FIGHTER AIRCRAFT DEVELOPMENT WITH MODEL-BASED SYSTEM ENGINEERING

A Report from the Trenches

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AGENDA

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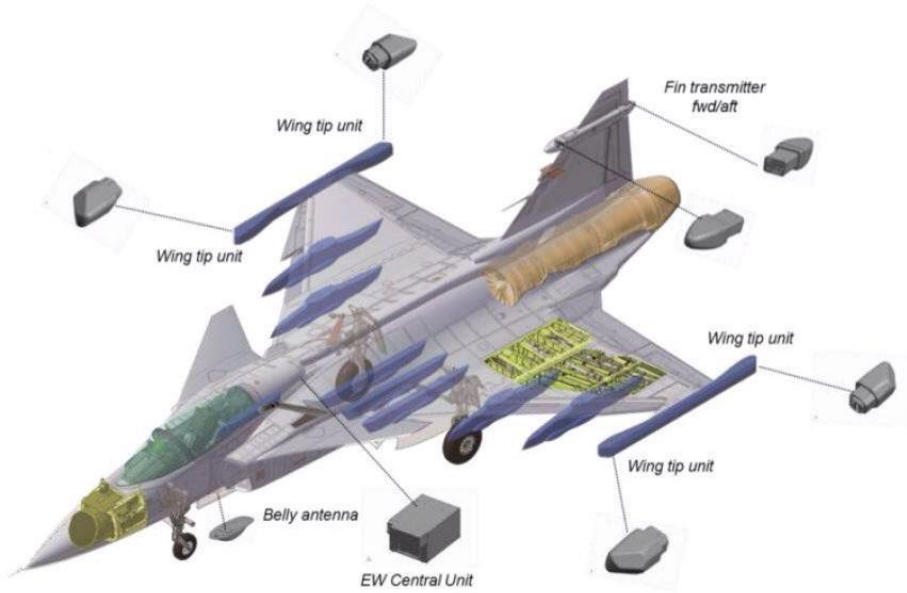

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A fighter aircraft developed using models

SAAB – THE DOMAIN








IS IT DIFFICULT TO DEVELOP AN FIGHTER AIRCRAFT?

