Mastering MBSE : From Systems Architecture to Systems Modelling

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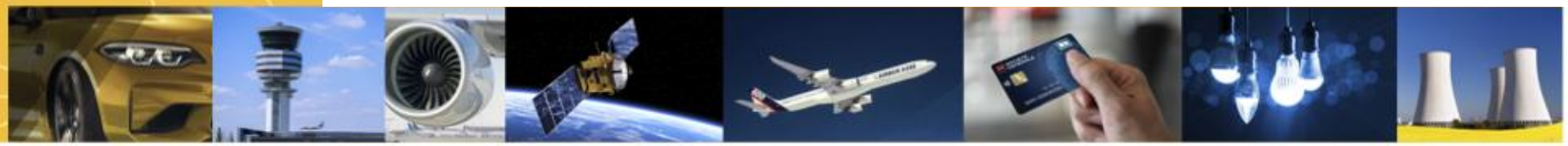
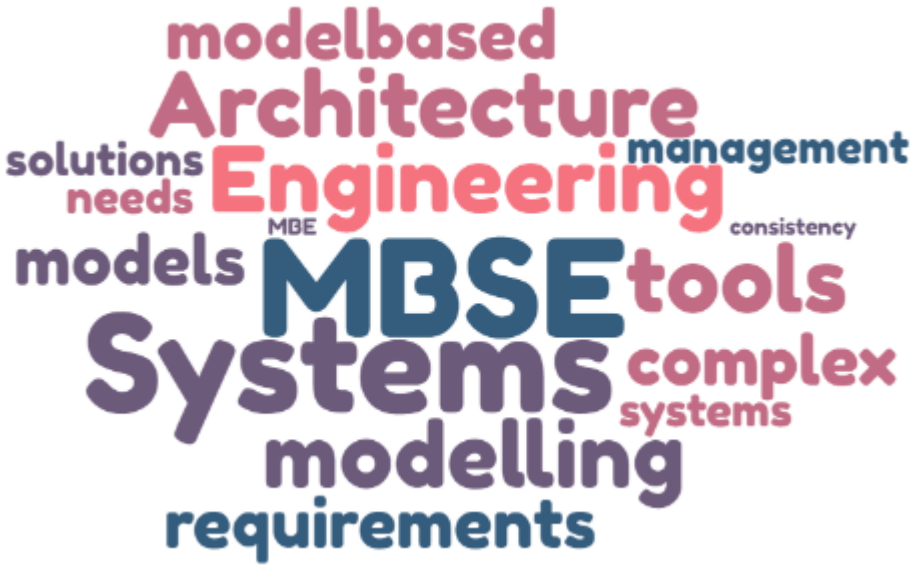


CESAMES

Why a Webinar on MBSE?



- MBSE, Systems Architecture, Systems modelling, etc: many terms are currently used, sometimes to represent similar activities, sometimes not
- The term **MBSE** is often used as a catch-all word in which we tend to put everything (including what we do not understand)
- However, it involves different types of **disciplines** (modelling, architecting, etc), with different **stakes**, and not perceiving it can lead to difficulties in its deployment

Indeed, how can we effectively deploy MBSE if we do not master its **content** and **stakes** ?

The purpose of this presentation is to share our vision of MBSE:

- **what** it is MBSE and what is ***behind*** MBSE
- some recommendations to **deploy** it effectively and without pitfalls

What is MBSE ?

