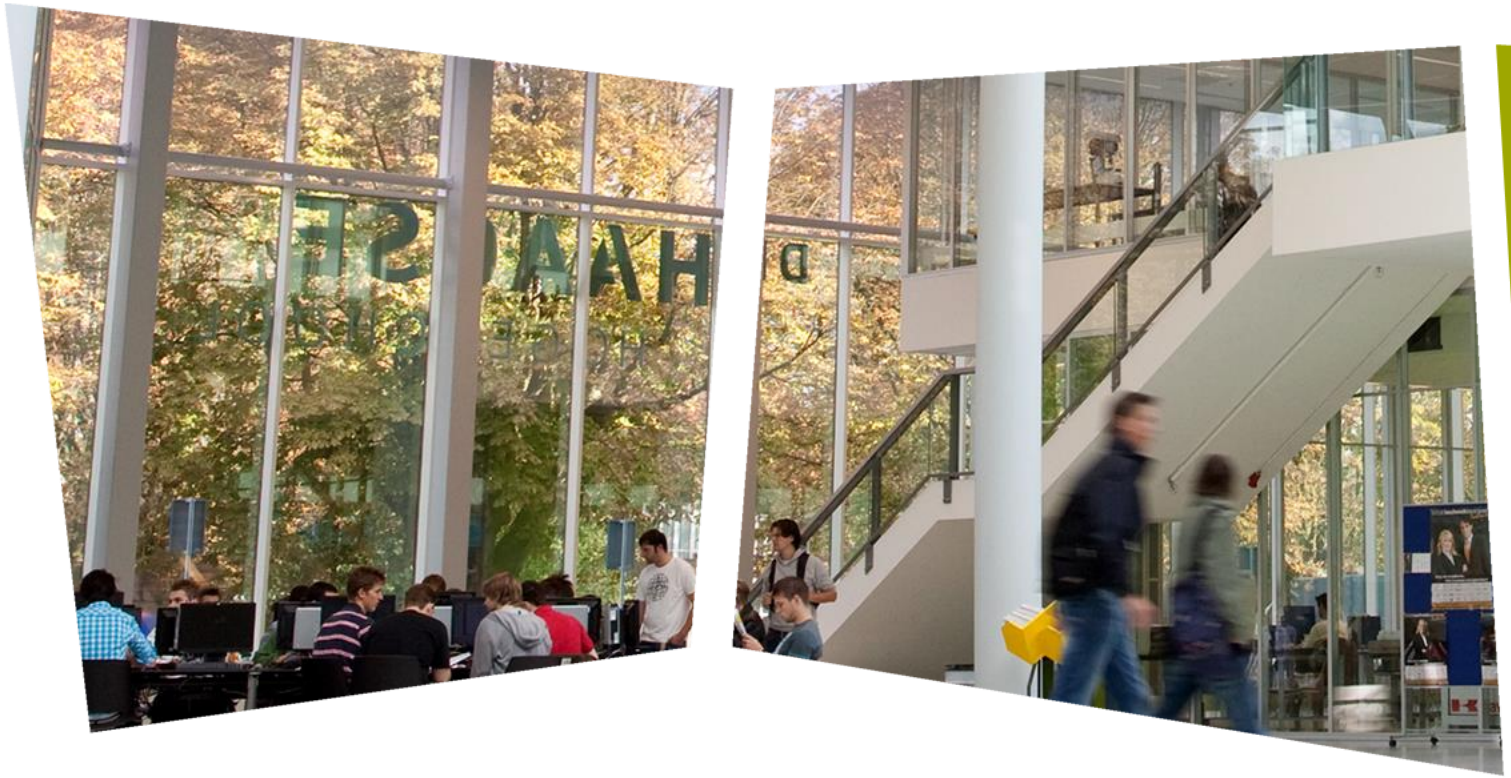


11 Februari 2020

ArieTaal

Mechanical Engineering

The Hague University of Applied Sciences

ENERGY DIAGNOSIS APPLYING SYSTEMS ENGINEERING

DE HAAGSE HOGESCHOOL

Why energy diagnosis?

