Towards Continuous Integration and Deployment in Aerospace

Is it Time to Retire the Vee Model?

Erik Herzog, Ph.D., CSEP
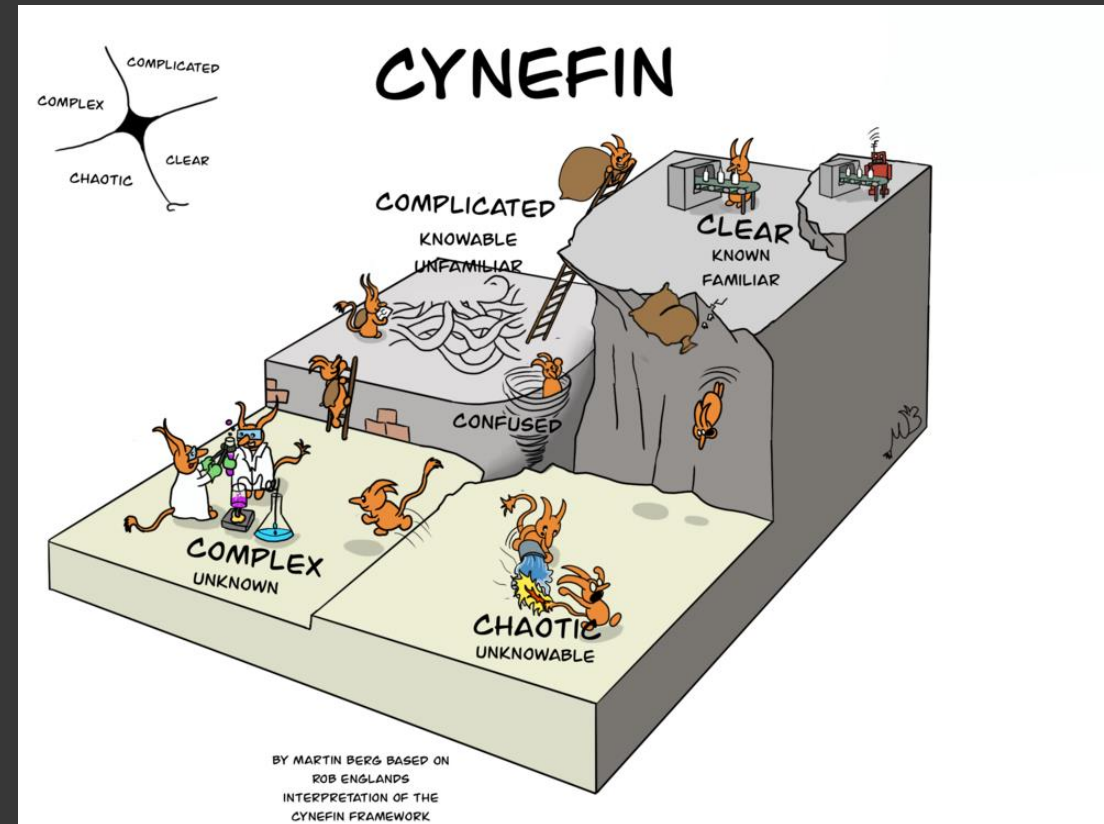
Saab Technical Fellow – Systems Engineering

Saab Aeronautics - our products

Erik Herzog | Issue 1

Is accurate prediction of complex systems development possible?