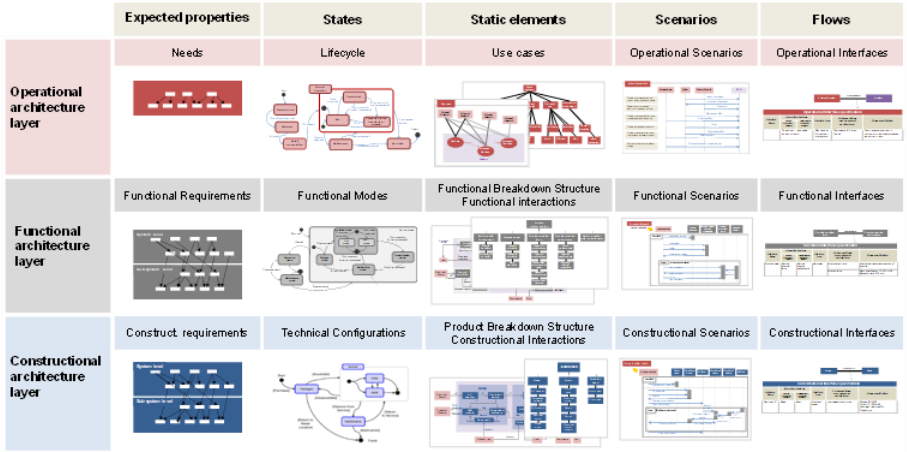
- MBSE means **Model-Based Systems Engineering**

- **Systems Engineering** ?

  The goal of systems engineering is to formalize and **master the design and validation of complex systems**, systems whose complexity makes impossible any management that is neither global nor structured.

- **Model-Based** Systems Engineering ?

  It is a **tooled** approach to systems engineering, focusing on the **use of models as the primary means of information exchange**, rather than document-based information exchange.



Model of a system

Made of **views** (=representations of a system from a given perspective) linked together

Model-based systems engineering *(MBSE) is the formalized application of modelling, to support system requirement definition, design, analysis, verification and validation activities, throughout all its life cycle face*

Source: INCOSE

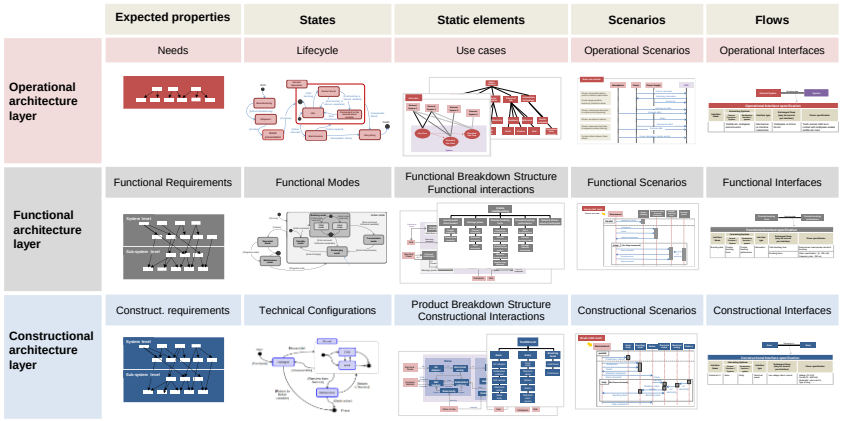
Why adopt MBSE

FROM DOCUMENT-BASED TO MODEL-BASED ENGINEERING

Without MBSE

Reports (system specification, test results)
each of which carries some information about the system

