

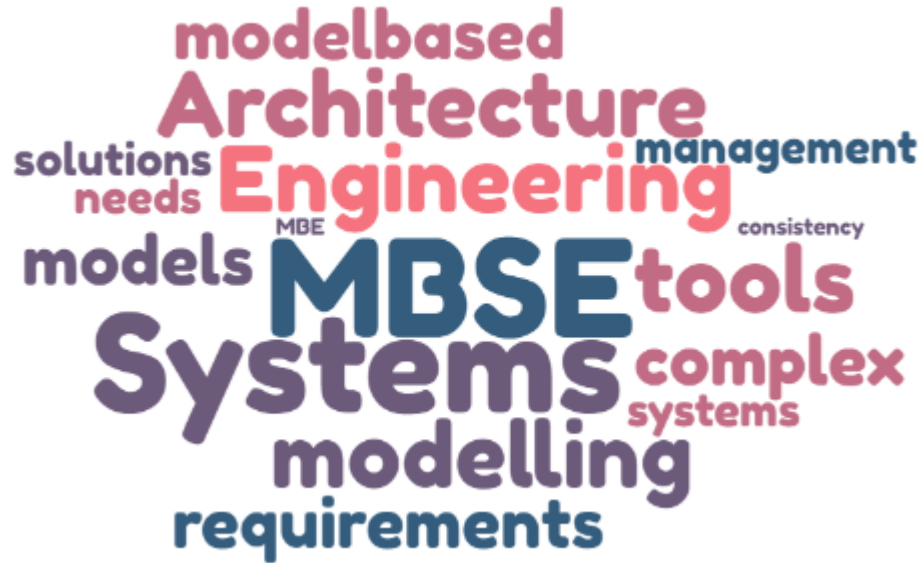
# Mastering MBSE : From Systems Architecture to Systems Modelling

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# 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** ?

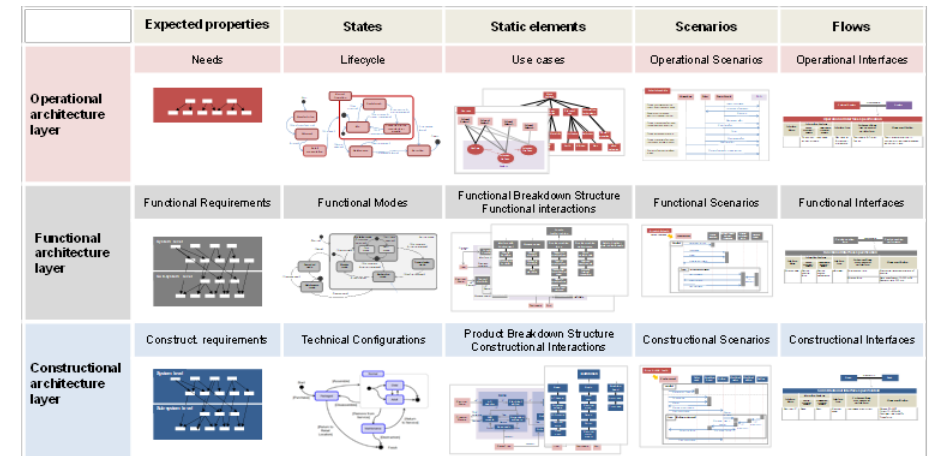


The purpose of this presentation is to share our vision of MBSE:

