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Experience from integrating Domain Driven Software System Design into a Systems Engineering Organization

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SAAB Aeronautics

Agenda

- What is a SAAB?
- Where we were – methodologywise
- Introducing MBSE into the organisation
- Alternative approaches to architecting
  - Systems Engineering
  - Domain driven design
- Harmonisation
- Discussion

What is a SAAB?

SAAB - a brief product history

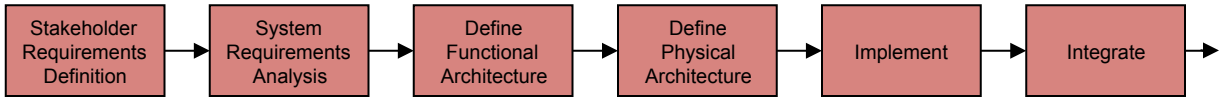
And what about us?

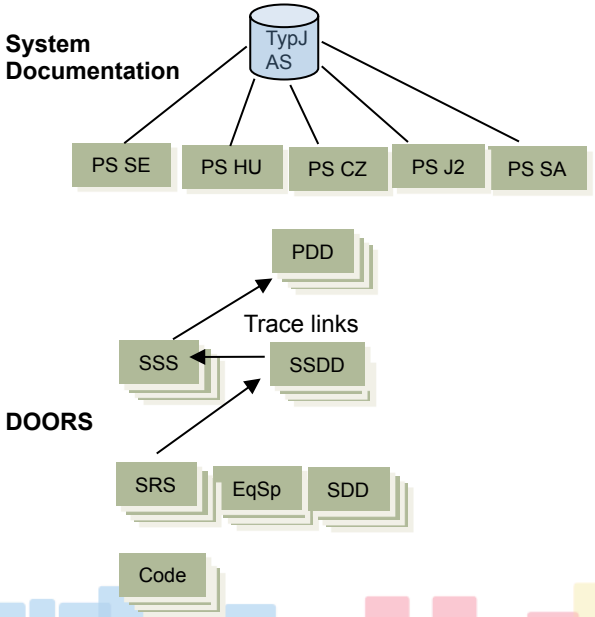
- Pär Hammarström
  - Systems architect – Gripen E
- Erik Herzog
  - Systems Engineering Methodologist – Gripen E

Company and product characteristics

- Fighter jets are obviosly complex systems
  - and safety critical
- A new product every 20-30 years
- Our organisation is optimised for developing and maintaining one product at a time
- Decentralised organisation
- Traditionally one customer, but changing fast with multiple export customers
- Opportunities for starting over comes seldom, and the same is true for methodology infusion