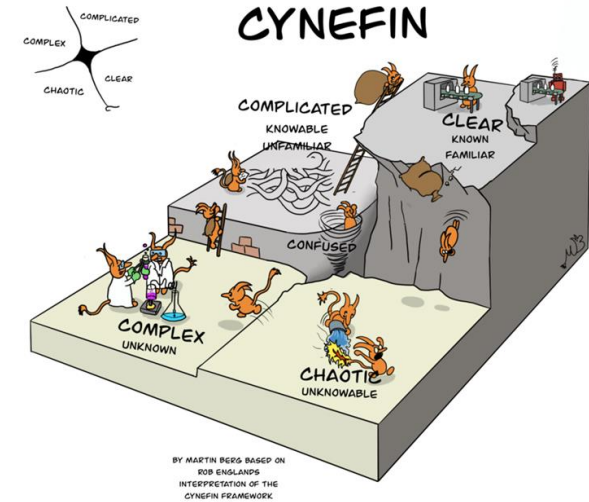Erik Herzog | Issue 1

Estimation and complexity

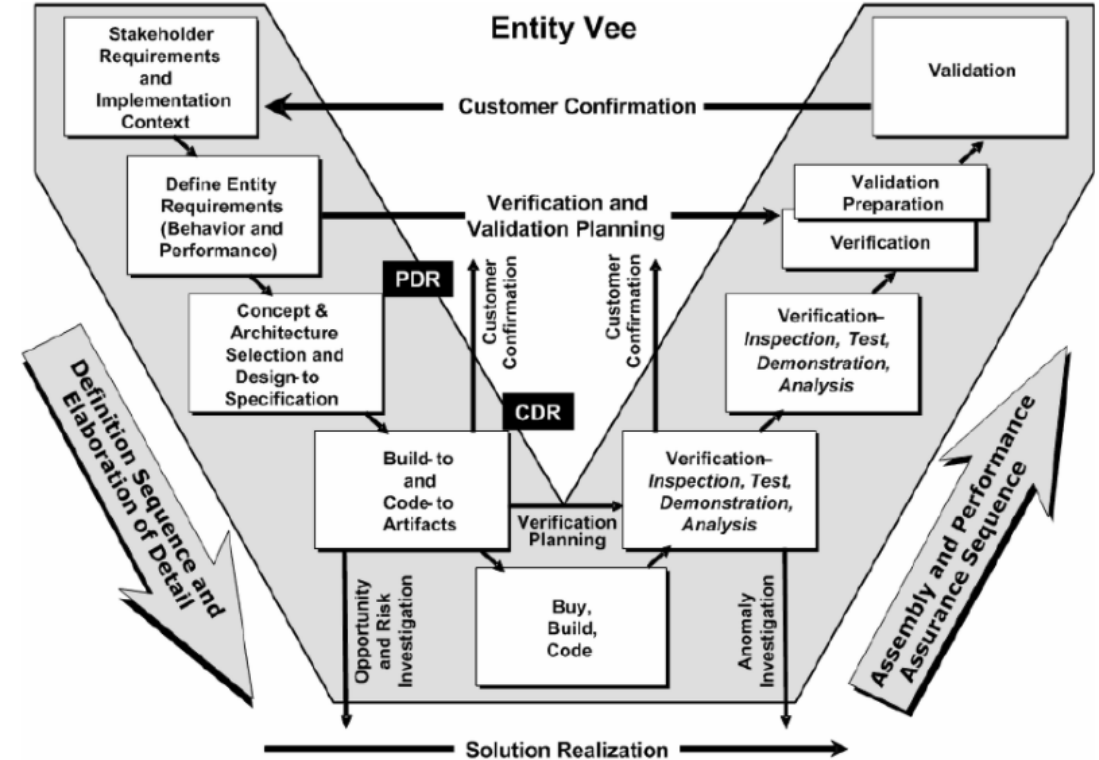- Everyone is able to operate the system as a pro

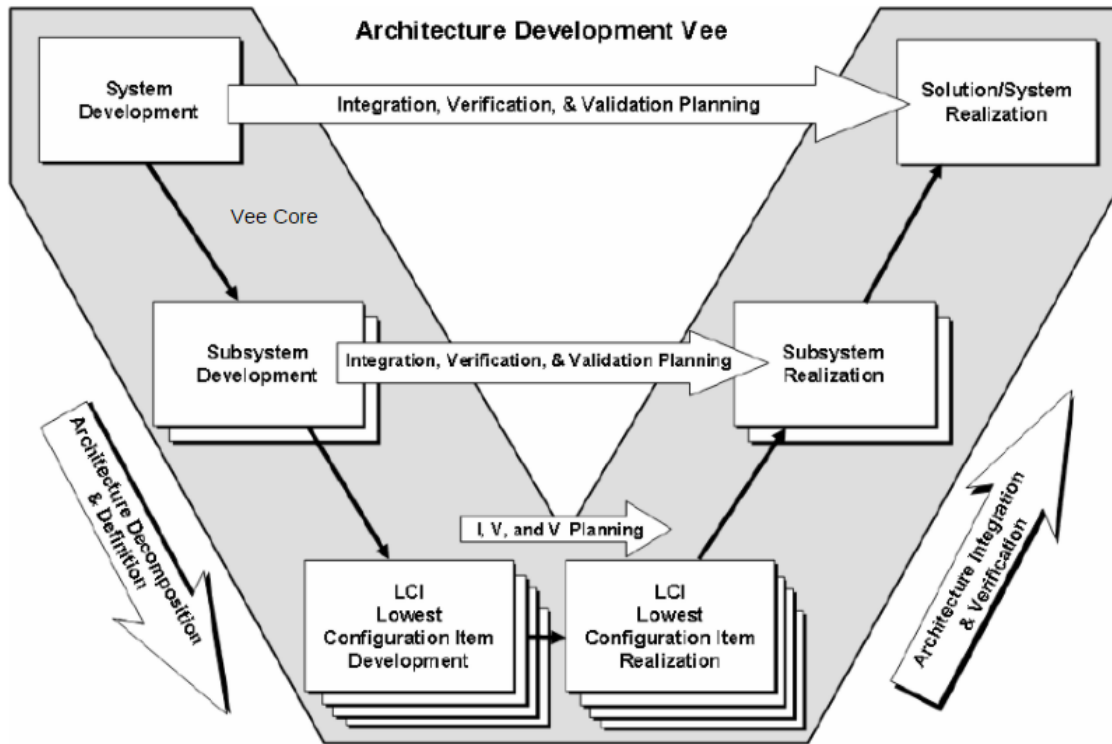- Operation require special skills

- Operation require special educations

The Vee model(s)

