THALES

Implementing the MBSE Cultural Change

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Stéphane Bonnet, Jean-Luc Voirin,
Véronique Normand, Daniel Exertier

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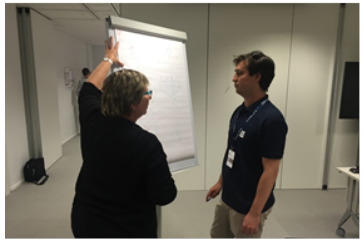
Seattle, WA, July 13 – July 16, 2015

Capella Thales Users Day, Paris, June 16th, 2015



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Which Cultural Change?

WHAT IS MBSE, HOW IS IT DIFFERENT?

Introduction

Model-Based Systems Engineering (MBSE)

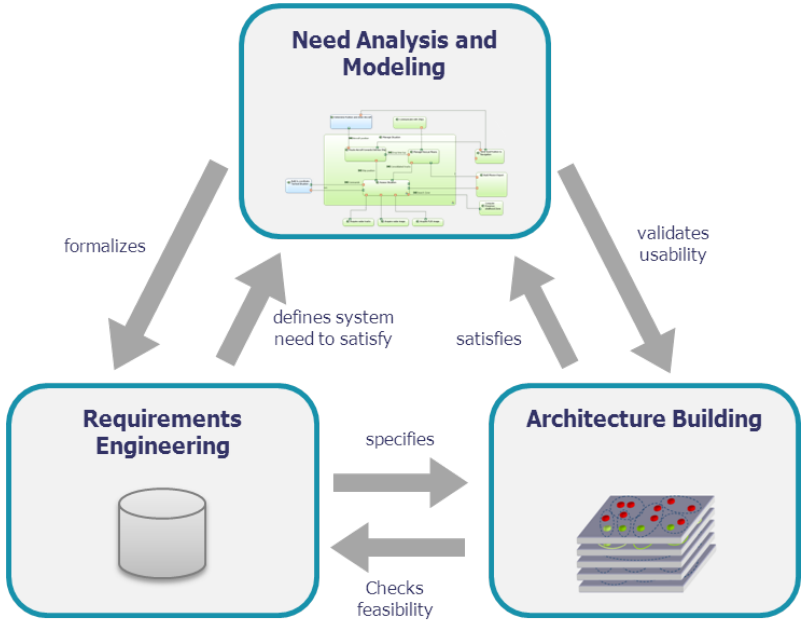
> Model-based systems engineering is the **formalized application of modeling to support system requirements, design, analysis, verification and validation activities** beginning in the conceptual design phase and continuing throughout development and later life cycle phases."

Vision 2020 (INCOSE-TP-2004-004-02, Sep 2007)

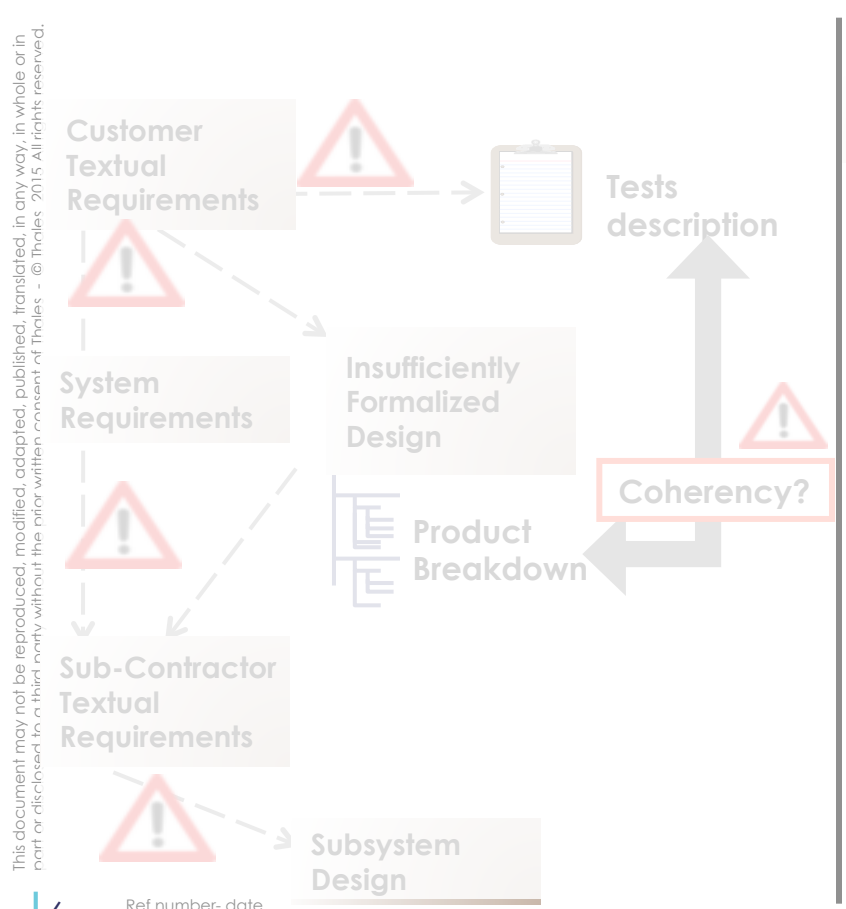
MBSE vs Tradional Systems Engineering

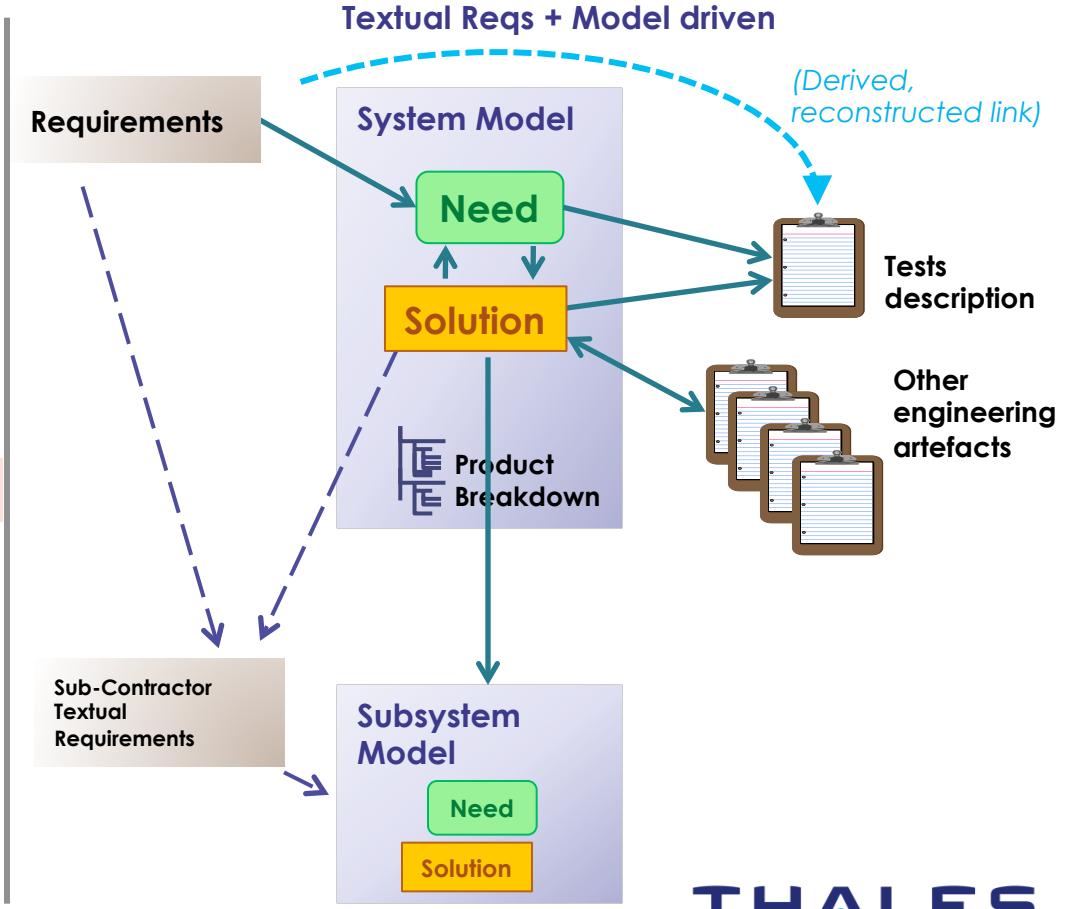
MBSE does not replace standard Systems Engineering practices