The way we used to work

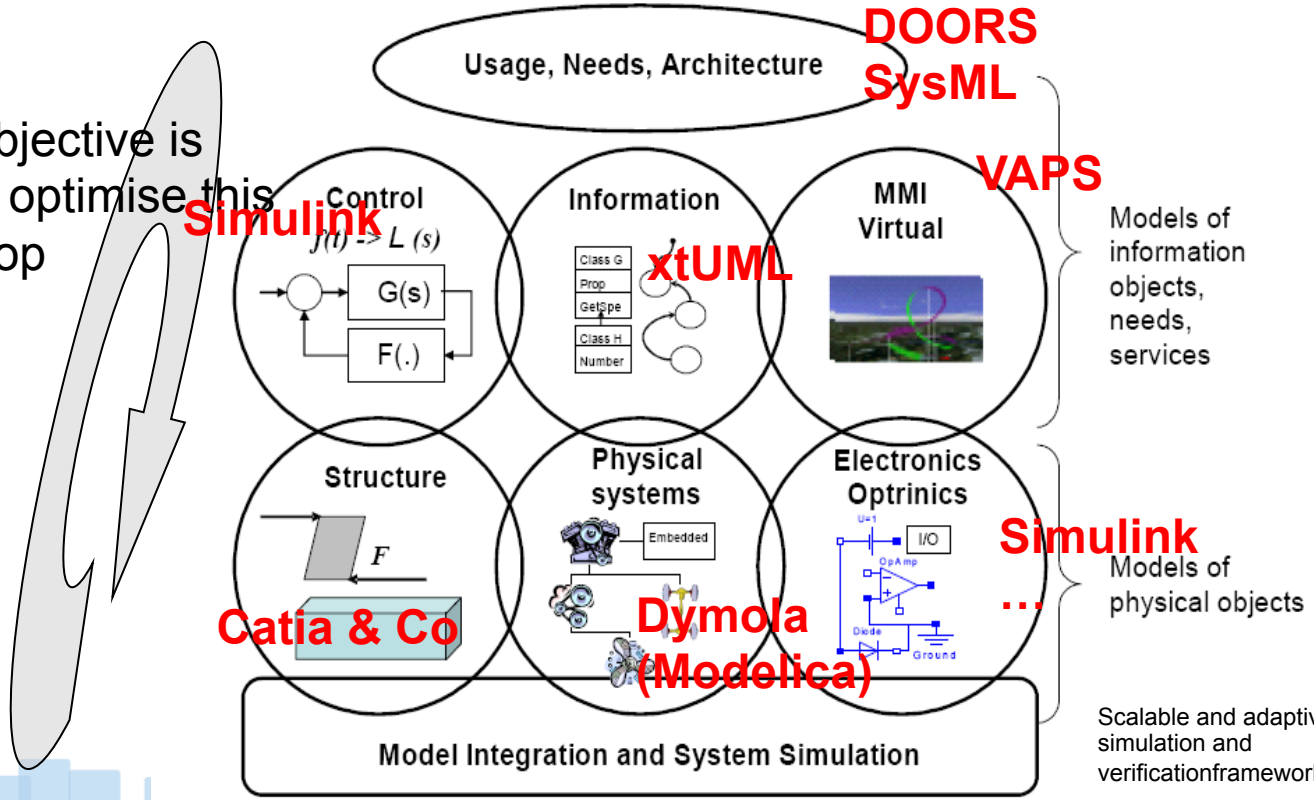




- Sequential process
- Complete one document prior to initiating work on the next one
- Fixed document structure
- Much focus on requirements (requirements in design documentation)
  - But all requirements were not verified
  - Inserted to maintain traceability
- No attempt to actually describe what the system looks like (in a reader friendly format)
- A separate safety process

Introducing MBSE

Objective is to optimise this loop



Methodology development organisation

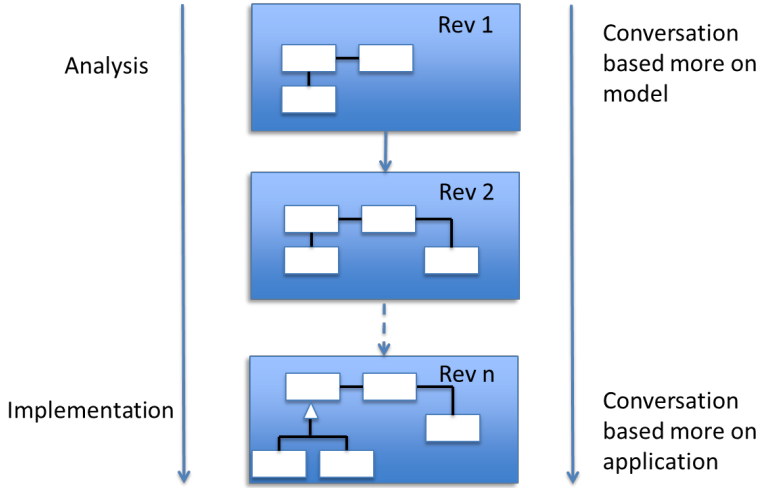
- Approach
  - Method development is closely integrated with product development
- The methodology domain is partitioned into a number of PM&Ts – in charge of **P**rocess, **M**ethods and **T**ools development and maintenance
- Sample PM&Ts
  - Mechanics
  - Systems Engineering
  - Systems characteristics
  - Software
  - …
- Experience
  - PM&T organisation works well, as long as the boundaries and interfaces are stable and well understood
  - Suboptimisation risk!
  - It does take an effort to coordinate methodology across PM&T boundaries

What so special about software?

