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Technological challenges and opportunities in Systems Integration

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CTO Land & Air Systems
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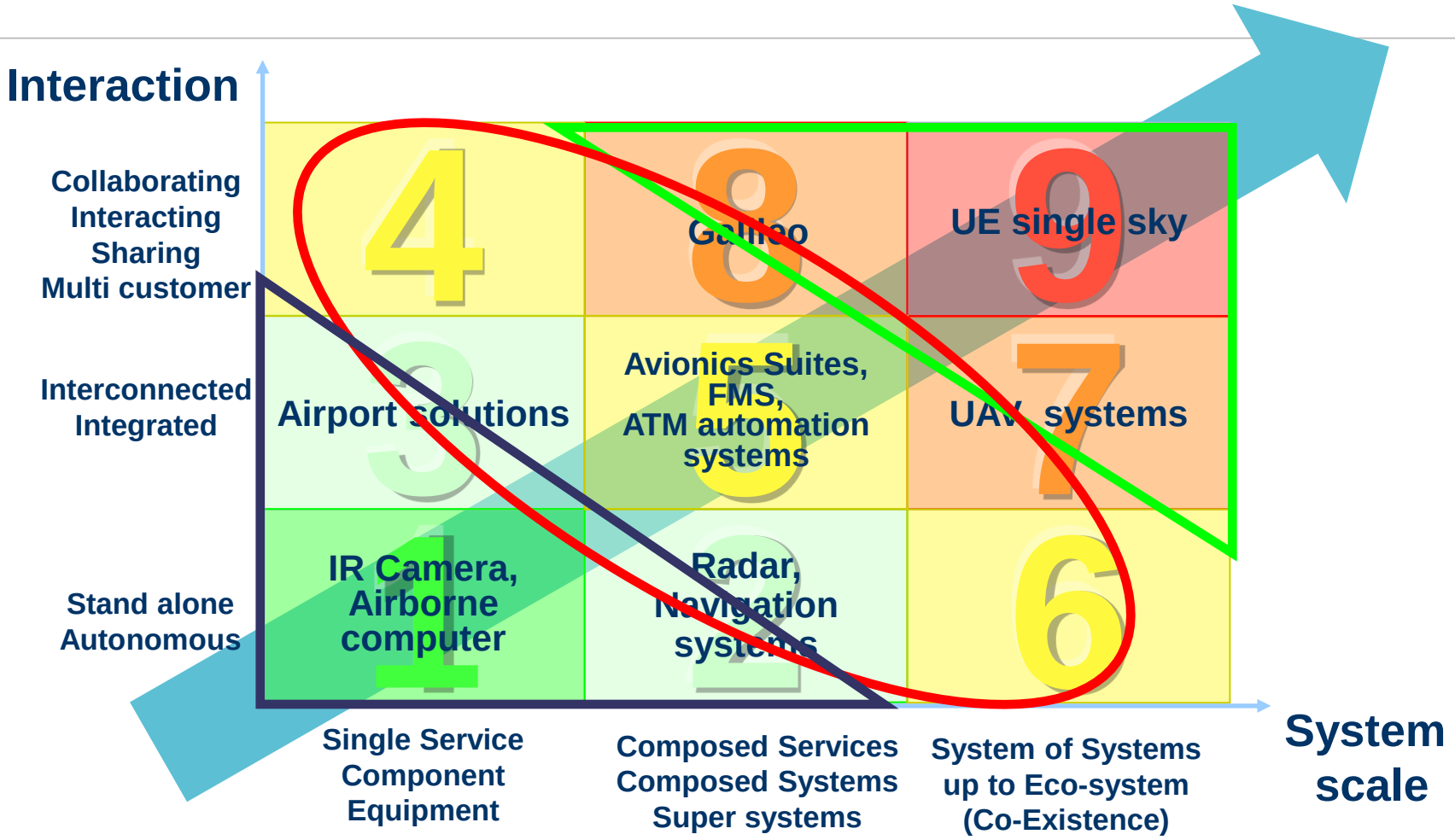
ICAS PC MEETING – KRAKOW – AUGUST 2015

What is complexity ?



Technology driven system architecture

Complexity mainly relies on hardware, technologies and algorithms.

