



Capella: an unexpected journey (open-sourcing a MBSE tool)

Stéphane LACRAMPE – ObeoSoft
stephane.lacrampe@obeosoft.com



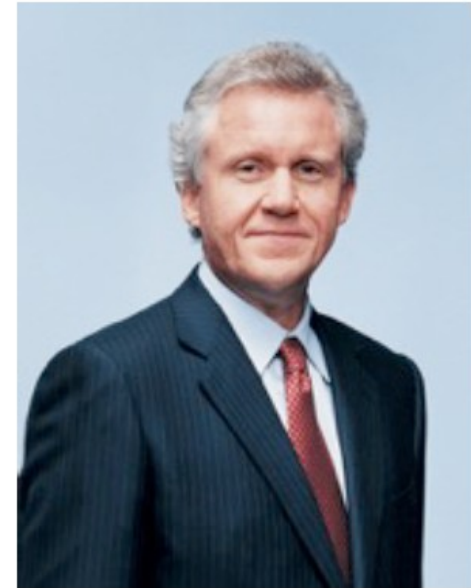
**Obeo creates modeling tools for
system and software engineers,
enterprise architects and domain
modeling experts**



Open Source Trends

Software is Eating the World





GE CEO Jeff Immelt

“Every industrial company will become a software company”

http://www.ge.com/ar2013/pdf/GE_AR13_Letter.pdf



Mike Milinkovich
Eclipse Foundation

“Every software company is an
open source company.”

Open Source is mainstream



MICROSOFT

TECH

Microsoft makes its 60,000 patents open source to help Linux

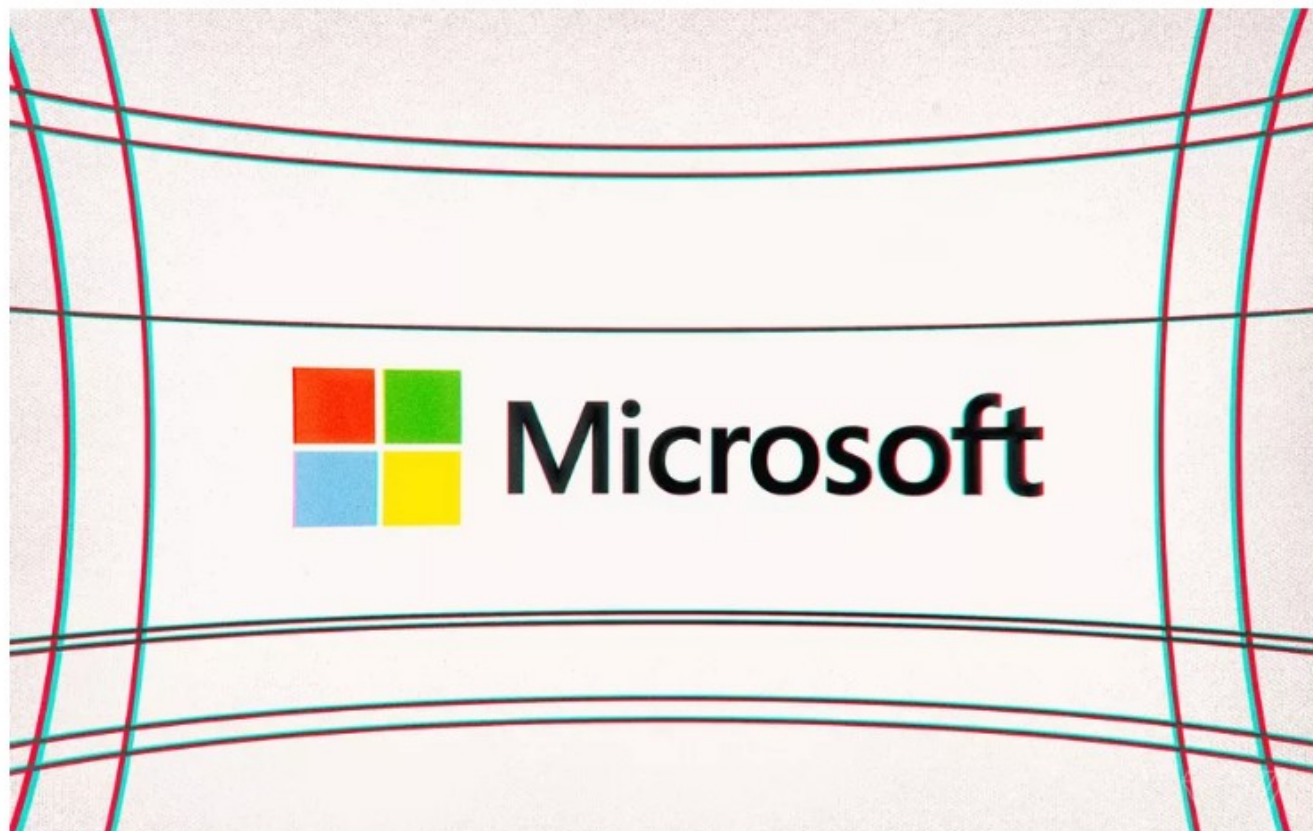
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The company is joining the Open Invention Network to protect Linux