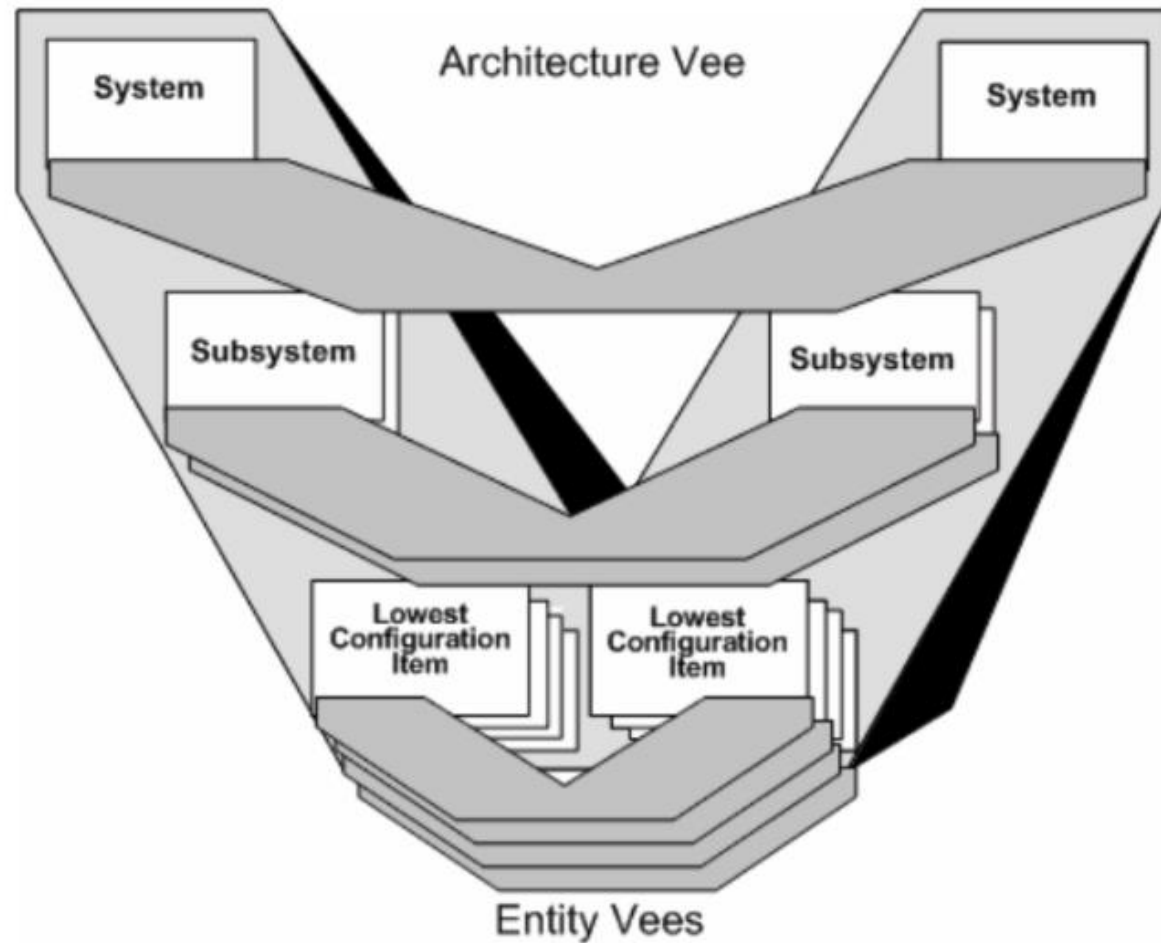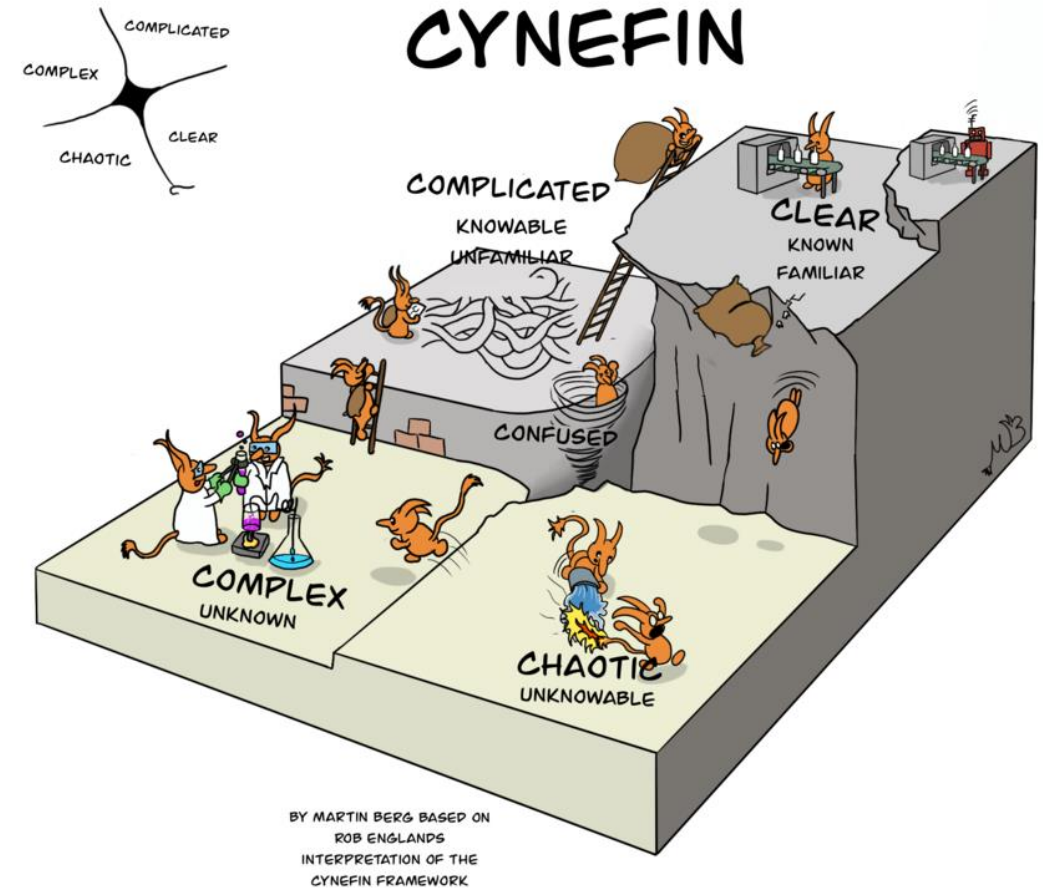# Vee models

