Searching for a Partner in .SE

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Date:
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Open

Issue:
1

Outline – Searching for a partner

- SAAB outline
  - The aerospace challenge
- Partnership scenarios SE
  - The new recruits
  - Professional guidance in the middle of the career
  - Diving into research
- Some thoughts on MBSE
- And something completely different

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SAAB - The domain

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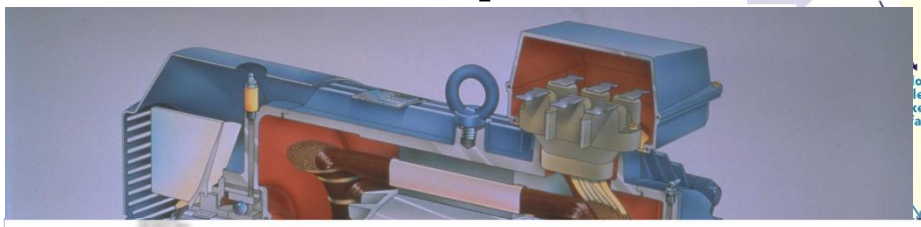
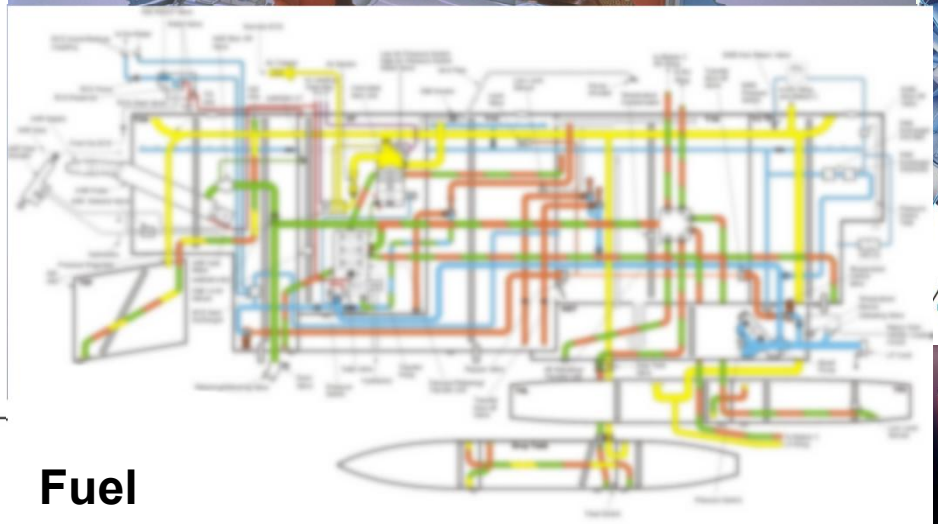
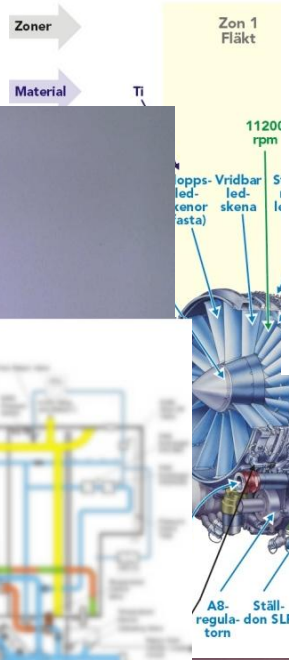
Outside Gripen