By Chaim Gartenberg | @cgartenberg | Oct 10, 2018, 1:23pm EDT



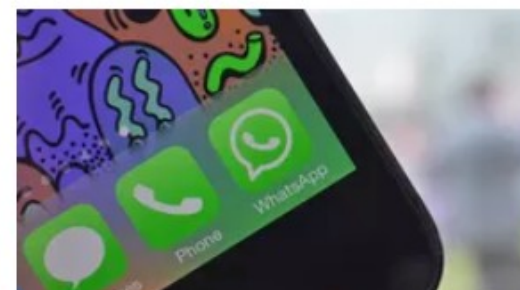
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MOST READ



Why Gorilla Glass phones still scratch as easily as they did in 2014



OPEN
SOURCE
SOFTWARE

PRODUCT
COMPANIES
EXAMPLE
TECHNOLOGIES
PRODUCTION
EXPRESSION
COSTS
CONTENT
PROCESS
BUSINESS
PRESS
PDF
BEER
MANY
CALLED
HARDWARE
CODE
MOVIE
BOOKS
CENTURY
TERMS
CULTURAL
RESEARCH
COMMUNITY
TECHNOLOGY
OPEN-SOURCE
COMPUTER
PROJECTS
MANUFACTURERS
PLATFORM
CREATIVE
INTERNET
PUBLIC
ANYONE
ALSO
INFORMATION
POLITICAL
NETWORK
SHARING
SIMILAR
DIGITAL
POTENTIAL
ORIGINAL
SYSTEMS
MADE
ONLINE
USE
WORLD
USERS
SCIENCE
VARIOUS
ANOTHER
ACCESS
FREE
SYSTEM
INNOVATION
WORK
COPYRIGHT
CONCEPT
NEW
LICENSE
USING
FORMAT
CASE
ECONOMIC
DEVELOPMENT
STANDARDS
AVAILABLE
MEDIA
CULTURE
INTERNATIONAL
COST
COMPANY
MOVEMENT
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DESIGN
SHARED
AUTHORS
HISTORY
MAKING
PROJECT
NOW
EDIT
COMMONS
ISBN
MODEL
POLICY
PATENT
KNOWLEDGE
LIKE
OTHERS
FILM
TOWARD
IDEA
ETHIC
BASED
TIME
DATA
RIGHTS
VOL
LIMITED
LIBRARY
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WEB
USED
BEGAN
EVEN
RICHARD
WIKIPEDIA
WITHOUT
RESOURCES
PRACTICES
LAW
PRODUCTS
SCIENTIFIC
FILE
TOWNS
PROPERTY
MANAGEMENT
ORGANIZATIONS
RAYMOND
INCLUDING
MESSAGEBOARDS
BLOGS
PHARMACEUTICALS
PUBLISHING
EXAMPLES
SOCIETY
INTELLECTUAL
ECONOMICS
POLITICAL
SIMILAR
DIGITAL

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To be open source or Not To Be open source

- **Source Code**
- **IP / Ownership**
- **License**
 - EULA
 - Open Source



Open Source Software Freedoms

- **Open Source Initiative (<https://opensource.org/>)**
- **You are free**
 - to run the program for any purpose
 - to study how the program works, and change it to make it do what you wish
 - to redistribute copies
 - to distribute copies of your modified versions to others
 - See <https://opensource.org/osd> for the ten commandments
- **Different OSS licenses types**
 - Business friendly (EPL, Apache, MPL, BSD...)
 - Contaminating (GPL...)
 - More than 100+ OSS licenses..
 - Too many ?