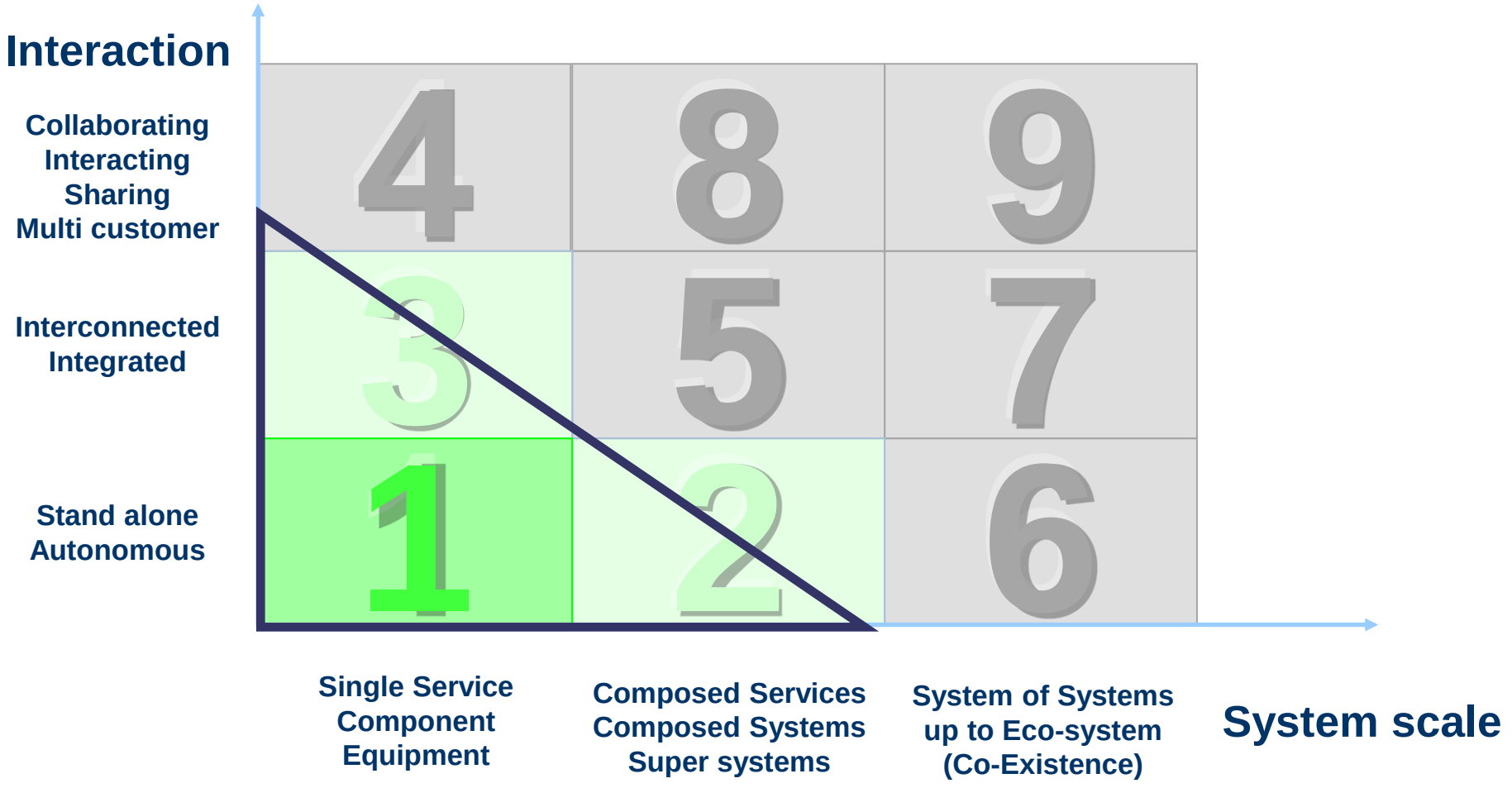
Functions driven system architecture

Complexity mainly relies on high level of interaction between functions, non functional constraints, interfaces, data, components

Capability driven system architecture

Complexity comes from complex interactions between operational needs, capability and services, business processes and organisations

Yesterday (2000-2010) : Technology driven (1/2)



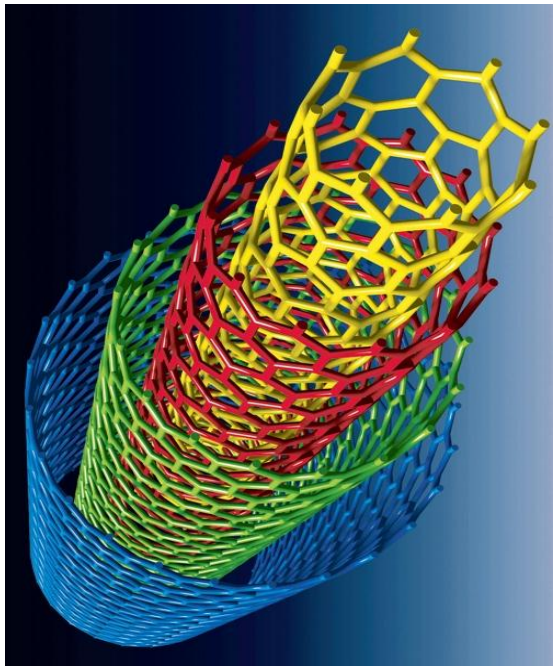
Yesterday (2000-2010) : Technology driven (2/2)

System engineering rationale

- Requirement engineering
- Physical Analysis
- Technical Simulation

Future challenges

- New technologies, new materials
- Increased computational power
- "Multi-physics" approach & simulations
- Complex algorithms