CHALLENGE: HANDLE MULTIPLE SYSTEM PROPERTIES


RCS


Payload


Fuel capacity

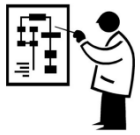

Fuel consumption


Center of Gravity


Service life


Weight


Environmental impact


Safety


Range


Supportability


Availability


Development Cost

Flight envelope

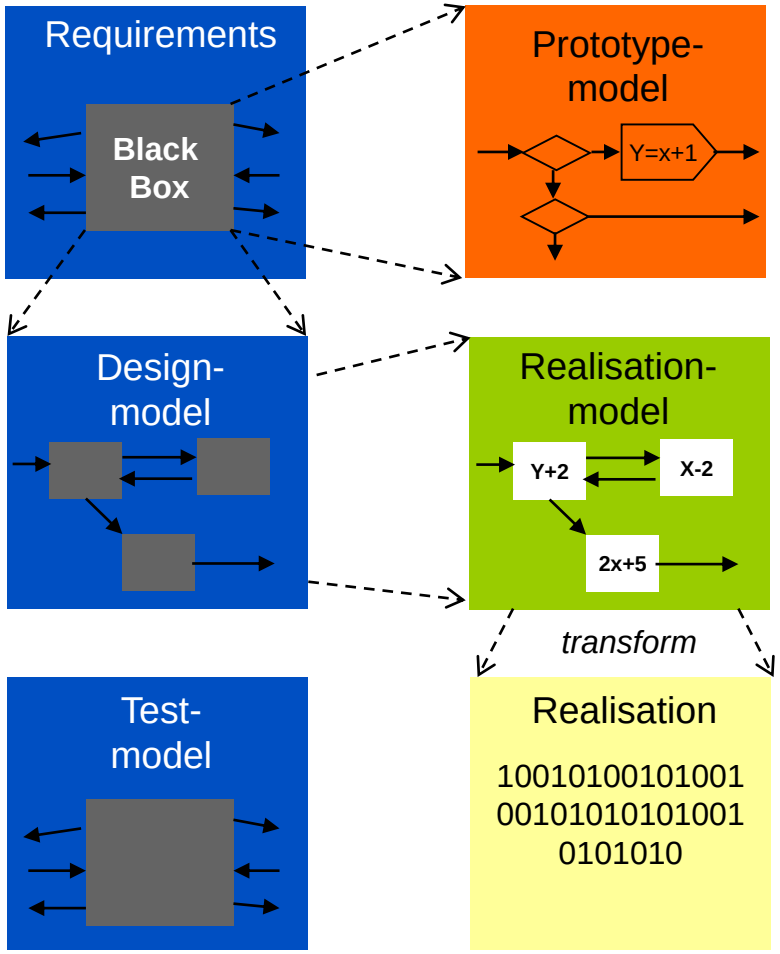
Maintenance interval

Survivability

Operational cost

USE OF MODELLING & MODELS

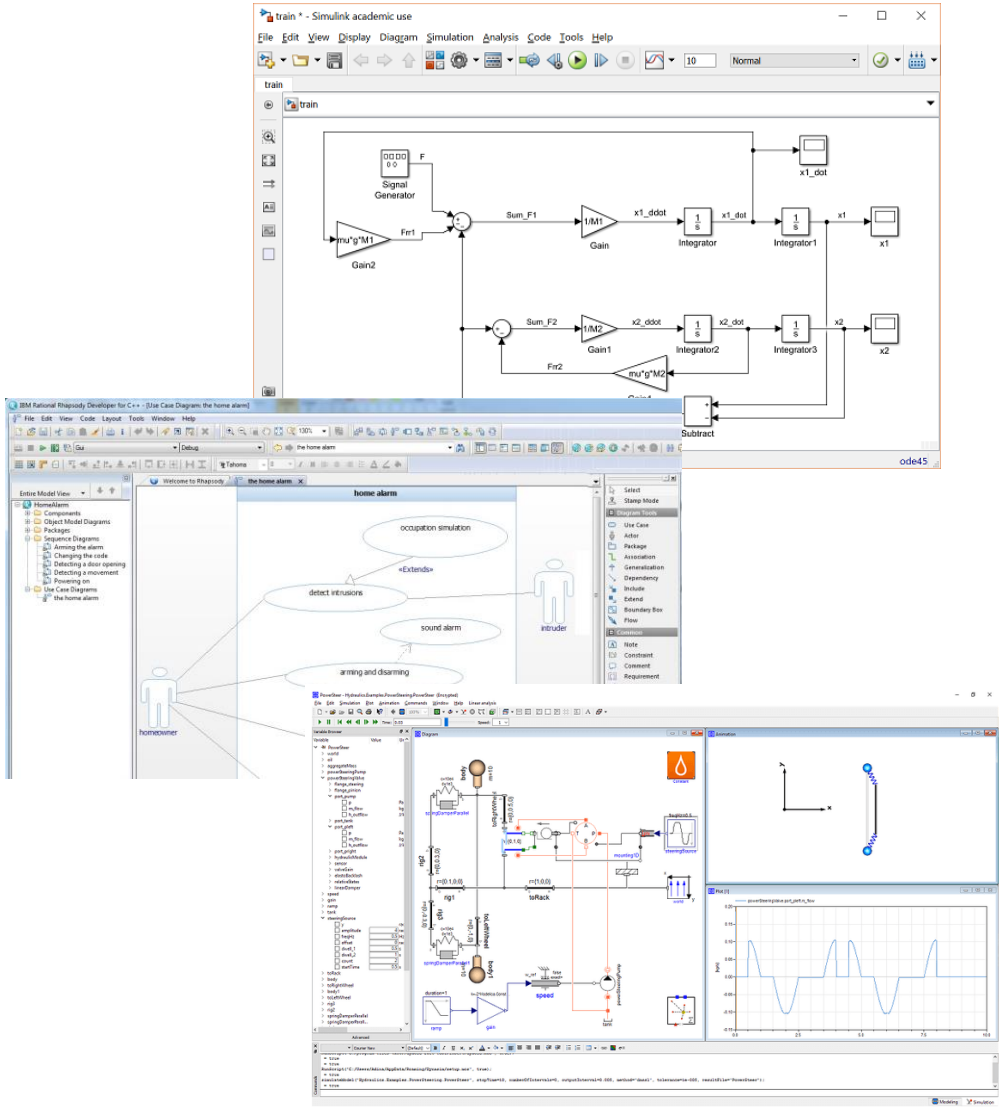
DIFFERENT KINDS OF MODELS



- **Requirements** containing model fragments expressing required system properties.
- **Prototype model** potentially executable, meeting high level functional requirements. May be used for code generation.
- **Design model:** Architectural and functional design at a suitable level of abstraction.
- **Realisation model** potentially executable, meeting requirements, structure corresponds to the realisation.
- **Realisation** executable object code (for verification in target system)
- **Test model** realises requirements based testing. May be used to verify the prototype and realisation models as well as the realisation.

