ENHANCE THE EFFICIENCY OF SYSTEMS ENGINEERING WITH A TAILORING OF SE PROCESSES AND ARCADIA METHOD

Capella Days – 15/11/2023

Bruno VUILLEMIN

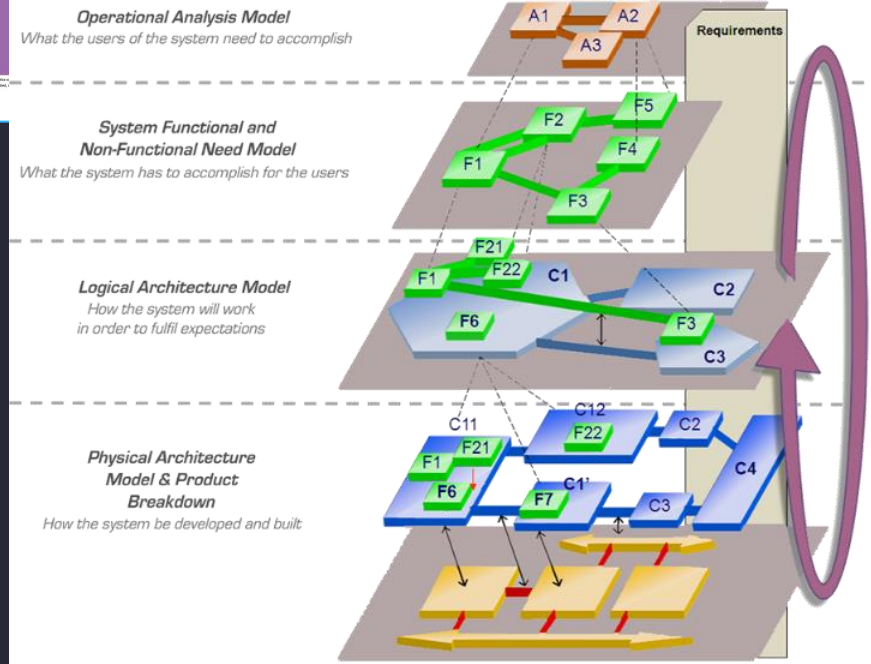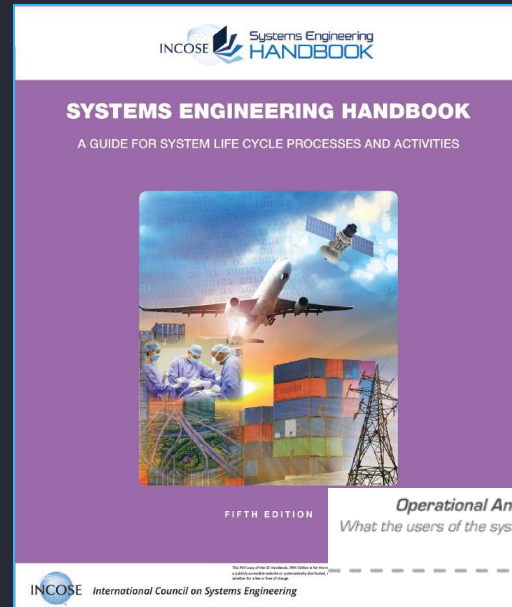Senior Expert
Systems Engineering
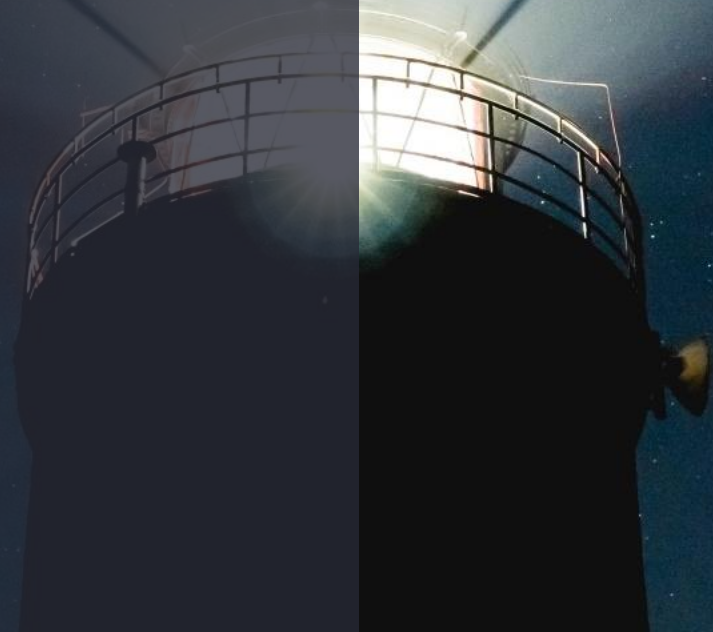and Architecture