- **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

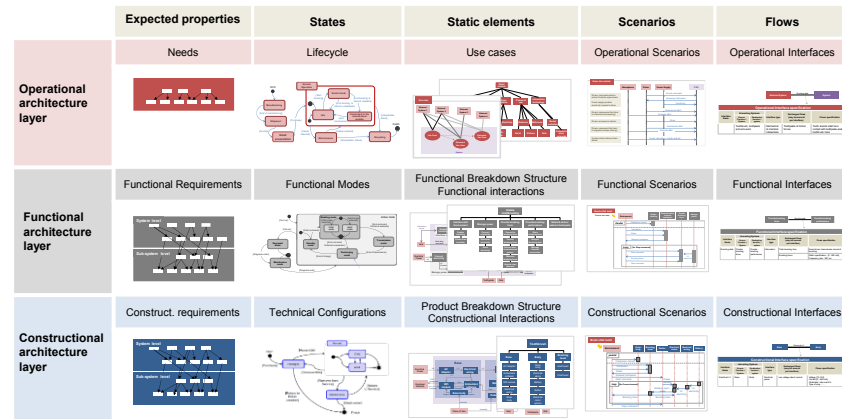
## FROM DOCUMENT-BASED TO MODEL-BASED ENGINEERING

### Without MBSE



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

### With MBSE



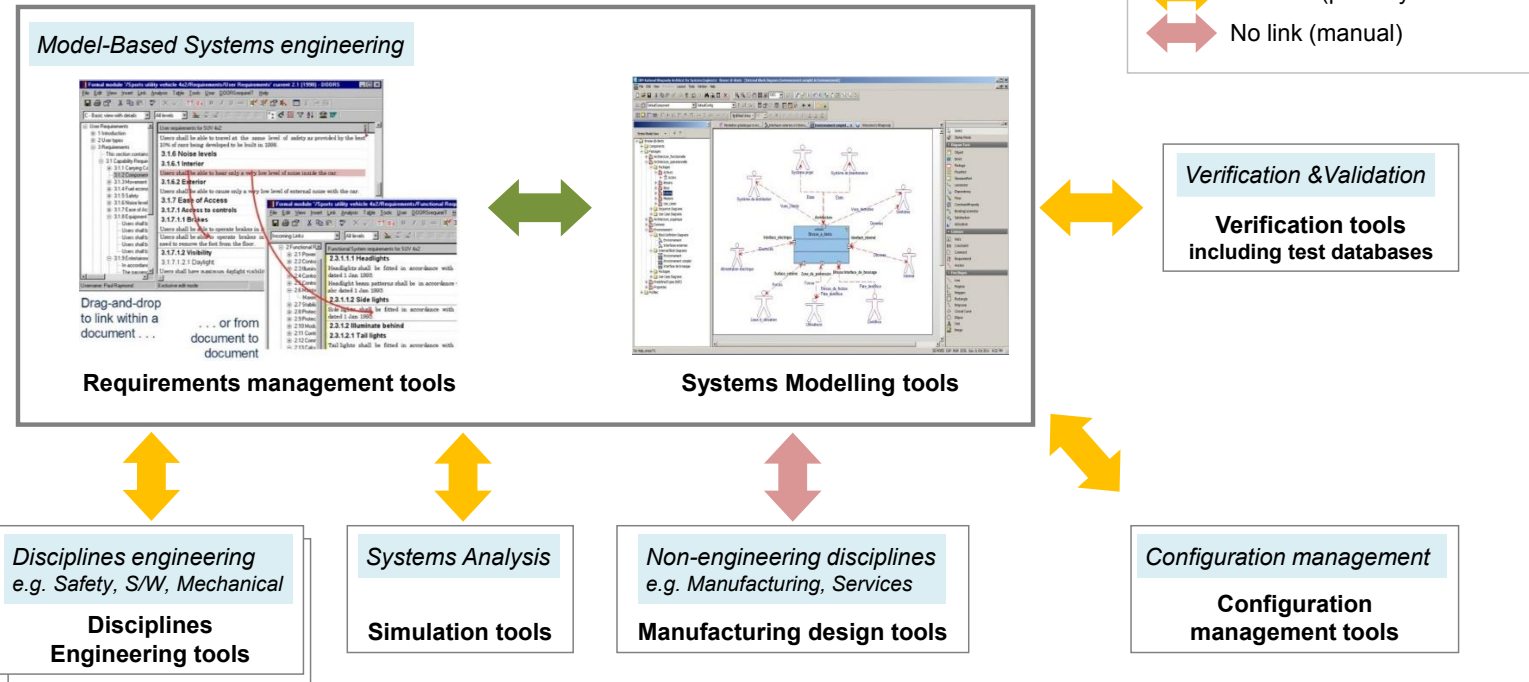
**Digital model of a system**  
from which documents are automatically generated