The dual Vee model

Architecture Vee

System — System

Subsystem — Subsystem

Lowest Configuration Item — Lowest Configuration Item

Entity Vees
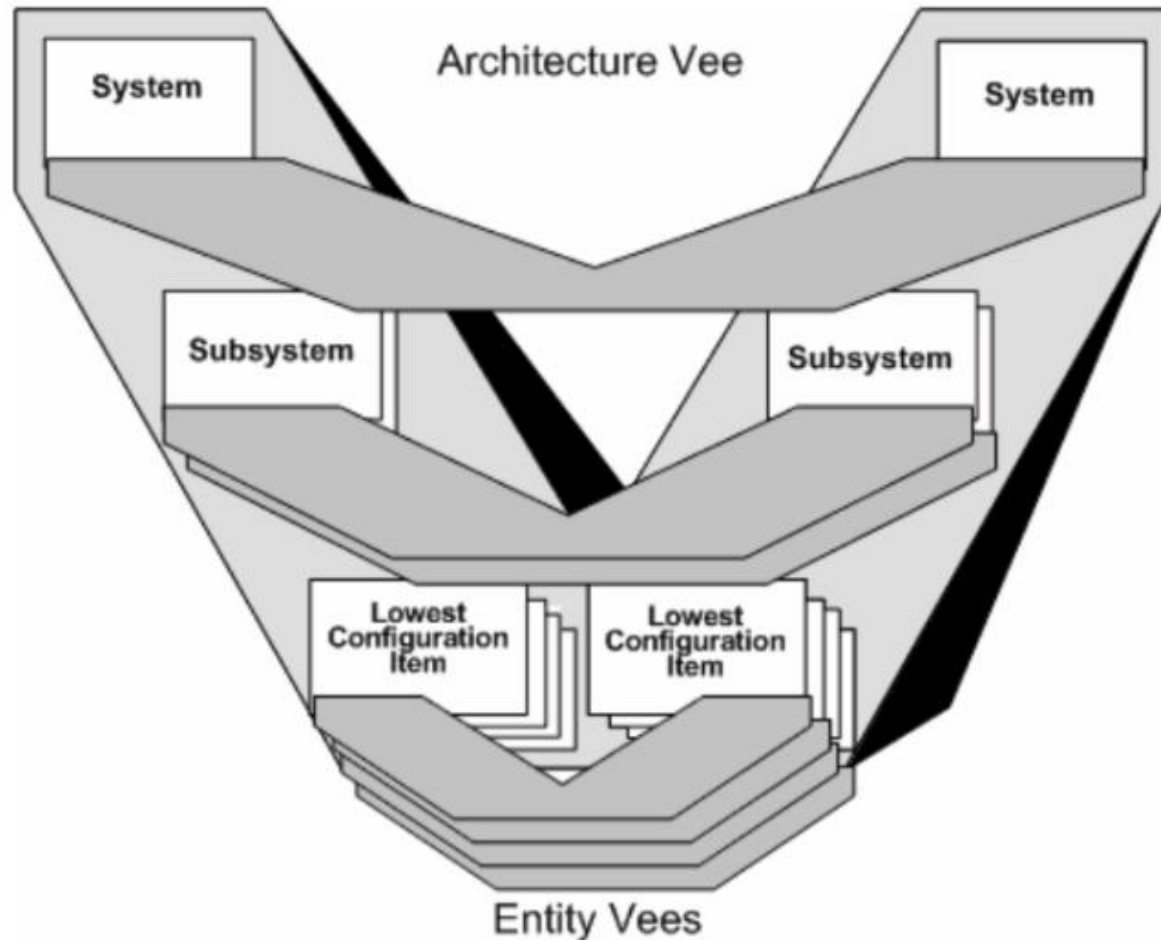
Vee model under unpredictability