Bruno.vuillemin@capgemini.com

AGENDA

1. Capgemini Systems Engineering & Architecture
2. Tailoring ?
3. Tailoring of SE Processes
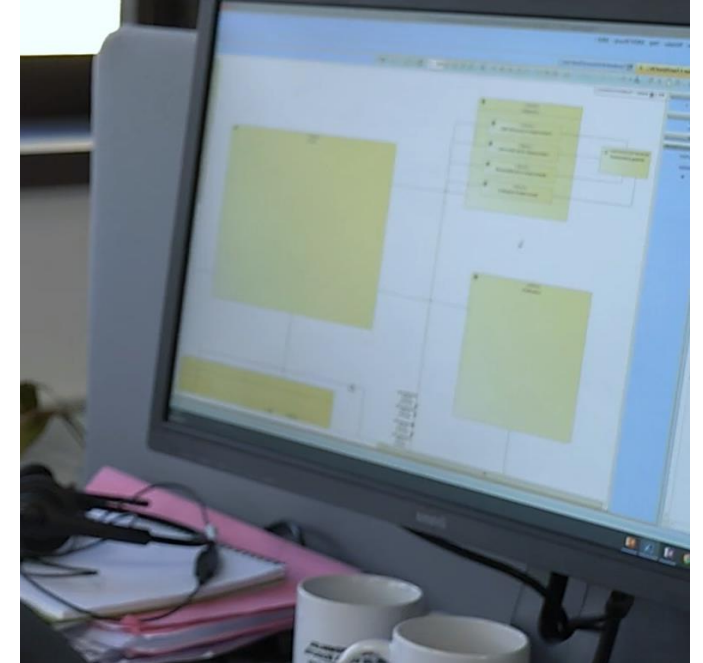4. Tailoring of ARCADIA Method
5. Conclusion and way forward
6. Q&A

1

SYSTEMS ENGINEERING AND ARCHITECTURE

CAPGEMINI ENGINEERING

- SEA Team - Systems Engineering & Architecture

- Multi-industries & multi-clients

- SE Activities (including MBSE with ARCADIA/CAPELLA)

- Research & Innovation project « ECSE »
    Efficient and Connected Systems Engineering

AN END-TO-END SE/MBSE VISION WITH CAPGEMINI ENGINEERING

SE SETUP

Addressing « MBSE pilots », Capgemini Systems Engineering Expertise Center SETUP **MBSE process, methods and tools**, define **Roadmap** with MBSE pilots based on a cross-fertilization approach.

SE DEPLOYMENT

Addressing « MBSE pilots », Capgemini Systems Engineering Expertise Center DEPLOY MBSE best-in-class practices by **Training & Coaching** based on a cross-fertilization approach.

MBSE Experts

SE OPERATION

Addressing « Architects and Systems Designers », Capgemini architects and designers teams are designing Systems, Products, Manufacturing or Services by **operating MBSE in their day-to-day design** work.

Examples: ADAS, Connectivity, Train, Power Plant, Industrial Systems, Avionic satellite systems, ATAs, aircraft, car, …

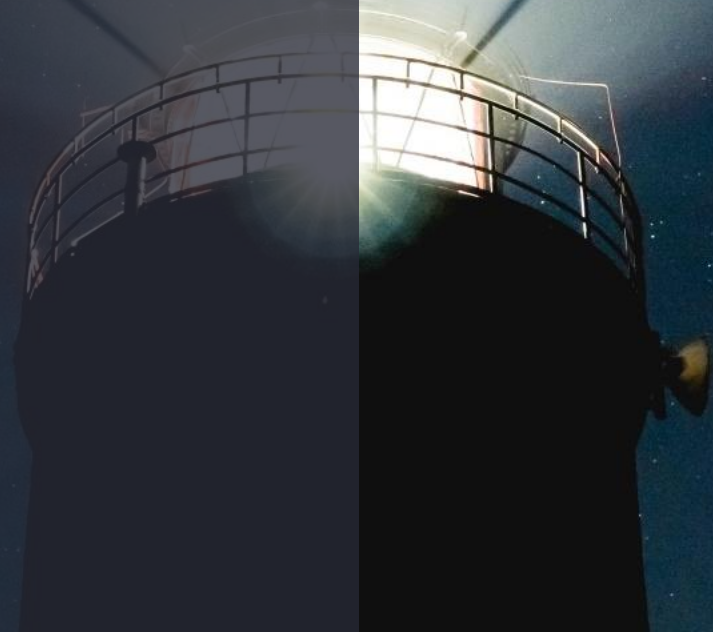MBSE practitioners

A CROSS-FERTILIZATION HISTORY FOR SE & MBSE

2

TAILORING ?
WHY AND ADDED VALUE

TAILORING ?

Definition (INCOSE Handbook) :

"Adapt the processes to ensure that they meet the needs of an organisation or a project"

Keywords :
- Realistic
- Efficiency
- Value oriented
- Shared
- Applicable
- Translate into client language
- Models are means not objectives

Means :
- Focus on value
- Focus on risky topics
- Focus on innovations
- Focus on interfaces
- ...

'One size fits all'
doesn't always fit

GENERIC vs REALISTIC ?