Open

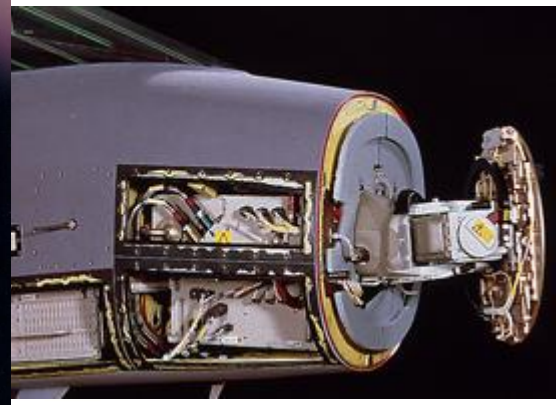
Inside Gripen







SAFETY CRITICAL APPLICATION

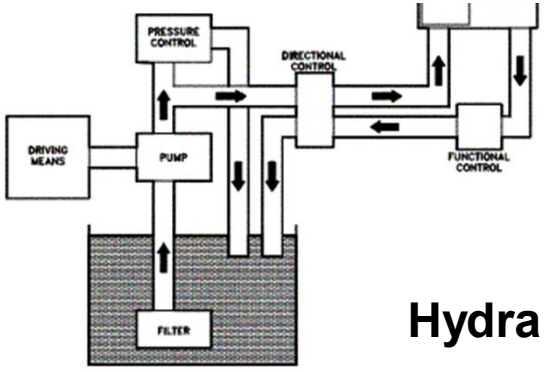


TT5
EBK-tem-
peratur

Flamvakt

LVDT
A8-läget
(på undersidan)

Fuel



Hydraulics

Computing performance

Sensors

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The system and some example system properties

Payload

Fuel capacity

Fuel consumption

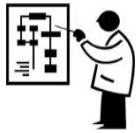
Service life

Weight

Center of Gravity

Environmental impact

Range



Safety

Supportability

Availability

Development Cost

RCS

Maintenance interval

Flight envelope

Operational cost

Survivability

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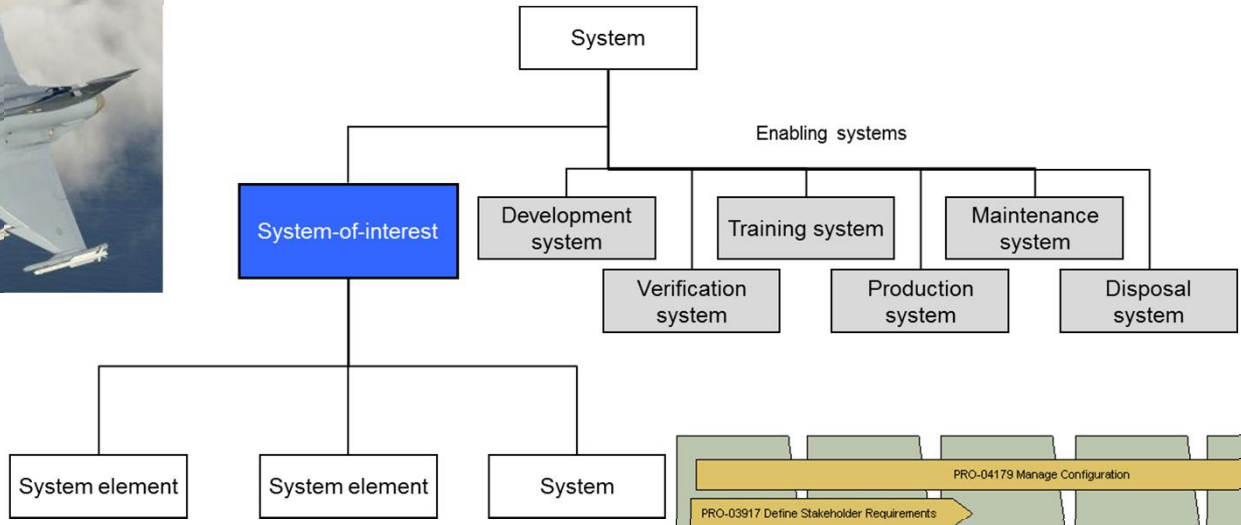
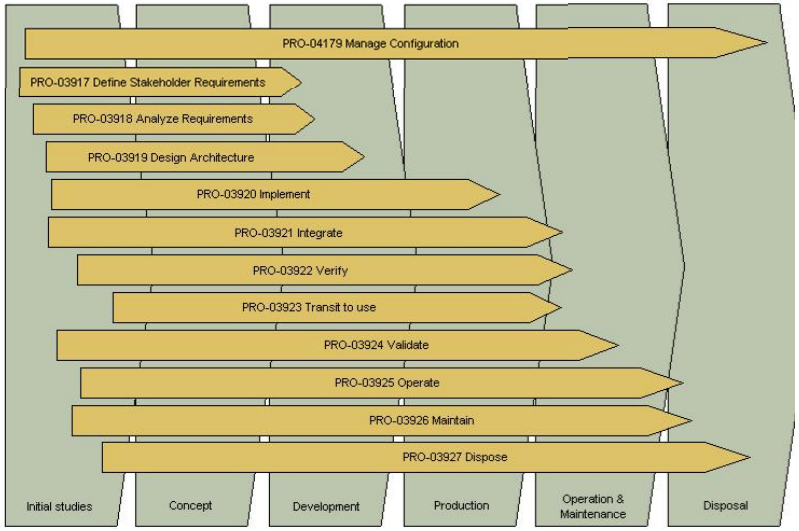
SAAB