- Does not obey the laws of physics
  - plastic
- Instant production
  - virtual
- Data and structure may be separated
- Configurable, even self-configuration capability

Domain Driven Design

- Popularised by Evans in 2003
- Focus on the domain knowledge and knowledge transfer between domain expert and developer by the use of ubiqutuous language
  - Use of models to capture the evolution of the understanding of the domain
- Anti-corruption layers/bridges to translate between domains
  - To maintain independence between domains
- SAAB has adopted the xtUML approach and associated methodology by Schlaer/Mellor and Starr
  - Focus on code generation, MDA and reuse across components in the system



Example Structures

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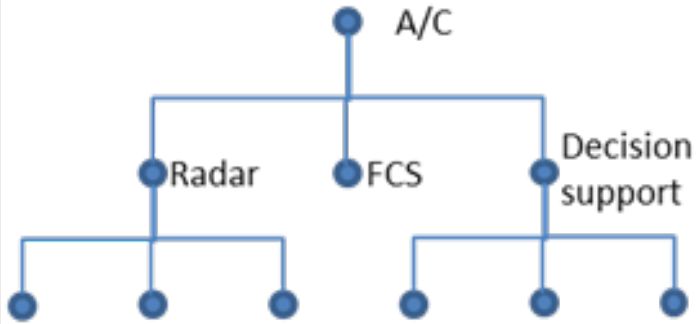

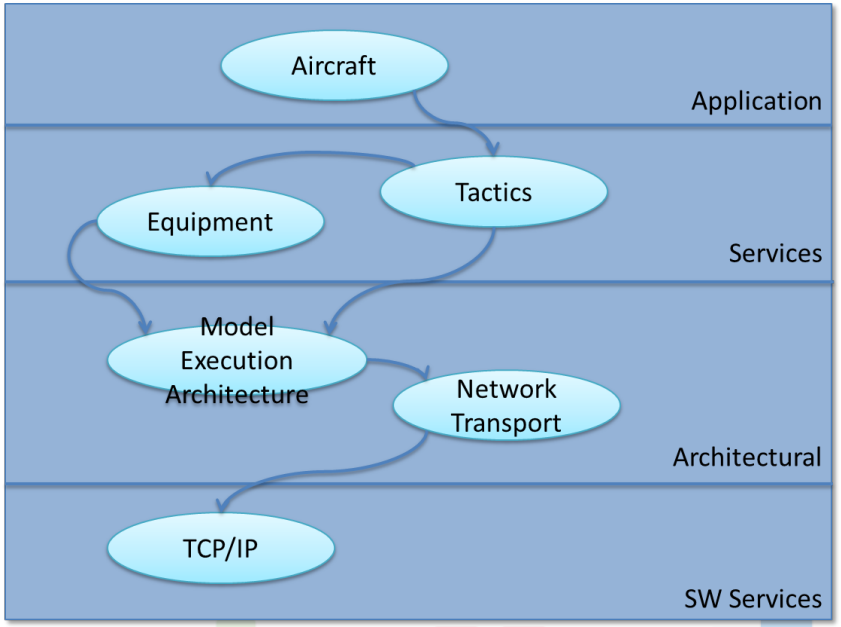

Systems Engineering vs DDD

Area	Systems Engineering	Domain Driven Design (Evans)	Domain Driven Design (Starr)
Point-of-departure	Mission (Purpose)	Subject Matter	Subject Matter
Analysis approach	Top-down	Top-down	Top-down-Bottom-up
Decomposition	Functional and Physical	Semantic (shallow, using “uses” relation)	Semantic (elaborated layering and decomposition)
Re-use	Standard machine elements	Mainly between products, secondary goal	Primary goal, building blocks shared within product