Level	Generic	Steps of the Tailoring Framework				Concrete application on a projet
Process	SE Processes (ISO15288 & INCOSE Handbook)	**P01** **Complexity grid**	**P02** **BPMN SE processes model**	**P03** **Versatile SE Data Model**	**P04** **SEMP template**	SEMP of the project
Method	ARCADIA method (AFNOR XP Z 67-140)	**M01** **Layer cartography**	**M02** **Concepts cartography**	**M03** **Views cartography**	**M04** **MBSE method template**	MBSE method for the project
Tool	- CAPELLA embedded user manual - Standards plugins	*Not covered in the presentation*				- User guidelines and sheets for the project - Specific plugins

CAPGEMINI TAILORING FRAMEWORK
(transition from « generic » to « applicable » on a specific project)

3
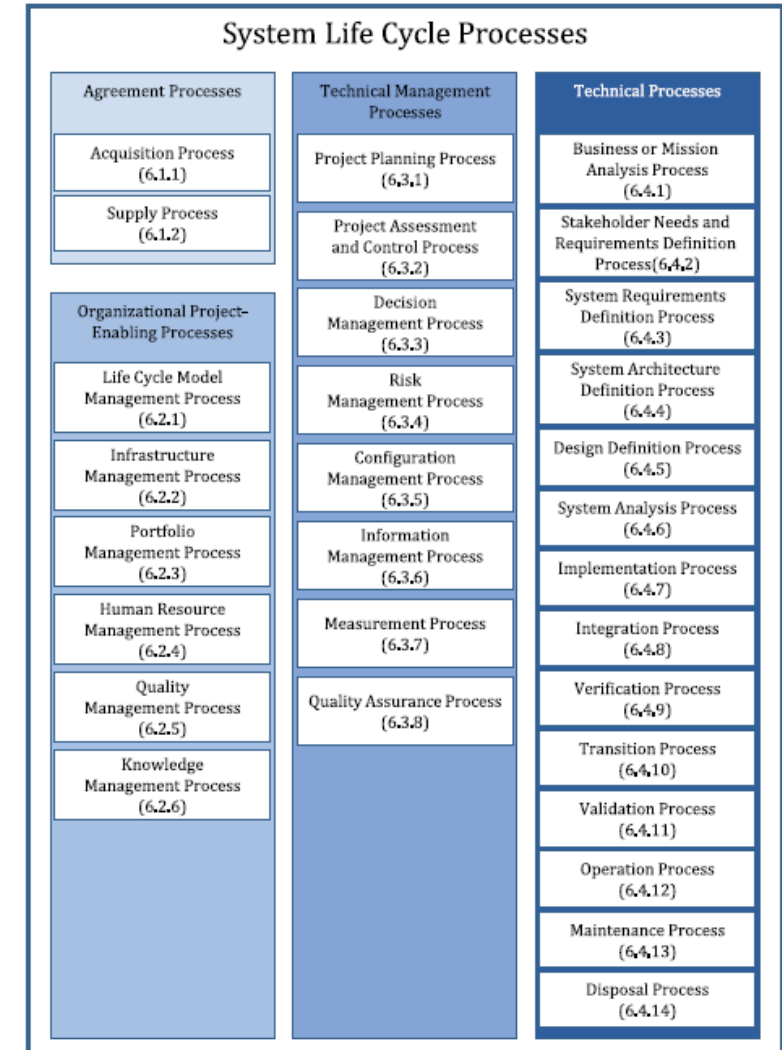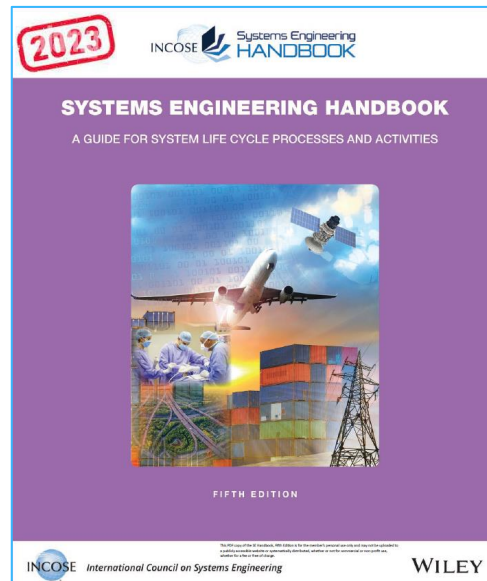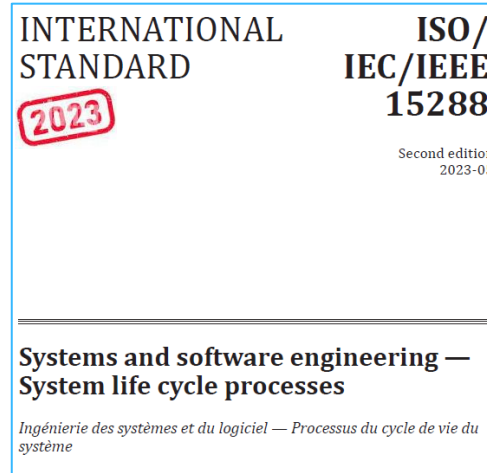# TAILORING OF SYSTEMS ENGINEERING PROCESSES
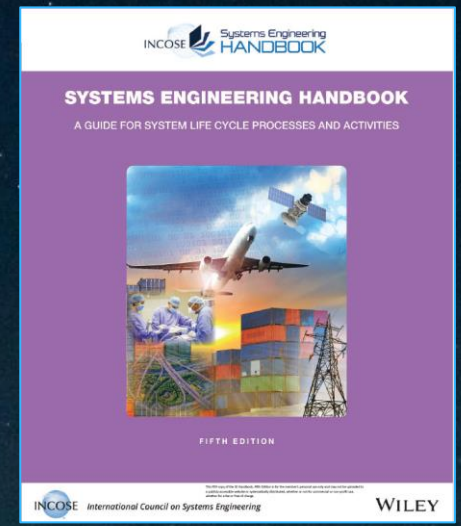
TAILORING OF SE PROCESSES