- Formalizes parts of systems engineering
- Combines traditional methods and best practices with rigorous modeling techniques



Comparing Approaches in Thales





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Arcadia and Capella

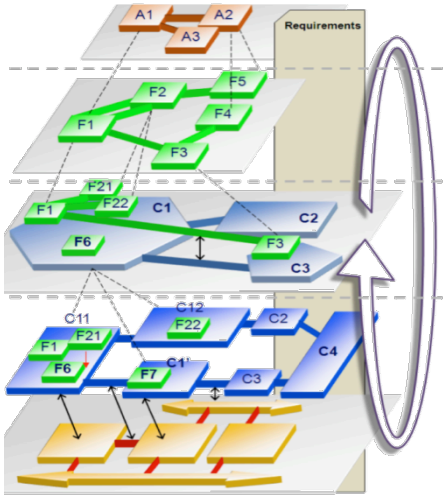
A MODEL-BASED METHOD FOR SYSTEMS, HARWARE AND SOFTWARE ARCHITECTURAL DESIGN

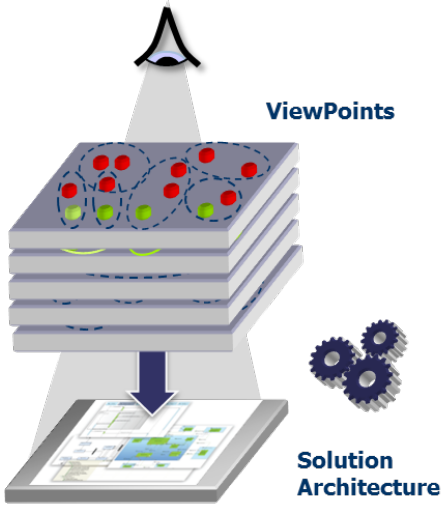
AN OPEN SOURCE MODELING WORKBENCH SUPPORTING ARCADIA

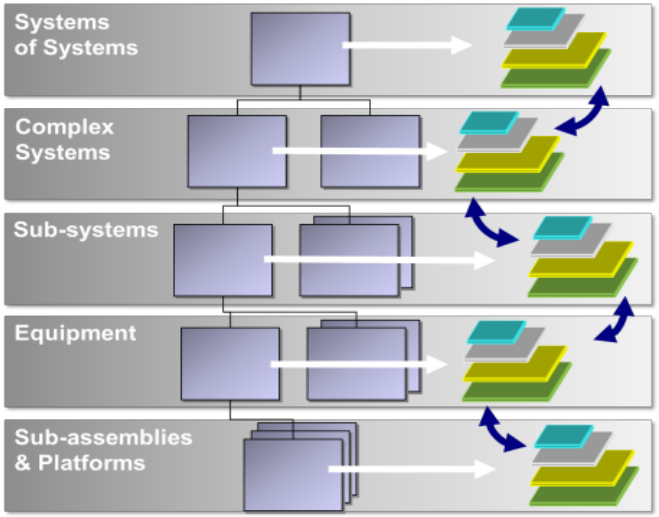
ARCADIA Capella

www.thalesgroup.com

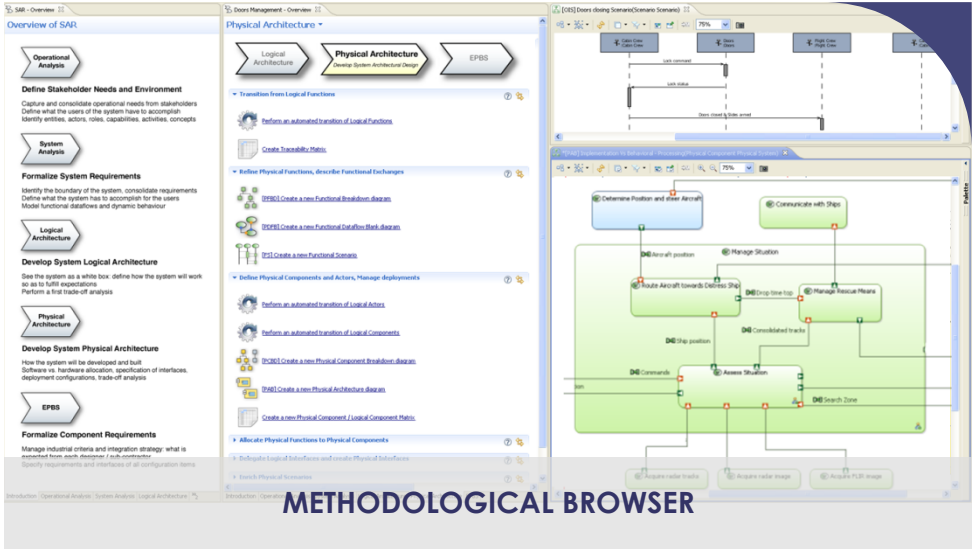
Arcadia



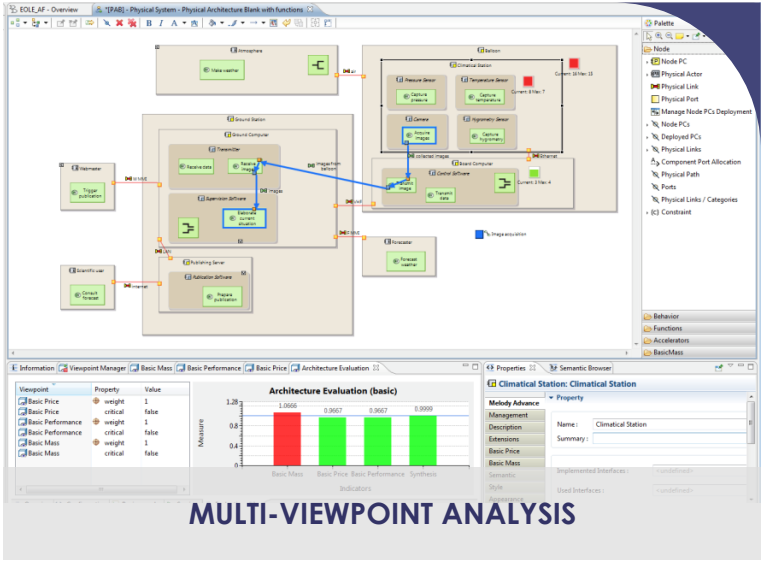




Capella



METHODOLOGICAL BROWSER



MULTI-VIEWPOINT ANALYSIS

Open Source, mature MBSE workbench – **Demos on the Polarsys Booth**

http://www.polarsys.org/capella