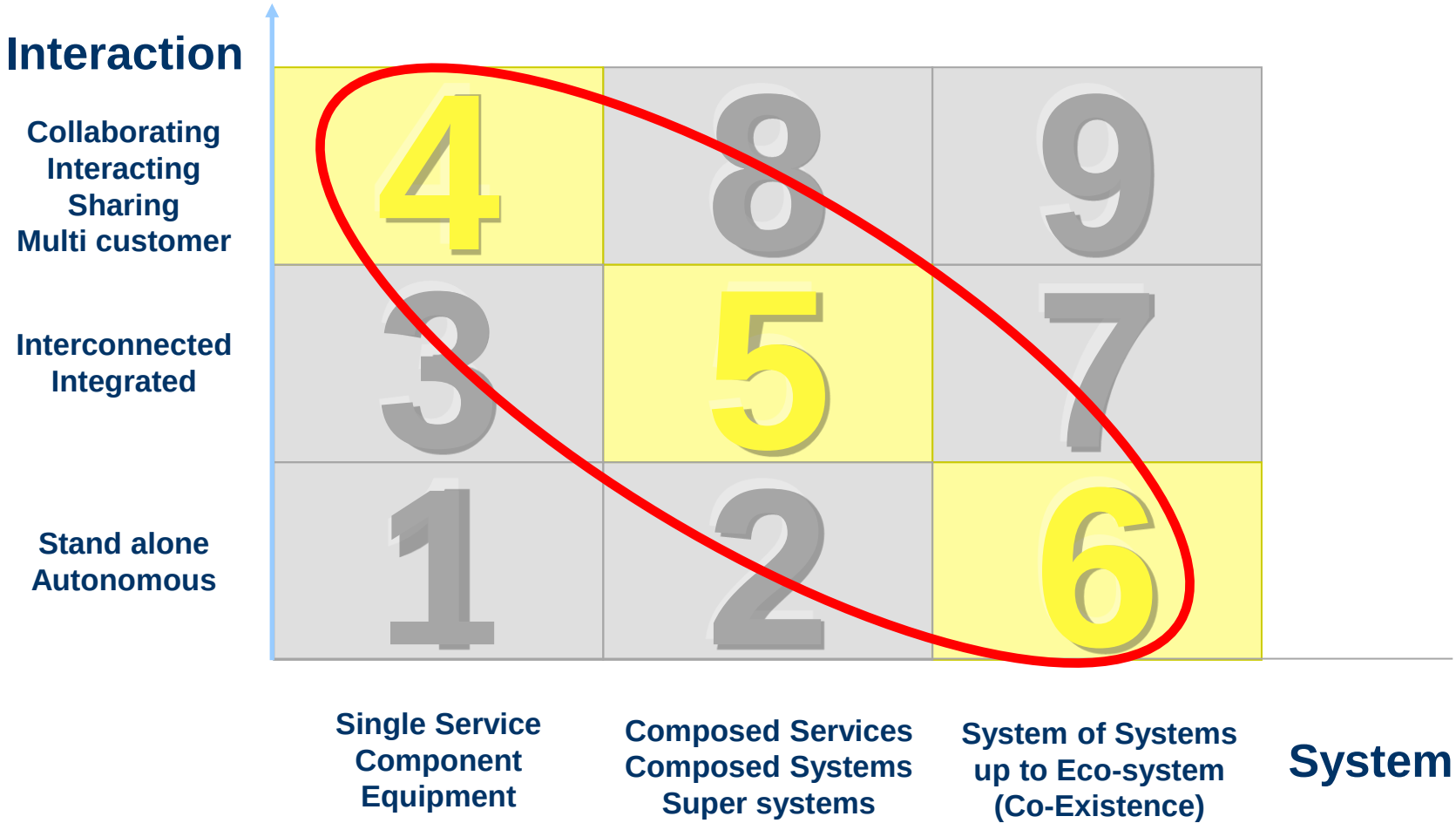


Nano-technologies

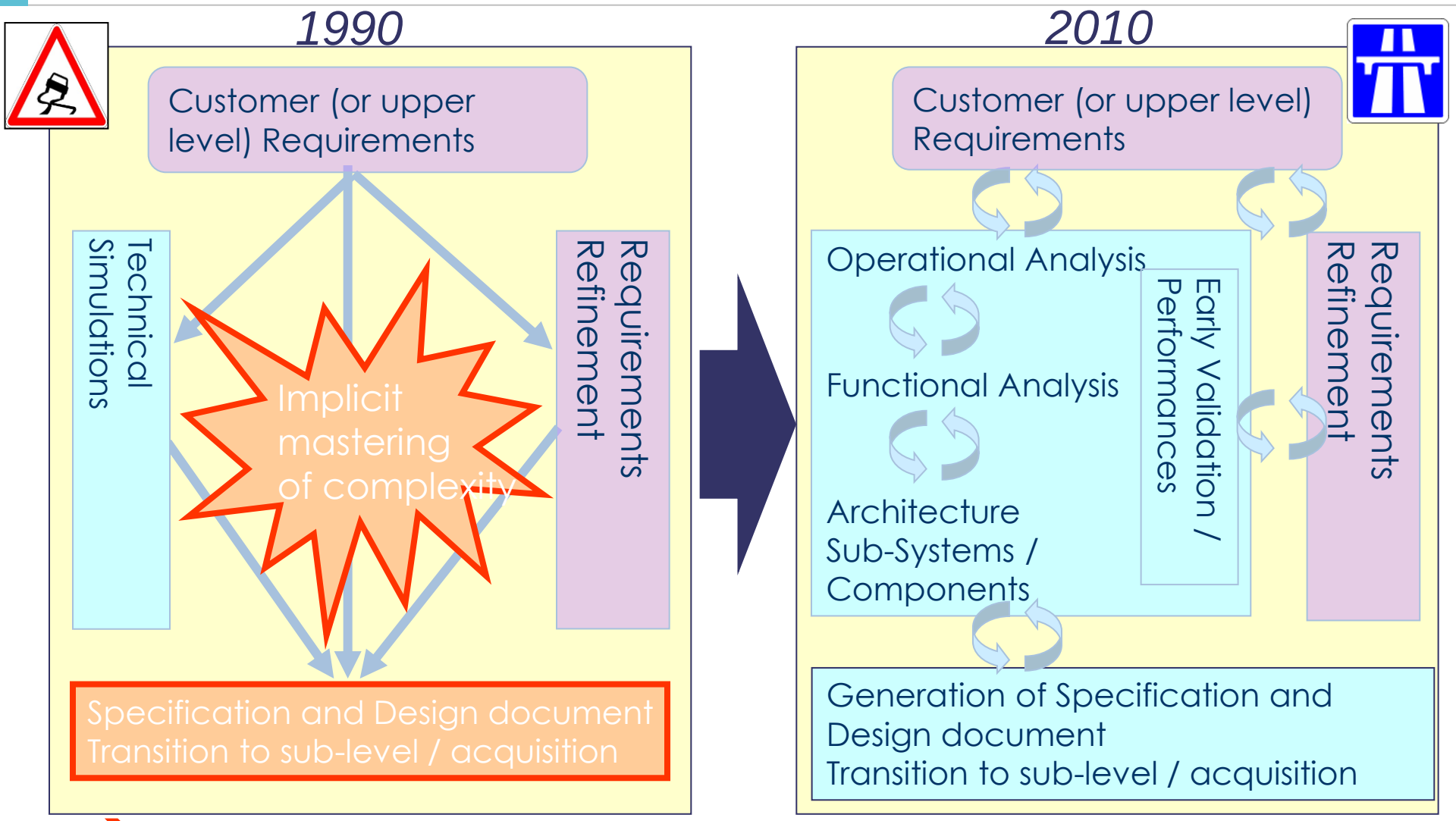
Examples

- Electronic scanning / multifunction radar for airport
- Laser anemometry, CAT detection, ..

Today (2010 – 2020) : Functions driven