With MBSE



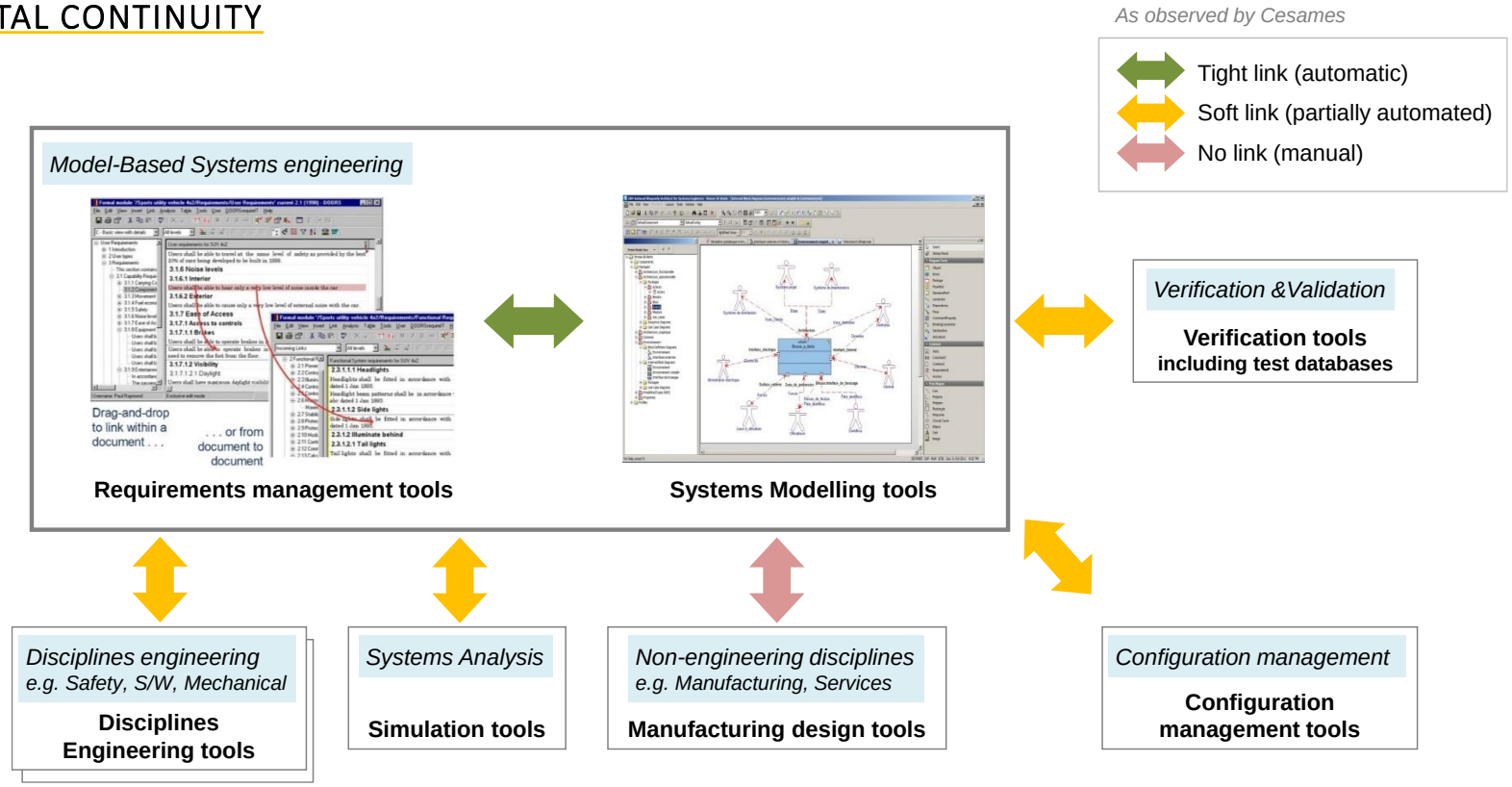
Digital model of a system
from which documents are automatically generated

Model-Based Systems Engineering enables to build **digital models of a system,** which are **long run engineering assets** that enable to face more efficiently **classic engineering stakes** such as:

- **Gathering and linking all relevant data from customer needs** to design choices,
- **Providing several points of view** of a same product,
- **Identifying all impacts** of a requirement change on a product quickly,
- **Ensuring the completeness** of the design of a system (through automatic consistency checks).

Why is MBSE a trending topic?