Development: an Honest View(?)

- At least 4 planning views looking into the future

- **Requirements**
  - The desired properties of the realised system

- **Architecture**
  - The desired structure, behaviour, interfaces of the realised system

- **Resources**
  - Who shall perform the work, and when
  - Priorities between contesting tasks

- **Time**
  - The desired point in time when a particular realisation should be ready

There is a lot of uncertainty embedded in these views

Proper application of modelling and simulation may decrease, but not remove the uncertainty

We are not clairvoyant enough to identify what we will integrate a long time in advance!

There is also the constant change in the opportunities of when to integrate

Saab approaches for addressing identified problems

The 4-Box Development Model

- **Development level**: Customer and authority communication – **Slow!**

- **Weapon System edition**: Integrated products, in test aircraft or simulators – **Flexibility in content!**

- **Development step**: Incremental development of capabilities and components – **Flexibility in approach!**

- **Main Track**: Warehouse for all product data – capturing what is available for integration
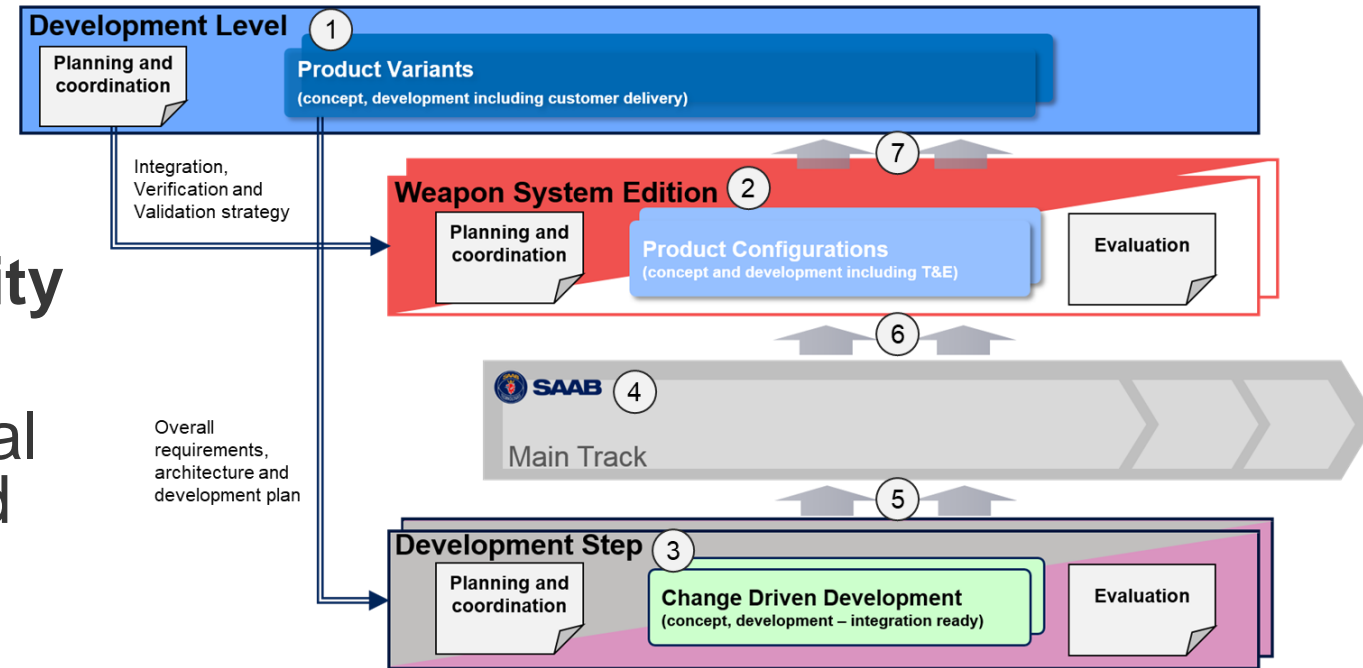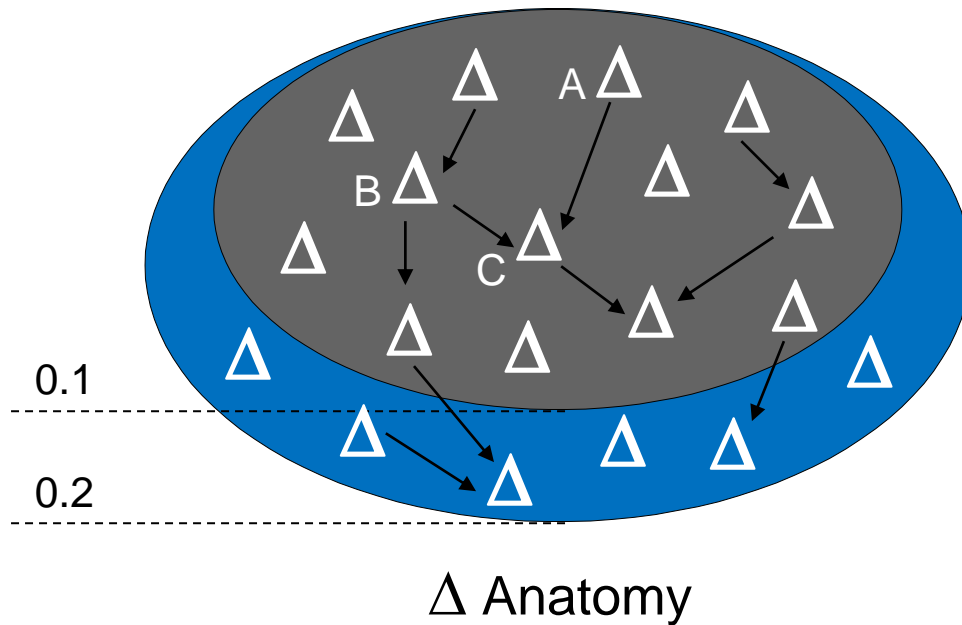
The 4-Box Development Model
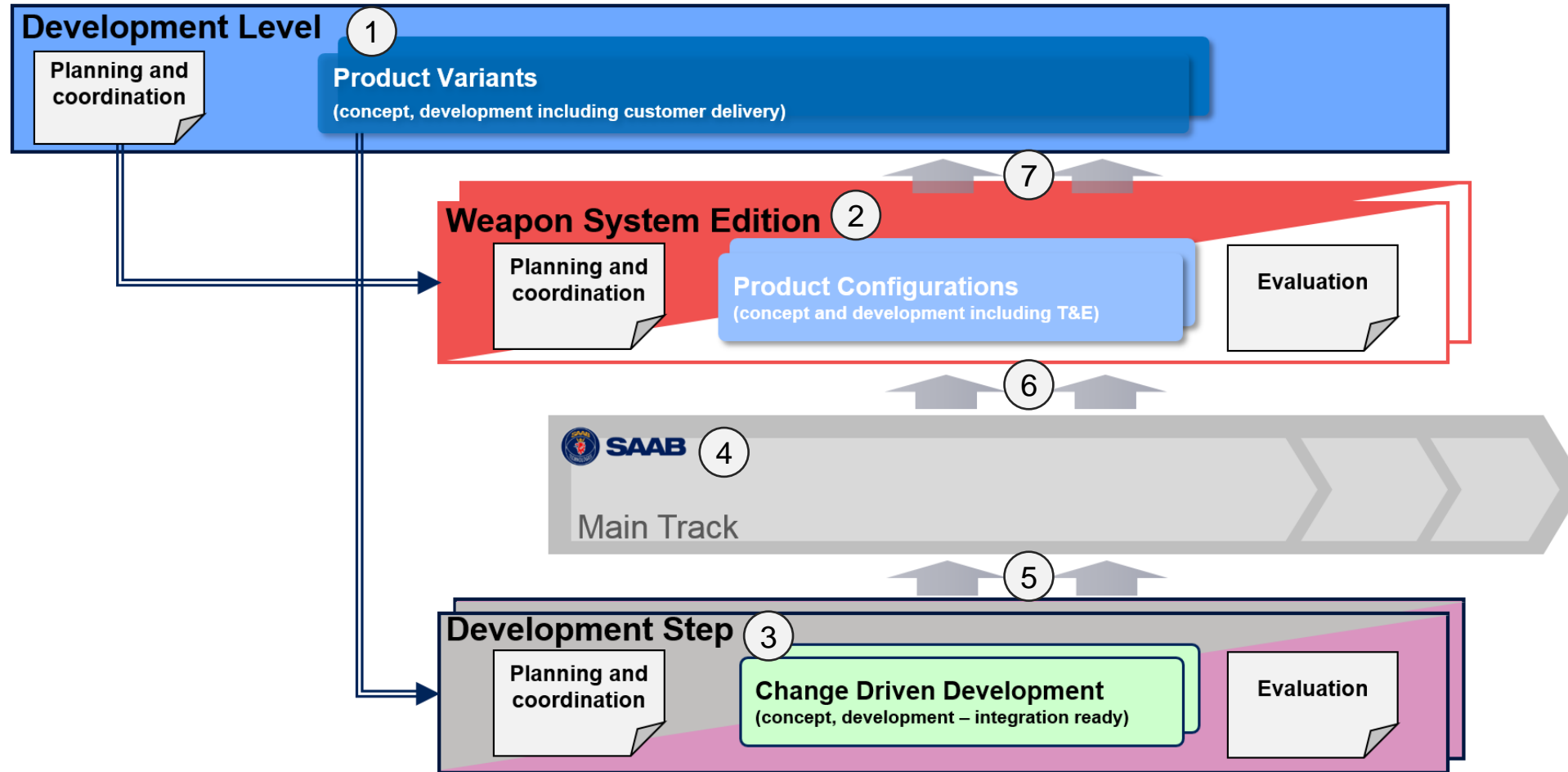
Managing Integration Using Anatomies