Open Source Foundations



Introducing Thales journey on Arcadia and Capella

THALES

Global leadership

N°1
worldwide



Payloads
for telecom satellites



Air Traffic Management



Sonars



Security for interbank
transactions

N°2
worldwide



Rail signalling systems



In-flight entertainment
and connectivity

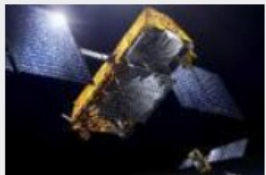


Military tactical
radiocommunications

N°3
worldwide



Commercial avionics



Civil satellites

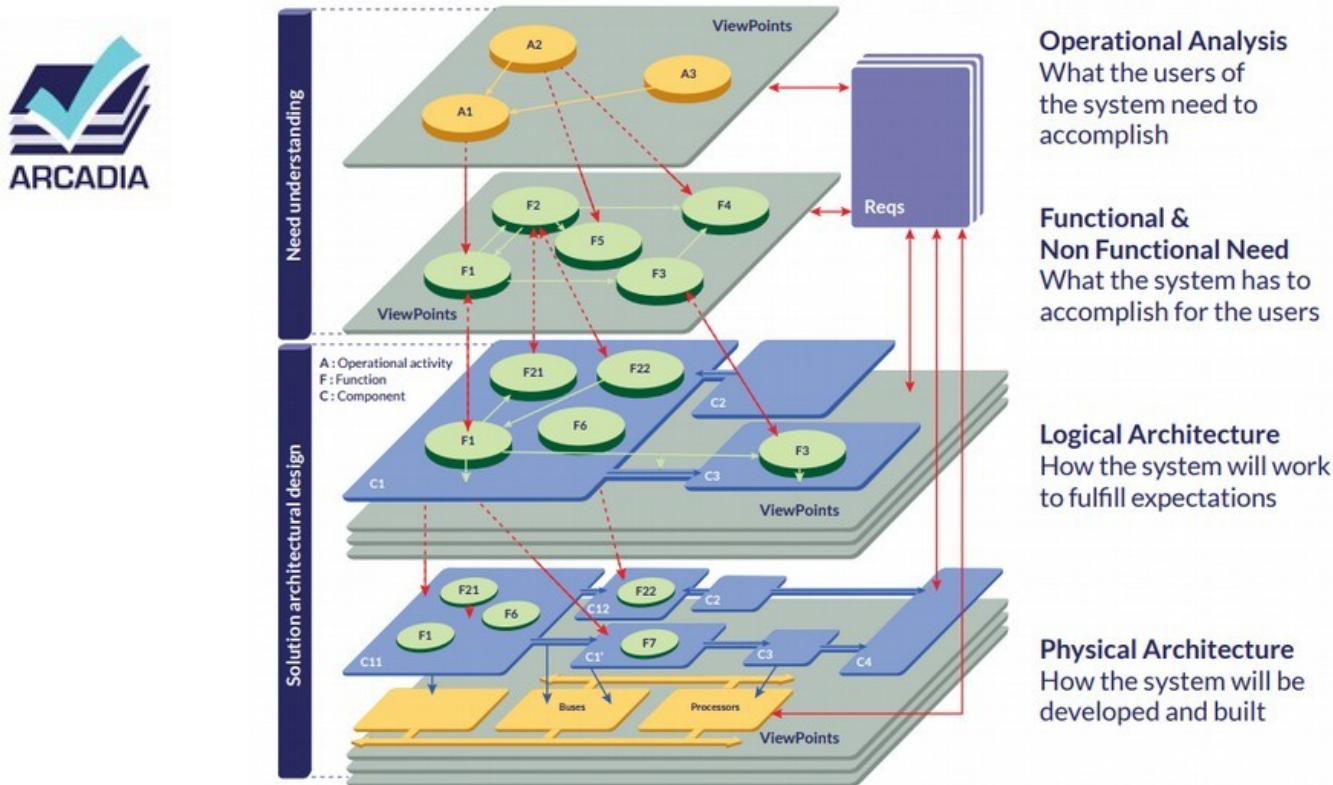


Military surface radars

€15
billion
in revenues

Back in early 2000

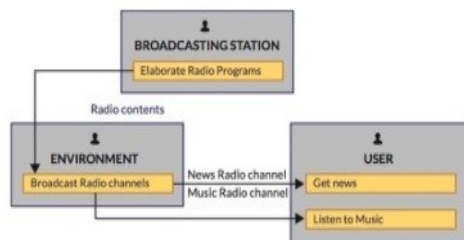
- **Thales market evolution:** Systems Engineering and Model Based Systems Engineering envisioned as key capabilities to master for the future
- 2001-2006 : First experiments of MBSE
- Global plan to analyze the systems engineering practices
- **Arcadia** is a **tooled method** to Define, Analyze, Design & Validate **System, Software, Hardware Architectures**



Customer Operational Need Analysis

What the users of the system need to accomplish

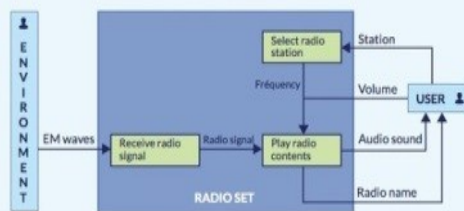
- ✓ Define operational capabilities
- ✓ Perform an operational need analysis