CURRENT STATUS OF SE PROCESSES

- Major SE International standards updated in 2023

- INCOSE Handbook 2023 (Version V5) in line with ISO15288-2023

- Generic and multi-industries processes

- Large source of knowledge for SE projects

INTERNATIONAL STANDARD — ISO/IEC/IEEE 15288

2023 — Second edition 2023-05

Systems and software engineering — System life cycle processes

Ingénierie des systèmes et du logiciel — Processus du cycle de vie du système

2023 — INCOSE Systems Engineering HANDBOOK

SYSTEMS ENGINEERING HANDBOOK

A GUIDE FOR SYSTEM LIFE CYCLE PROCESSES AND ACTIVITIES

FIFTH EDITION

INCOSE International Council on Systems Engineering — WILEY

System Life Cycle Processes

Agreement Processes	Technical Management Processes	Technical Processes
Acquisition Process (6.1.1)	Project Planning Process (6.3.1)	Business or Mission Analysis Process (6.4.1)
Supply Process (6.1.2)	Project Assessment and Control Process (6.3.2)	Stakeholder Needs and Requirements Definition Process(6.4.2)
Organizational Project-Enabling Processes	Decision Management Process (6.3.3)	System Requirements Definition Process (6.4.3)
Life Cycle Model Management Process (6.2.1)	Risk Management Process (6.3.4)	System Architecture Definition Process (6.4.4)
Infrastructure Management Process (6.2.2)	Configuration Management Process (6.3.5)	Design Definition Process (6.4.5)
Portfolio Management Process (6.2.3)	Information Management Process (6.3.6)	System Analysis Process (6.4.6)
Human Resource Management Process (6.2.4)		Implementation Process (6.4.7)
Quality Management Process (6.2.5)	Measurement Process (6.3.7)	Integration Process (6.4.8)
Knowledge Management Process (6.2.6)	Quality Assurance Process (6.3.8)	Verification Process (6.4.9)
		Transition Process (6.4.10)
		Validation Process (6.4.11)
		Operation Process (6.4.12)
		Maintenance Process (6.4.13)
		Disposal Process (6.4.14)

TAILORING OF SE PROCESSES

> **FINDINGS ON CURRENT SE PROCESSES DESCRIPTION**

- Large volume of knowledge :
  - ISO15288 :
    - 120 pages
    - 30 processes
    - 111 activities
    - 447 tasks

  - INCOSE Handbook :
    - 345 pages

- Inputs / Outputs at process level only
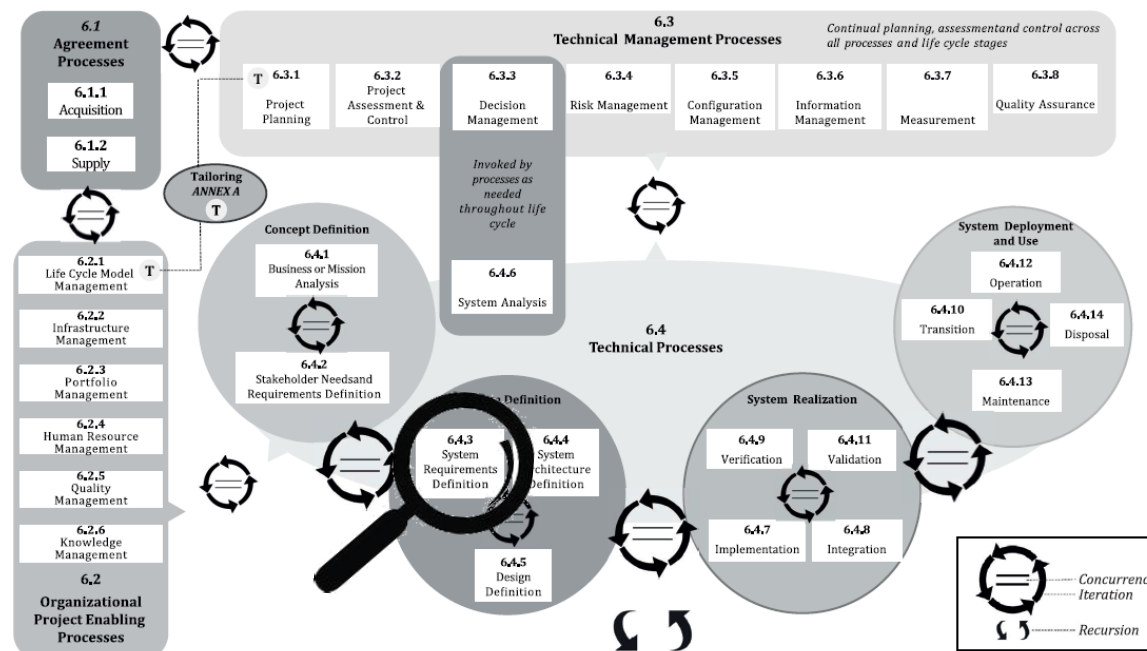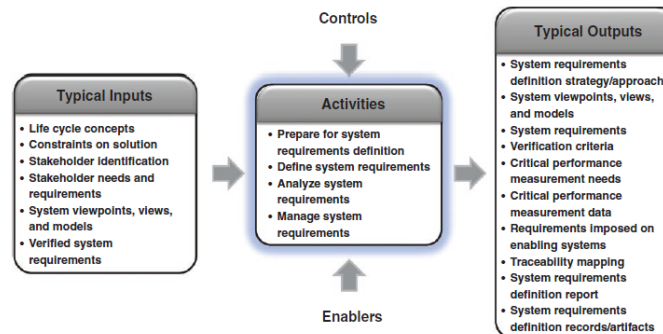
- Textual description of tasks for each activity

