Modelling normal performance variability with FRAM
And: Risk analysis with FRAM

Aviation & Petroleum Industry
An initial discussion

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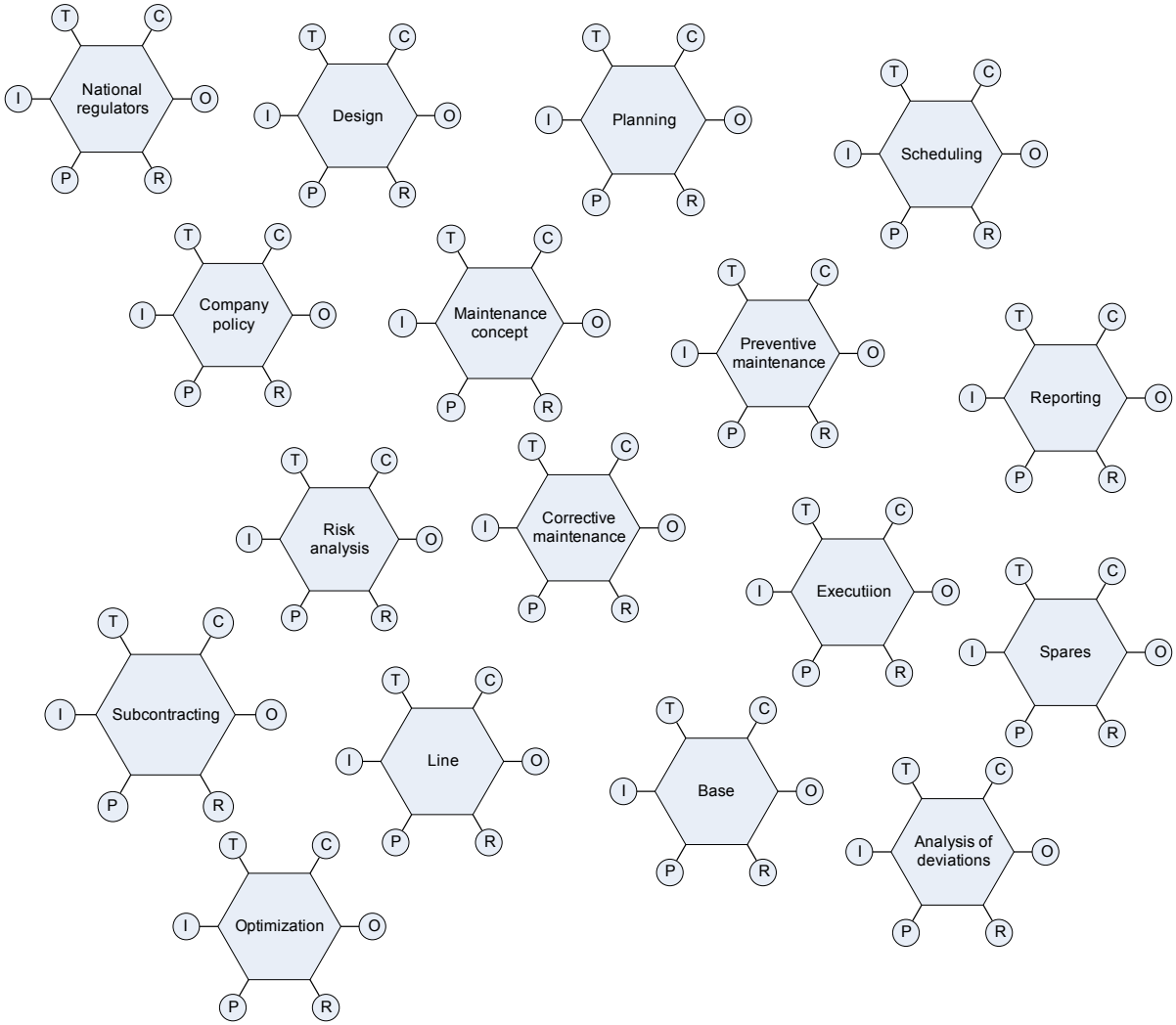
Background and objective

- It is required to address a situation where there could be a conflict between production and safety in a socio-technical system

- How we capture normal variability both POSITIVE and negative characteristics without looking only for errors?