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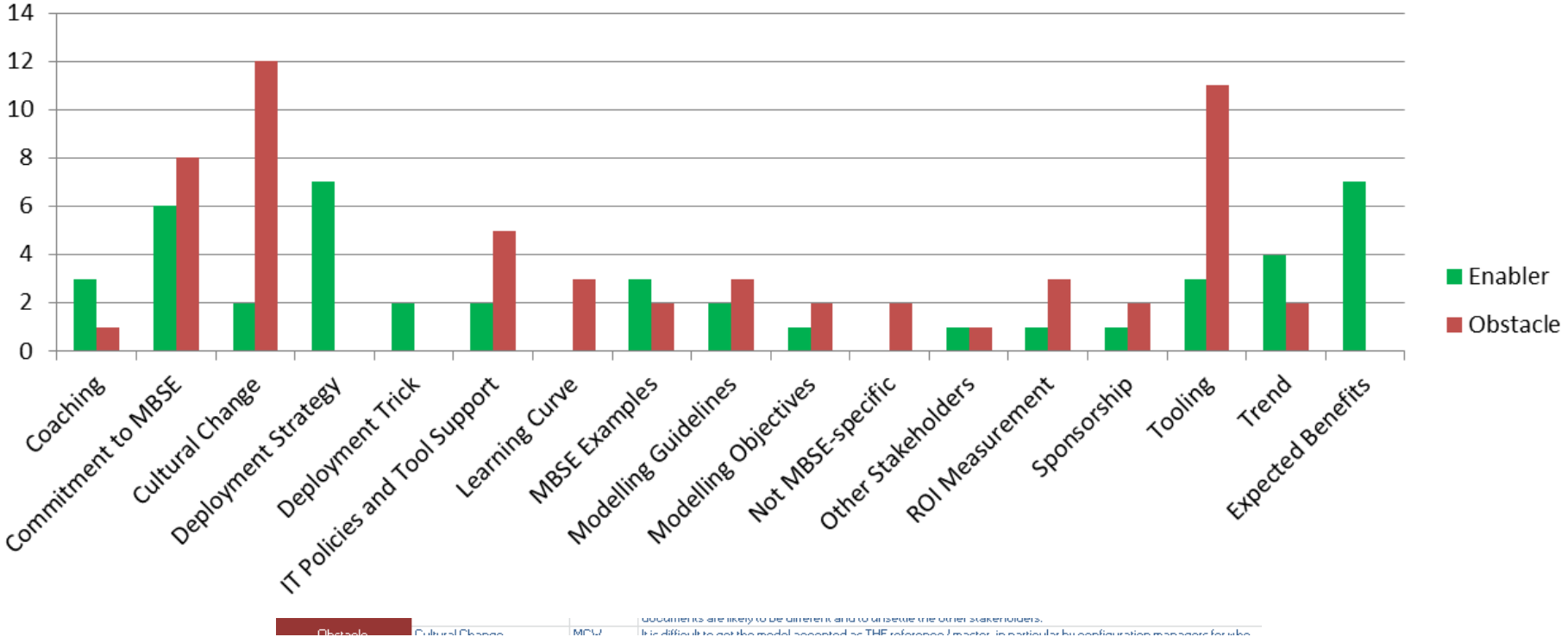
MBSE Deployment Enablers and Obstacles - Survey Results

WORKSHOP HELD IN INCOSE MBSE SYMPOSIUM, CANBERRA, AUSTRALIA, OCTOBER 2014

MBSE Deployment Enablers and Obstacles

> 35 + 20 participants

Detailed resuilts available for download:
http://polarsys.org/capella/events.html



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Deployment Actors and Organization

A NETWORK OF HIGHLY SKILLED AND MOTIVATED INDIVIDUALS WORKING FOR A COMMON GOAL

Stuttgart, 2015

Deployment Actors

Top Management, Engineering Transformation Managers, Technical Directors, Programme Directors, etc.

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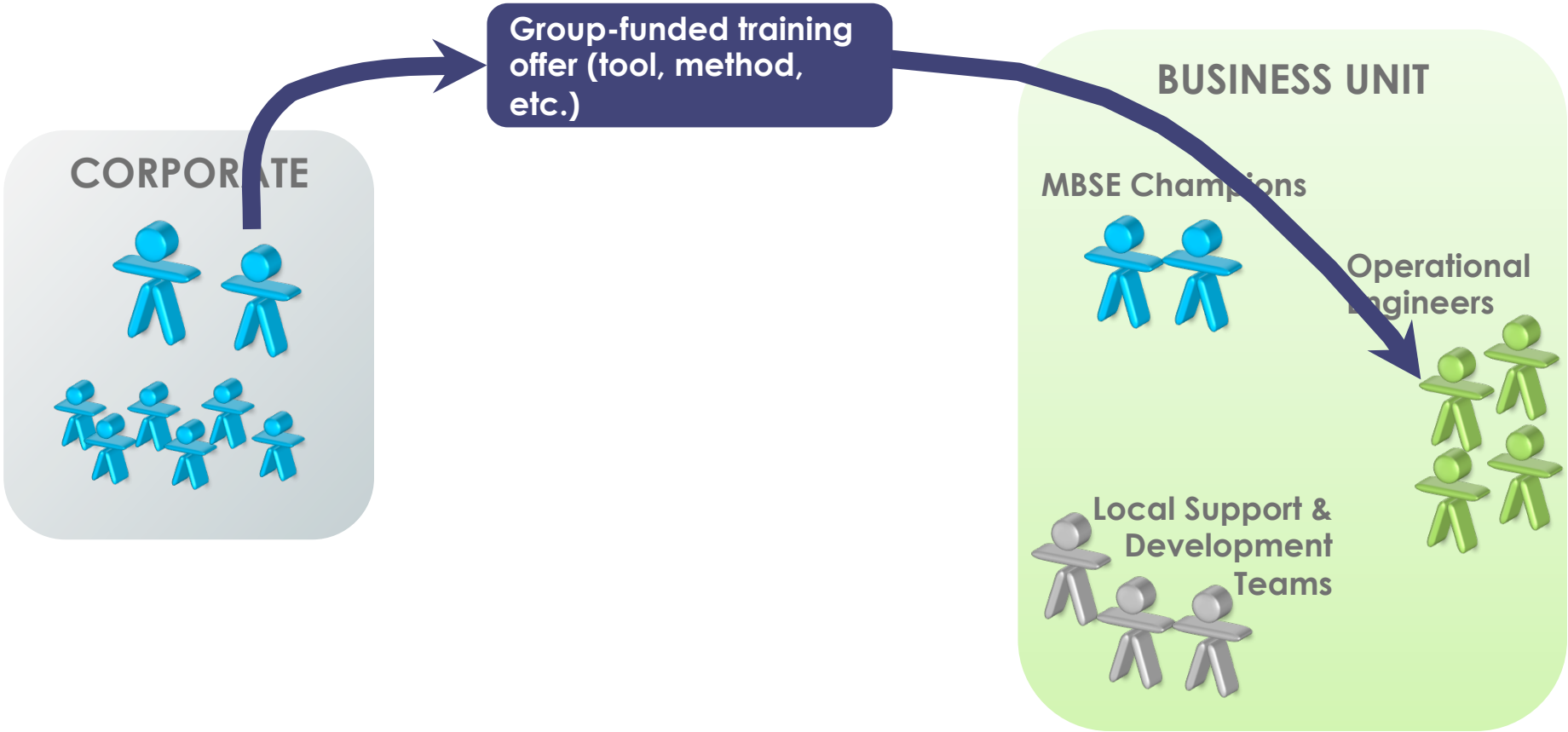
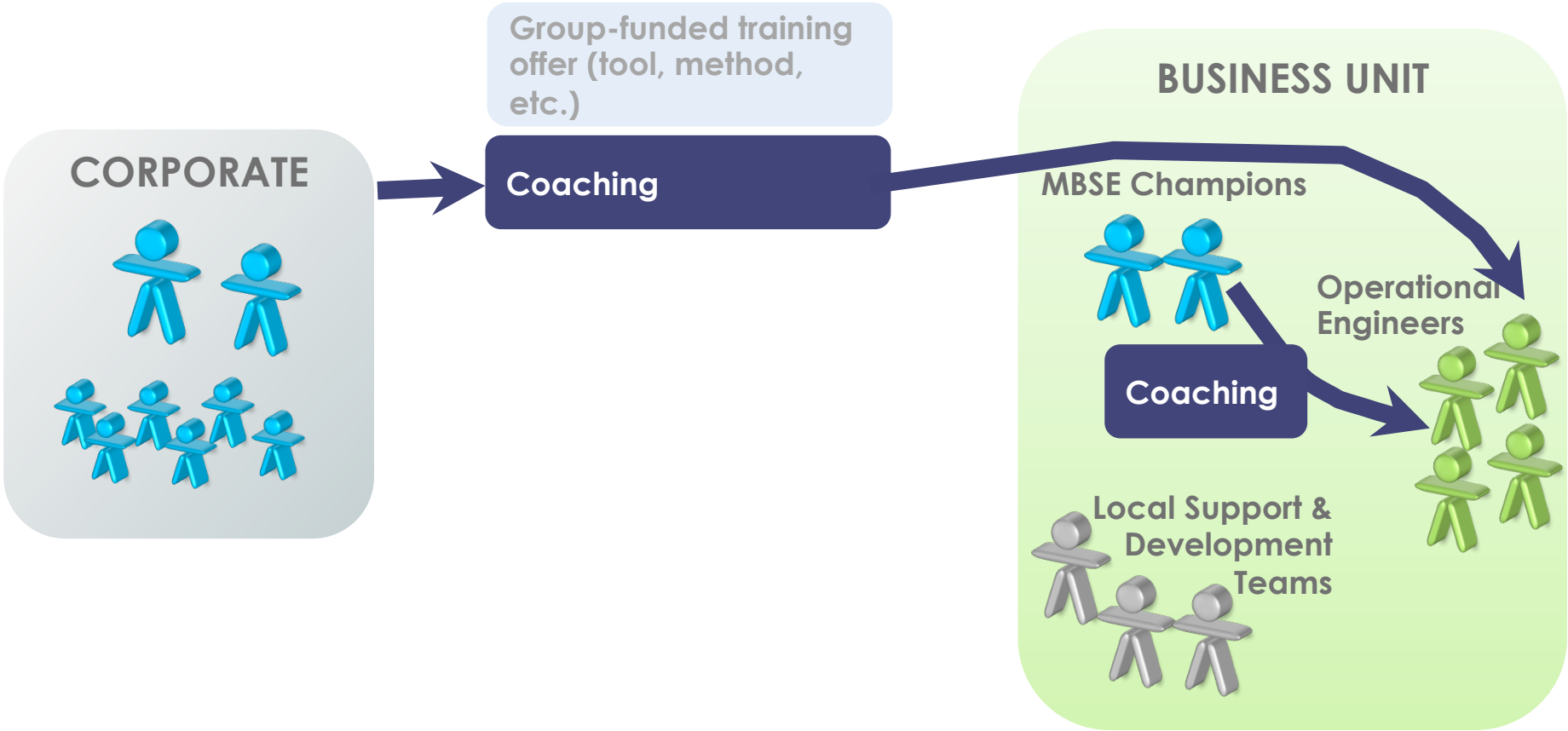
Key Organizational Structures Supporting MBSE Deployment