IT'S LINKED TO DIGITAL CONTINUITY



MBSE often takes part to wider projects of **digital transformations of enterprises** that target **digital continuity** between the data of all disciplines (sometimes called Model Based Engineering)

- Systems Engineering tools being at the **heart** of a global toolchain
- …bringing opportunities such as potential issues (digitalisation of the system design becoming a necessity)

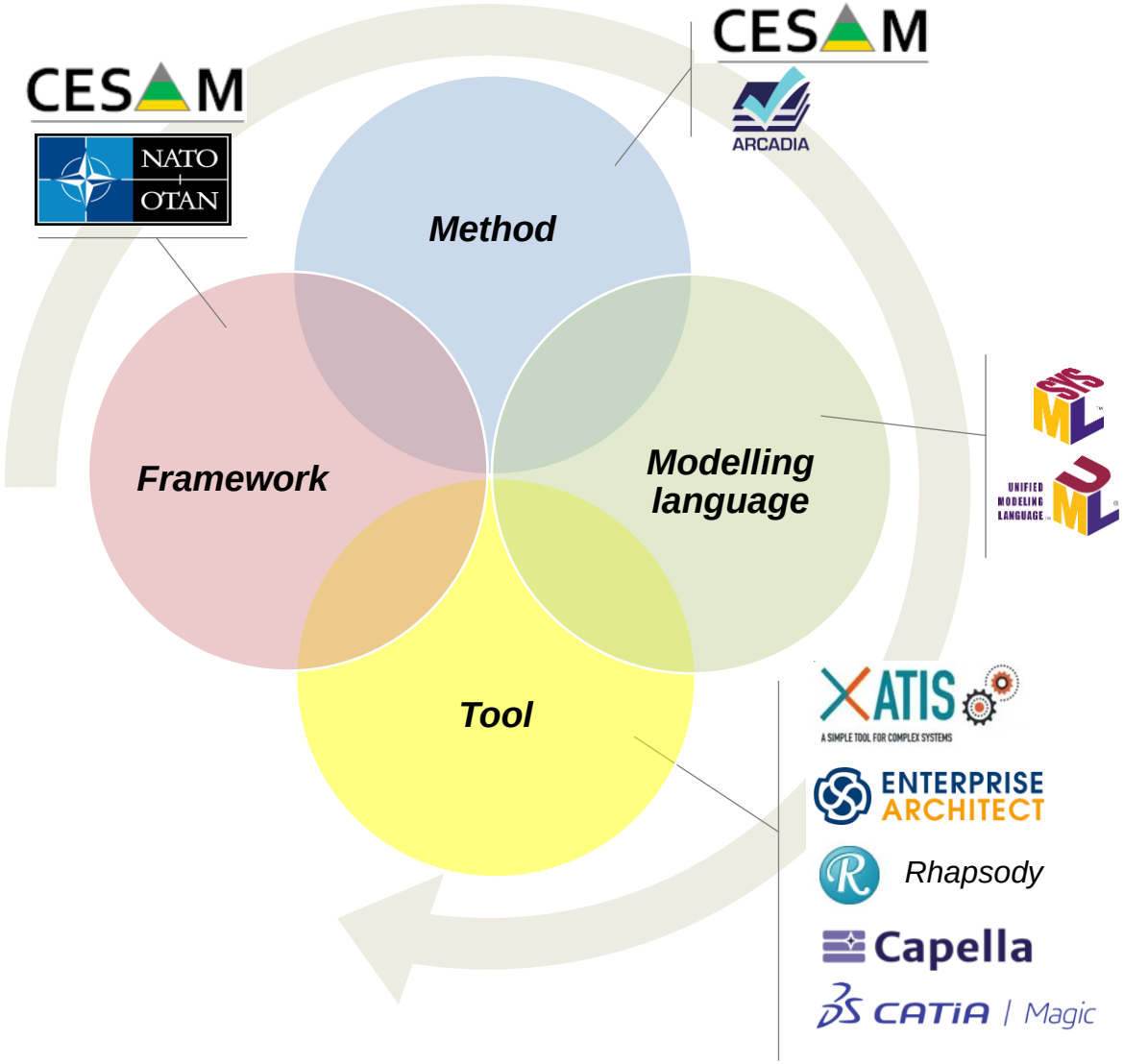
Our vision of what is behind MBSE

The 4 pillars for MBSE deployment

AN APPROACH BASED ON 4 PILLARS

Mastering MBSE requires considering the following 4 pillars:

- The architectural **framework**
  What are the representations (views) of the system that will form the model and how are they related?
- The **Method**
  How and with whom to define these representations, step by step?
- The **Modelling Language**
  What formalization should we choose to transcribe these representations from a formal point of view?
- The **(Modelling) Tool**
  What tool should I use to formalize and contain the model?