From requirement modelling… to architecture modelling



➔ late discovery of design issues during IVVQ => early validation of the architecture

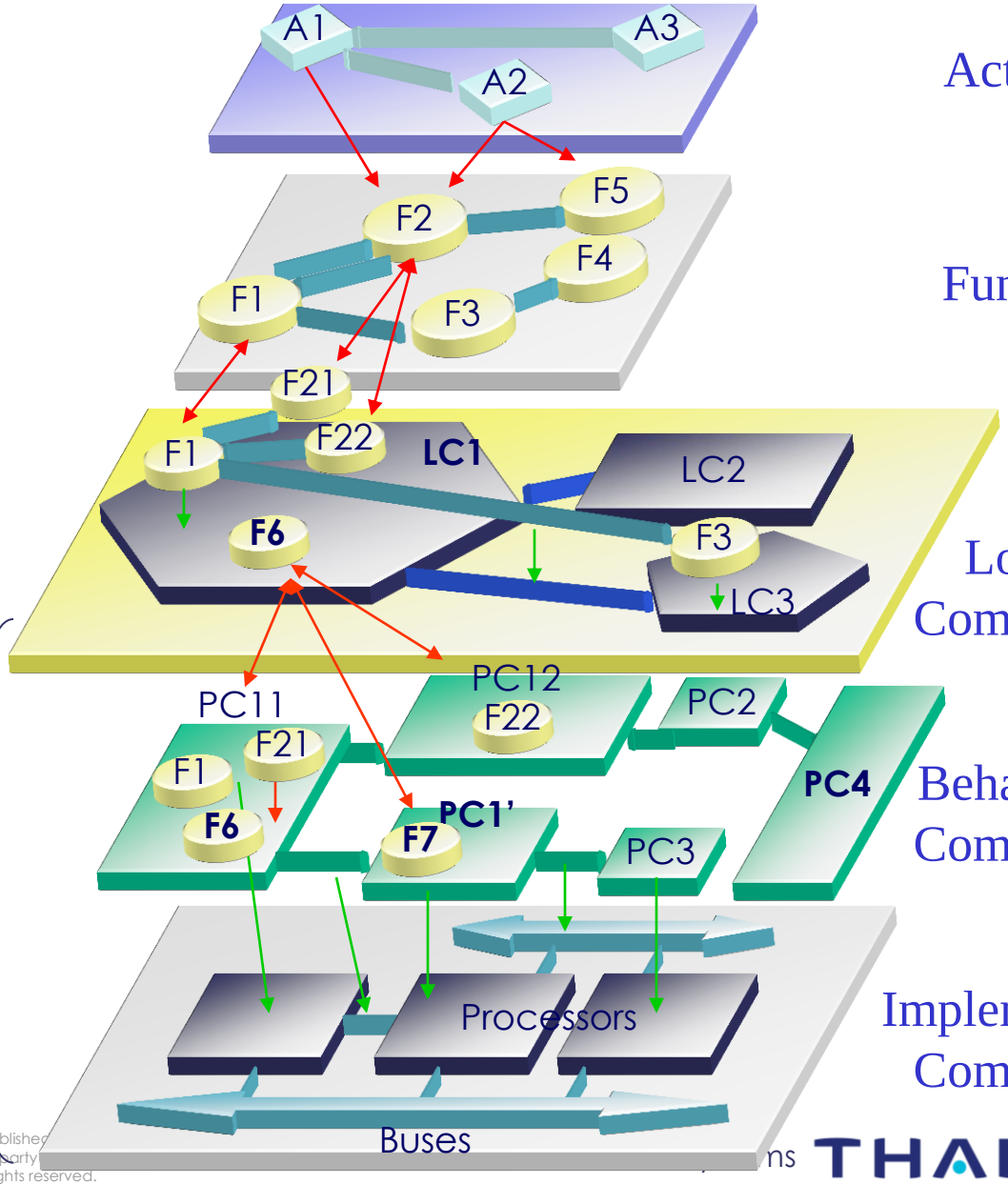
Model-based Architecture (MBSE) : ARCADIA@ Thales