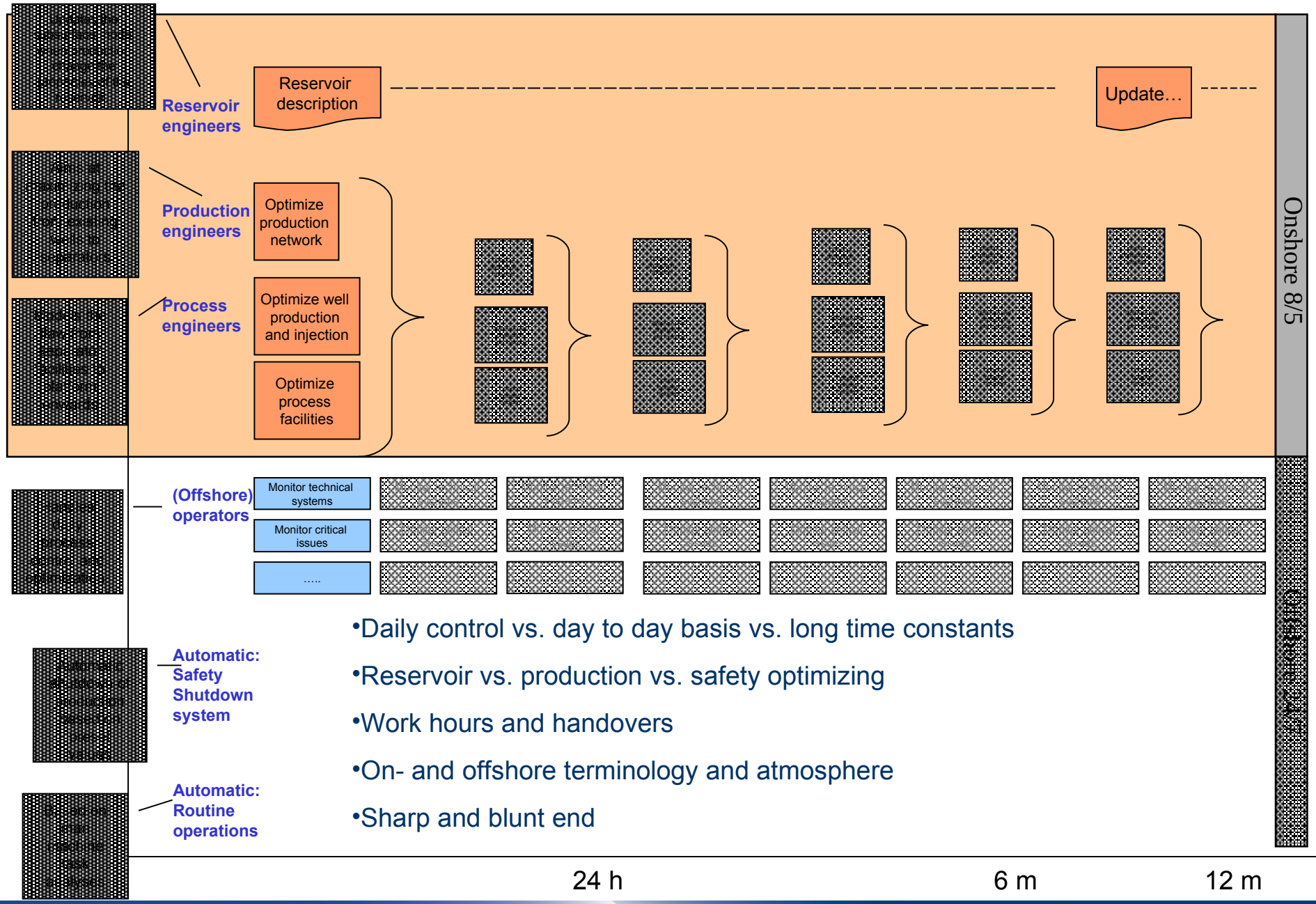
Aviation – maintenance context



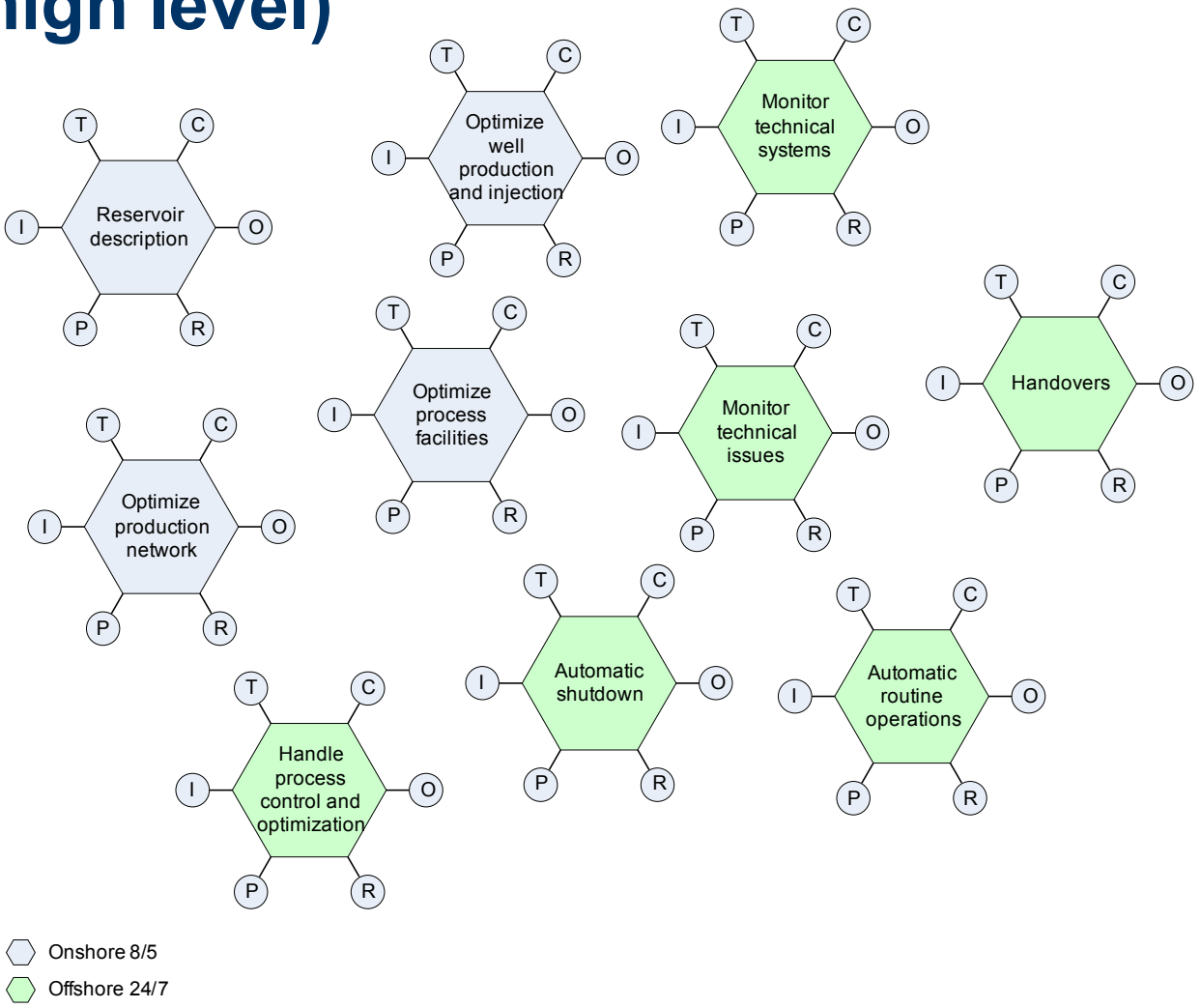
Petroleum industry context

Production optimizing

- Short- and long-term control and optimization of oil and gas flow in a value chain from reservoir, via offshore facilities to export from installations.
- Major communities involved:
  - reservoir engineers
    - Responsible for updates of the subsurface model when production change the properties of the reservoir
  - production engineers
    - Responsible from reservoir, meaning to maximize the production from the existing wells to the separators (separate oil-gas-water) on the platform
  - process engineers
    - Responsible for modeling the flow from the separation facilities on the platform onwards.
  - (Offshore) operators
    - Handle daily process control and optimization. Monitor safety (emergency and shut-down alarms), technical systems and equipment, minute to minute production Many additional tasks related to CCR
  - Various contractors that are involved at various points…..
- Surroundings: Drilling and well control, maintenance, company, authorities…