System/SW/HW Need Analysis

What the system has to accomplish for the Users

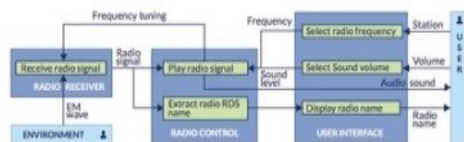
- ✓ Perform a capability trade-off analysis
- ✓ Perform a functional and non-functional analysis
- ✓ Formalise and consolidate requirements



Logical Architecture Design

How the system will work so as to fulfil expectations

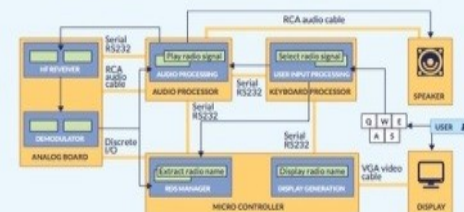
- ✓ Define architecture drivers and viewpoints
- ✓ Build candidate architectural breakdowns in components
- ✓ Select best compromise architecture



Physical Architecture Design

How the system will be developed & built

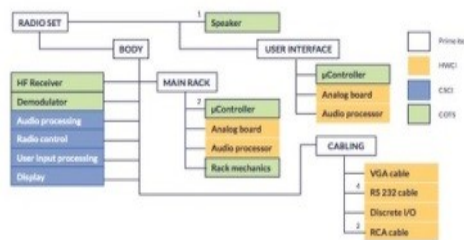
- ✓ Define architectural patterns
- ✓ Consider reuse of existing assets design a physical
- ✓ Design a physical reference architecture
- ✓ Validate and check it



Development Contracts

What is expected from each designer/sub-contractor

- ✓ Define a components IVVQ strategy
- ✓ Define & enforce a PBS and component integration contract



- Operational capabilities
- Actors, operational entities
- Actor activities
- Interactions between activities & actors
- Information used in activities & interactions
- Operational processes chaining activities
- Scenarios for dynamic behaviour

- Actors and system, capabilities
- Functions of system & actors
- Dataflow exchanges between functions
- Functional chains traversing dataflow
- Information used in functions & exchanges, data model
- Scenarios for dynamic behaviour
- Modes & states

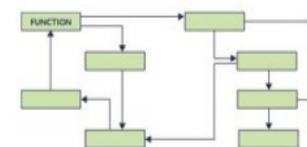
SAME CONCEPTS, PLUS :

- Components
- Component ports and interfaces
- Exchanges between components
- Function allocation to components
- Component interface justification by functional exchanges allocation

SAME CONCEPTS, PLUS :

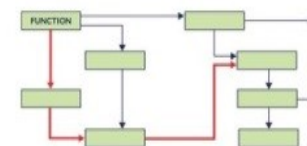
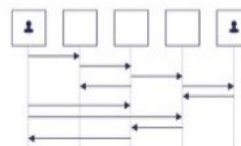
- Behavioural components refining logical ones, and implementing functional behaviour
- Implementation components supplying resources for behavioural components
- Physical links between implementation components

- Configuration items tree
- Parts numbers, quantities
- Development contract (expected behaviour, interfaces, scenarios, resource consumption, non-functional properties...)

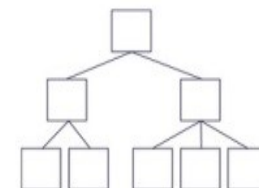


Dataflow: functions, op. activities interactions & exchanges

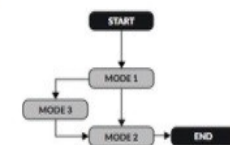
Scenarios: actors, system, components interactions & exchanges



Functional chains, operational processes through functions & op. activities

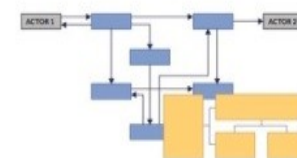
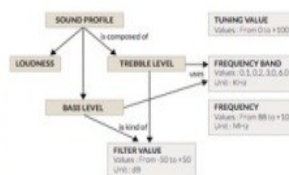


Breakdown of functions & components



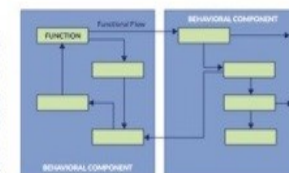
Modes & states of actors, system, components

Data model: dataflow & scenario contents, definition & justification of interfaces



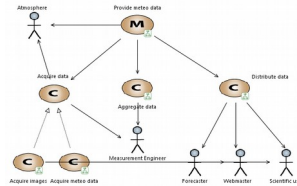
Component wiring: all kinds of components

Allocation of op. activities to actors, of functions to components, of behav. components to impl. components, of dataflows to interfaces, of elements to configuration items



Why Arcadia is different?