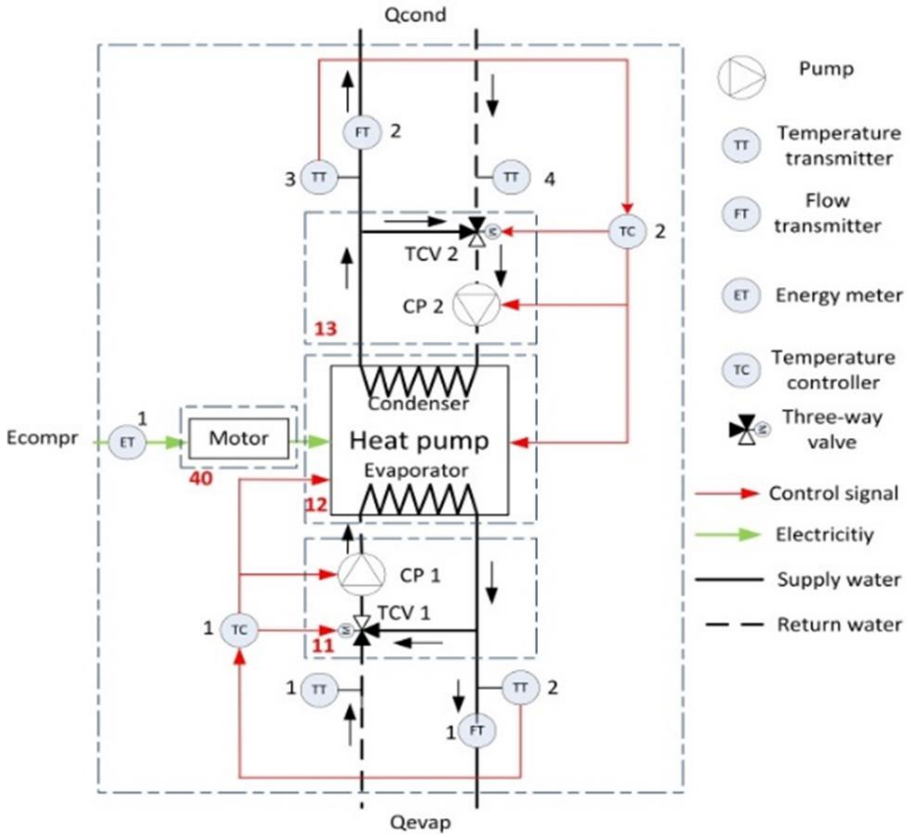
- Higher energy consumption
- Complaints indoor climate.

Set up and usage of FDD (Fault Detection and Diagnosis) systems is time consuming

- No standards
- Specific FDD methods
- Not fully automated
- Design separately from HVAC design

Engineerings practices

Process and Instrumentation Diagrams (P&IDs)



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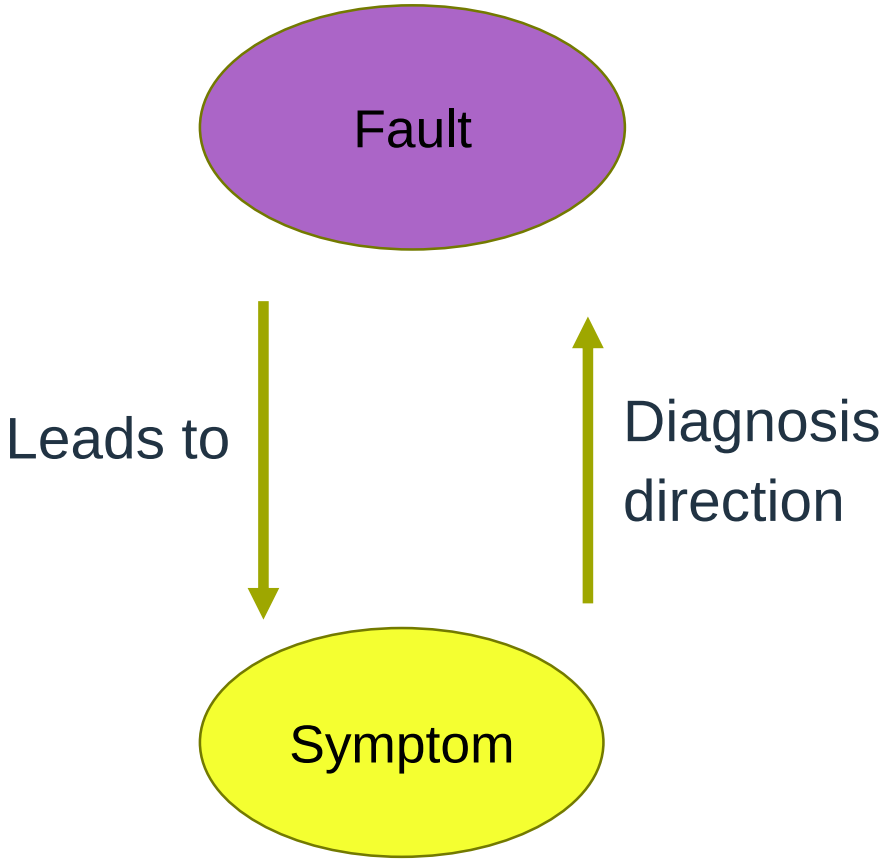
Isolation of faults