Figure 5 — Interrelationships between processes

System Requirements Definition Process

TAILORING OF SE PROCESSES

OBJECTIVES OF THE TAILORING OF SE PROCESSES

WHY ?

- Adapt generic and large cartography of processes
- Prepare concrete deployment of SE on a project
- Ensure efficiency of SE on a project
- Gain membership of project team

Raison to tailor processes for a system :
- Innovation or recurrent
- Concept only or go down to the production of a final system
- Same need, new solution (obsolescence, re-engineering)
- Retro-engineering
- …

Technical Processes

Business or Mission Analysis Process (6.4.1)	
Stakeholder Needs and Requirements Definition Process(6.4.2)	
System Requirements Definition Process (6.4.3)	✅
System Architecture Definition Process (6.4.4)	✅
Design Definition Process (6.4.5)	
System Analysis Process (6.4.6)	
Implementation Process (6.4.7)	❌
Integration Process (6.4.8)	
Verification Process (6.4.9)	✅
Transition Process (6.4.10)	
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Operation Process (6.4.12)	
Maintenance Process (6.4.13)	❌
Disposal Process (6.4.14)	

TAILORING OF SE PROCESSES

P01	P02	P03	P04
Complexity grid	BPMN SE processes model	Versatile SE Data Model	SEMP Template

MEAN PROVIDED BY THE
TAILORING FRAMEWORK

Complexity grid :

- Characterize system type

- Characterize system complexity

- Useful input for the tailoring of SE processes and SE activities (including MBSE with ARCADIA / CAPELLA)

- Allow comparisons between projects

TAILORING OF SE PROCESSES

MEAN PROVIDED BY THE TAILORING FRAMEWORK

- BPMN SE processes model to support tailoring

From textual description of processes to graphical representation of processes, activities, tasks and input/output flows between tasks

- SIPOC for each activity

- Used to decide what SE processes, activities … shall be deployed for the project

TAILORING OF SE PROCESSES

MEAN PROVIDED BY THE TAILORING FRAMEWORK

VeSEDaM : Versatile SE Data Model

Bring a complete, state of the art, method to issue a useful data model on any Systems Engineering project.

Structure :
- Concepts
- Attributes
- Relationships (semantic, cardinality, …)