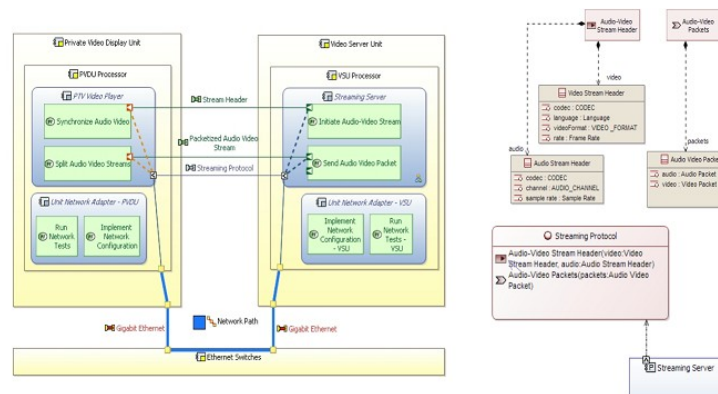
Instances first



Functionnal Analysis support

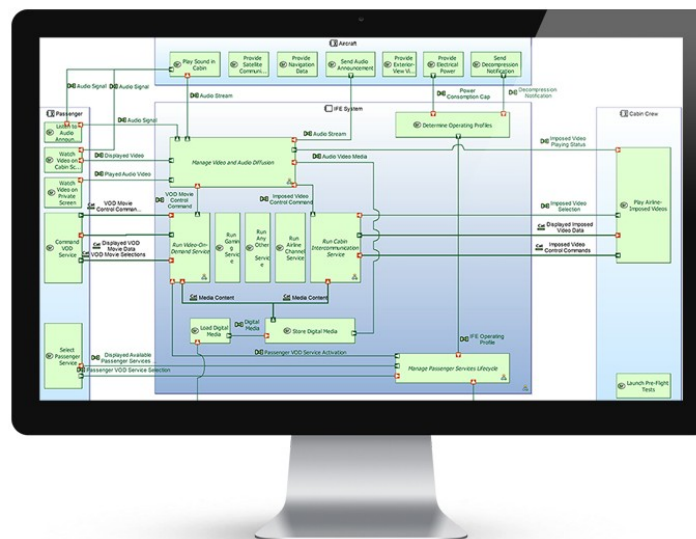


Functions, Interfaces and components integration



Arcadia: a tooled method

- **Tool needed**
 - Commercial tools maturity
 - Internal development capability
- **Partnering with Obeo**
 - Open innovation and technology creation
 - Open Source knowledge
- **Capella development**
 - Capella is the modeling tool that implements the Arcadia method