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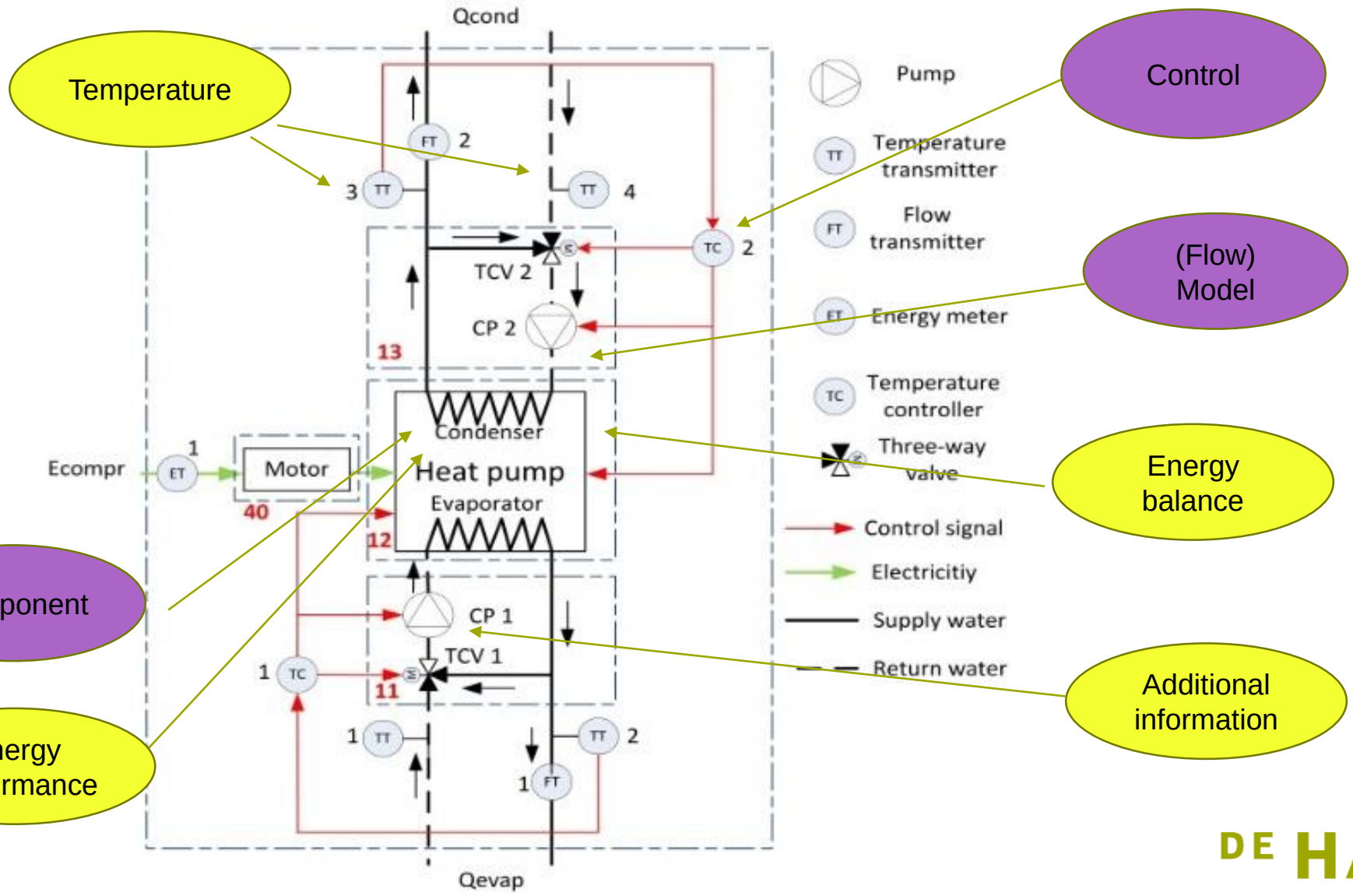
Faults and symptoms from P&ID (4S3F method)