**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)

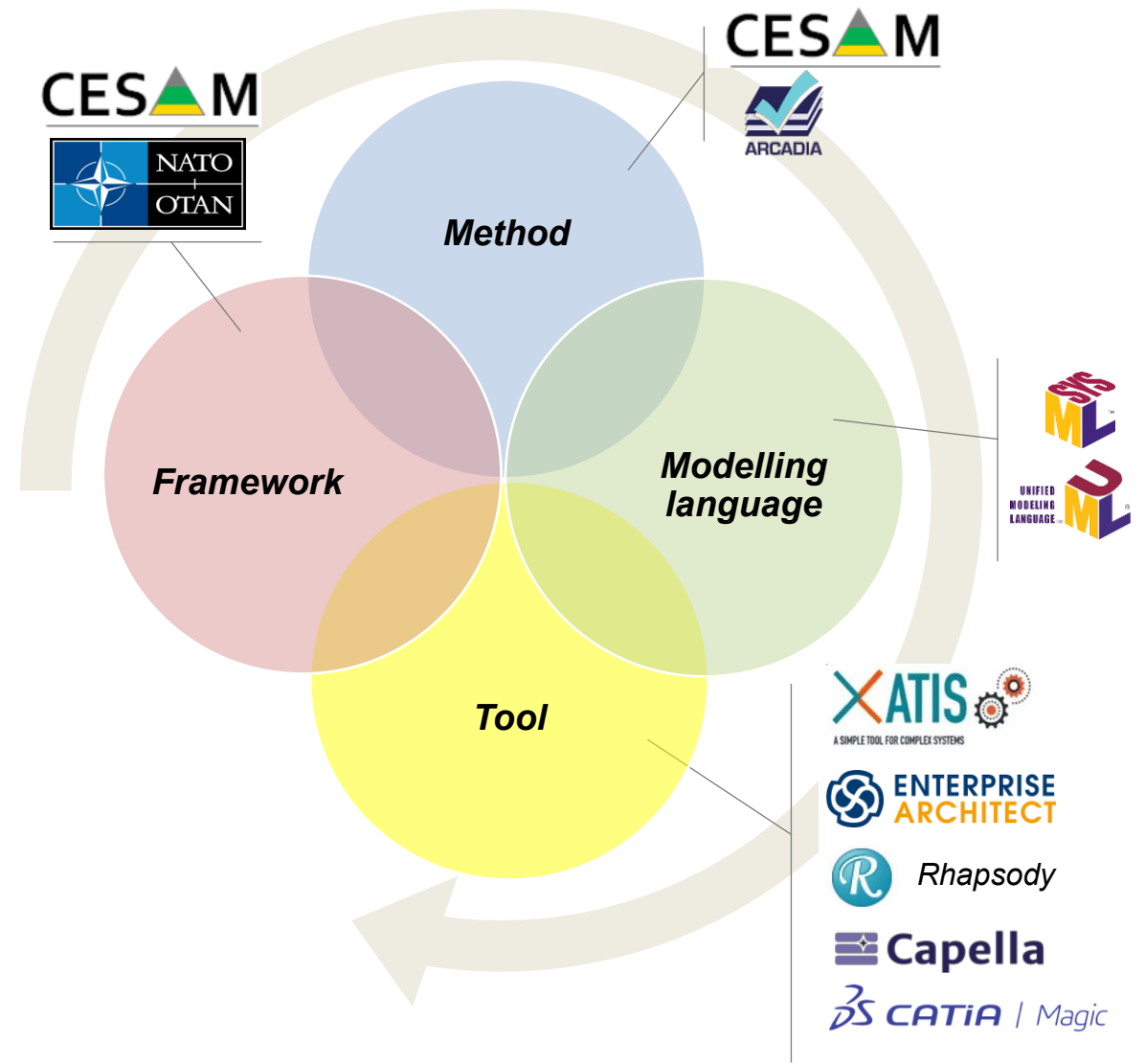
# **Our vision of what is behind MBSE**

# 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.**



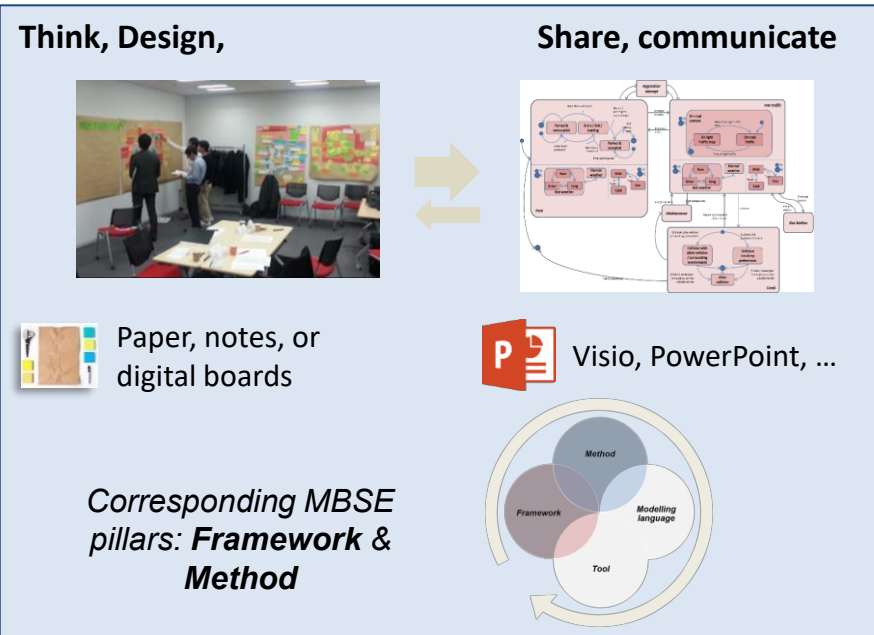
# Applying MBSE

## FROM SYSTEMS ARCHITECTURE TO SYSTEMS MODELLING

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