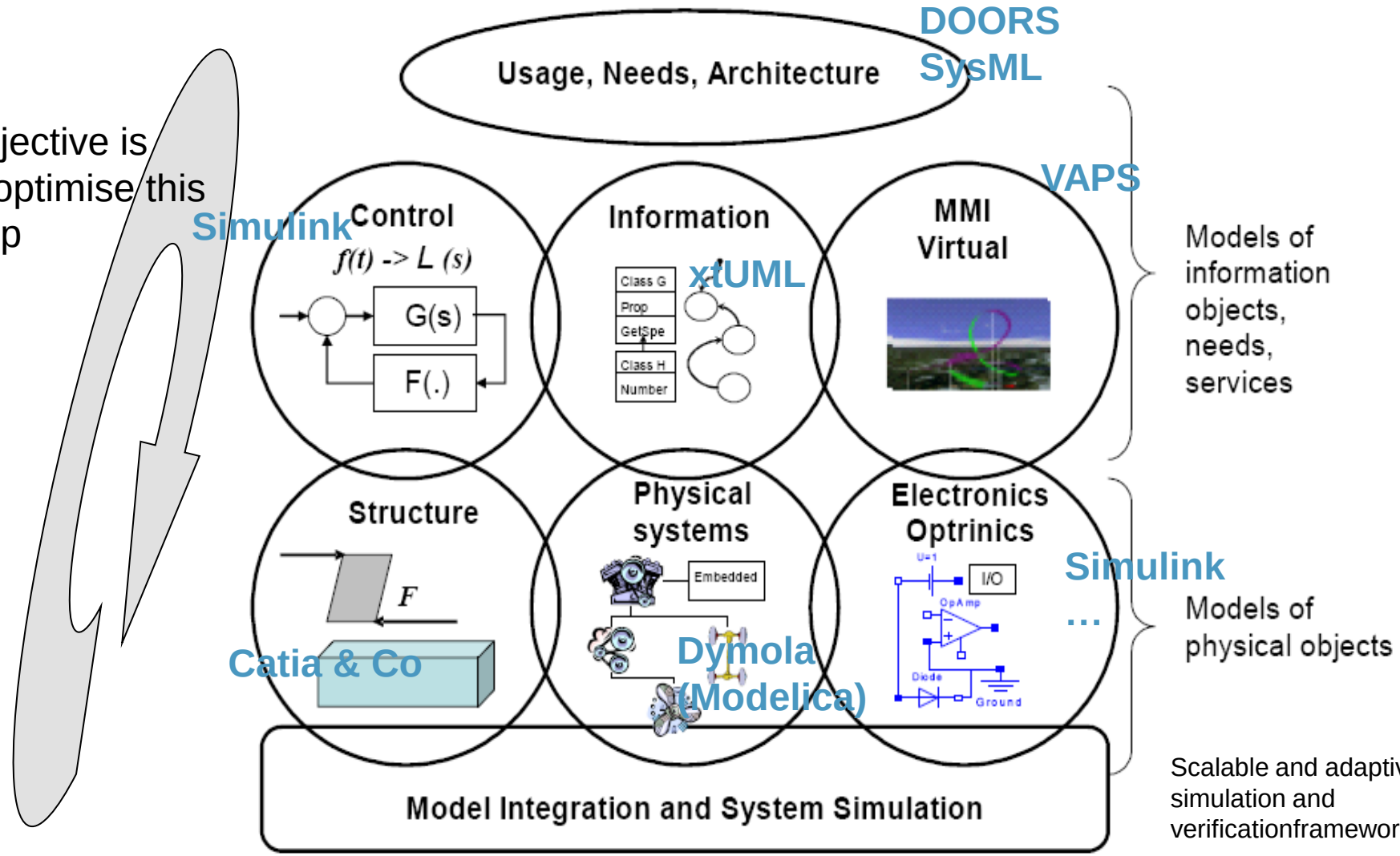
WHAT BENEFITS DID WE EXPECT?

- Early validation – ability to simulate design concepts to increase
  - Understanding feasibility
  - Acceptance for solution
- Improved communication – ability to discuss design alternatives in an objective way
- Improved accuracy – ability to determine and tune performance early in development
  - Fewer flight-test
- Improved quality – right the (almost) first time
- Improved efficiency – quicker turn-around

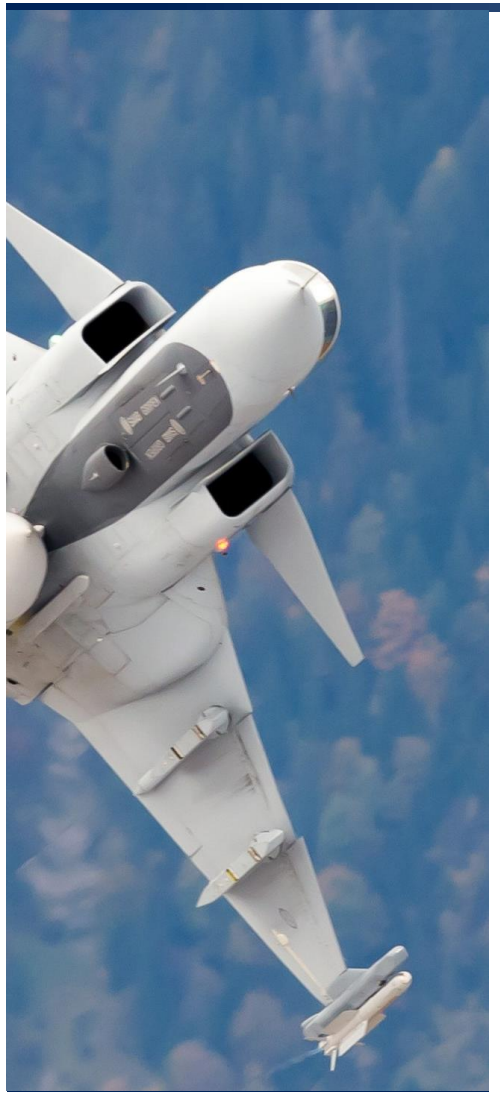


USE OF MODELLING TOOLS

Objective is to optimise this loop



DOES MBSE STAND UP TO THE HYPE?