Content :
- Environnement
- Requirements
- Operational layer
- Functional layer
- Physical layer
- V&V
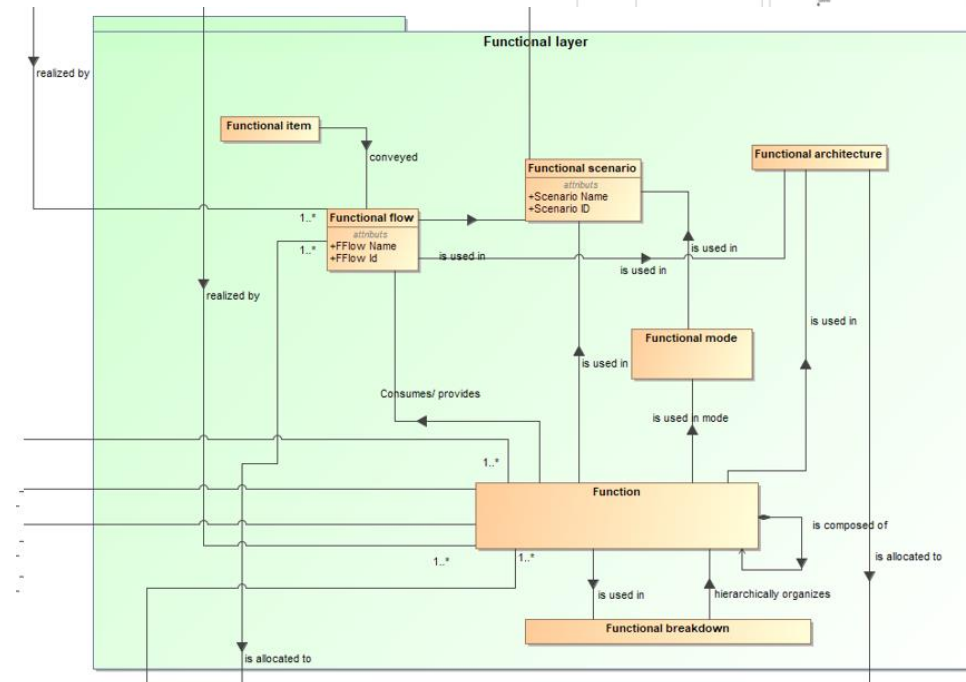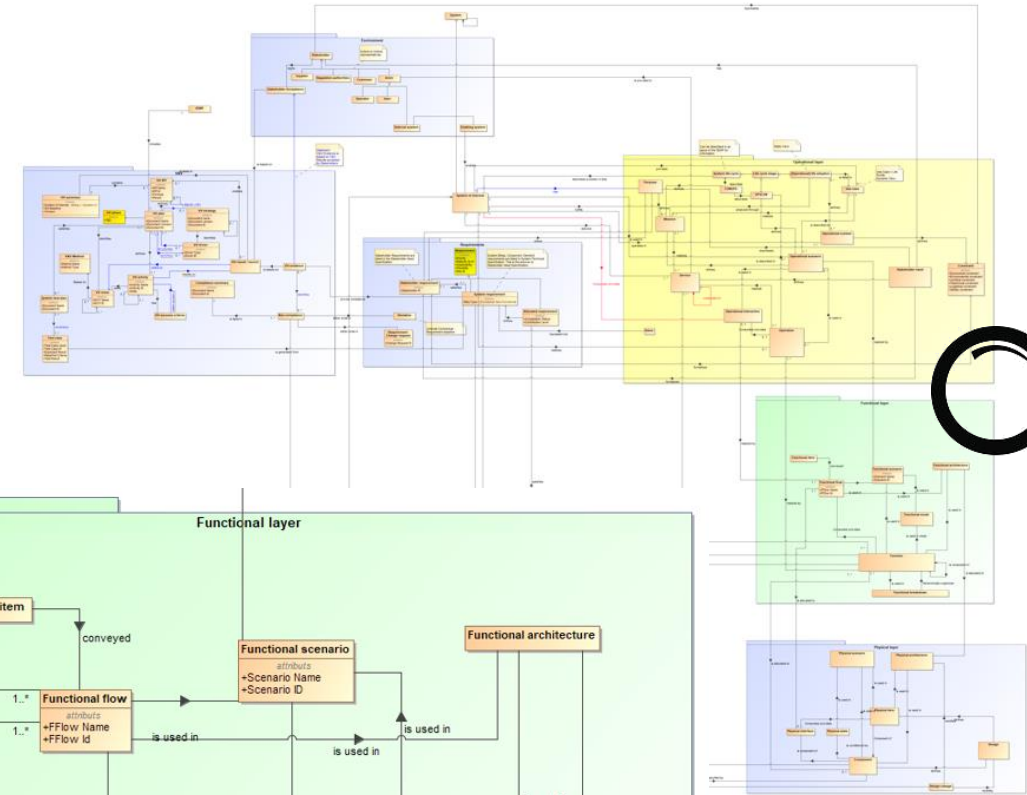
TAILORING OF SE PROCESSES

P01	P02	P03	P04
Complexity grid	BPMN SE processes model	Versatile SE Data Model	SEMP Template

RESULT OF SE PROCESSES TAILORING FRAMEWORK

SEMP (System Engineering Management Plan)

- Formalisation of SE processes tailoring results into a SEMP document

- Transition from « generic »
  to « applicable » on a specific project

- Concrete information for a specific project

- Simple, clear and applicable content by the project team

Capgemini

PROJECT ECSE

SYSTEM ENGINEERING MANAGEMENT PLAN

ECSE SEMP template
Version 1.0
02/11/2023

Content of the SEMP :
- System's objectives
- SE Datamodel
- SE Lifecycle developement
- SE Processes
- SE Deliverables
- SE Roles and RACI
- SE Method
- SE Tool chain
- SE KPI

PROJECT TEAM
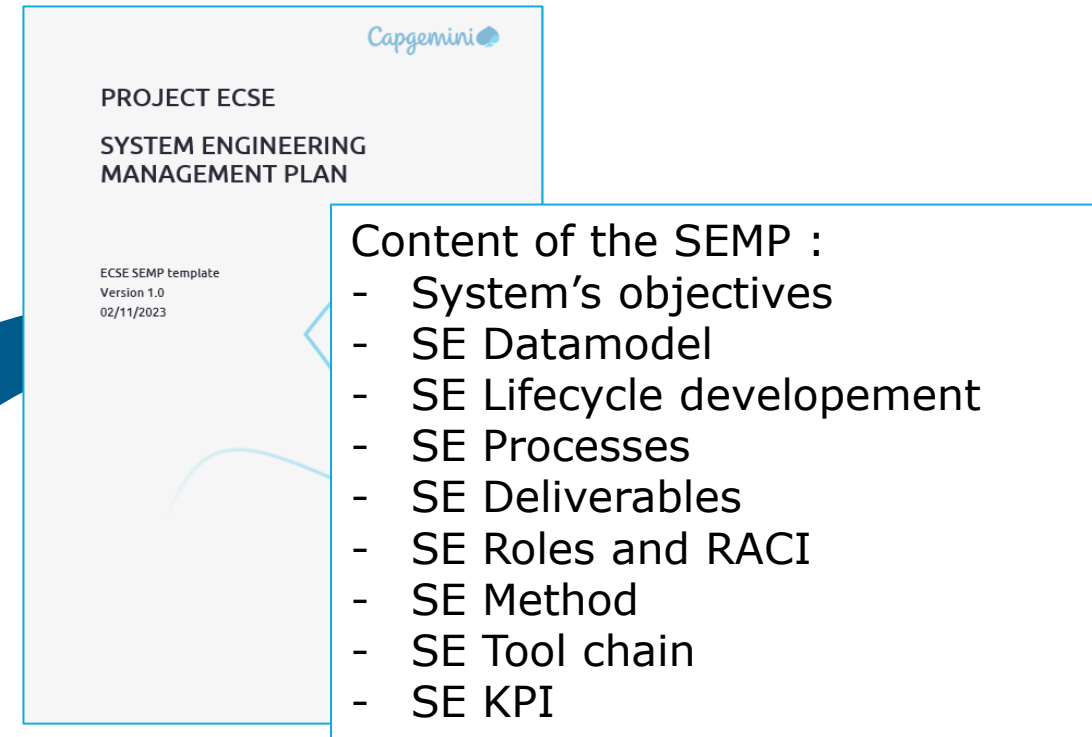
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TAILORING
OF MSBE ARCADIA METHOD