Operational Analysis Model

System Functional Model

Logical Architecture Model

Physical Architecture Model



Activities

Functions

Logical Components

Behavioural Components

Implementation Components

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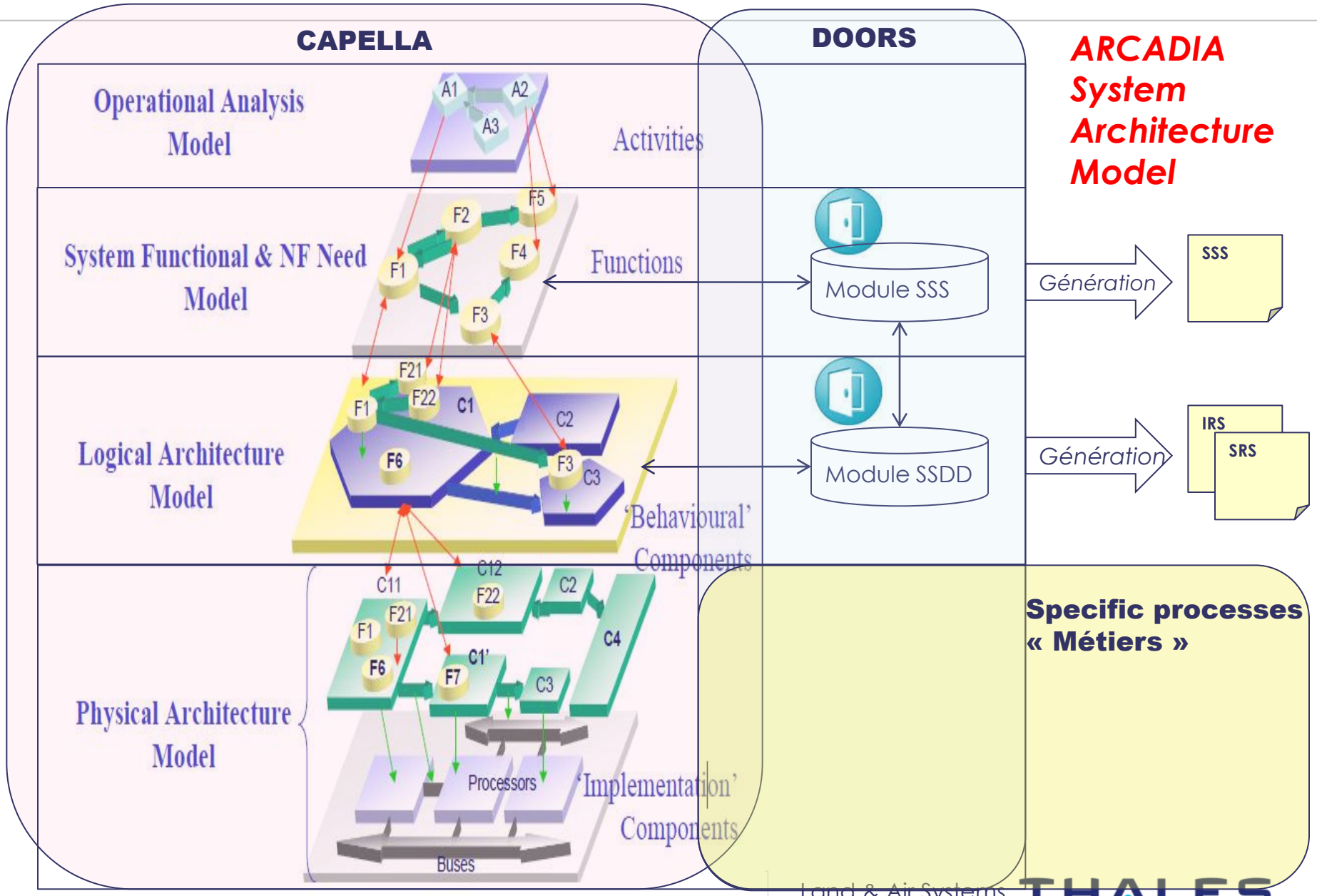
Tooled-up process : from specification to implementation