Key Organizational Structures Supporting MBSE Deployment



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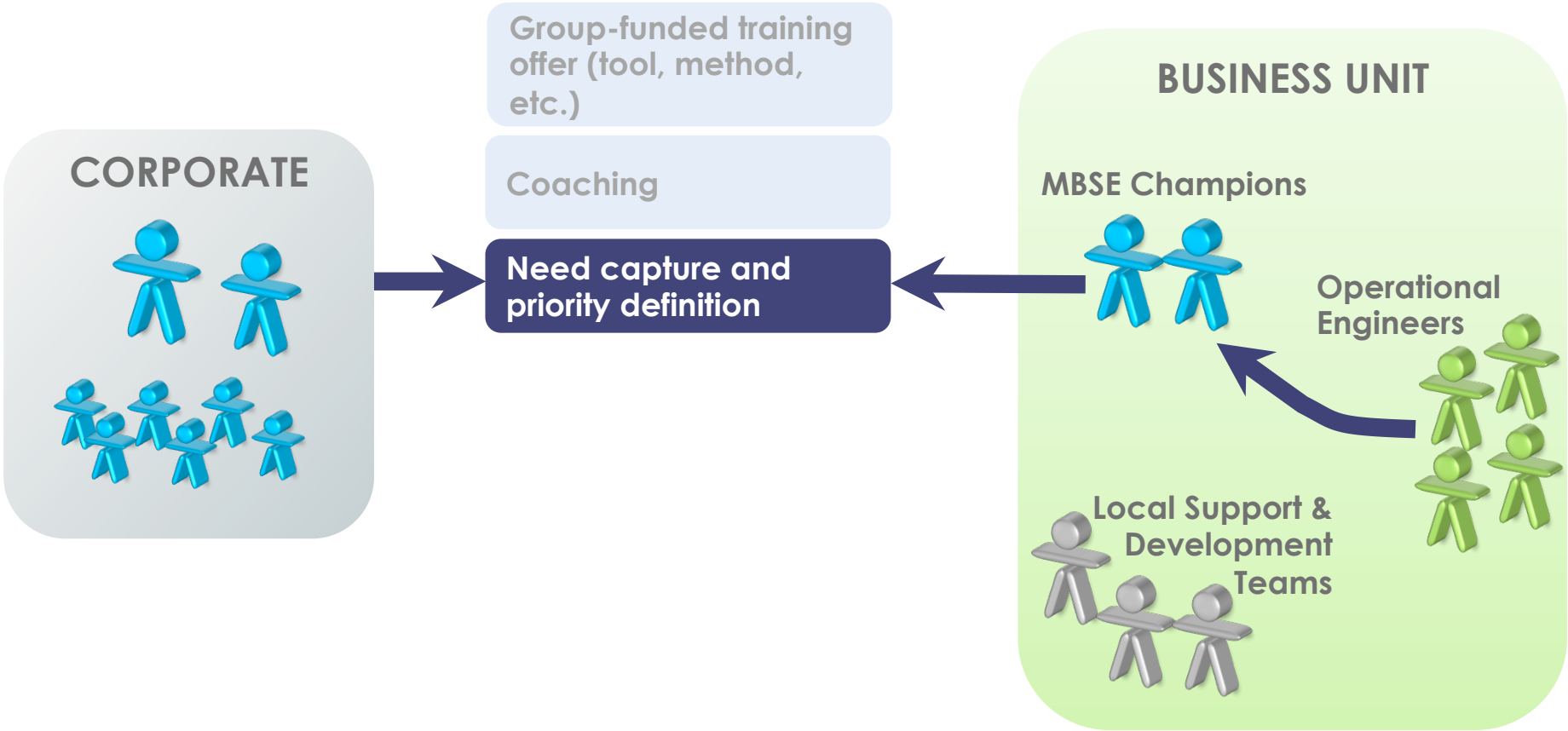

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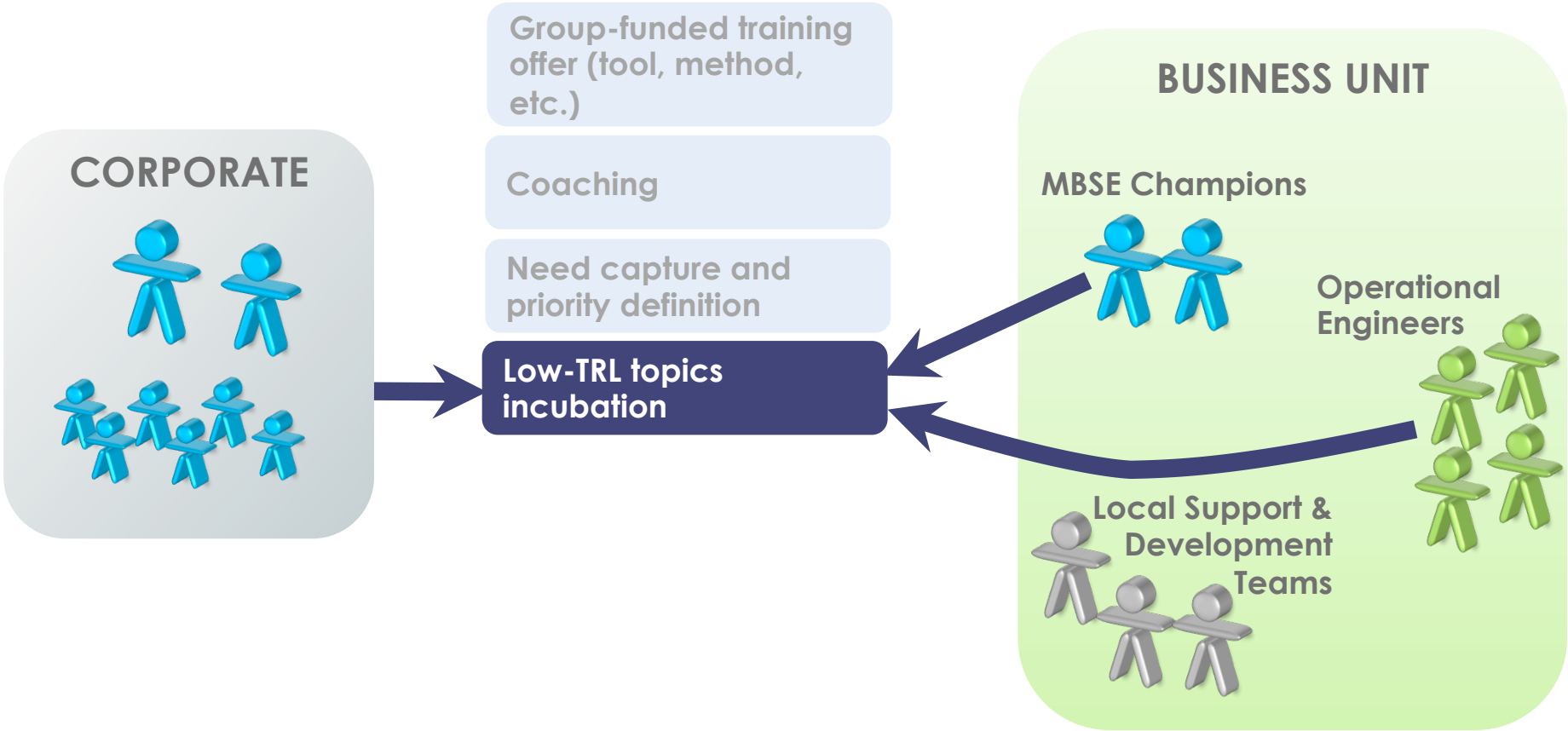