Engineering Systems as SAAB



- Complex
- Heterogeneous
- Safety critical
- Communication intensive



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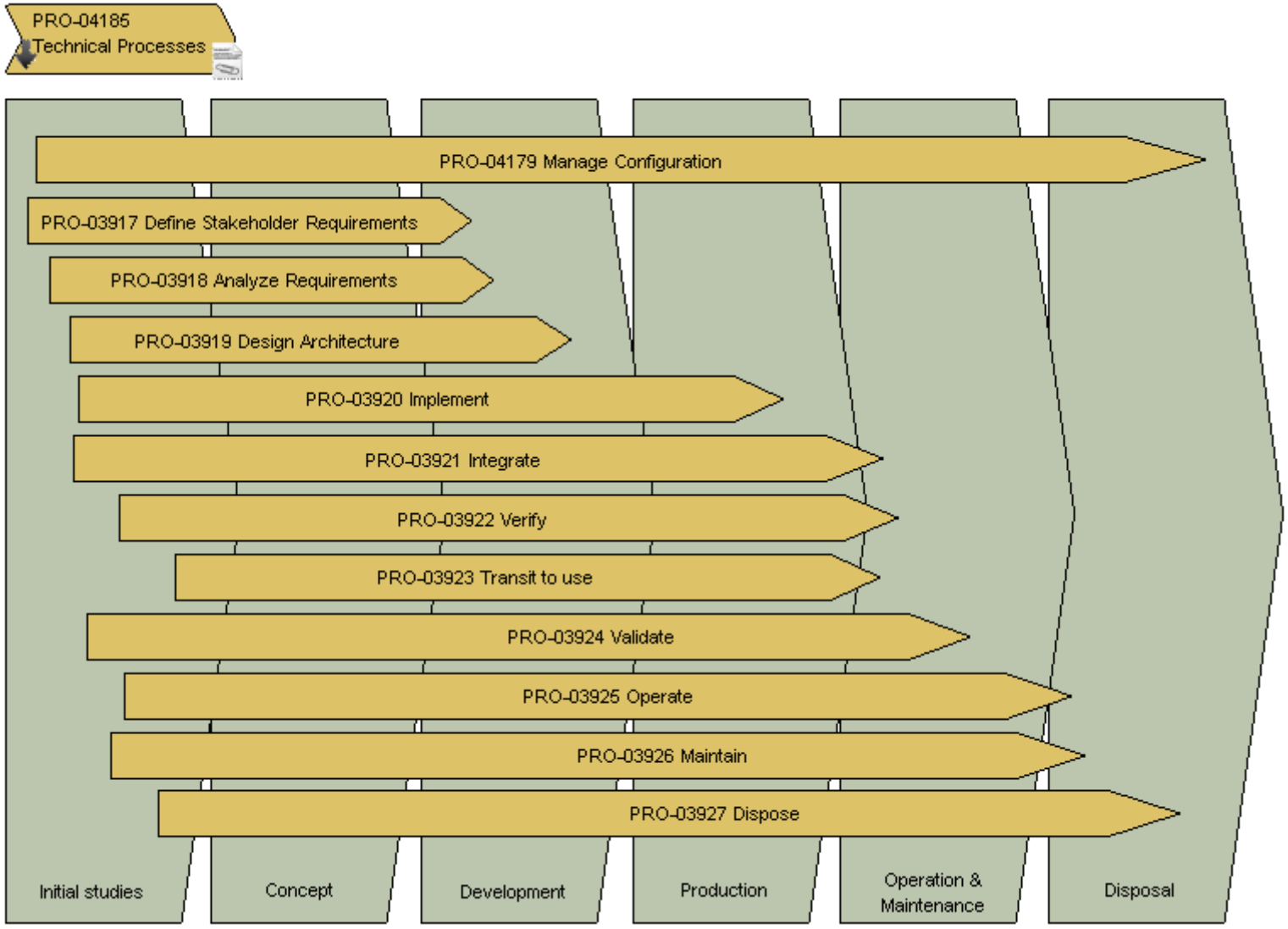
A closer look at the process