TAILORING OF ARCADIA METHOD

OBJECTIVES OF THE TAILORING OF ARCADIA METHOD

Objectives :

- Support tailored SE activities and deliverables by an efficient MBSE method

- Focus on what is expected by the project (defined into PMP and SEMP of the project)

- Define before modelize

Technical Processes

- Business or Mission Analysis Process (6.4.1)
- Stakeholder Needs and Requirements Definition Process (6.4.2)
- System Requirements Definition Process (6.4.3)
- System Architecture Definition Process (6.4.4)
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- Disposal Process (6.4.14)

Operational Analysis Model
What the users of the system need to accomplish

System Functional and Non-Functional Need Model
What the system has to accomplish for the users

Logical Architecture Model
How the system will work in order to fulfil expectations

Physical Architecture Model & Product Breakdown
How the system be developed and built

Transverse usage of ARCADIA layers to support other processes (« right of the V cycle »)

TAILORING OF ARCADIA METHOD

CRITERIA FOR THE TAILORING OF ARCADIA METHOD

Criteria for ARCADIA tailoring :

- Maturity about SE
  - Reduced usage of Operational Arcadia layer
  - Black and / or White box approach (need / solution areas)
  - Static and / or behavior modeling
  - …

- Objective of the project
  - Capture needs
  - Architecting solution
  - Generate documents
  - System or Sub-systems level
  - …

- Objectives of the model
  - Describe with low level formalism (« Visio like »)
  - Support communication
  - Prescriptive modeling
  - Documentation
  - …

Layers
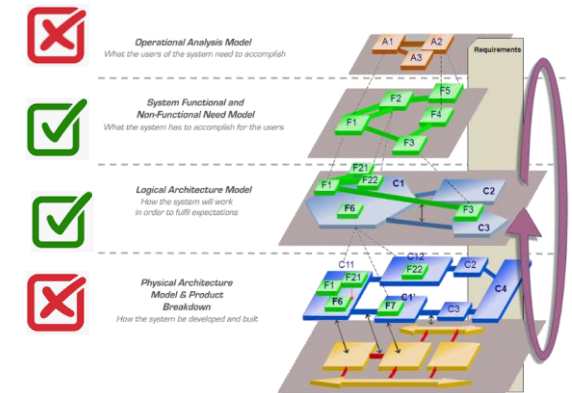
Concepts
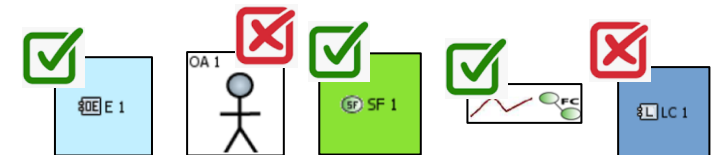
Views
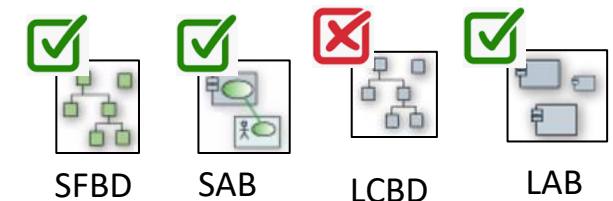
SFBD   SAB   LCBD   LAB

TAILORING OF ARCADIA METHOD

MEAN PROVIDED BY THE TAILORING FRAMEWORK

ARCADIA layers cartography :

- Select applicable ARCADIA layers for the project

    - Full operational analysis layer if SE maturity of the SE Team

    - Physical architecture layer if necessary to go down the physical formalization of the solution