2007 First Obeo/Thales prototype to validate the concepts

2008 Thales Capella modelling workbench

2009-Present Mature product

PROTOTYPING

SIRIUS
DEVELOPMENT

THALES SYSTEM
MODELING
WORKBENCH
DEVELOPMENT

FIRST
OPERATIONAL
DEPLOYMENTS

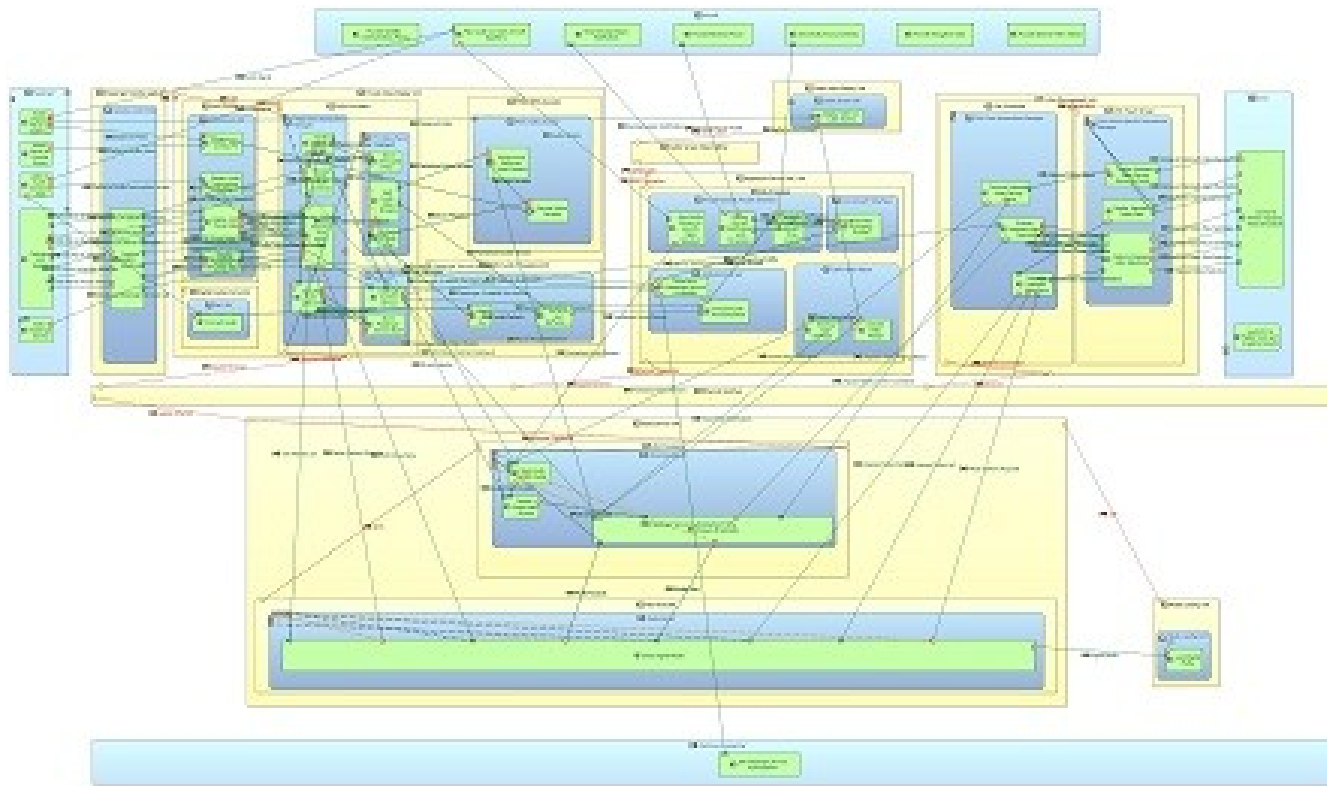
CONSOLIDATION
AND NEW
DEVELOPMENTS

2008 Specification and development of Sirius foundations

2009 First operational pilot projects, launch of Obeo Designer, based on Sirius

By end 2010

Arcadia and Capella are considered by top level management as major triggers for an engineering transformation



Adoption within Thales

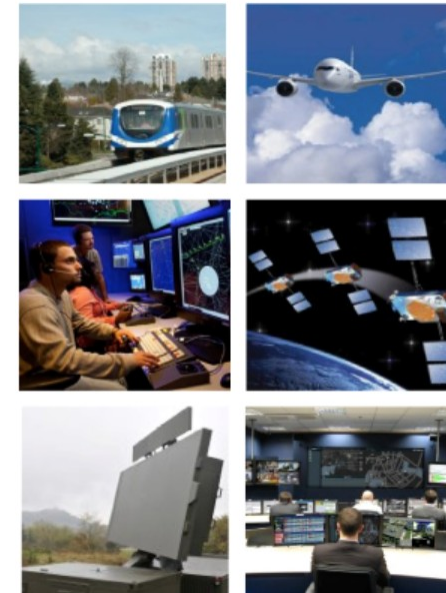
• Critical Information Systems

- Ground Exploitation Systems
- Command & Control (air, sea, railways...)
- Large secured Communication Networks
- Satellite Control Networked Ground Stations
- Surveillance systems