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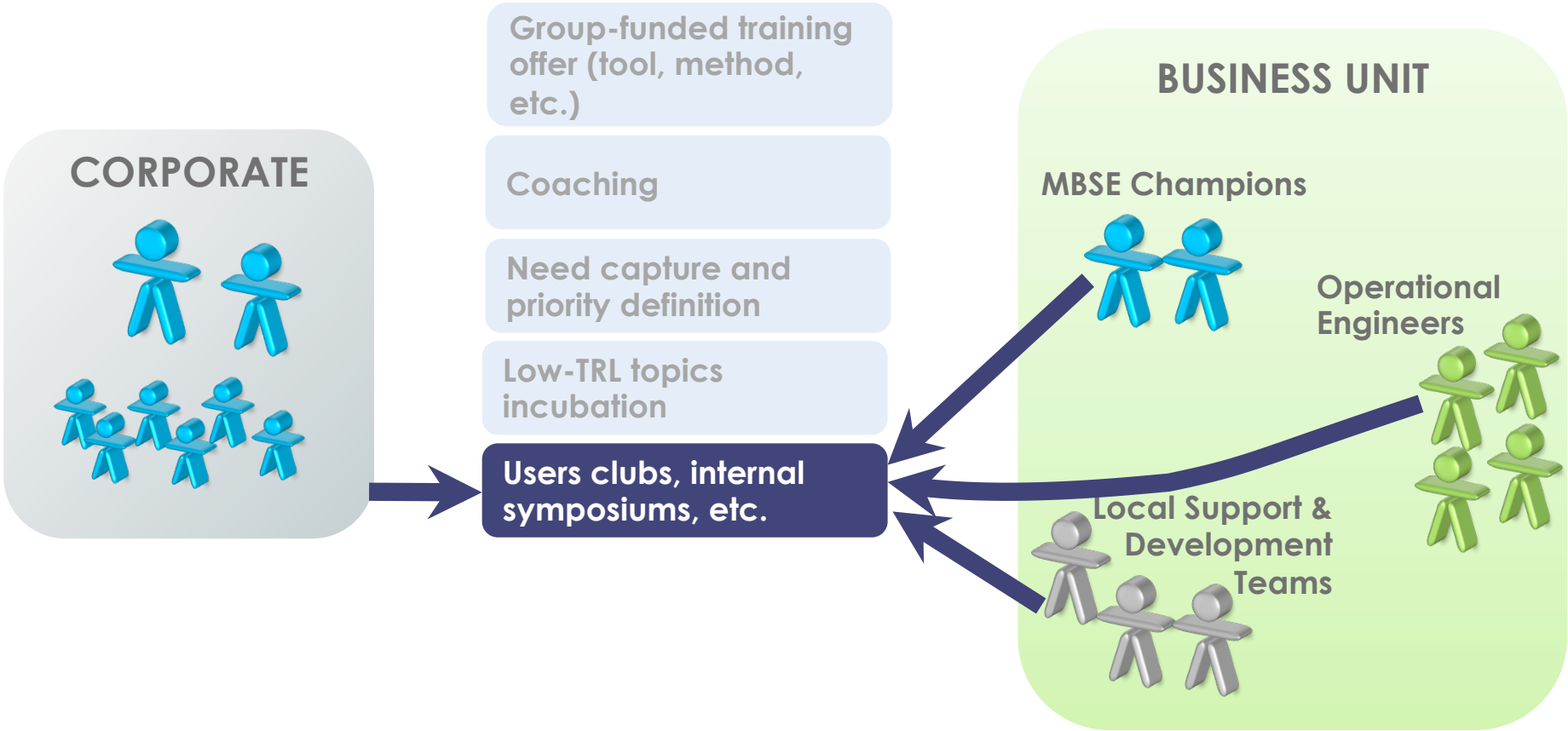

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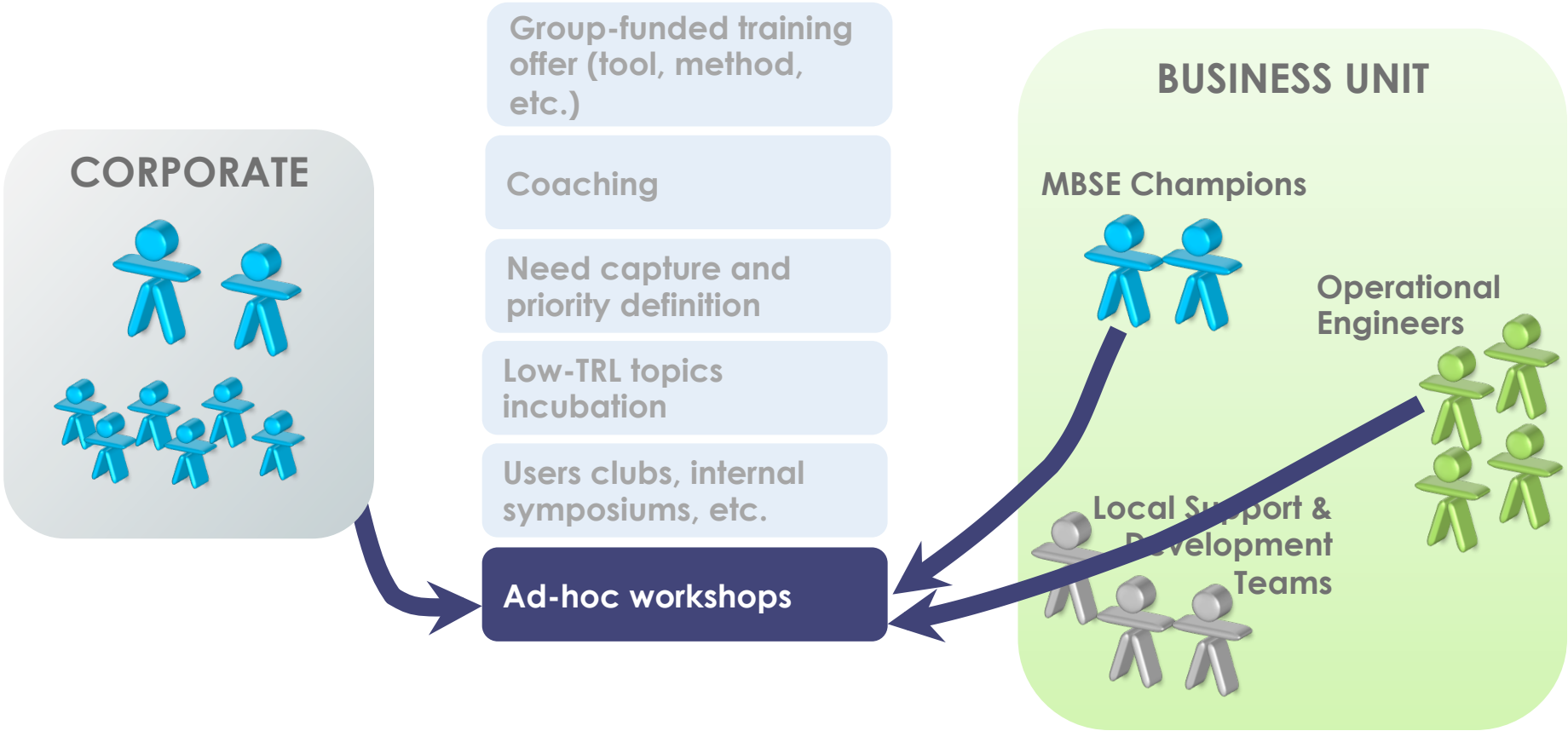


Key Organizational Structures Supporting MBSE Deployment

CORPORATE

Group-funded training offer (tool, method, etc.)

