

Mistake was A-2; ***Terrible mistakes A-5 (CNC did not exist at the end of 1800) and C3***

Exercise 7

1. Why the voltage is important in a electric car battery?
2. If we replace a battery 400V with a new one 800V assuming same Power and same Circuit Resistance which is the losses reduction in %?
3. And if we replace with a 48V one?

1. Because the losses decrease with higher voltage

2.

Consider the formulas:

- $P = V^* I$
- $Losses = R * I^2$
- $P=400*I1=800*I2$
- $I2=I1/2$
- $Losses\ 1= R*I1^2$; $Losses\ 2=R*I2^2$
- $Reduction= (1-L2/L1)=(1- I2^2/ I1^2)=(1-1/4)= 0,75$ or 75% reduction

3.

- $P=400*I1=48*I3$
- $I3=8,3*I1$
- $Losses\ 1= R*I1^2$; $Losses\ 3=R*I3^2$
- $Reduction= (1-L3/L1)=(1- I3^2/ I1^2)=$
- $(1-70)=-69$ or **6900% increase**