Each of these pillars can be implemented in different ways, which may or may not be compatible.

Applying MBSE

FROM SYSTEMS ARCHITECTURE TO SYSTEMS MODELLING

MBSE has two **phases** with very distinct but objectives, stakes and involved skills

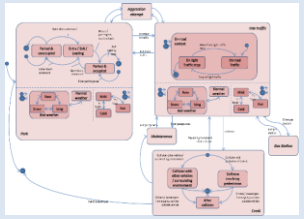
MBSE process

Systems architecture

Understand the problem to be solved by the system and architect an optimal system that answers it

Think, Design,

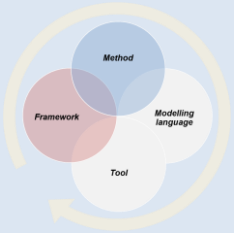
Share, communicate



Paper, notes, or digital boards

Visio, PowerPoint, …

Corresponding MBSE pillars: ***Framework*** *&* ***Method***

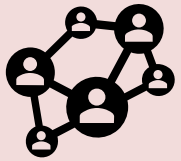


[Architecture stable enough for modelling]

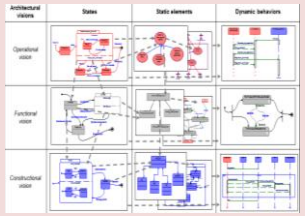
Systems modelling

Model the system in an efficient way to find the information reliably and connect it to disciplines models with optimal continuity

Prepare,

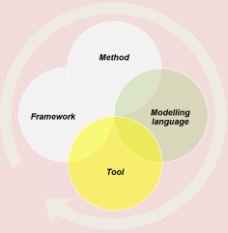


Formalise, capitalise



Modelling tools, rules, templates

Corresponding MBSE pillars: ***Modelling language*** *&* ***tool***



Both are crucial and needed for a right implementation of MBSE

MBSE Deployment: Our recommendations

Recommendation #1 : Deploy it… when needed!

FROM SYSTEMS ARCHITECTURE TO SYSTEMS MODELLING

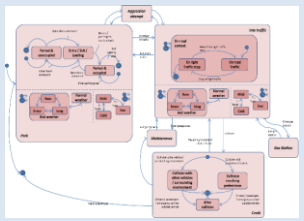
MBSE requires a specific **workload** (highly compensated by the time saved in further development), and applying a full MBSE process for any project can lead to a poor perception of what the approach can bring… and a disengagement of the main actors.

The **need and value** for MBSE shall be defined in order to assess and adapt the right effort for each activity.
The MBSE process shall **not be implemented identically** regardless of the phase of the project.

Systems architecture

Think, Design,

Share, communicate



Paper, notes, or digital boards

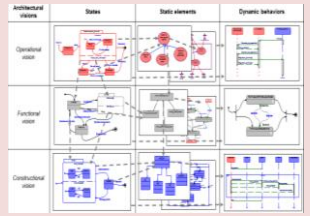
Visio, PowerPoint, …

[Architecture stable enough for modelling]

Systems modelling

Prepare,

Formalise, capitalise



Modelling tools, rules, templates

- Assess **what** shall be modelled and with what level of detail
- Focus only on **key** architectural views in early development (or RFP), and on all views of the model in development phase.

- **Frame** the needs for modelling (e.g traceability, referencing, formalized exchanged of information with partners, detailed design, digital continuity , etc)

Recommendation #2 : Get the global picture & sketch a roadmap

MBSE DEPLOYMENT… IS A LITTLE TRANSFORMATION

A classic pitfall is to consider the deployment of MBSE only through the deployment of a modelling tool.