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PARTNERSHIP SCENARIOS

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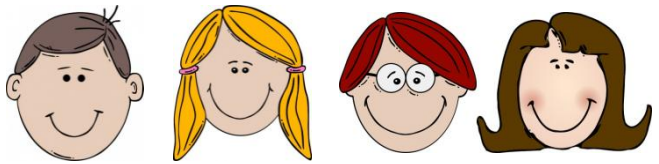
The new recruits



Lifecycle management
Verification & Validation of heterogeneous systems
System of systems
Requirements management
Systems thinking
System integration
Systems architecting and design
Reliability, Availability & Maintainability
Systems engineering
System safety
Operations analysis
System modelling & simulation
Multi-disciplinary trade studies
Configuration management
Human system integration
Development of heterogeneous systems

Computer Science
Machine design
Electronics engineering
Engineering management
Material sciences
…
…
…
Logistics
Aeronauticsl engineering

Ecomics, HR, Law, …

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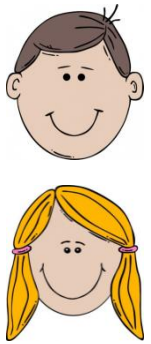
SAAB

Continuous competence development

- Internal training programs
- General Systems Engineering courses
  - 6-20h introductions
  - INCOSE CSEP preparation courses
    - 20 students/year
- Dedicated courses in
  - Safety
  - ILS
  - Architecture
  - …
- In this scenario we are missing a partner that can offer more in depth training in systems engineering subjects
  - And provide a meeting space for people and organisations with similar challenges



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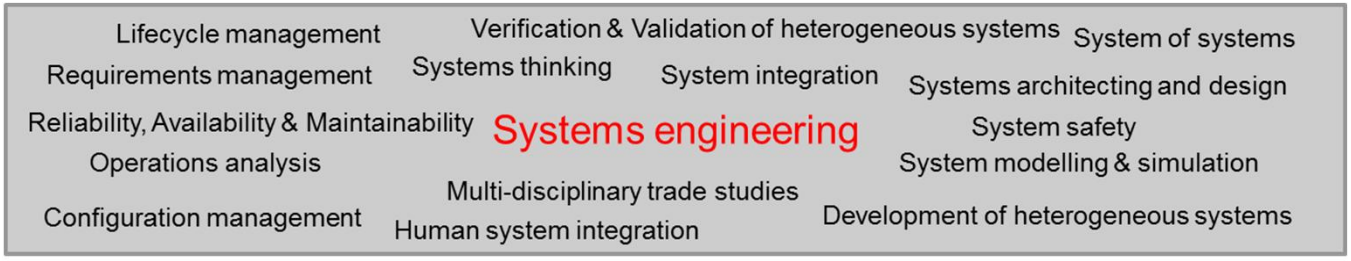
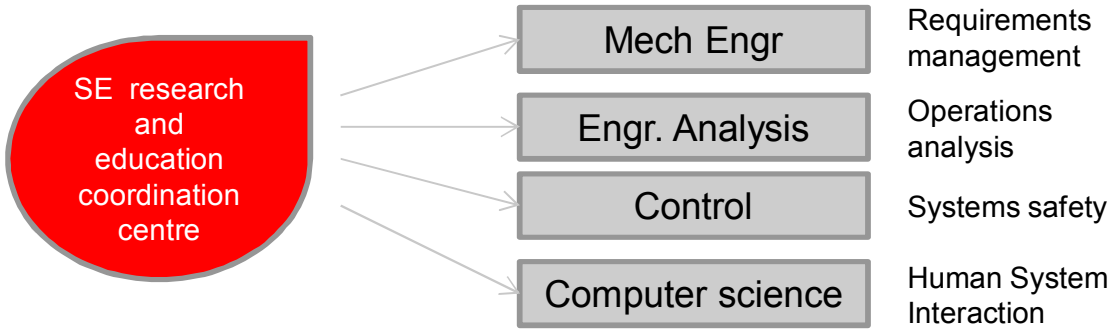
Research

- Many of our research projects are systems related
- When placed at non-systems institutions a lot of time and energy is required to adapt to the academic tradition of that institution
  - Difficult to take advantage and build on earlier research