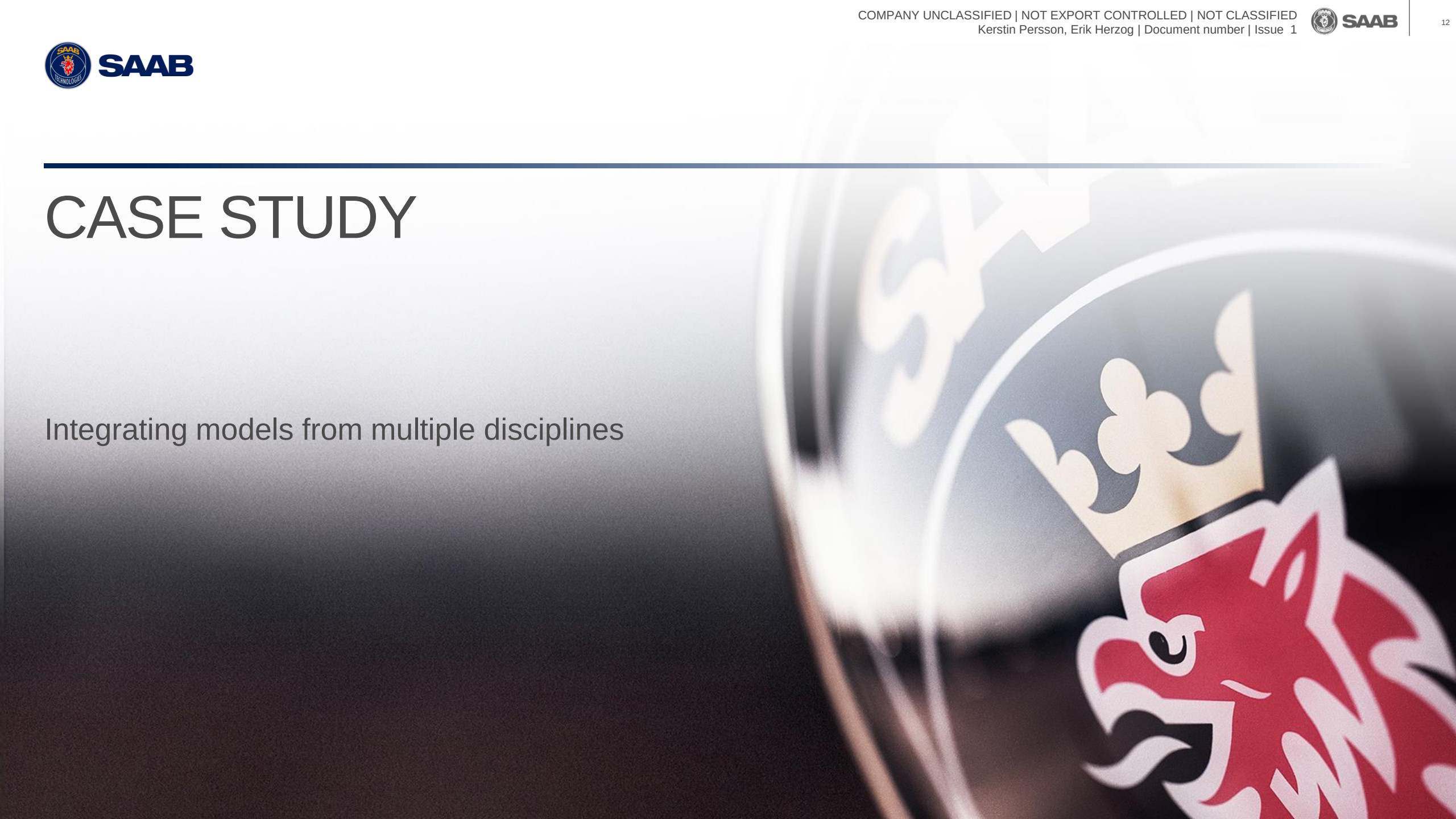
+ Ability to model complex systems
  + As long as we remain within a single modelling domain
+ Simulation allow for early feedback
  + Higher quality
+ Code generation
  + Decrease in the number of implementation errors
+ Availability of block libraries seems to facilitate success

- Limited CM/PDM capabilities
  - Except for Catia & Co
- No integration with change management
  - Truncated workflows
- UML tools for code generation do work
  - Very general language, organisations need to build their own domain support
- Modeling domain interoperability and model interoperability is a challenge