Coaching

Need capture and priority definition

Low-TRL topics incubation

Users clubs, internal symposiums, etc.

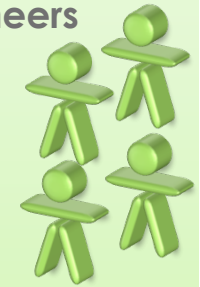
Ad-hoc workshops

Tool support, CCB

BUSINESS UNIT

MBSE Champions

Operational Engineers



Local Support & Development Teams

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Focus on MBSE Coaching

WHAT ARE THE ACTIVITIES OF A COACH?

Coaching: Modeling Objectives and Strategy

Why modeling?

- **The goal is not to model!**
- Modeling helps reach engineering goals
- Make sure all MBSE activities contribute to these goals
- Different objectives = different stopping criteria = different costs
- **Be modest in setting modeling objectives, be incremental**

Coaching: Modeling Objectives and Strategy

Who will be the contributors? The consumers?

- **MBSE implies changes in other disciplines**: Configuration management, requirements management, etc..
- The model cannot be "just for to the architects". Specialty engineers, design authorities, IV&V practitioners, etc.
- Once something is put in the model **it should become THE reference**

Coaching: Modeling Objectives and Strategy

What are the inputs and outputs of the model?
Which traceability scheme?

- Does the model illustrate an existing specification document? Or does the model help write it?
- Does the model help write subsystems' specification? Which traceability ?
- Are the interface defined within the model or referenced?
- Is IV&V driven by the model?

Coaching: Modeling Objectives and Strategy

How many models? Which relationships between them?

- **System & subsystems**?
- **Product line model and derived models**?
- Configuration management & multi-user?
- **Model libraries, model building blocks** in catalogs, etc.

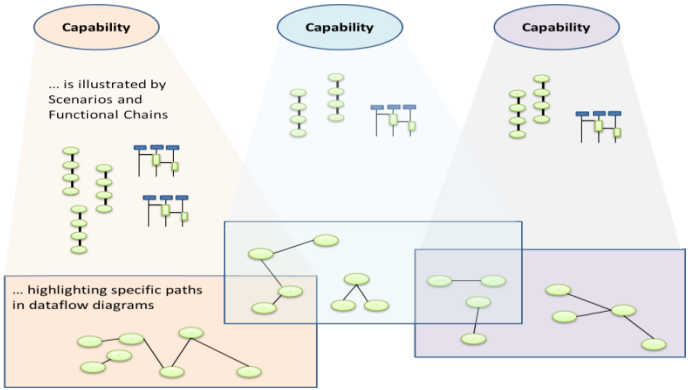
Coaching: Modeling Objectives and Strategy

- Coaching helps define the strategy and set the objectives
- Not answering these questions early often leads to failures
- A “model management plan” should be written

Coaching: Help Write Modeling Guidelines

Structure of the model(s)

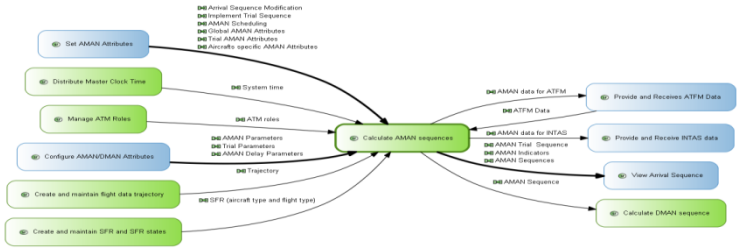
- What will be **the logical reading grid of the model**?
- Capability-driven?
- What are the steps to model a new feature / new set of requirement?



Coaching: Help Write Modeling Guidelines

What kinds of diagrams?

- Which kinds of diagrams will be used and **for which purpose?** (architecture, dataflows, sequence diagrams, functional chains)
- Strategy for diagrams: publication, analysis, creation?



Coaching: Help Write Modeling Guidelines

Modeling conventions

- Naming of elements
- **Layout of diagrams**
- **Diagram contents**: synchronization, contextual elements, filters, etc.

Coaching: Help Write Modeling Guidelines

Responsibility

- **How is responsibility distributed?**
  Per Capability? Per Component?
- How is the contributions organized?

Coaching: Help Write Modeling Guidelines

Model validation strategy

- **Different objectives** mean different model content means **different validation rules**
- Selection of checking rules, definition of validation profiles
- Which strategy for model checking?

Coaching: Help Write Modeling Guidelines

Review process

- **Which kinds of reviews? Which frequency?**
- How to prepare reviews?
- Definition of maturity statuses for elements and diagrams? How to log rework actions?

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DOs and DONTs

HIGHLIGHTS FROM COACHING ACTIVITIES

DOs and DONTs - Role of the model

BEST PRACTICES

- **Have clear modelling objectives**
- **Share models with all stakeholders, make them THE reference**
- Involve other engineering teams (subsystems, speciality, etc.) in **co-engineering**
- …

PITFALLS

- **Have no stop criteria** and thus detail too much functional dataflow / architecture
- **No separation between need and solution modelling**
- **Keep several engineering levels into one single model "for the sake of simplicity"**
- Consider that any information that may be of interest for me should be in my model

DOs and DONTs - Model Management

BEST PRACTICES

- Define and share guidelines (wiki)
- **Organize regular model reviews**
- Measure model progress
- Give different purposes to diagrams: Model building, communication, documentation, model analysis, etc.
- Be iterative
- **Make models easily accessible (html)**
- Create baselines / intermediate versions

PITFALLS

- Use hand-made diagrams when automated building is possible
- Don't master the state and progress of model maturity/validity
- **Detail too much well-known parts and not enough less-understood ones**
- Try to model everything with the same tool. Choose the right tool!

DOs and DONTs - Tool Support

BEST PRACTICES

- **Have means to develop quick wins** (import & export of information from & to the model)
- Organize local change control boards, give the operational users a view on what is done « at corporate level »
- Anticipate the needs of operational end-users (discuss with them on a regular basis)

DON'Ts

- **Have no local support**
- **Let operational end-users validate / install / configure the engineering environment**
- **Think « large, division-wide rollout » without experimenting first on pilot projects**

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Arcadia/Capella Agile-like Modeling Manifesto

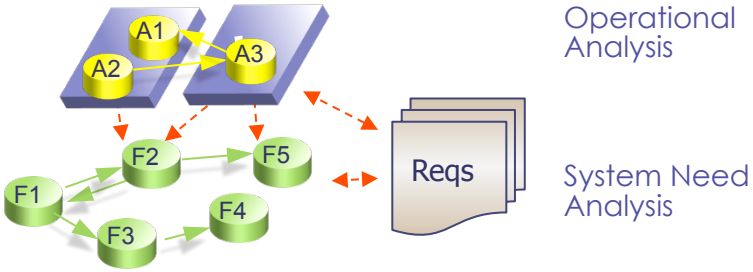
A PARALLEL BETWEEN THE MODELING BEST PRACTICES AND THE AGILE PRINCIPLES

http://agilemanifesto.org/principles.html

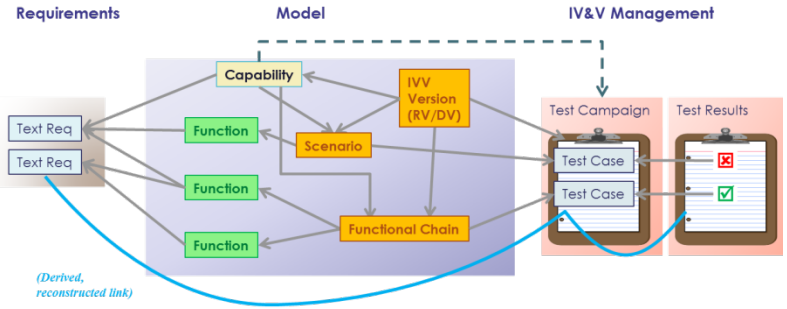
A Parallel between Agile principles and Arcadia/Capella Modeling

Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.