    - EPBS

    - …

- In line with SE objectives and deliverables defined in the SEMP
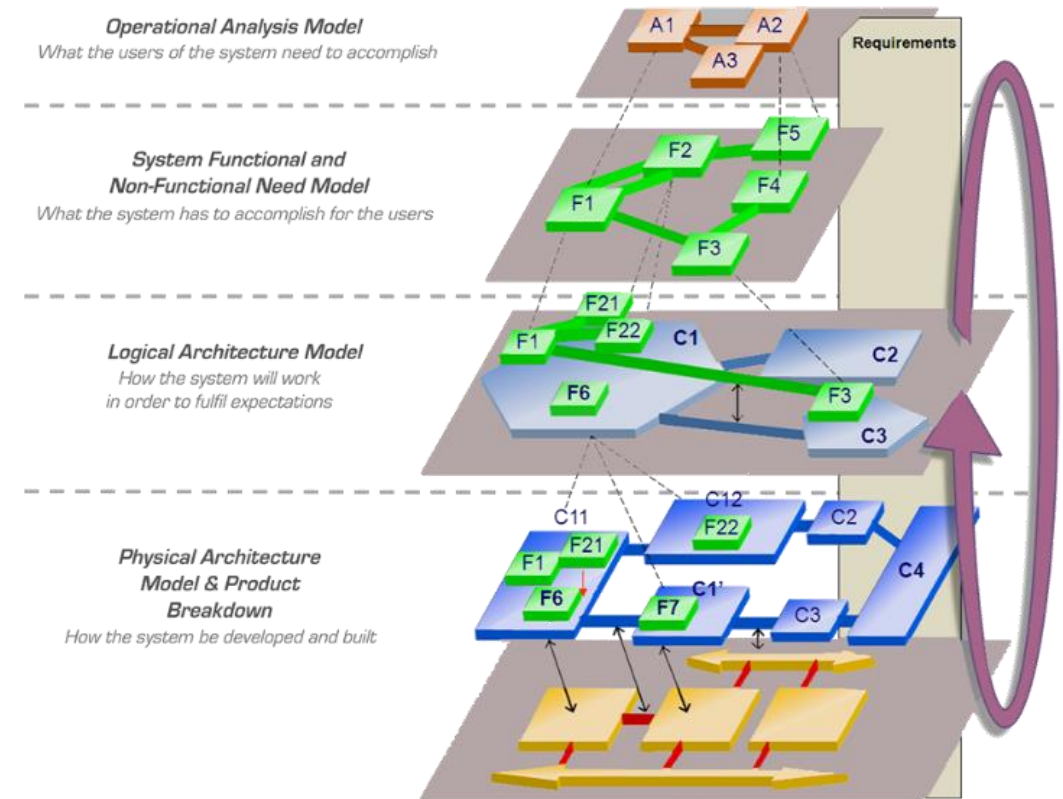
Operational Analysis Model
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How the system be developed and built

Requirements

TAILORING OF ARCADIA METHOD

MEAN PROVIDED BY THE TAILORING FRAMEWORK

ARCADIA concepts cartography :

- List of available ARCADIA concepts per layer

- Select useful ARCADIA concepts for the project

- In line with MBSE objectives

- In line with selected layers

TAILORING OF ARCADIA METHOD

MEAN PROVIDED BY THE TAILORING FRAMEWORK

❌ ✅

ARCADIA views cartography :

- List of available ARCADIA views per layer

- Select useful ARCADIA views for the project

- In line with MBSE objectives

- In line with selected layers and concepts

TAILORING OF ARCADIA METHOD

> **MEAN PROVIDED BY THE TAILORING FRAMEWORK**

MBSE method template :

- Applicable MBSE method by project team on the project

- Concrete application of tailored ARCADIA as the MBSE method for the project

- In line with MBSE objectives

- In line with selected layers, concepts and views

5
CONCLUSION AND WAY FORWARD

TAILORING OF SE PROCESSES AND ARCADIA MBSE METHOD
CONCLUSION AND WAY FORWARD

CONCLUSION

- Be pragmatic

- Be applicable

- Adapt language to people

- MBSE is a mean for SE. SE is a mean for right system

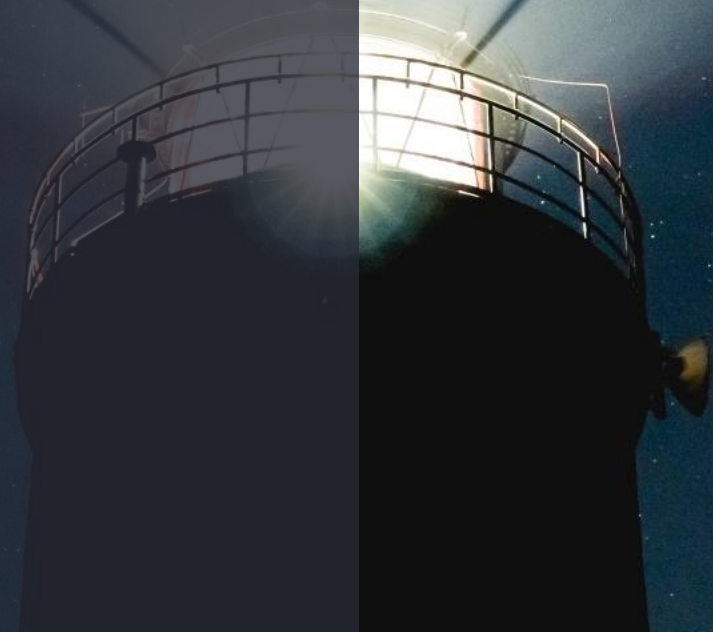- MBSE models are means and not objectives

WAY FORWARD

- Update CAPGEMINI Tailoring Framework to be in line with ISO15288 and INCOSE Handbook 2023 versions

- Use more multi-industries and multi-projects return of experiences

- Extend tailoring to CAPELLA tool with plugins

LESS IS MORE

6
Q & A

GET THE FUTURE YOU WANT

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