Reservoir engineers
Reservoir description
Update…
Production engineers
Optimize production network
Process engineers
Optimize well production and injection
Optimize process facilities
Onshore 8/5
(Offshore) operators
Monitor technical systems
Monitor critical issues
…..
Automatic: Safety Shutdown system
Automatic: Routine operations
•Daily control vs. day to day basis vs. long time constants
•Reservoir vs. production vs. safety optimizing
•Work hours and handovers
•On- and offshore terminology and atmosphere
•Sharp and blunt end
24 h
6 m
12 m

Petroleum – Production optimization context (at very high level)



Prior to the analysis

- Collection of information (documents+interviews)
  - Work process descriptions
  - Qualitative observations
  - Do we need description of incidents/accidents or this will affect the analysis in a negative way?
  - Success history telling?

Questions - comments

- Normal operations involve several work processes. How to handle the complexity?
- Do we need “industry experts” to carry out an analysis?

0 Describe the target situation or scenario

- Criteria for scenario selection
  - Regular, irregular, unexampled events
  - Critical
  - Normal+normal=critical
  - Always underspecified

Questions - comments

- What is a target situation of normal work
- Target situation – successful operation – what does this mean?
- What is a good enough scenario description?
  - Use a time sequence?
  - Describe both what is normal and what actually happened

1 Identify essential system functions

Criteria for ”essential”

- Just the functions that makes system work…
- Guessing this is very critical to get right ☺
- Interviews to capture ”the work as planned and as performed”

Questions

- Level of analysis
  - On what level should functions be described in order to obtain a good analysis?
- How do we describe time and it’s impact short term – long term?
- When to stop the description?

  - Breakdown of the system into functions until each of them defines an acceptable process(one you can reasonably validate in the context of the action)

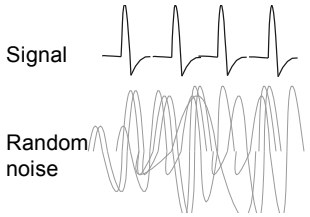
2 Potential for variability

- Variability could be endless
- How we identify normal and abnormal variability?
- Need for another way to visualize variability?

Questions

- We have a check list but it limits the ”things to look for”
  - How do we capture other ”CPCs” that are important

3 Functional resonance



Use FRAM network in a multidisciplinary work environment

Questions - comments

- How you identify “resonance” that is essential to the system
- Resonance between two normal processes

4 Identify “barriers” for variability and…

” *(1) Physical barrier systems block the movement or transportation of mass, energy, or information. Examples include fuel tanks, safety belts, and filters.*

(2) Functional barrier systems set up pre-conditions that need to be met before an action (by human and/or machine) can be undertaken. Examples include locks, passwords, and sprinklers.

(3) Symbolic barrier systems are indications of constraints on action that are physically present. Examples include signs, checklists, alarms, and clearances. Potential functions encompass preventing, regulating, and authorizing actions.

(4) Incorporeal barrier systems are indications of constraints on action that are not physically present. Examples include ethical norms, group pressure, rules, and laws. “

Questions

- How you go from resonance to “damping factors” identification
- How do we select essential “damping factors”
- Which kind of “damping factors” support flexibility, early warnings, creativity and improvisation*

4 …Performance monitoring

- Barriers
- CPCs
- Early warnings….

….+ reactive information….monitoring everything and having focus on what's important

- Drifting towards failure and sudden disruptions??

Questions

- What to look for? What do we do from a risk perspective?
  - Performance monitoring is an important factor when FRAM is used in risk analysis and for risk prevention.