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Looking west

- **Norwegian Institute of Systems Engineering, Kongsberg**
- ”Norwegian Institute of Systems Engineering (NISE) er organisert som et institutt under Fakultet for Teknologi, og masterprogrammet Systems Engineering ligger under instituttet. Instituttets viktigste oppgave er å utdanne høyt kvalifiserte masterstudenter i Systems Engineering, med relevant kunnskap norsk industri etterspør.”
- Master programs in
  - Systems Engineering
  - Systems Engineering and industrial economics
  - Systems Engineering and embedded systems
- Stand-alone courses
  - Advanced materials
  - Fundamentals of Systems Engineering
  - Knowledge Based Development
  - Lean Product Development
  - Robust Engineering
  - Systems Integration
  - System Modelling and Analysis
  - Subsea Production System Technical Safety
  - Subsea Production Technology and Application
  - Advanced Systems Architecting
  - Project Management of Complex System
  - Robust Engineering
  - Subsea Systems Architecture
  - System Architecture and Design
  - System Supportability and Logistics

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SOME THOUGHTS ON MBSE

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A troubled integration – a true story

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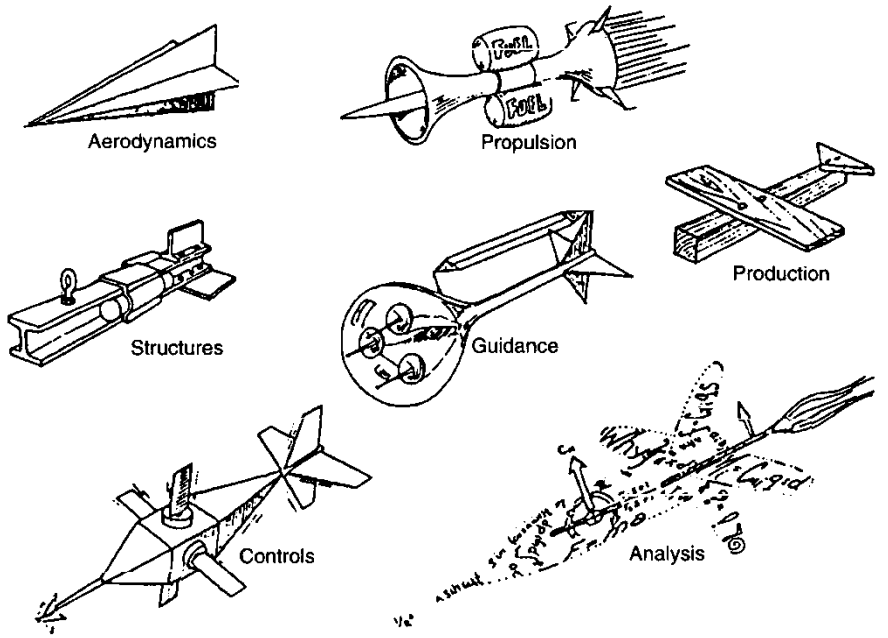
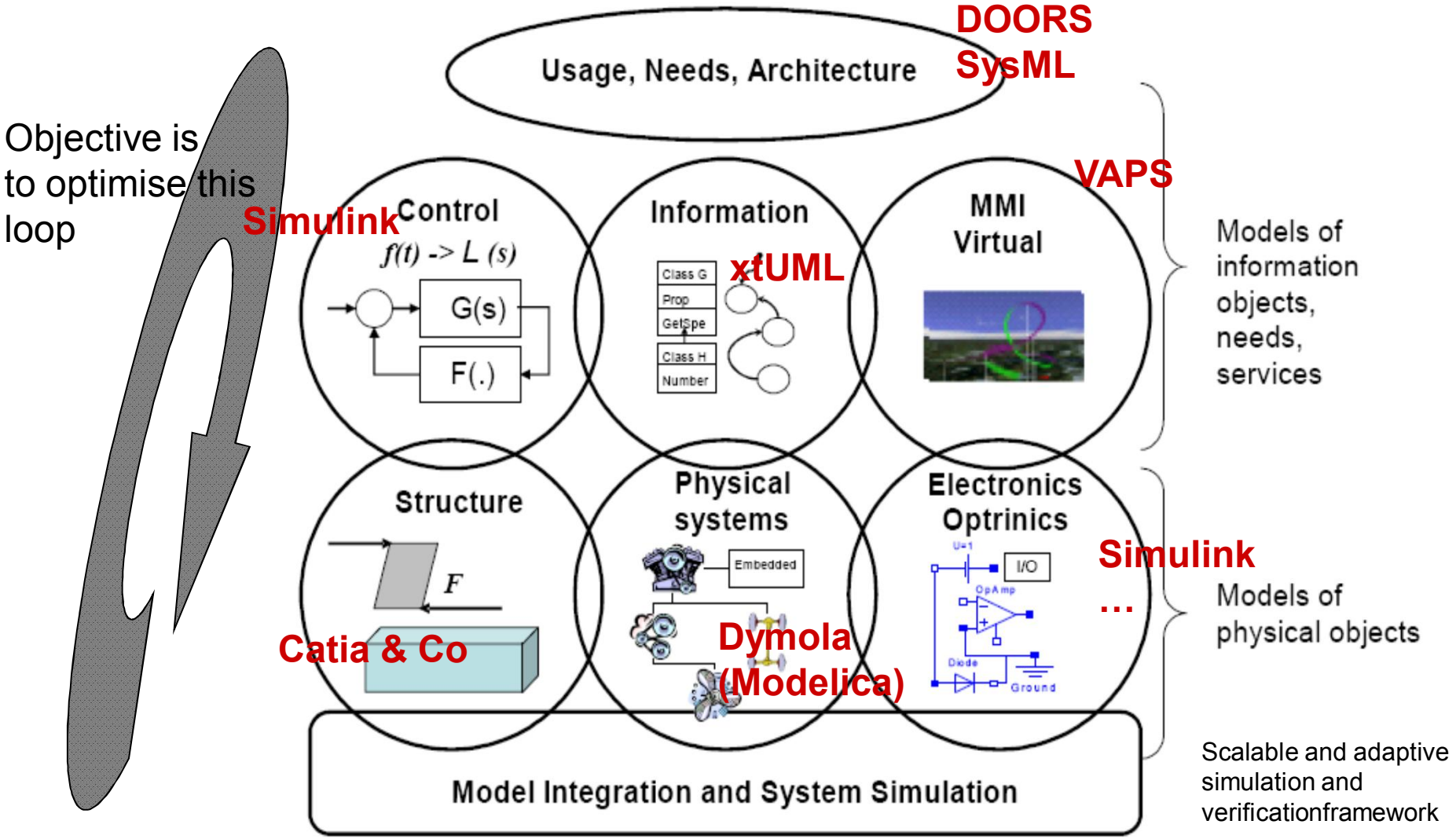
Some insights in industrial daily life