### Systems architecture

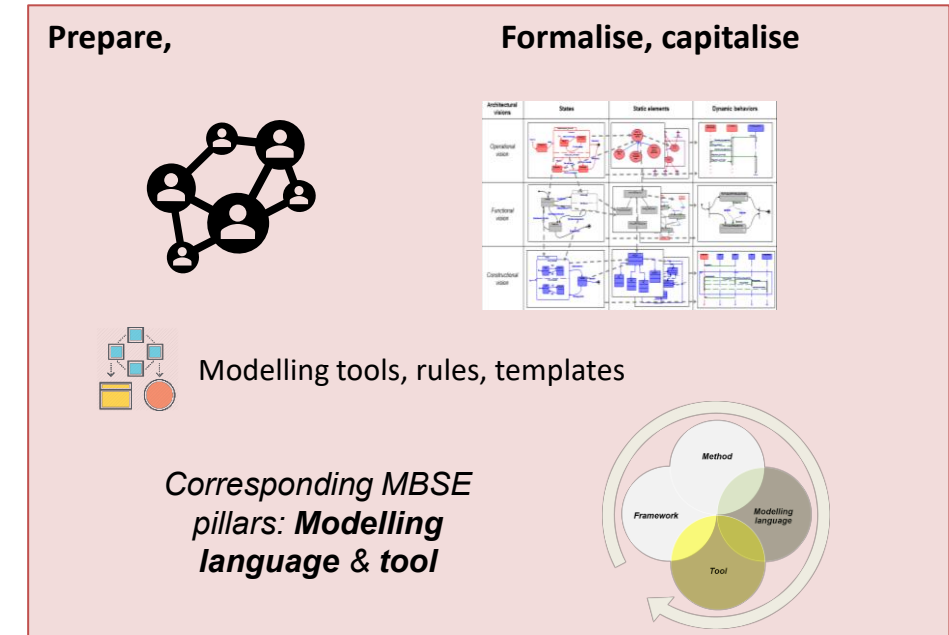
Understand the problem to be solved by the system and architect an optimal system that answers it



[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



**Both are crucial and needed for a right implementation of MBSE**



# **MBSE Deployment: Our recommendations**

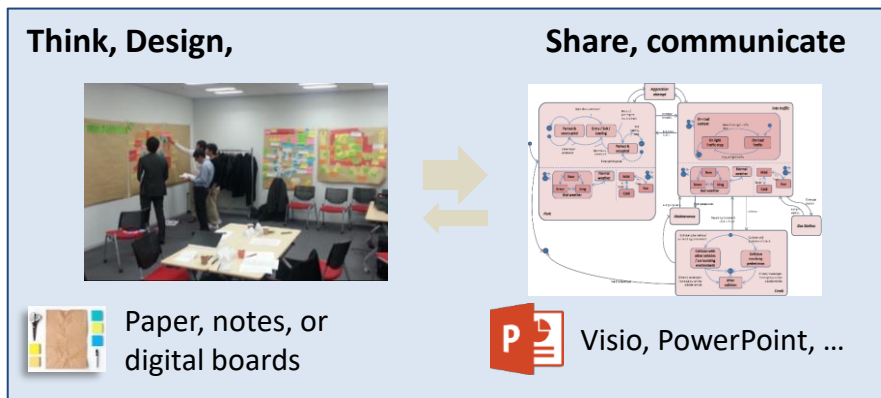
# Recommendation #1 : Deploy it... when needed!