Semantic Decomposition vs Physical Decomposition

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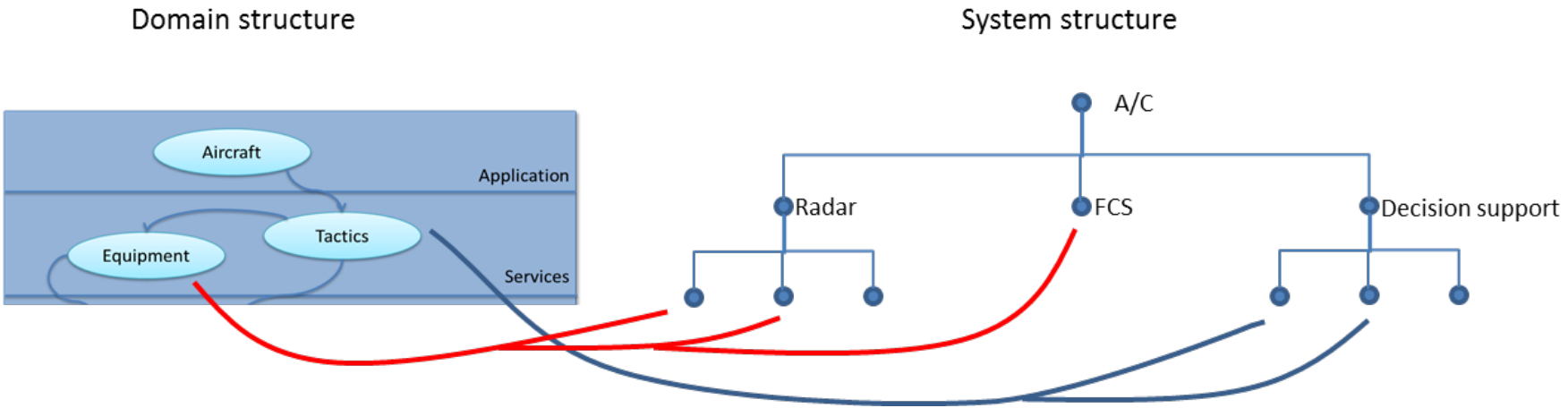
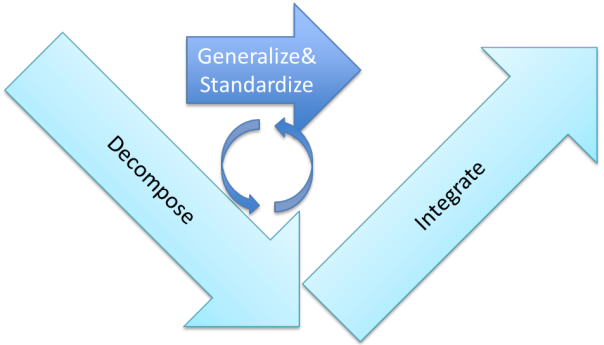


Analysis – why is this confusing?

- DDD and SE both focuses on decomposition
  - But they are not identical
- SAAB has traditionally managed only one Configuration item structure
  - Based on established subsystems
- Need to create Configuration items both for systems and software domains
  - Along with the associated clear ownership
- Need for the organisation to clearly understand when development is in the product dimension and the domain dimension

Integrating Domain Driven Design in a Systems Engineering organisation

- Make a clear distinction between the
  - System architecture
  - Domain architecture
- Domain identification and development is performed in parallel with product development
- In effect the domain architecture is an important element in the development system for the Gripen weapon system
  - Must be managed together
- Assign clear ownerships to each element in respective architecture



Current status at SAAB

- Domain reuse is not so easy to accomplish as originally anticipated
- Focus has shifted to a more opportunistic approach
  - Focus on demonstrating success on the simple cases prior to proceeding to more ambitious ones