MÄLARDALENS HÖGSKOLA
Institutionen för Innovation,
Design och Teknik

EXAM

Industrial Process Development (PPU413)

Date: 2017-01-10 Time: 14:10-19:30

Exam: TEN 1 Utilities: Calculator, dictionary

Responsible teacher: Antti Salonen, tel (016-163606), mobile 0709-378469

Max score: 40 p
Pass (Swedish, 3 – ECTS, E): 20p
ECTS, D: 25
Swedish, 4: 30
ECTS, C: 30
ECTS, B: 34
Swedish, 5: 36
ECTS, A: 38

Good Luck!

Q 1:

Chen, et.al (2008) present a case study, in which they use VSM and Kaizen events in order to improve a production process. When setting the future state, Chen, et.al. mean that batch production is not desired from a lean perspective. What arguments do they have for this statement?

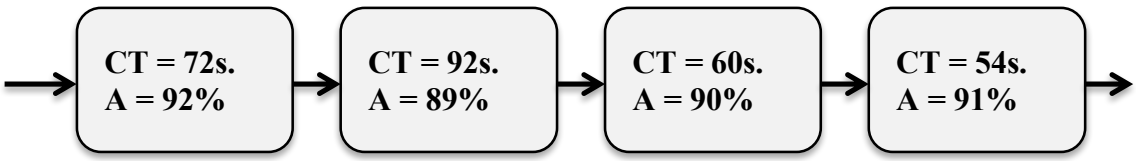
(5 P.)

Batching is not desired from a lean perspective, because:

- **it will increase inventory levels and therefore increase the lead time.**
- **batching will also make it difficult to track quality problems.**

Q 2:

How many products can, on average, be produced during an eight hour shift in the line below?



CT = Cycle time, A = Availability

(4 P.)

(8 x 3600/92) x 0.92 x 0.89 x 0.90 x 0.91 = 209.92

Answer: 209 units/day (alternatively, 210 units/day)

Q 3:

Name two advantages, and two disadvantages of Work sampling, compared with Time study

(4 P.)

Advantages:

More cost efficient (5-50% of time study)

Qualified analyst not required

Study can be interrupted

Less effect on the operators

More easily accepted by the operators

Disadvantages:

Time study permits a finer breakdown of activities

No method study

Averages of groups, no individual differences

Risk of doing too few samples

Q 4:

Name and describe the five steps of improvement associated with Theory Of Constraints.

(5 P.)

Identify the bottleneck

Find the operation that has the lowest actual capacity in the system.

Exploit the bottleneck

Improve the capacity in the bottleneck as much as possible

Subordinate all other activities

Adjust the production pace to match the true capacity of the bottleneck

Improve the bottleneck

If necessary, invest in new equipment or change the system in order to improve the capacity of the bottleneck operation

Avoid inertia

Identify the next bottleneck within the system and restart the work.

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Q 5:

According to Bengtsson & Osterman, 2014, which are the two root causes for “improvements in vain”?

(2 P.)

It springs from ineffective application of problem solving processes where resources are spent aiming at the wrong desired state or starting from an incomplete understanding of the current state,

It can also spring from an inefficient improvement process where you expend effort and resources without incomplete understanding of Lean, wrong choices and wrong priorities or if you overspend effort and resources to reach the desired state.

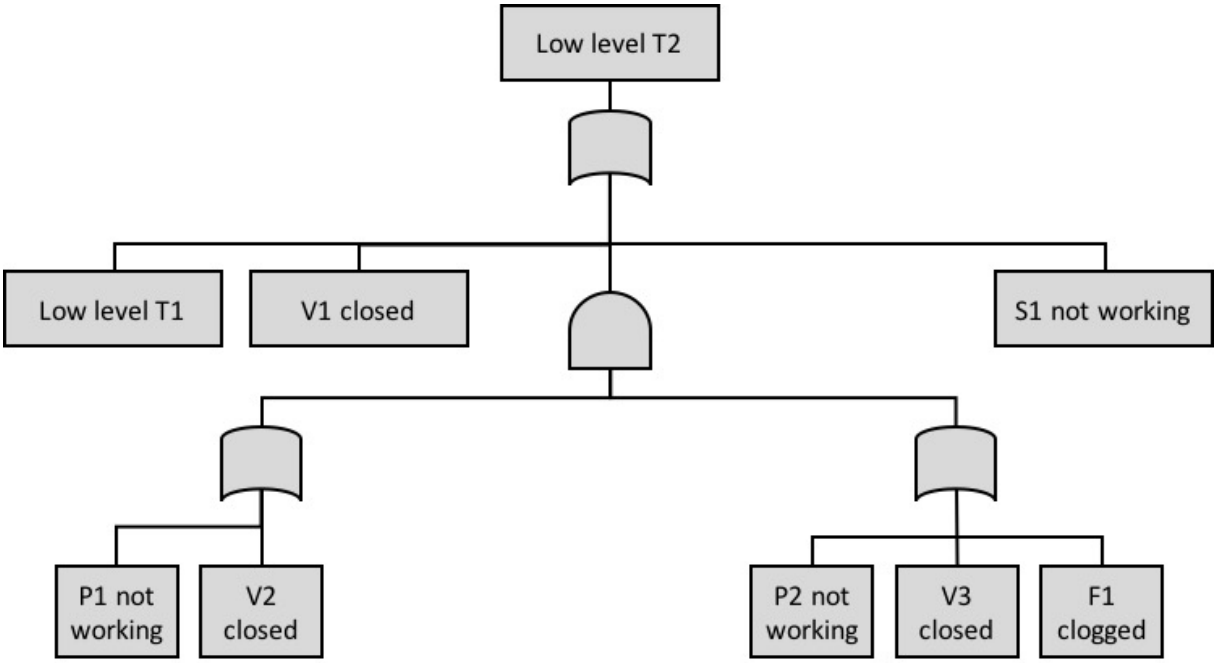
Q 6:

The system that is shown below keep the fluid level in tank T2 at a certain level. In order to work, the system need to fulfill the following conditions:

1. The level sensor S1 has to be functional
2. V1 has to be open
3. Either P1 has to be working and V2 open, **or:**
4. P2 has to be working and V3 has to be open and the filter, F1 shall not be clogged.
5. Also, there has to be fluid in tank T1

Draw a Fault tree for the top event: ”Low level in T2”.
Base the Fault tree only on the above mentioned circumstances.

(5 P.)



I have approved other more complex solutions as long as they are correct.

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Q 7:

Acme engineering is about to start producing a new product with an estimated life cycle of 25 years. In order to produce it, the company needs to buy a new machine and two alternatives have been selected. Both alternatives are expected to run 4300 h/y. The data of the two alternatives is found below:

Data	Machine X	Machine Y
Acquisition cost	1350000 €	930000 €
Maintenance cost	11500 €/y	???
Life length	30 y	35 y
MTBF	350 h	300 h
MTTR	2 h	3 h
Cost of downtime	480 €/h	480 €/h
Operations cost	42000 €/y	48000 €/y

Calculate what yearly maintenance cost Machine Y could have and still be an interesting alternative to Machine X.

(5 P.)

$LCC = C_A + t_C(C_O + C_M + C_{DT})$

$LCC_X = 1350000 + 25(42000 + 2x480x(4300/350) + 11500) = 2982357$

$LCC_Y = 930000 + 25(48000 + 3x480x(4300/300) + C_{MY}) = 2982357$

$C_{MY} = (2982357-930000)/25 – (48000 + 3x480x(4300/300)) = 13454$

Q 8:

In the paper by Yamamoto and Bellgran, 2010 a fundamental mindset for driving improvements towards lean production is presented. Further, an operative way of practicing the mindset is proposed. Which are the four steps of this operative way?

(4 P.)

Reduce.

This step is to change or to set a parameter by which people have little choice but to feel the need for improvement.

See.

This step is to carefully observe the shop floor to identify the problems brought up to surface.

Think

The think step is about coming up with solutions to the problems and

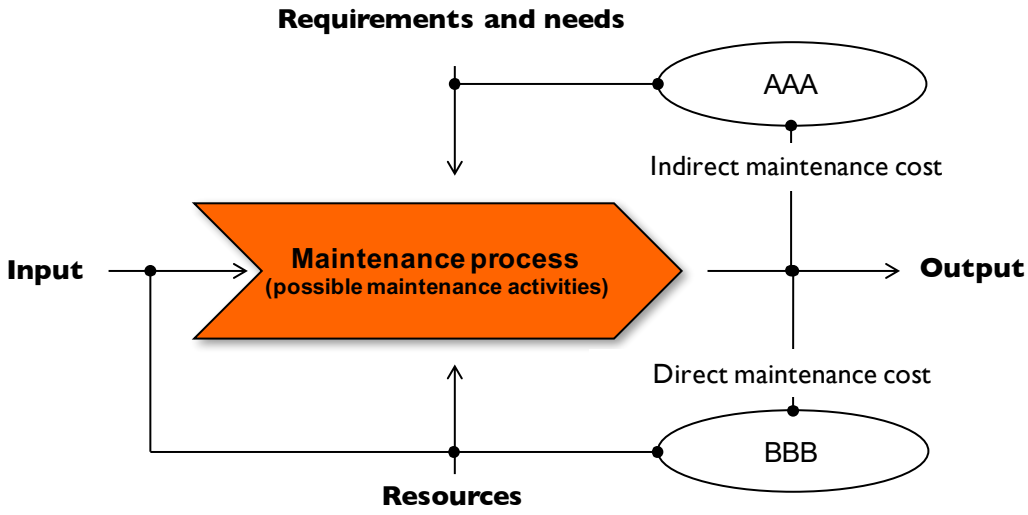
Act.

the act step is to implement the solutions.

Q 9:

The picture below illustrates the maintenance process, according to Bengtsson & Salonen (2014). Which performance related terms are in the picture represented by AAA, and BBB?

(2 P.)



AAA: Effectiveness (Alternatively: Effect)
BBB: Efficiency

Q 10:

In the lecture on Discrete Event Simulation, Erik Flores presented a four step process for the problem formulation process, aiming at securing that the right problem is solved. Which are the four steps of this process?

(4 P.)

1. **Establish the need for a solution**
2. **Justify the need**
3. **Contextualize the problem**
4. **Write the problem statement**