## FROM SYSTEMS ARCHITECTURE TO SYSTEMS MODELLING

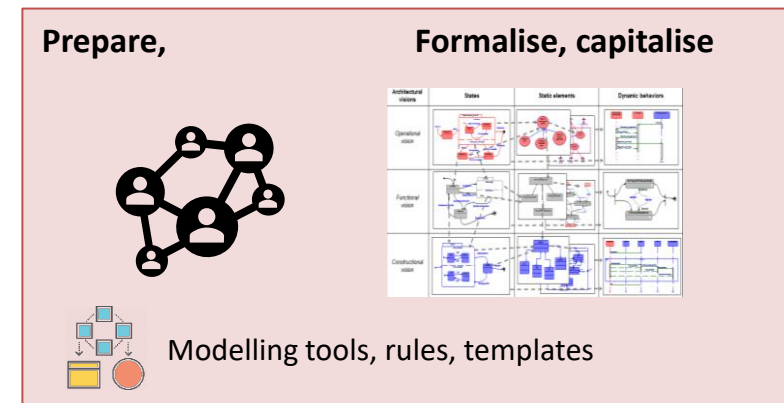
MBSE requires a specific **workload** (highly compensated by the time saved in further development), and applying a full MBSE process for any project can lead to a poor perception of what the approach can bring... and a disengagement of the main actors.

➔ 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



### Systems modelling



[Architecture stable enough for modelling]



- 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

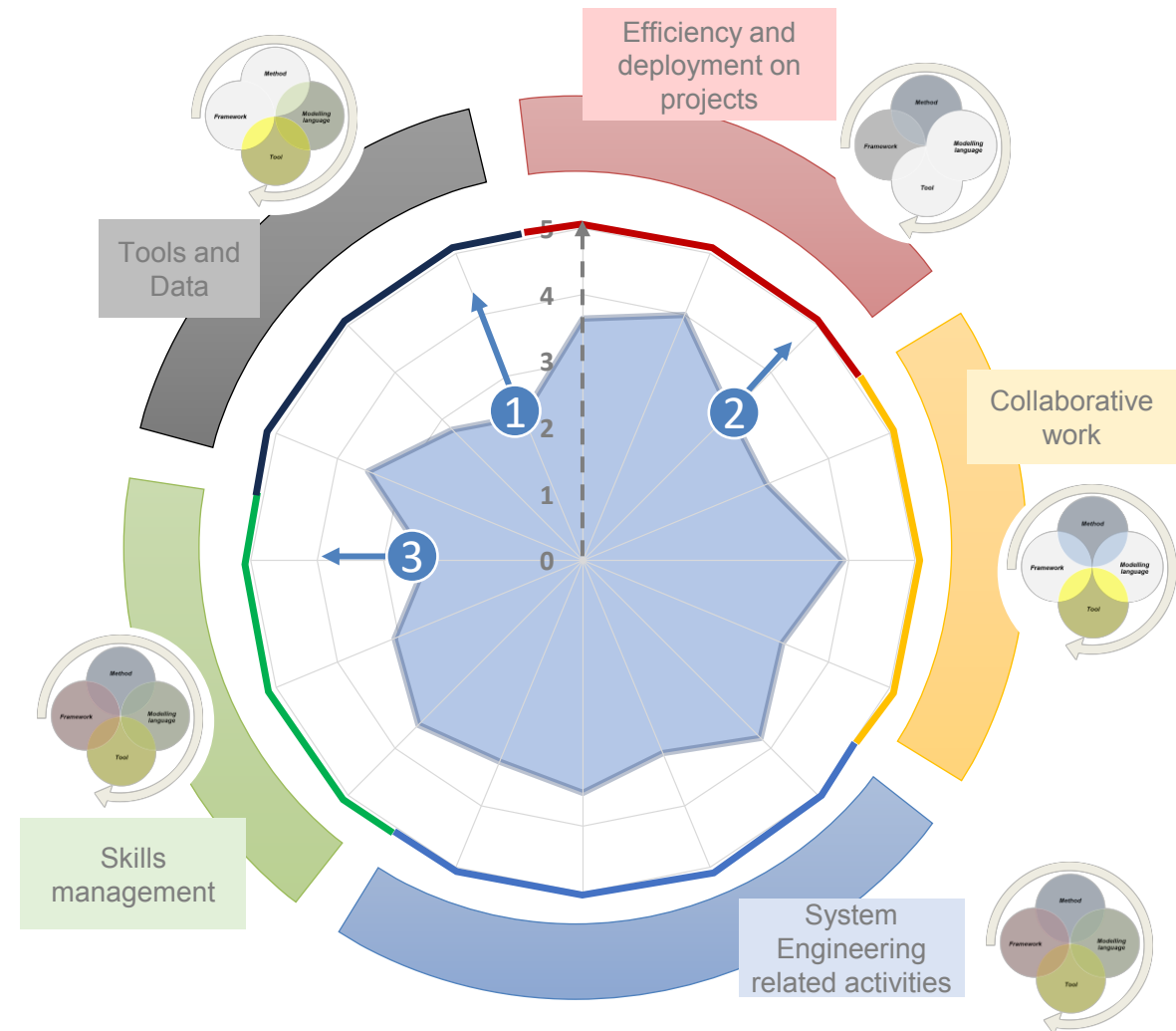
**In short : deploying MBSE is a (little) transformation!**