Many modelling domains still need to mature to reach its full potential

CASE STUDY

Integrating models from multiple disciplines



COMPLEX SYSTEM COVERING MANY DISCIPLINES

Radar

Hydraulic

Fuel

Navigation

Weapons

Landing gear

Flight control

Communication

Engine

Display

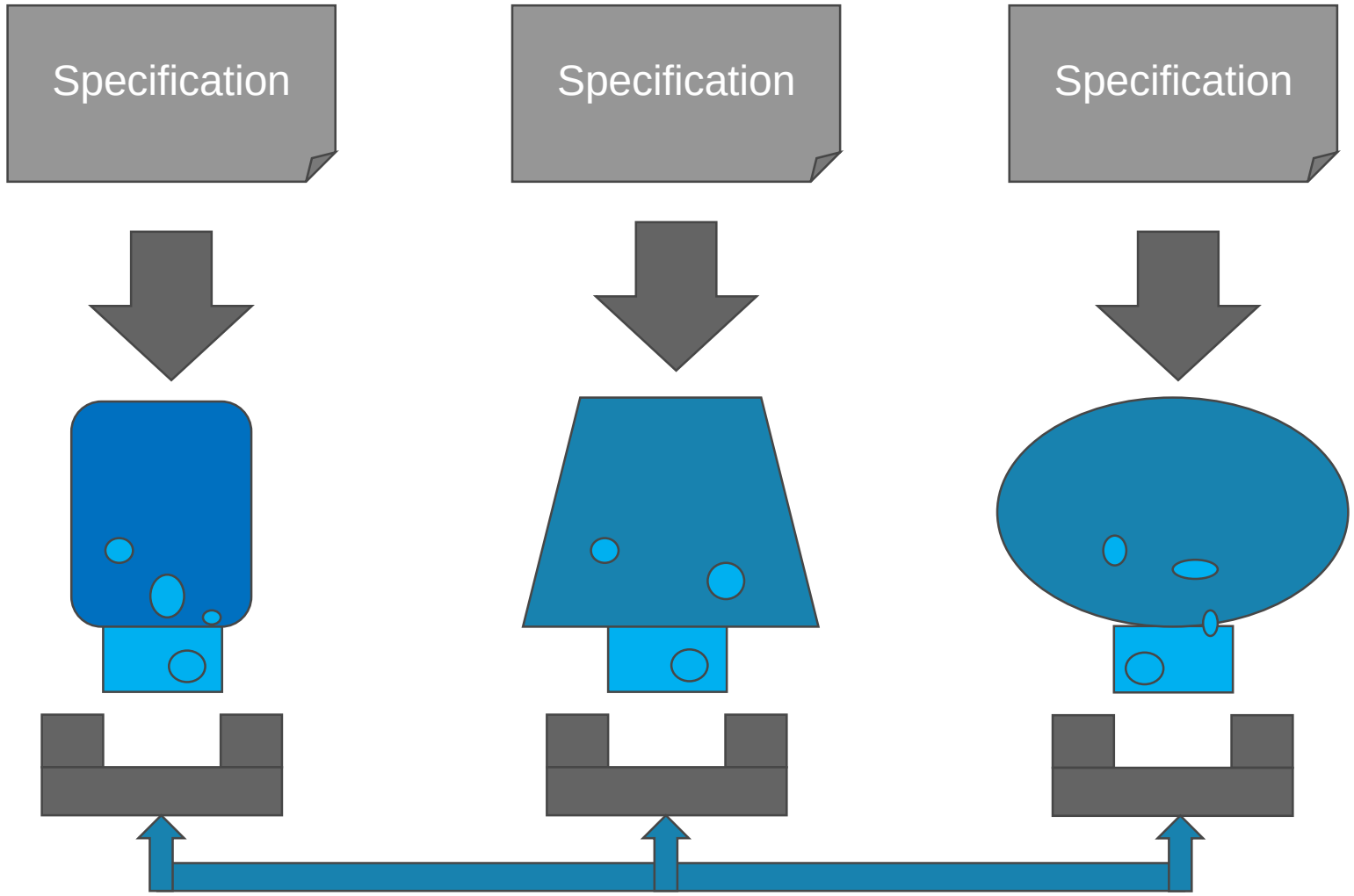
Planning

- Different disciplines and design methods
- Highly integrated software functions across multiple units on one platform