But adopting MBSE **requires getting a global picture**: different aspects of Engineering are involved

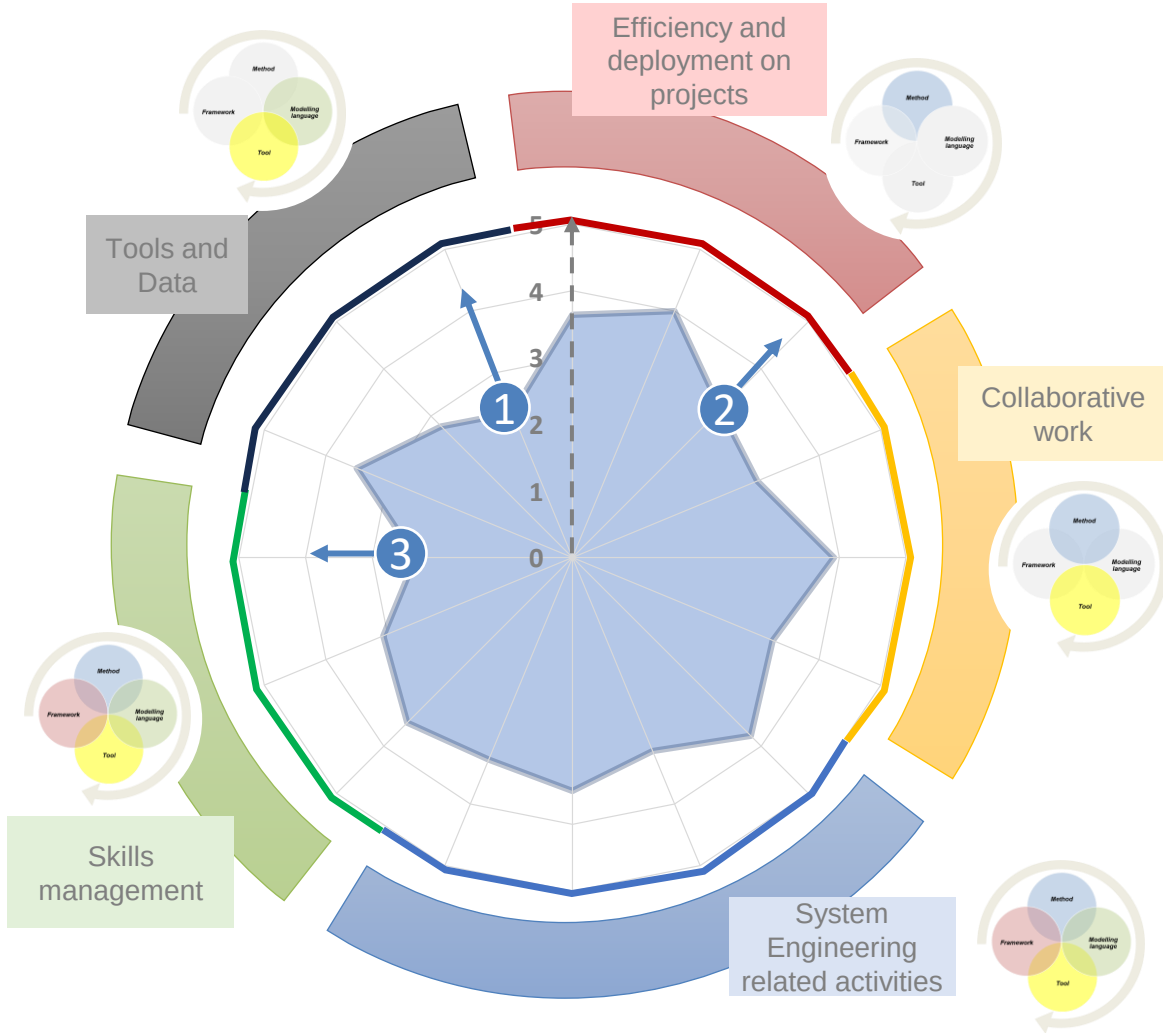
In short : deploying MBSE is a (little) transformation!