- **Secure Customer need understanding** by operational analysis and functional non functional system need analysis



- **Drive IV&V** with scenarios and functional chains

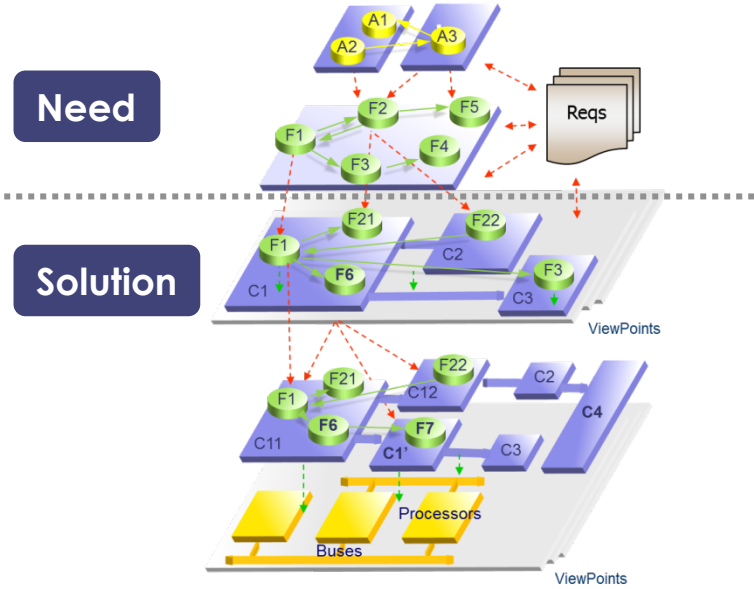


- **Define incremental customer deliveries**, based on operational capabilities

A Parallel between Agile principles and Arcadia/Capella Modeling

Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage

- Maintain **separation of need w.r.t. solution**, while maintaining traceability for impact analysis
- **Check changes** against need and against solution
- Secure changes by **model-based impact analysis**

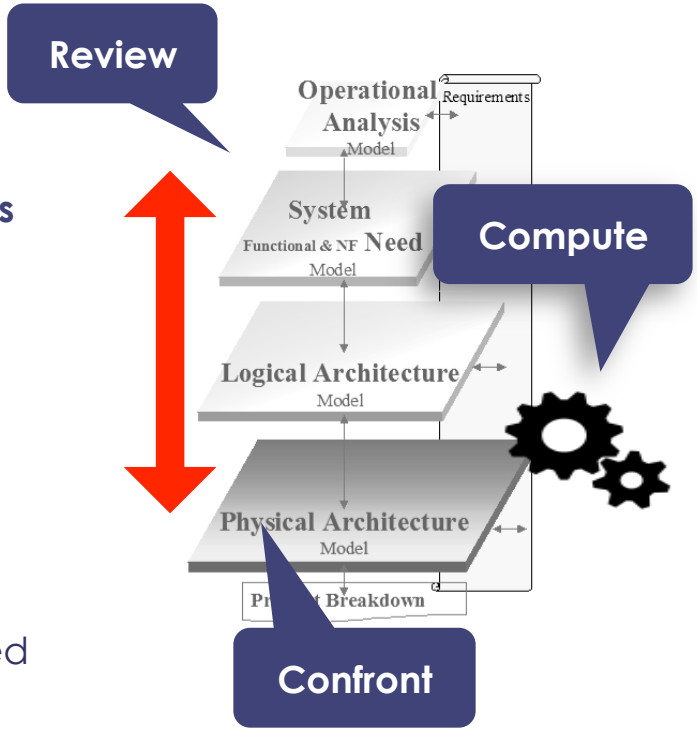


A Parallel between Agile principles and Arcadia/Capella Modeling

Working software is the primary measure of progress

> A model is "working" when…

- All appropriate **concepts & views** are effectively used
- **Consistency** is ensured at any level **between these views**
- **Consistency** is ensured between **need and solution** model parts
- **Need** part is validated with **customer**
- **Solution** part is validated by major **stakeholders** (incl. specialities, sub-system/SW/HW engineering…)
- Appropriate **analysis viewpoints** have been run & passed

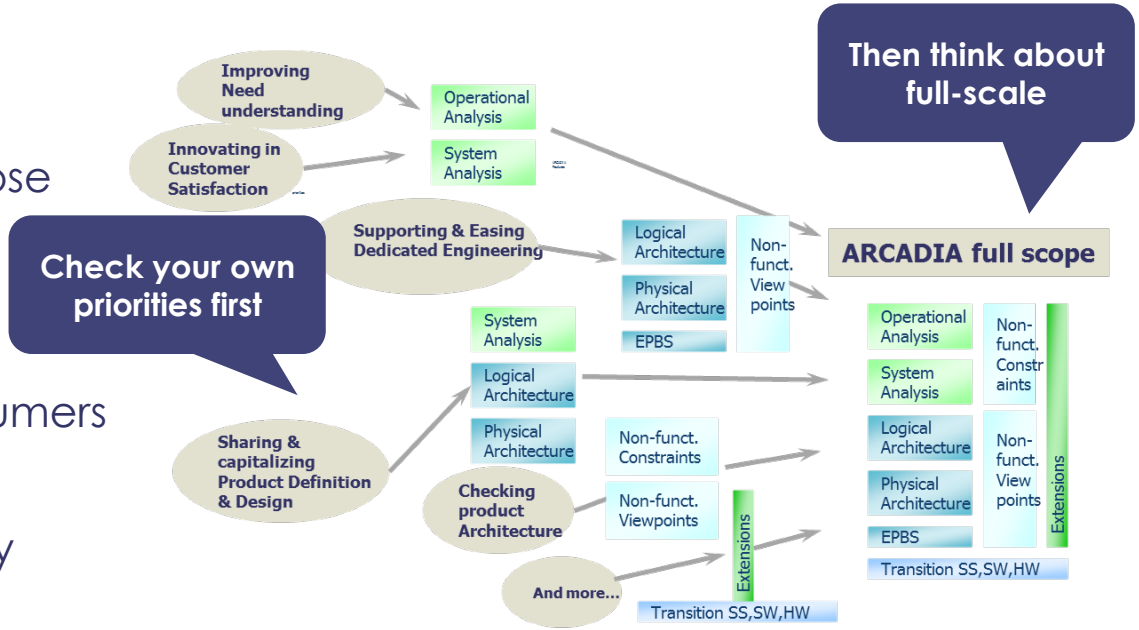


A Parallel between Agile principles and Arcadia/Capella Modeling

Simplicity--the art of maximizing the amount of work not done--is essential.

At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

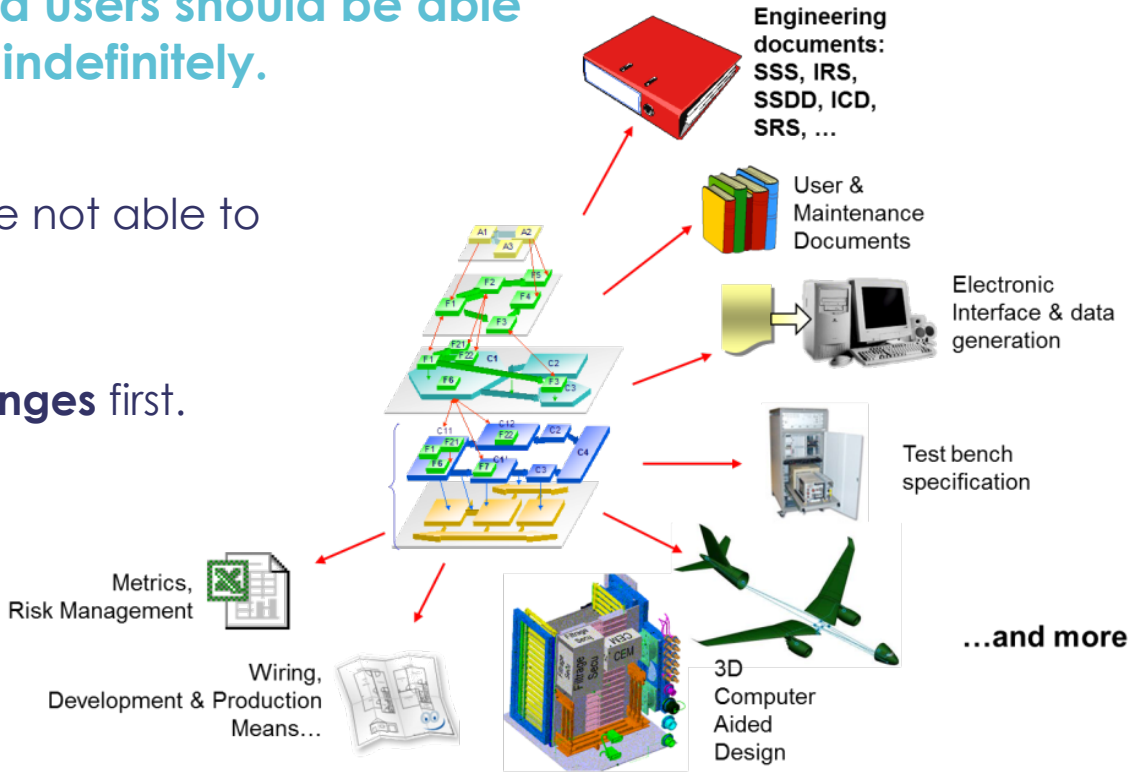
- **Don't model anything** if you don't know for what purpose
- Build models according to **the way you will exploit them** and according to users / consumers
- Define stop criteria accordingly