Fault

Symptom



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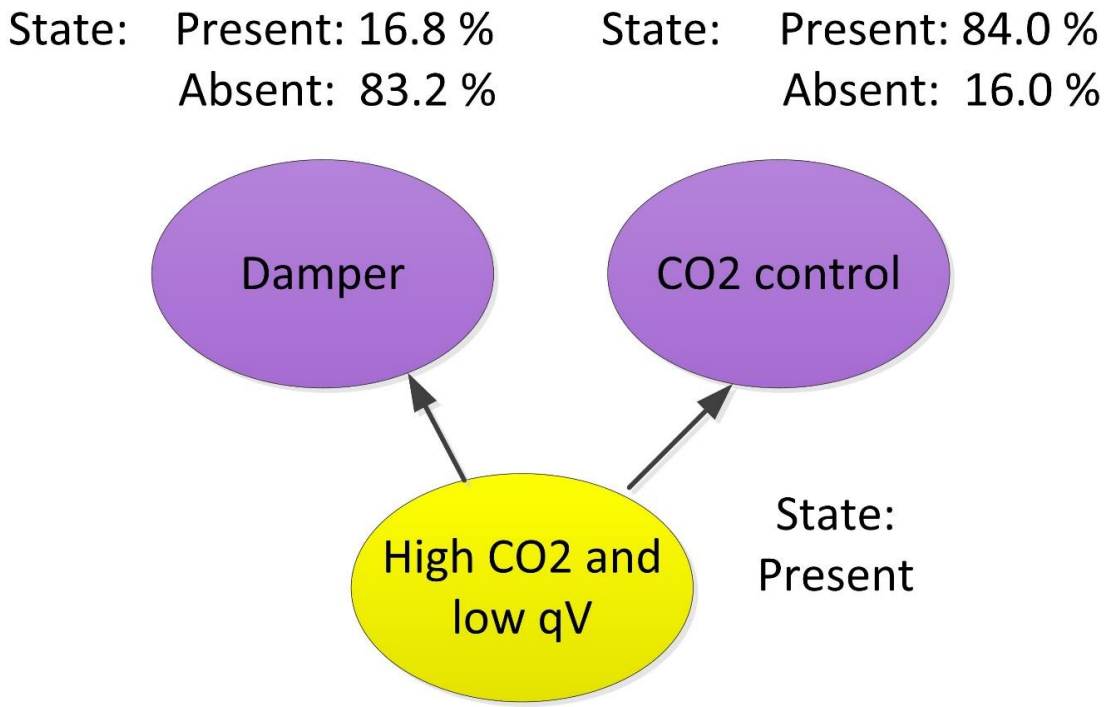
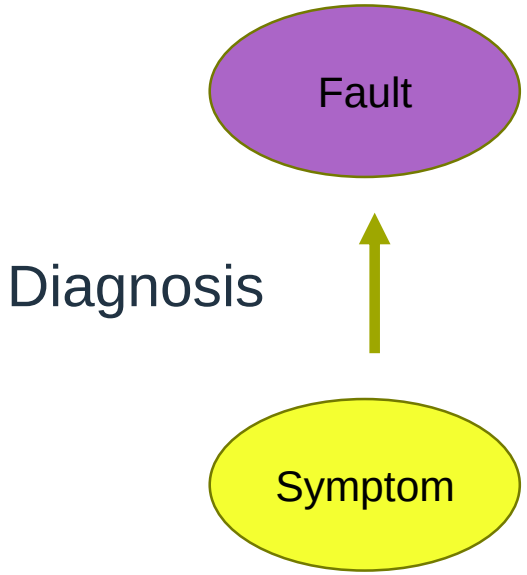
Linking Faults to Symptoms
Diagnostic Bayesian Networks (DBN):
Estimate fault probabilities