Accept that individual activities are not predictable – keep alternative integration paths open as long as possible

Δ Anatomy

The anatomy shows all currently planned system changes (Δ) and their dependencies.

The dependencies constrain the order in which changes can be done, and determine the possible level of parallelism.

⟶ Integration Dependency: Both A and B must be integrated before C can be integrated and tested.

SAAB

*The model presented is right for Saab – but we have to remember:*

"All models are approximations. Essentially, all models are wrong but some are useful"

George Box

_____

Summary

- Shortcomings of the V model – from a Saab perspective

- Introduction of a 4-box development model to
    - Separate activities with different time horizons
    - Support flexibility in development
    - Manage multiple integration configurations
    - Facilitate a product family approach

- Integration anatomies to manage integration alternatives

Δ Anatomy
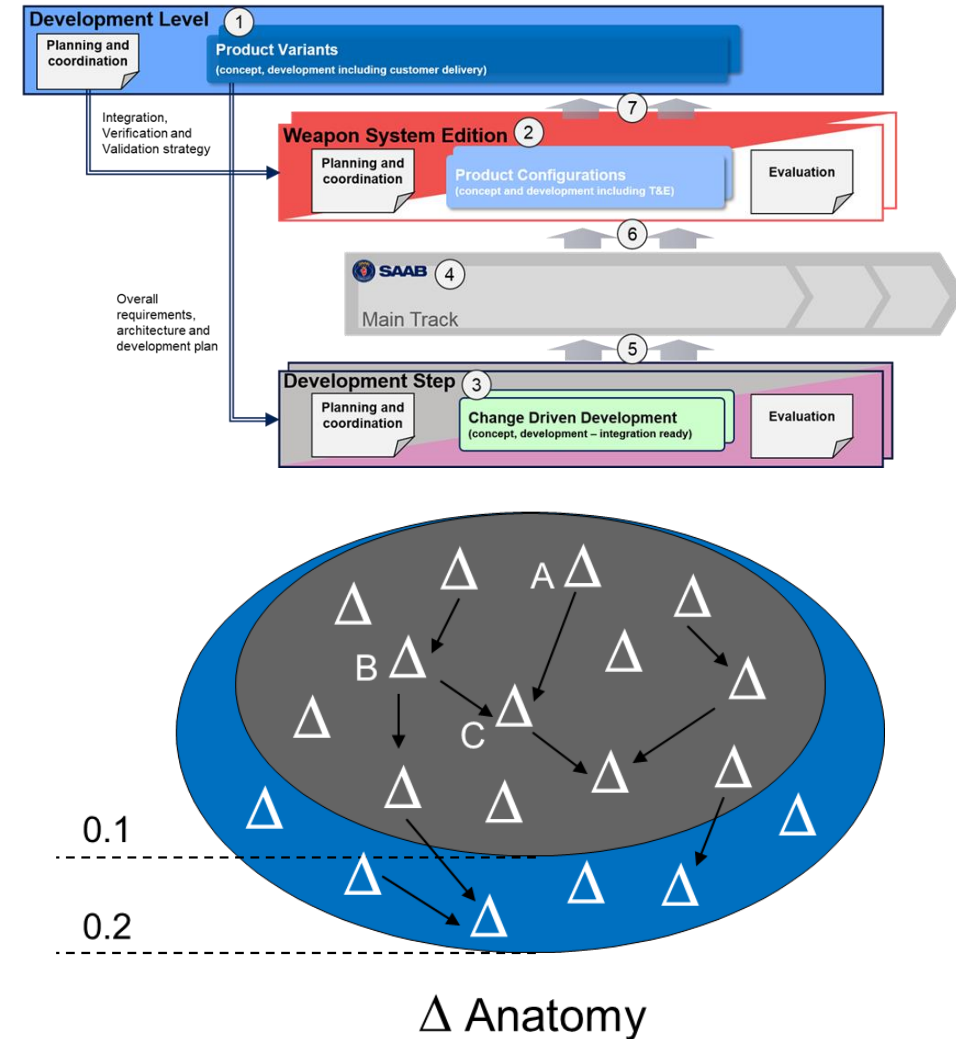
Discussion
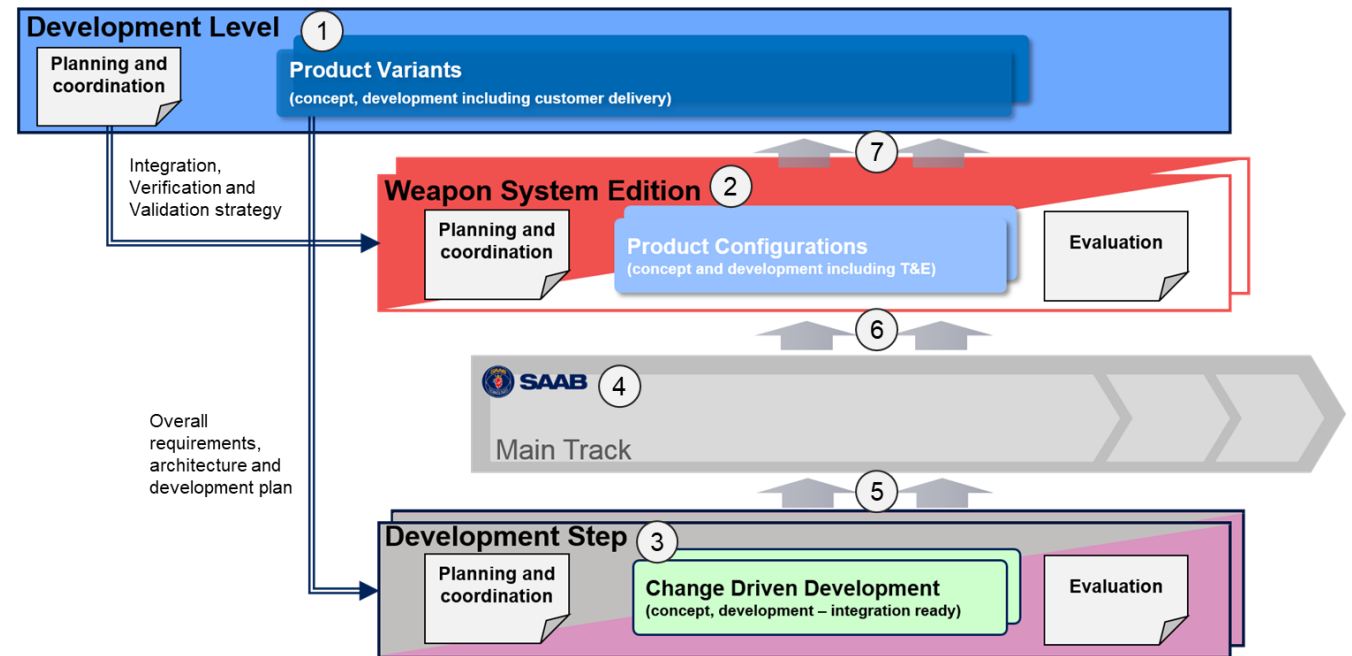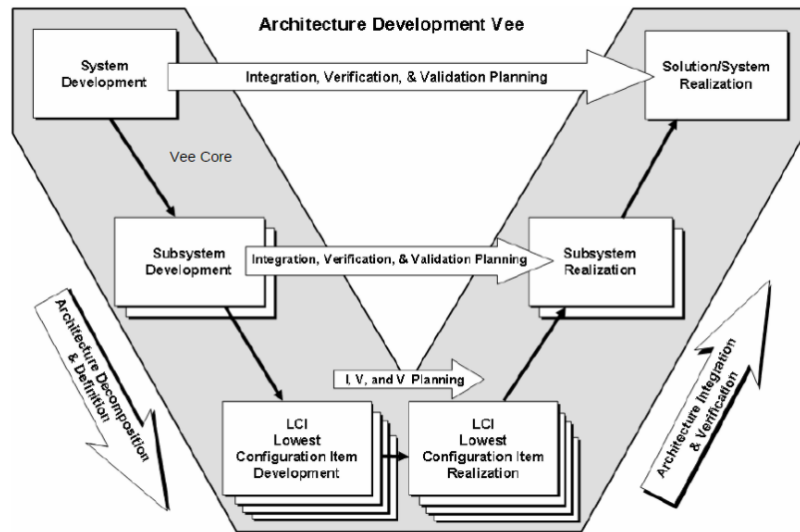
An Assortment of Papers

- **A 4-Box Development Model for Complex Systems Engineering**
  (INCOSE IS 2022)

- **Don't Mix the Tenses: Managing the Present and the Future in an MBSE Context**
  (INCOSE IS 2022)

- **Genesis – an Architectural Pattern for Federated PLM**
  (INCOSE IS 2022)

- **From Brownfield to Greenfield Development - Understanding and Managing the Transition**
  (INCOSE IS 2021)

- **Heterogeneous System Modelling in Support of Incremental Development**
  (ICAS 2022)