As for any entreprise transformation :

- The **maturity axes** shall be identified
- The **starting point** and the **target** shall be defined for each axe… enabling to define the main **steps** of the transformation

Example of a maturity assessment of a company, which enabled to define the first axes of deployment :

1. Standardize **tools** & **modelling language**
2. **Include** method within project milestones
3. Perform MBSE awareness (**skills**)



MBSE Maturity assessment radar grid with main axes of improvement

Recommendation #3 : Develop Systems Engineering skills

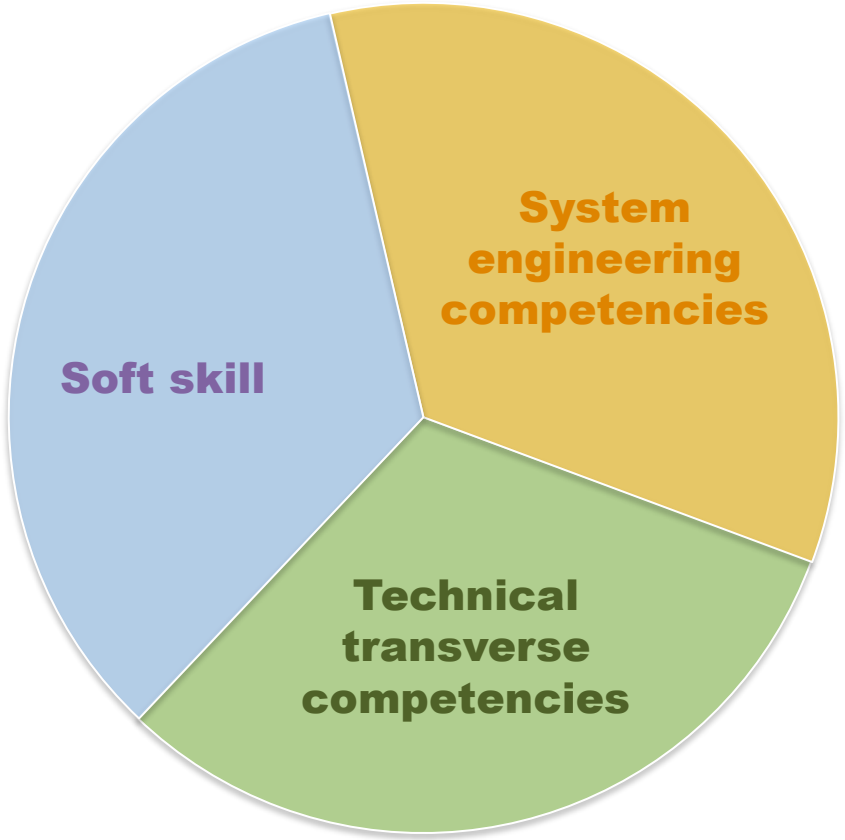
FROM SYSTEMS ARCHITECTURE TO SYSTEMS MODELLING

An other classic pitfall, linked to the previous one, is to focus on modelling language and tool skills only, when deploying MBSE.

But **develop System Engineering skills for both system engineers and systems modellers** is key to MBSE deployment success, as knowing how to architect an optimal system that answers the problem to be solved, is a necessary prerequisite to any efficient modelling.

Any system engineer or system modellers shall be able (but not at the same level of knowledge) to rely on:

- **Technical transverse competencies** - to under technical stakes at hands,
- **System engineering competencies** - to know what are the essential views of the system to model, their relationships, how and with whom are defined these representations, and the optimum level of details for each step of the process,
- **Soft skills competencies** – to acquire customer oriented, facilitation and open-mindedness capabilities necessary to create convergence among all stakeholders of the project.