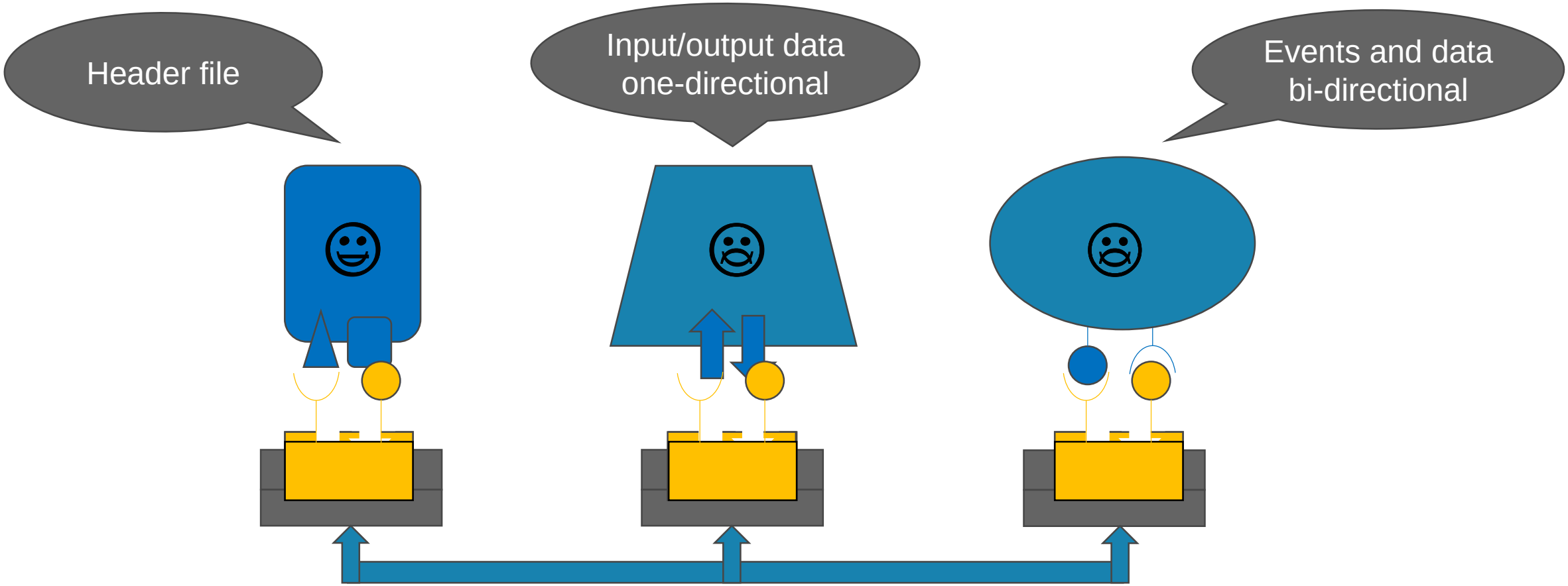
INTEGRATION IN TRADITIONAL DEVELOPMENT

Integration

- Case-by-case solution
- Work intensive
- High risk for low decoupling