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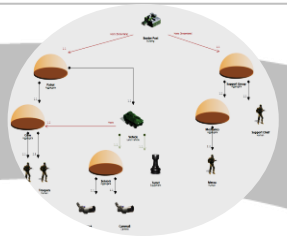
Upstream MBSE : Concept Development & Experimentation



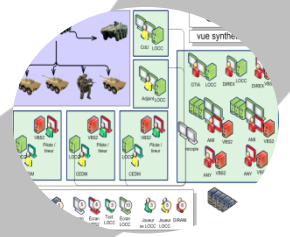
Modelling of
operational architectures
And high level architectures

Execution
of the models
for validation

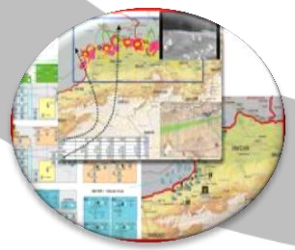
Needs identification
Formalisation

Illustration

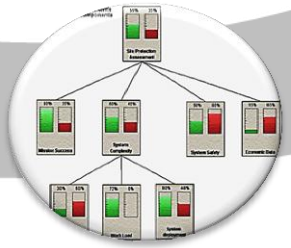
CD&E and Architecting
A key input to Engineering



Evaluation
Experimentation

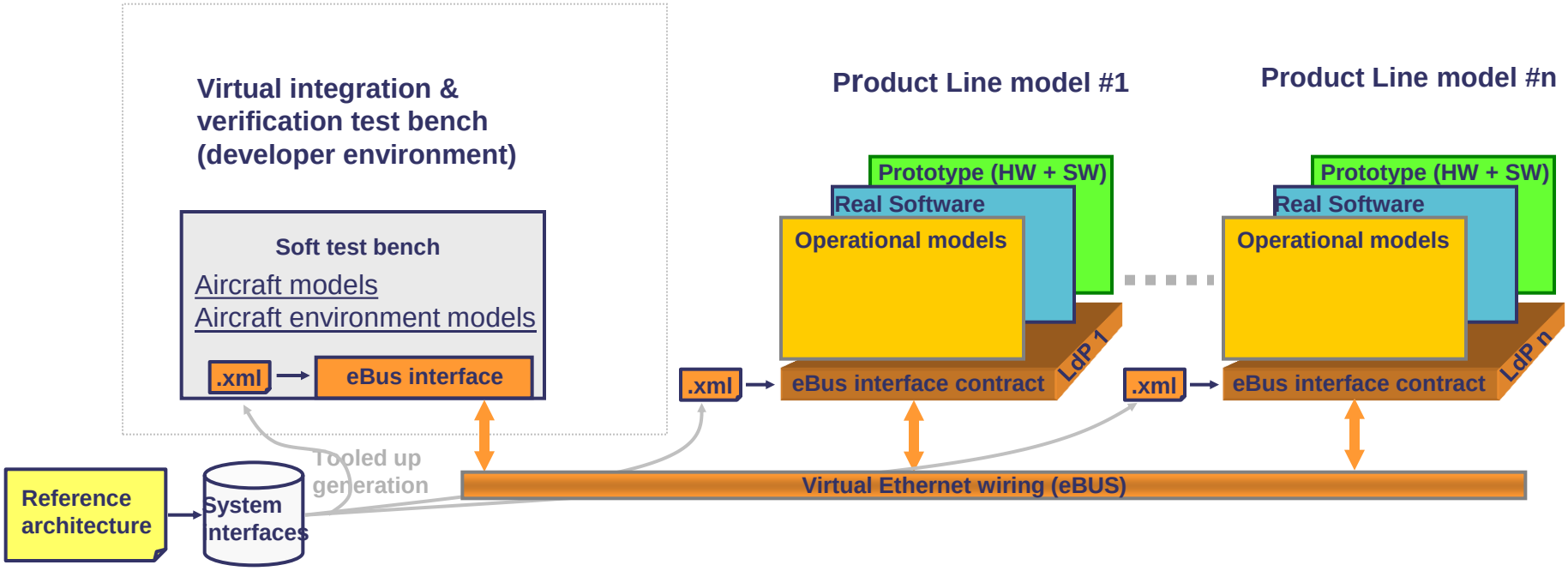


Performances evaluation
Sizing and optimisation



Multicriteria analysis

Downstream MBSE : Early validation



From System models and simulations to System test bench

- Scalability and Agility in system testing
- Fostering early validation

MBSE : what's next ? Three challenges

Challenge 1 : Federating Models / Simulations => MBSE Consistency

- Safety, security, … multi-physical
- How do we know that multiple models are describing the same system?
- How do we know that simulations operate in a consistent context / environment ? What about scenario relevance ?