System engineering skills

CESAMES

CESAMES

French reference group for the **MBSE** “system” approach

Academic background recognized worldwide

Spin-off 2011

Daniel Krob
INCOSE Fellow

Pragmatic and collaborative methodological approach

CESAM
CESAMES Systems Architecting Method

The largest community around MBSE

18.500 professionals
9.500 trained/certified

CESAM/COMMUNITY

Pragmatic support combining consulting, coaching, training and technical assistance

35
experienced system architects, certified, from the industry

Recognized at all stages of transformation through to implementation in projects

Our partners

VULCAIN ENGINEERING GROUP

DASSAULT SYSTEMES

CESAMES' mission is to improve operational performance and master complex systems over the entire life cycle

Significant and measurable benefits

-20 to -30%
on the duration of projects and the cost of engineering

-50 to -70%
on critical reservations when crossing stages

Nos Clients

COMAC
AIRBUS COMMERCIAL AIRCRAFTS
dgac
SAFRAN GROUP
AIRBUS HELICOPTERS
IDEMIA
HUAWEI
STELLANTIS
FORVIA faurecia
GROUPE RENAULT
Valeo
arianeGROUP
MBDA MISSILE SYSTEMS
AIRBUS DEFENCE & SPACE
EDF
framatome
SystemX
BOUYGUES CONSTRUCTION
Schneider Electric
GROUPE ADP
fives
VINCI ENERGIES
somfy
SNCF
Europe's Rail
ALSTOM mobility by nature
RATP GROUP
CESAMES

A common value proposition based on fertilization

OUR SUCCESSFUL INTERVENTIONS AT ALL THESE LEVELS

Consulting in Transformation

Advises and accompanies the biggest transformations of engineering departments towards the systems approach in France

Expert consulting

Training

fertilization

Assessment, training and certification of system architects and engineers

CESAMES Academy is one of the world's leading players

+ 8,000 trained / certified engineers

Coaching

Coaching of system architects and teams within projects

CESAMES is highly recognized for its operational contribution in the field of projects

+ 1,100 projects coached

Feedback satisfaction: 4.3/5

Operations

Produce within your project teams the system architectures that will make them successful

MBSE: CESAMES's training

1 DAY TRAINING

Become aware of what **MBSE offers and implies** in order to **efficiently model** a system and **efficiently tool** the System architecture process

- Understand the **fundamentals of MBSE**
- Understand the (bidirectional) **relationships** between **Systems Architecting** and **Systems Modelling**
- Understand the process to determine the **implementation** of the Systems Architecture framework **in a given modelling tool** (Enterprise Architect, Catia Magic, Xatis, Rhapsody, Capella…)

Maximum target group : 15 people

Cesames can support you through coaching, consulting or operation mission…

PREREQUISITE

Fundamentals of System architecture
(CESAM Associate certification is a plus!)

OVERVIEW OF THE TRAINING (1 DAY)

- **Fundamentals of MBSE**
- **Systems Modelling**
- **Structuring a model in a modelling tool**

Regular examples through case studies and feedback

Operational deployment

https://www.cesames.net/nos-clients/nos-webinaires/

- XATIS, LE LOGICIEL DE MODÉLISATION BASÉ SUR LA MÉTHODE CESAM
- COMMENT IMPLÉMENTER LA MÉTHODE CESAM DANS CAPELLA ?
- BÉNÉFICES ET POINTS DE VIGILANCE D'UN ARCHITECTE SYSTÈME AU SEIN D'UNE ÉQUIPE PROJET
- RETOUR D'EXPÉRIENCE SUR L'INGÉNIERIE SYSTÈME DANS DIFFÉRENTS CONTEXTES INDUSTRIELS
- COMMENT MIEUX VOUS ARMER (OU VOS ÉQUIPES) POUR FAIRE FACE AUX ENJEUX LIÉS À LA COMPLEXITÉ DE VOS PROJETS ?
- COMMENT SAVOIR CONCRÈTEMENT METTRE EN ŒUVRE UNE DÉMARCHE D'ARCHITECTURE DE SYSTÈMES ?
- …/…