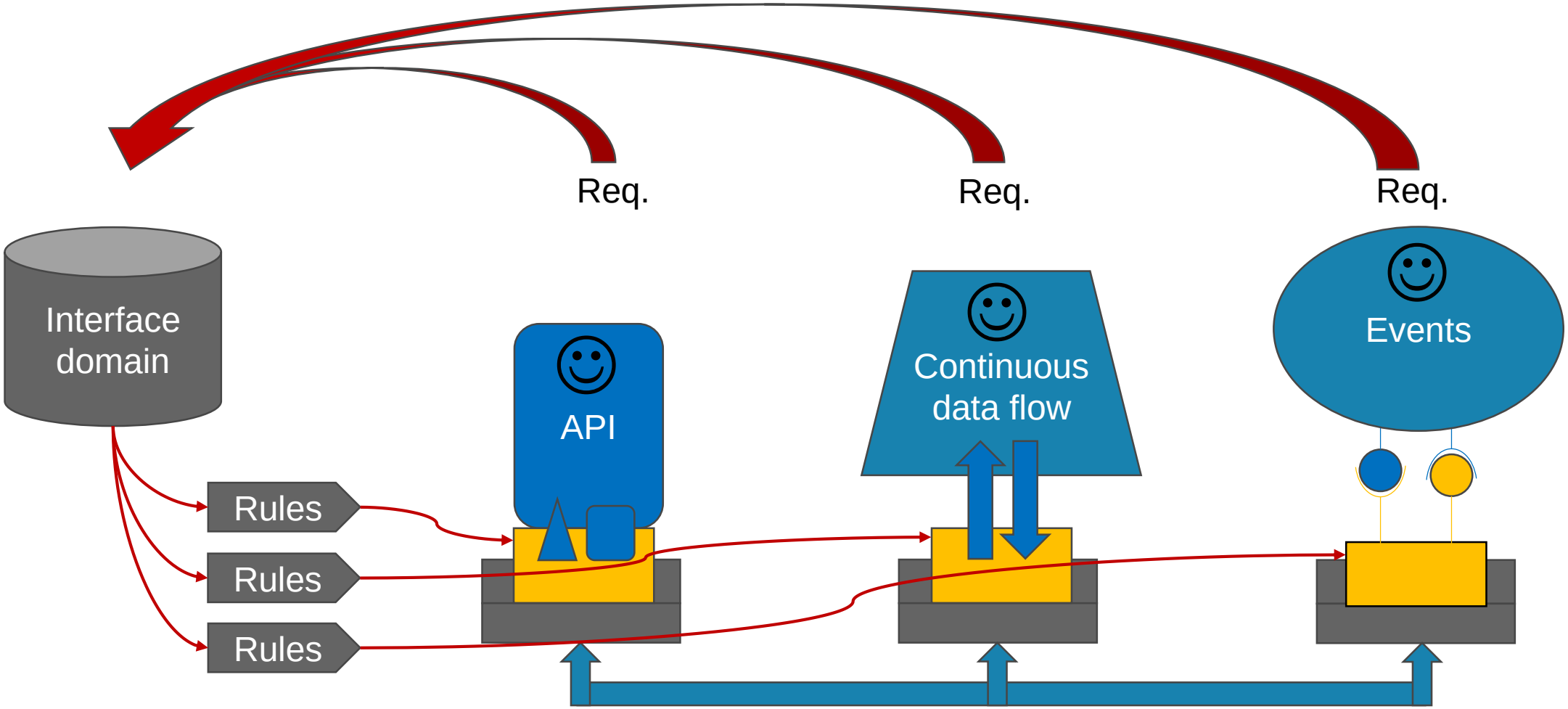


INTEGRATING MODELS FROM DIFFERENT DOMAINS



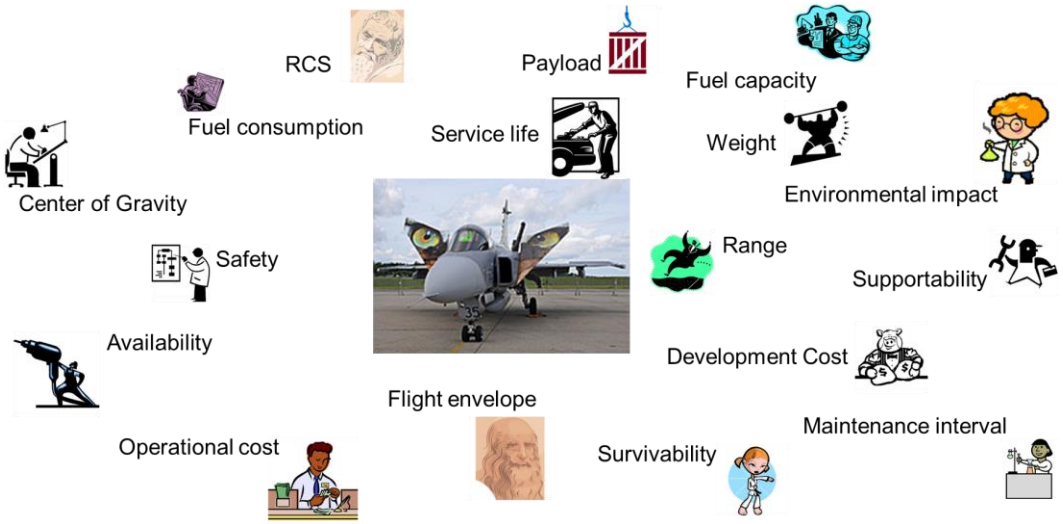
Who is in charge, and who must adapt?