- Formal models, simulations results, proofs matter little if we aren't in agree on what we are building
- Safety analyses, no matter how elaborate, of a system we do not intend to build has little value
- Parts built, but not compatible in the intended configuration has little utility even though they may be fully verified



Complex systems development is primarily a communication challenge

System design using models at SAAB



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Standards, strategies, tools

- Process
  - **ISO 15288**
- **Tool lifecycles** << System lifecycles
  - Need to migrate to new tools multiple times in the system lifecycle
- **Open standards** over proprietary methods
  - Follow industry standards where ever possible
- **Open standardised interfaces** over proprietary
- **Small specialised tools** over large general purpose systems
- Open source or commercial systems?
  - **Who cares?**
- Key standard initiatives
  - RQIF
  - OSLC
  - FMI
  - STEP
- Key capability improvement sought
  - **Integrated configuration management support of fine granularity information**

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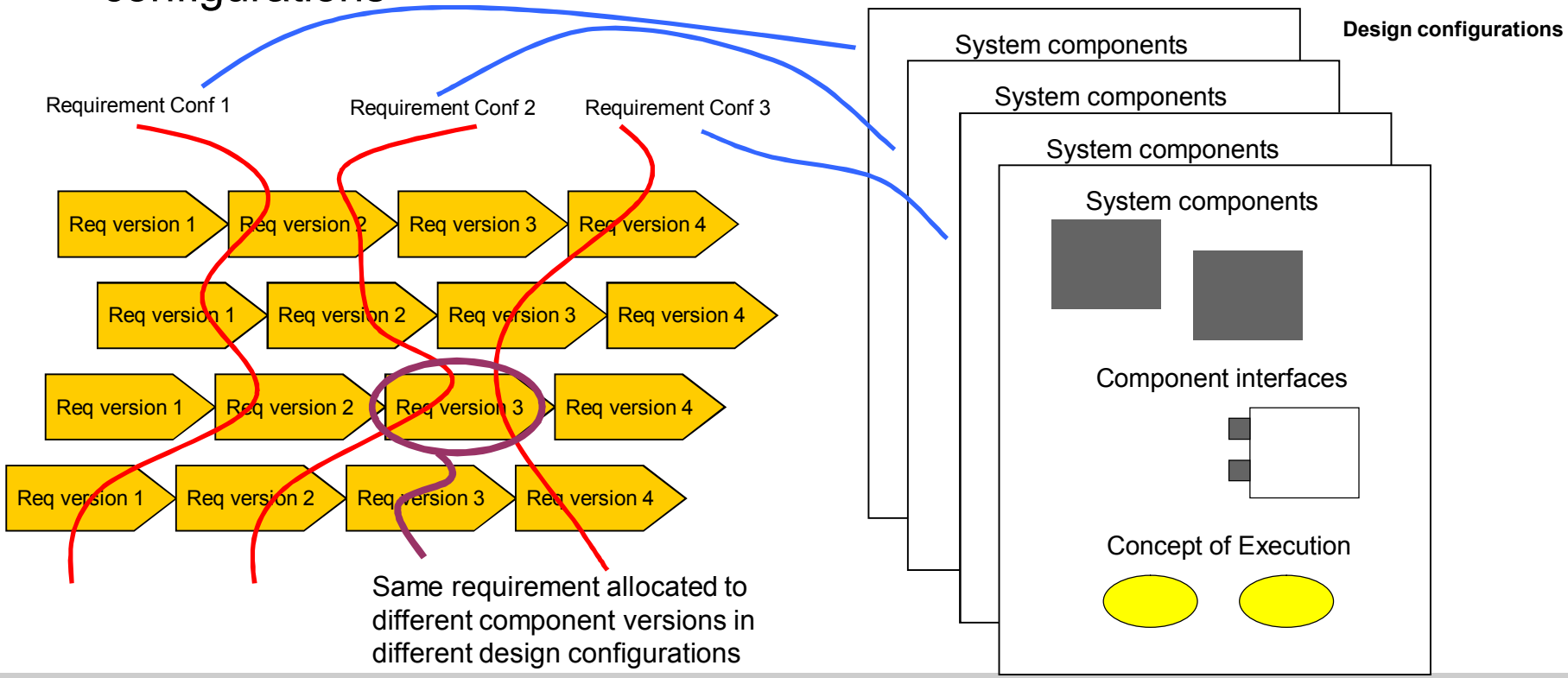
Variant management support

- Usage of a design elements in multiple contexts
  - Trace and allocation information is context dependent
- Most elements are likely common between two configurations



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SAAB

The integrated development environment

- Systems Engineering
  - Requirements management
  - Systems architecture/SysML
  - Verification
  - Change/Issue management
  - Configuration management
- Interfaces to domain engineering tools (OSLC and FMI)
  - Modelica
  - Matlab/Simulink
  - Software UML//xtUML
  - Mechanical engineering tools (Catia & Co)
  - Electrical engineering
  - Aerodynamics
  - …
- Interface to speciality engineering tools
  - Systems safety
  - ILS
  - Security
  - …

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Conclusions

- SAAB and, in fact, much of Swedish industry are facing system challenges
- From an industrial perspective SAAB is missing:
  - Systems Engineering infusion in standard masters programmes will reduce on the time to productivety and job frustration for new recruits
  - Advanced, targeted, courses will provide in depth competence development for senior Systems Engineers and for those who decide for a dedicated Systems Engineering programme
  - A research partner firmly rooted in the Systems Engineering tradition
- Use of models facilitates communication
  - Much, if not most, waste in development of complex systems is due to different parts of an organisation building different systems
  - Very important first step in the development of complex systems
- An open integrated engineering environment is envisioned
- Configuration management support is vital
  - Integrated in the engineering environment

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Something completely different

- June 3, 3rd Nordic Systems Engineering Tour, KTH, Stockholm
- July 13-16, 25th INCOSE International Symposium, Seattle, USA
- Aug 24, Air, Land, Sea Systems Engineering Tour, Linköping
  - CFP open until May 15

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