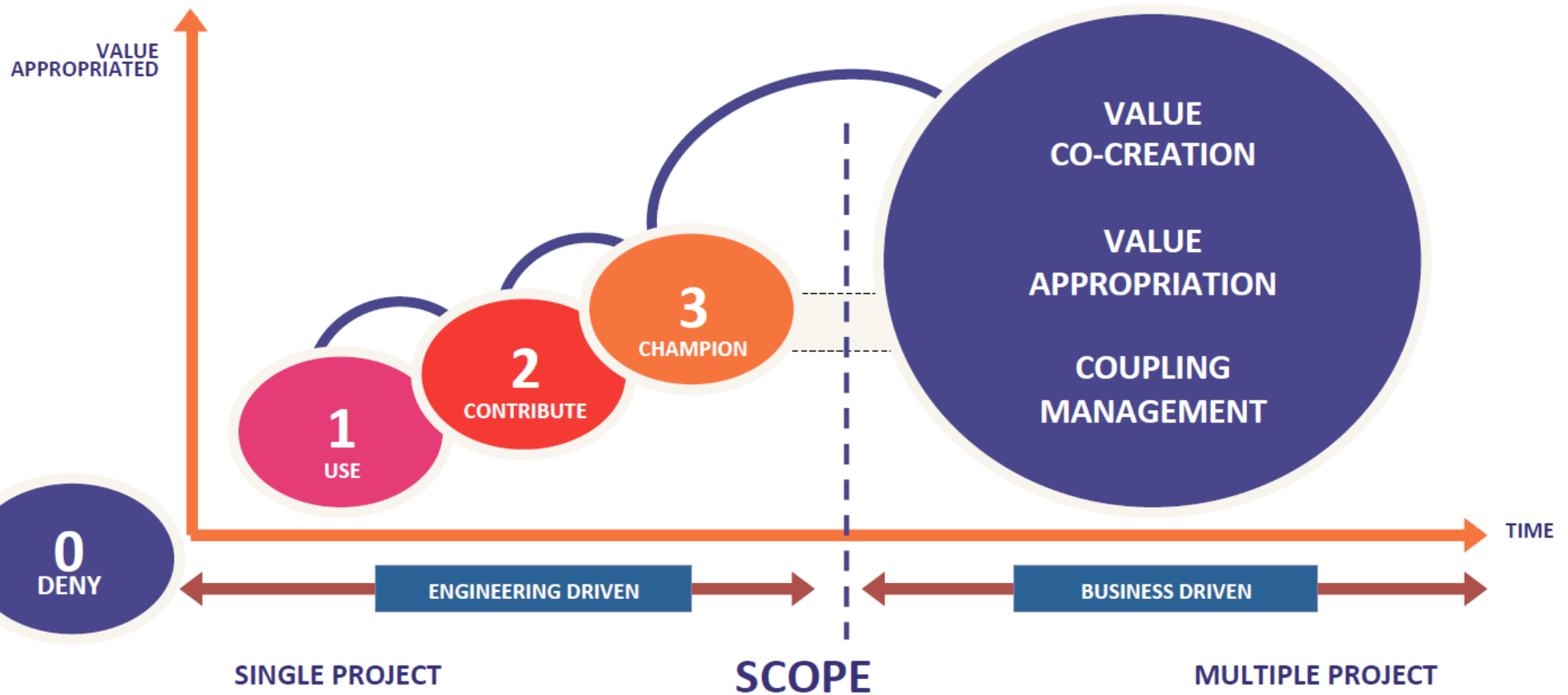
• Embedded Systems

- Combat systems (Radar, Self-Protection, Optronics...)
- Mission Systems (Air, Sea, Ground)
- Satellite Constellations
- Avionics Suites
- Computing Systems
- Electrical Power Systems
- Thermal Cooling Systems
- Railways signaling Systems



Open Source ?