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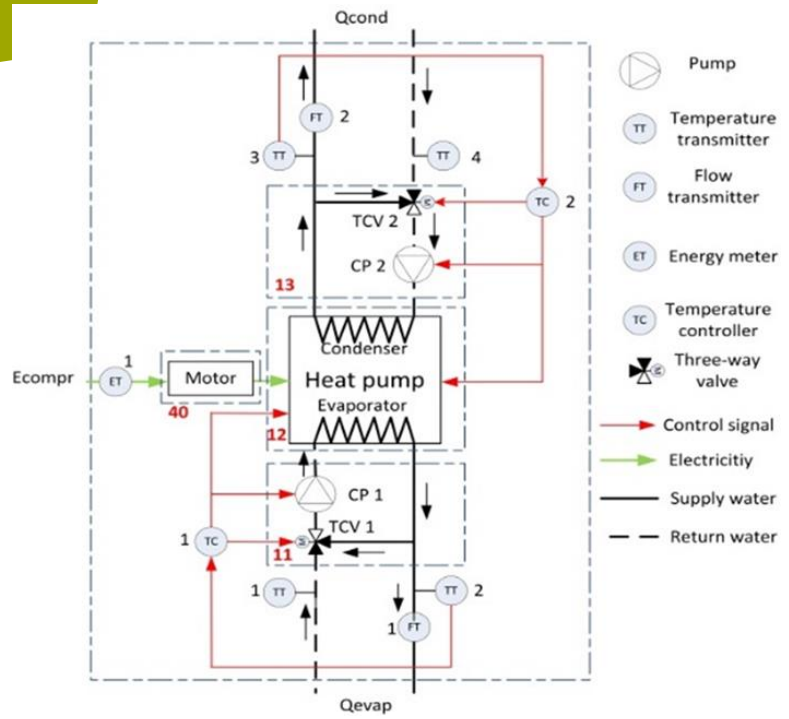
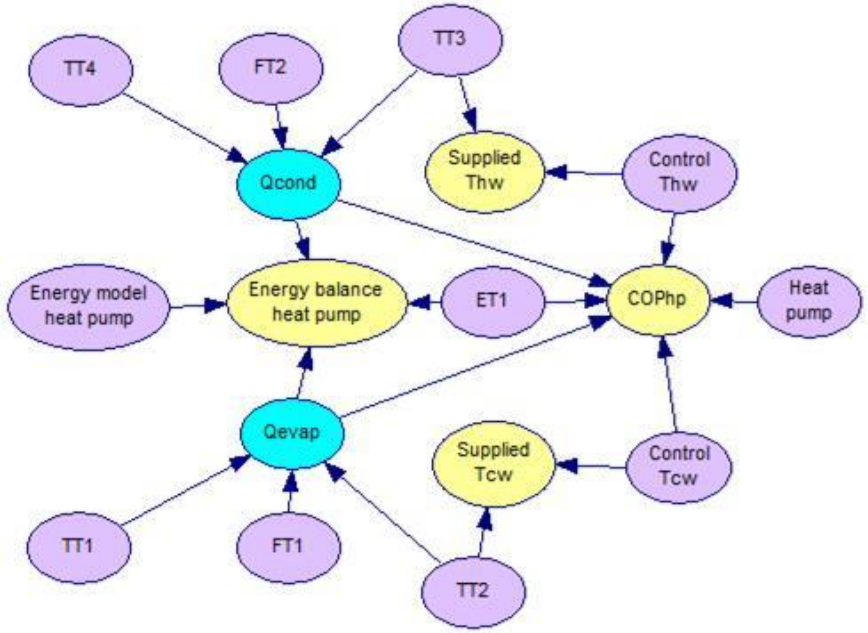
DBN (Dynamic Bayesian Network) is congruent with P&ID

Blue: help node
Purple: fault node
Yellow: symptom node



P&ID



DBN model

TT= Temperature sensor
FT= Flow rate sensor
ET= Electricity meter
Thw= hot water temperature
Tcw= cold water temperature
hp= heat-pump
Qcond = condensor heat
Qevap = evaporator heat

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Thank you for your attention

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