A Parallel between Agile principles and Arcadia/Capella Modeling

Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.

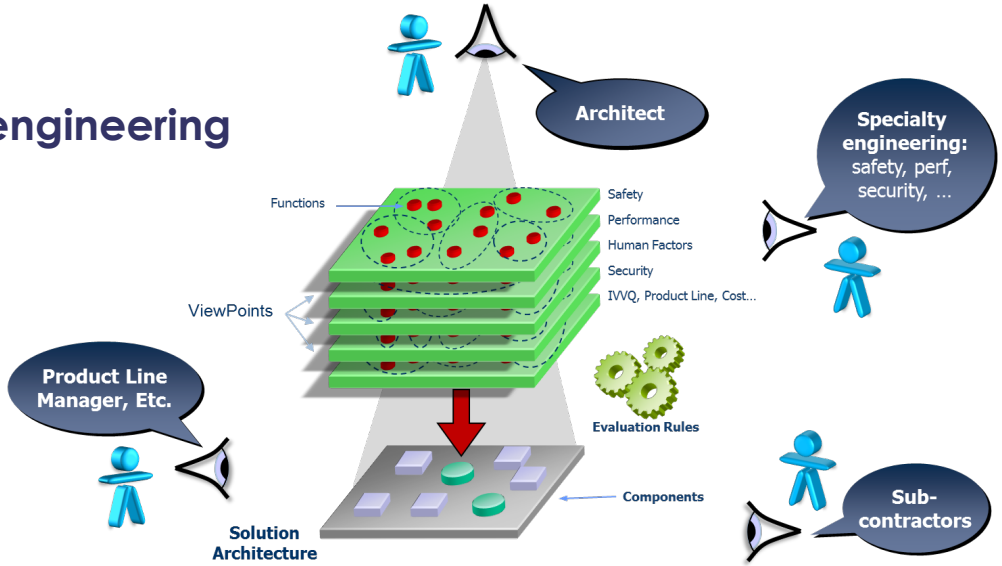
- **Don't model in details** if you are not able to keep the model **up to date**.
- Keep focused on **major challenges** first.
- "**Model once, use many**". Increases motivation for **up-to-date models**



A Parallel between Agile principles and Arcadia/Capella Modeling

Continuous attention to technical excellence and good design enhances agility

- Use models as a **means to secure engineering** and solution (not only documentation !)
- Be clear on modelling goals
- **Use models viewpoints to check, justify and capitalise architecture on a regular basis**

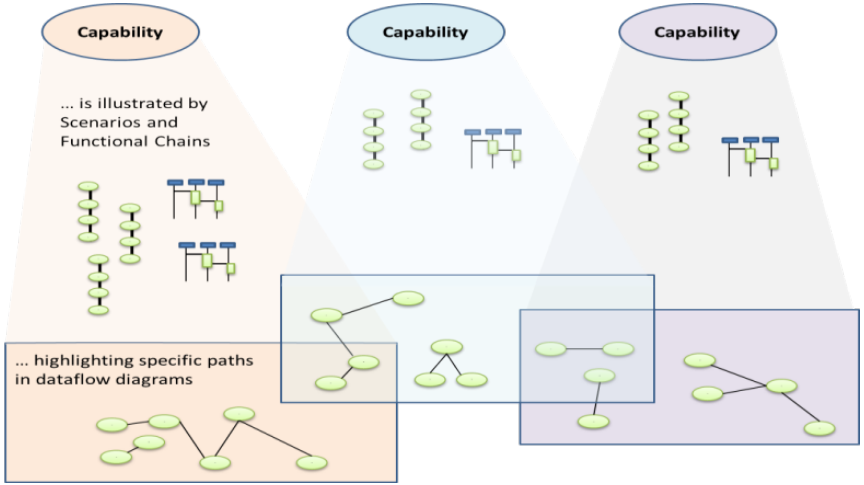


- Check adequacy of viewpoints, stop criteria, modelling rules continuously

A Parallel between Agile principles and Arcadia/Capella Modeling

Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.

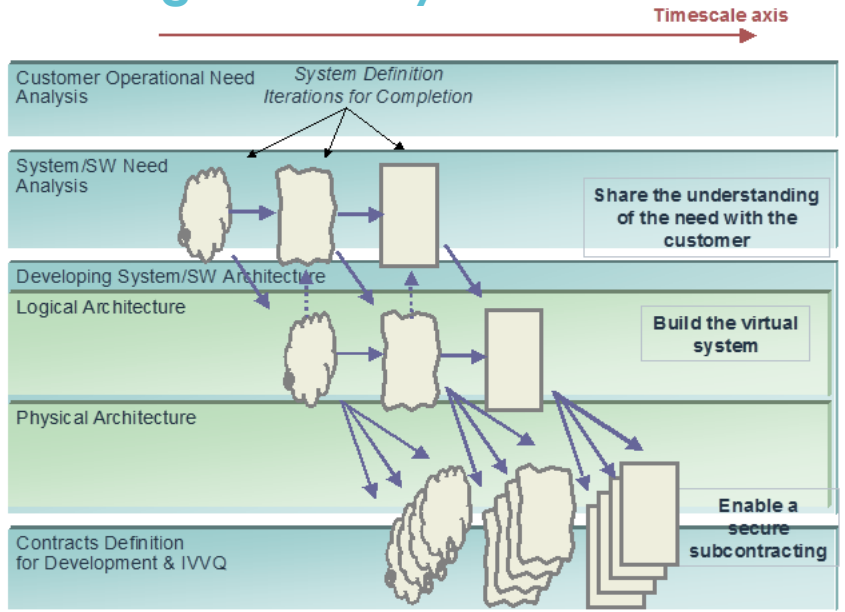
- Structure modelling activity by **(prioritized) capabilities** & increments
- Model and check model consistency **per capability**
- **Adjust modelling effort per weeks/month increment** of capabilities



A Parallel between Agile principles and Arcadia/Capella Modeling

Business people and developers must work together daily throughout the project.

- **Review the model** on the job daily or weekly with customers
- Consider model elaboration & use in a **timeline perspective**
- Be clear on the status of modelled parts:
  - Temporary/incoherent, Temporary/coherent,
  - Reviewed, Finalised…



A Parallel between Agile principles and Arcadia/Capella Modeling

Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.

The best architectures, requirements, and designs emerge from self-organizing teams.

- **Nominate modelling champions** and evangelists, also well recognized in the engineering domain
- Empower them for securing engineering by models

A Parallel between Agile principles and Arcadia/Capella Modeling

The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.

- Use models as the **whiteboard for face-to-face co-engineering**
- Capitalize analysis and design decisions in the models or link to them

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LinkedIn
http://www.linkedin.com/company/capella-modelling-workbench
Capella forum:
https://polarsys.org/forums/index.php/f/13/
Clarity consortium for the Capella ecosystem
http://www.clarity-se.org/

Clarity