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

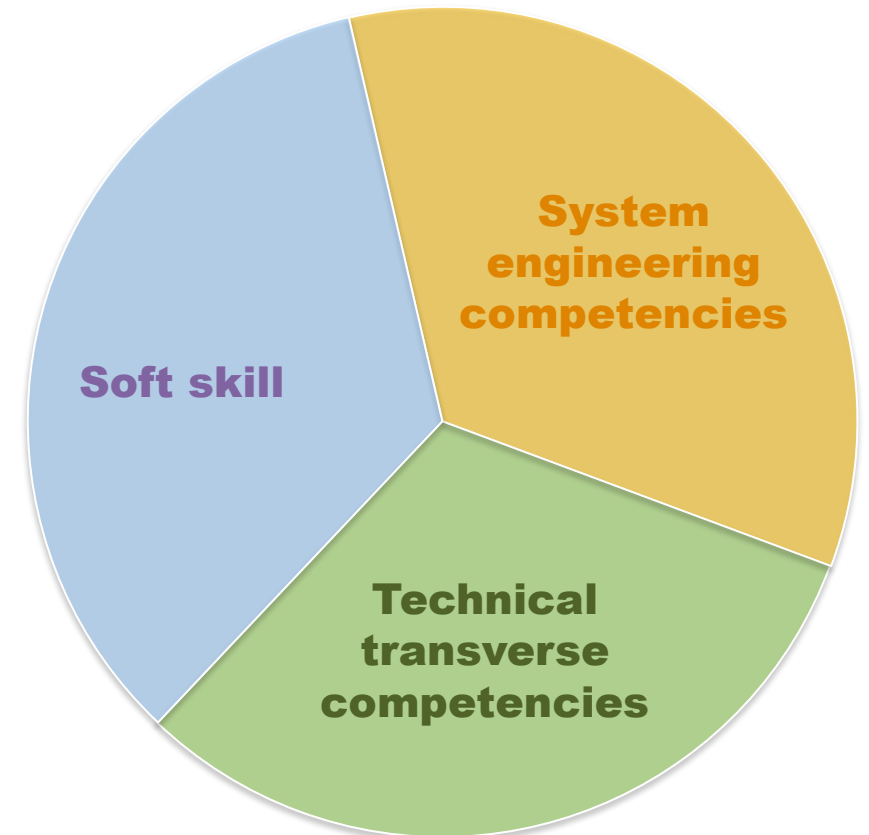
## FROM SYSTEMS ARCHITECTURE TO SYSTEMS MODELLING

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 understand technical stakes at hand,
- **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



