

# 1CM30 - Service Supply Chains for Capital Goods Spring 2014

## Exam Exercises - Set 4 Condition based maintenance

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1. The degradation of a production machine can be described by a DTM. The engineers collect the time to defect data in the lab by doing reliability testings. The time to defect data statistically suggest that the time to defect follows an exponential distribution with  $\lambda = 1$ . The time unit is one month. The engineers also collect the data about the duration from the defect time point till failure in the lab. The delay time seems to be a constant value 0.5, since the variance of the delay times are so small.

For this production machine, we will apply a periodic inspection policy with a fixed inspection interval  $\tau$ . When we detect defects on the machine, we will overhaul the machine to prevent unexpected failures. Upon failures we will also overhaul the machine.

The cost of a corrective overhaul is equal to EURO 3000. The cost of a preventive overhaul is equal to Euro 1000. The inspection cost is 10 Euro.

**Apart from these costs, the time period in the defective state also incurs an extra energy cost with a rate 25 euro per month, since the production system will consume more energy in the defective state.** To illustrate the extra energy cost, please take a look at the figure given below. The duration of defective state in a renewal cycle multiplied by the extra energy rate 25 euro per month is equal to the extra energy cost for a renewal cycle. Since the duration of defective state in a renewal cycle is random (different from cycle to cycle), this extra energy cost in a renewal cycle is also random. We should take this extra energy cost into account while we are evaluating the expected cycle cost under different renewal events.

Determine the average costs of the periodic inspection policy as a function of  $\tau$ .

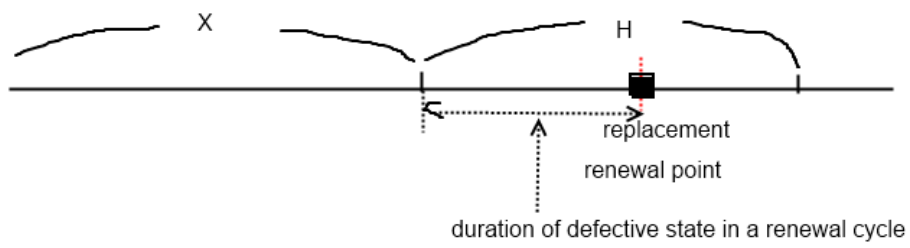


Figure 1: The Delay Time Model