Challenge 2 : Eliciting, expressing, comparing candidate solutions

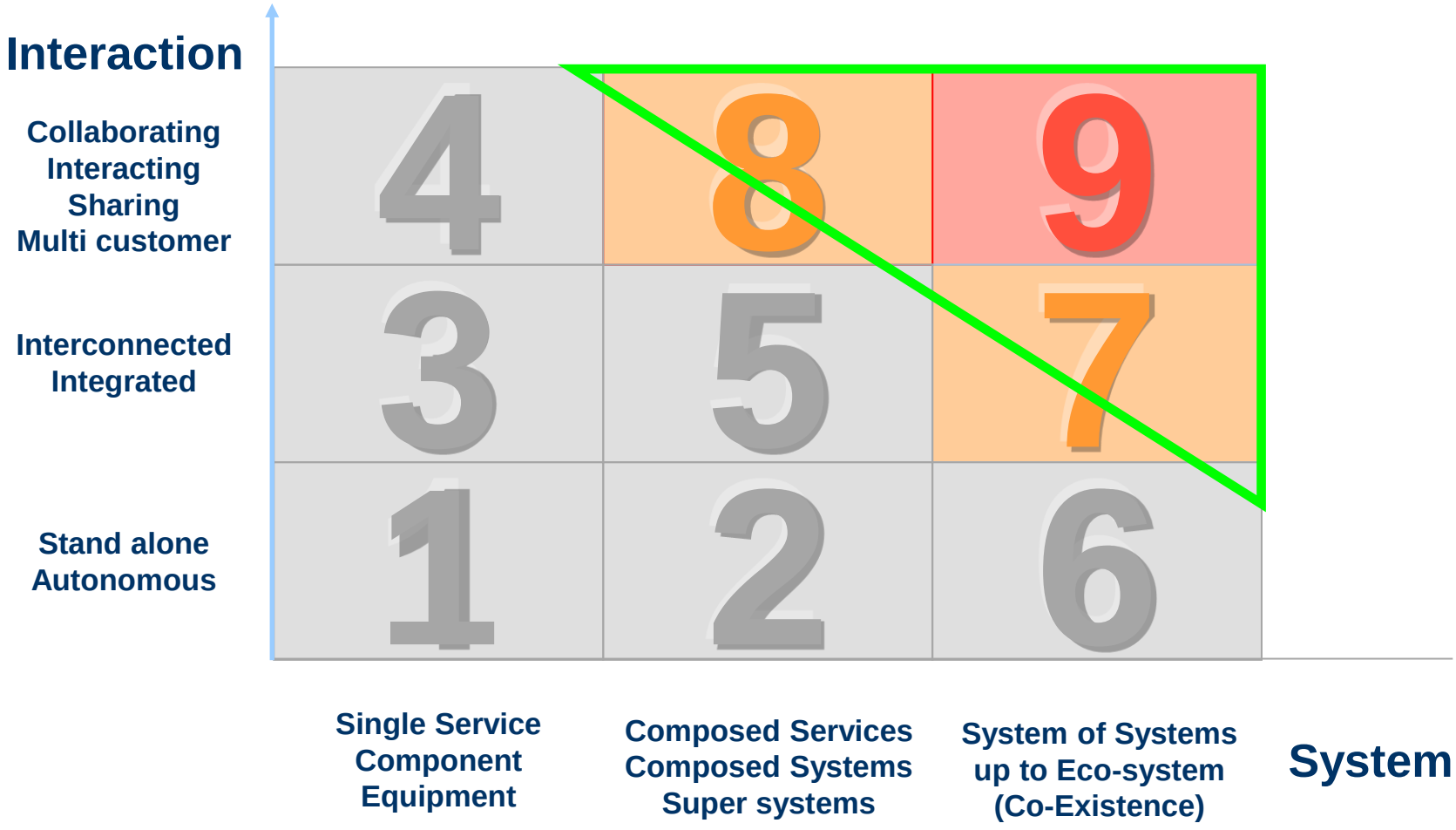
- How do we accelerate impact analysis and decision making?

Challenge 3 : Multi-criteria decision making

- What is a « better » architecture?
- What does mean « Value » across stakeholders?
- Identifying and weighting criteria?