INTRODUCING THE INTERFACE DOMAIN

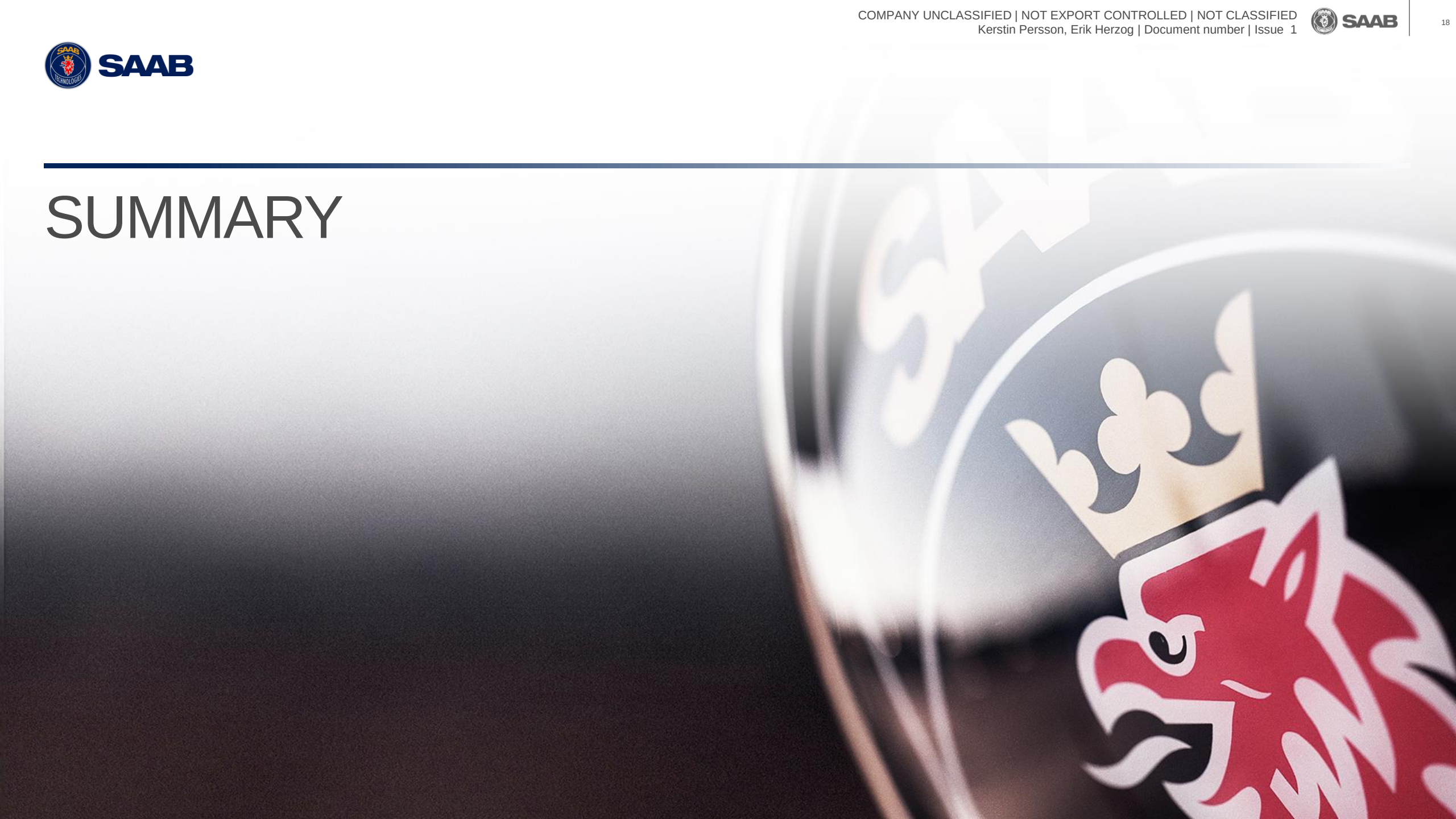


CASE STUDY – CONCLUSIONS

- Technical solution for an interface domain
  - Collect requirements from all applicable stakeholder domains.
  - Separate data and transformation rules.
  - Automate transformation to reduce implementation errors.
- Organisational Challenges
  - Go from flexible case-by-case implementation to a structured approach.
  - Define a solution that can be applied to all domains, don’t create a solution that fits one domain only.
- Conclusion summary
  - Technical challenges are just hard work!
  - Organisational challenges are harder to deal with.

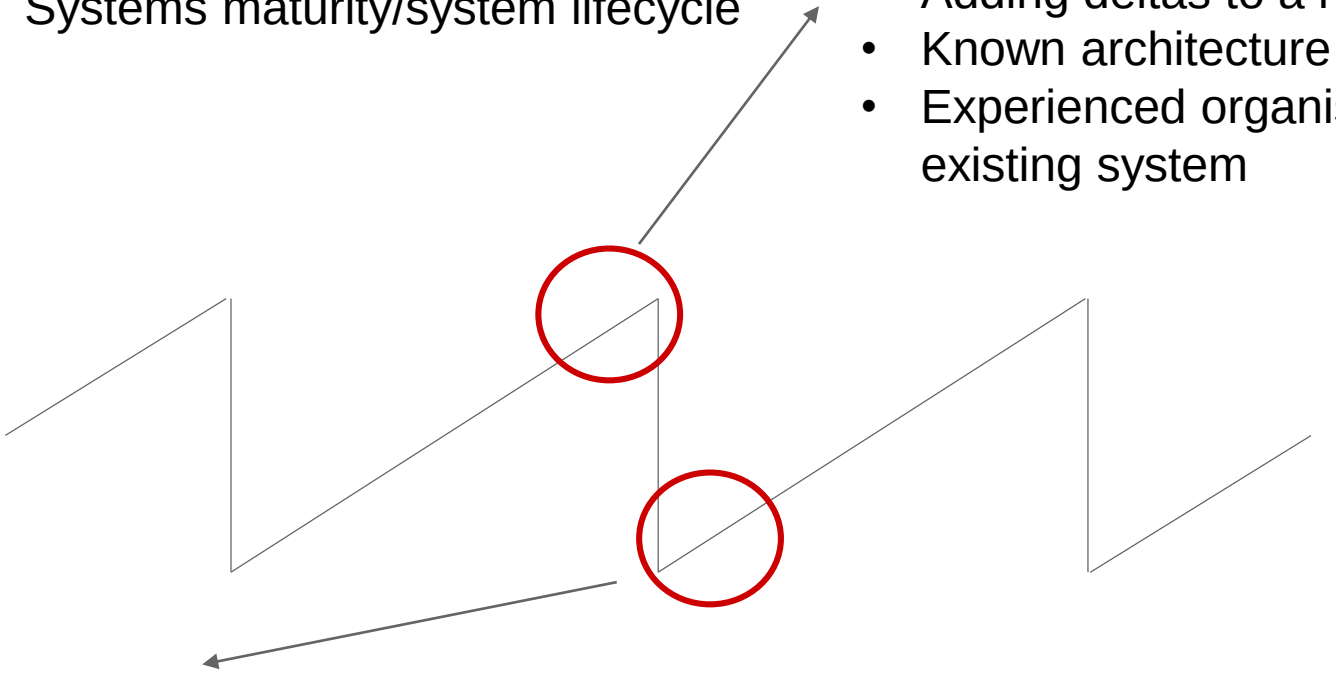


SUMMARY



LESSONS LEARNED – IT'S ABOUT THE PEOPLE NOT THE TOOLS

Systems maturity/system lifecycle



- Adding deltas to a highly mature system
- Known architecture and constraints
- Experienced organisation – in terms of continuous development of an existing system

- No baseline system available, only some proven parts
- New architecture, constraints are not known
- Inexperienced organisation - in terms of development of a new system

QUESTIONS?