Pragmatic and  
collaborative  
methodological  
approach



The largest  
community around  
MBSE

18.500 professionals  
9.500 trained/certified



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



## 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

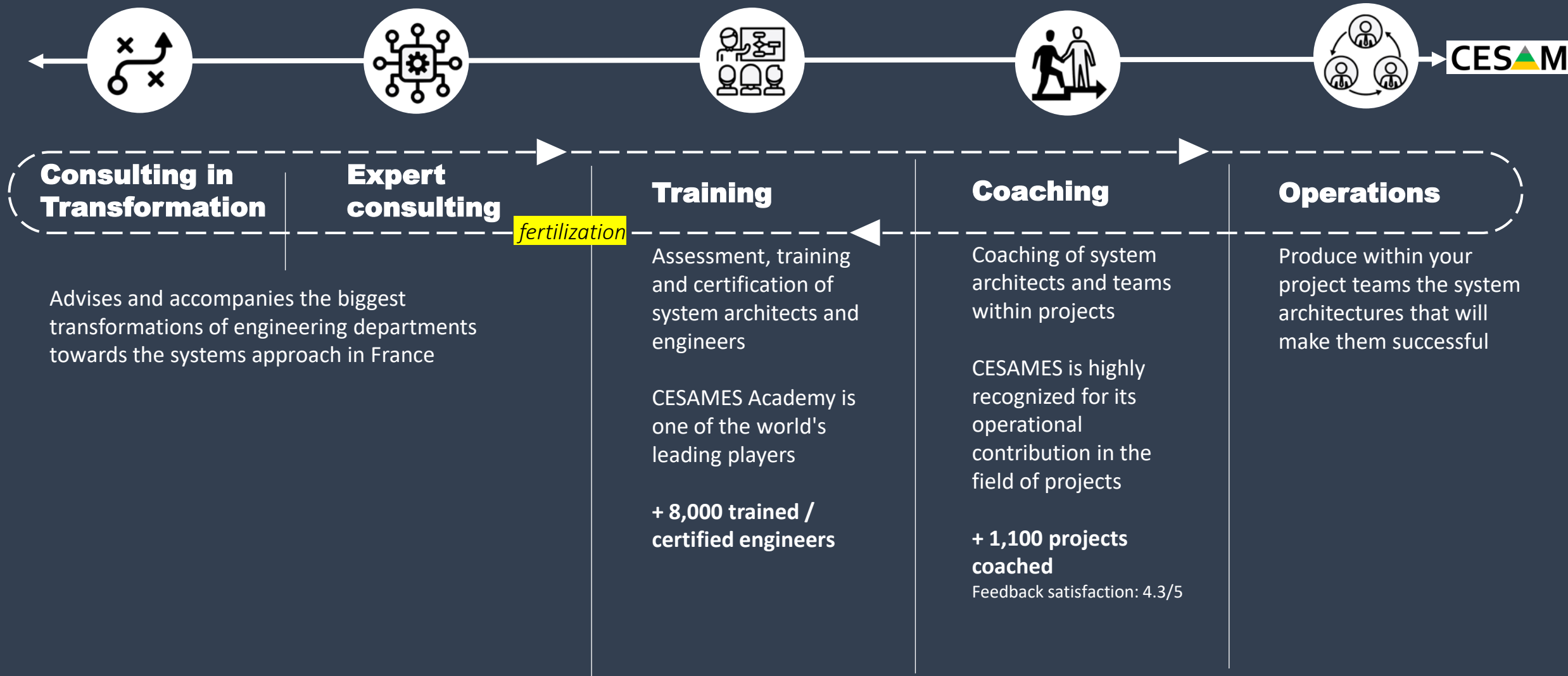
**-50 to -70%**  
on critical  
reservations  
when crossing  
stages

## Nos Clients



# A common value proposition based on fertilization

OUR SUCCESSFUL INTERVENTIONS AT ALL THESE LEVELS





# 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... )



### OVERVIEW OF THE TRAINING (1 DAY)

*Cesames can support you through coaching, consulting or operation mission...*

#### PREREQUISITE

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



Fundamentals of MBSE

Systems Modelling

Structuring a model in a modelling tool

**Operational deployment**

*Regular examples through case studies and feedback*