Key Breakthroughs : collaboration across stakeholders, continuous activities during system development (agility, feedback)

Tomorrow (2020 – 2030) : Capability driven



Tomorrow (2020 – 2030) : Two main challenges

System Definition unstableness

- Unstable problem space, unstable solution space, unstable stakeholders space. Systems in "System-of-systems context"
- Obsolete deliveries due to very long cycles on technical as well as on functional and operational sides

System Testing incompleteness and operation unstableness

- Full testing becoming non achievable
- Some testing not achievable in the real world at reasonable cost / schedule
- Lessons learnt from system operation will bring needs to be satisfied in short loops

Key directions to address these challenges :
- collaboration to deliver value on a step by step basis
- incremental approach, "design for evolutions"

“Functional Health Monitoring” (1/2)

Infrastructure

Function

Ph… H…nal H…n Monit.

SOFTWARE EATING THE WORLD

Structure, engine

Electronics

Complex software

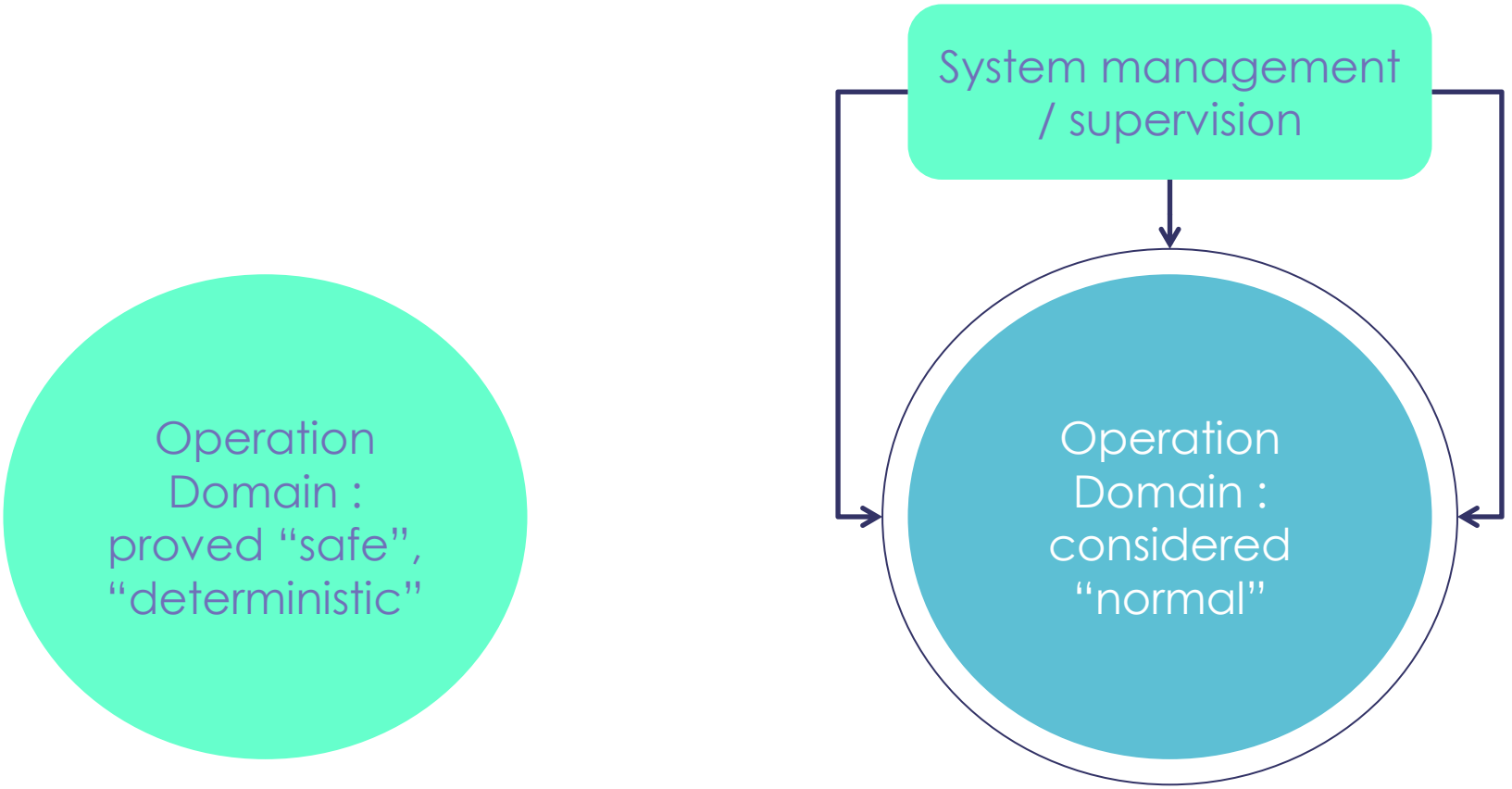
Net-Centric

Continuous Monitoring

Maintenance Free

Proactive Monitoring of connected A/C Health trends for non disruptive maintenance

“Functional Health Monitoring” (2/2)



Resilience will need new capabilities in system management, where supervision will monitor and organize system stability and reconfiguration, in relation with overarching System of Systems

Technological challenges and opportunities

- Complex algorithms, “multi-physics” approach
- Consistent Model-Based System Engineering
- Scalability and agility in system testing
- Incremental approach, “design for evolutions”
- Collaborative design
- Functional health monitoring