Maturity Model



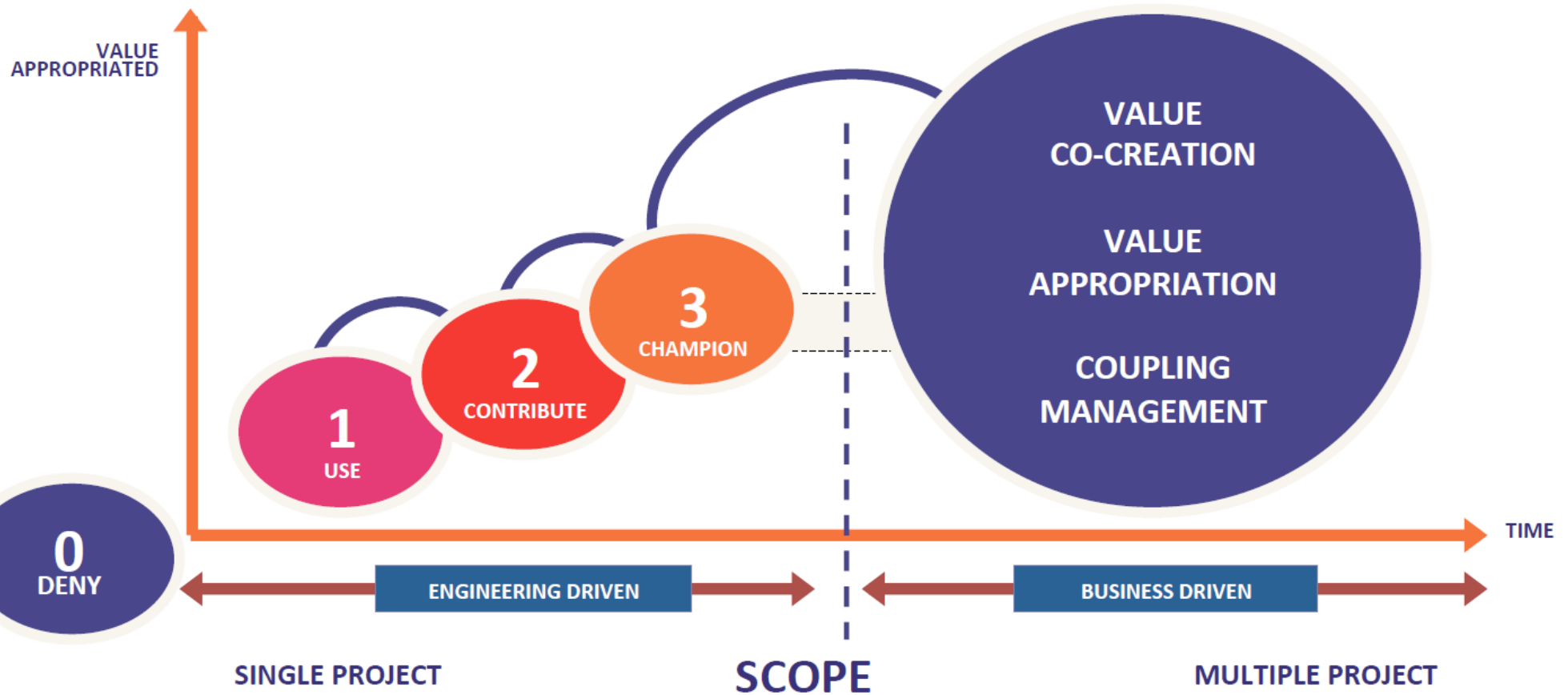
1&2 - Use and contribute to Open Source



EcoreTools



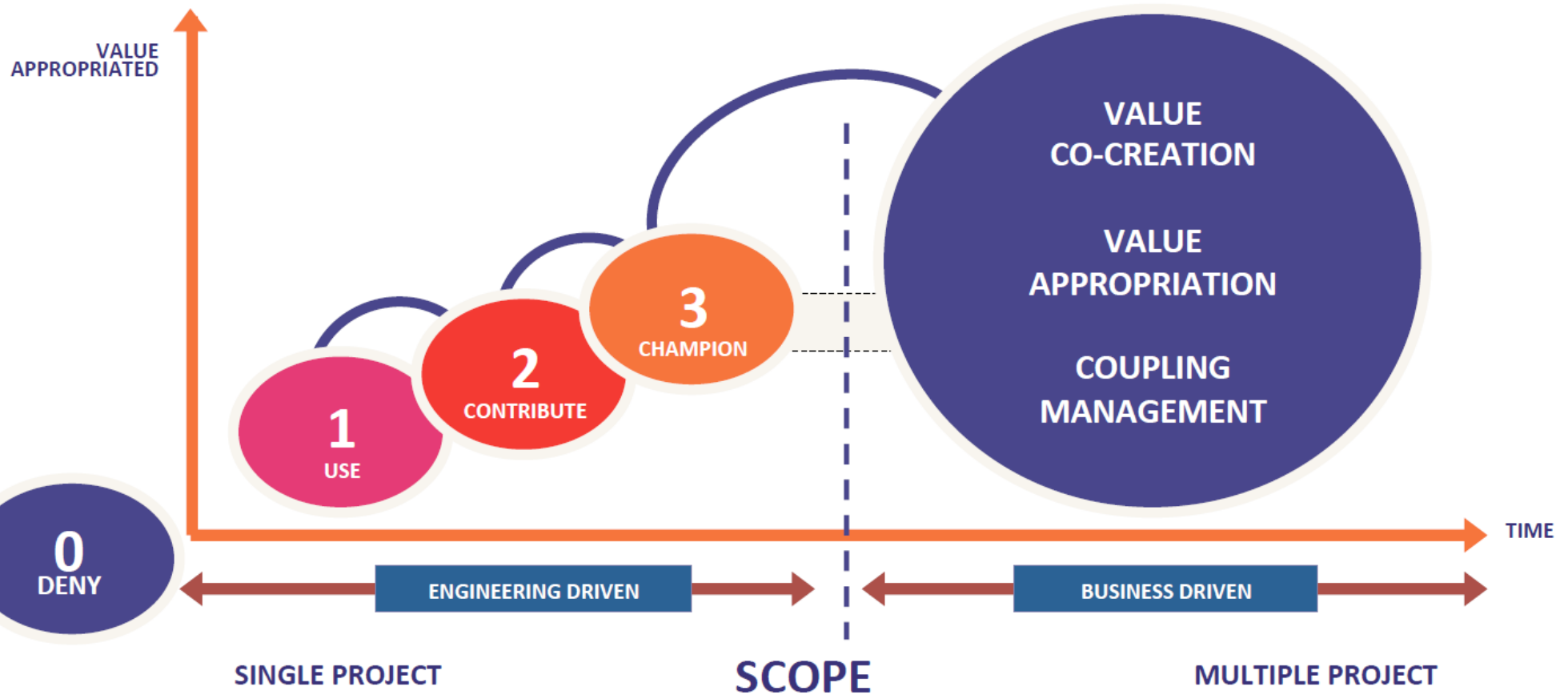
Maturity Model



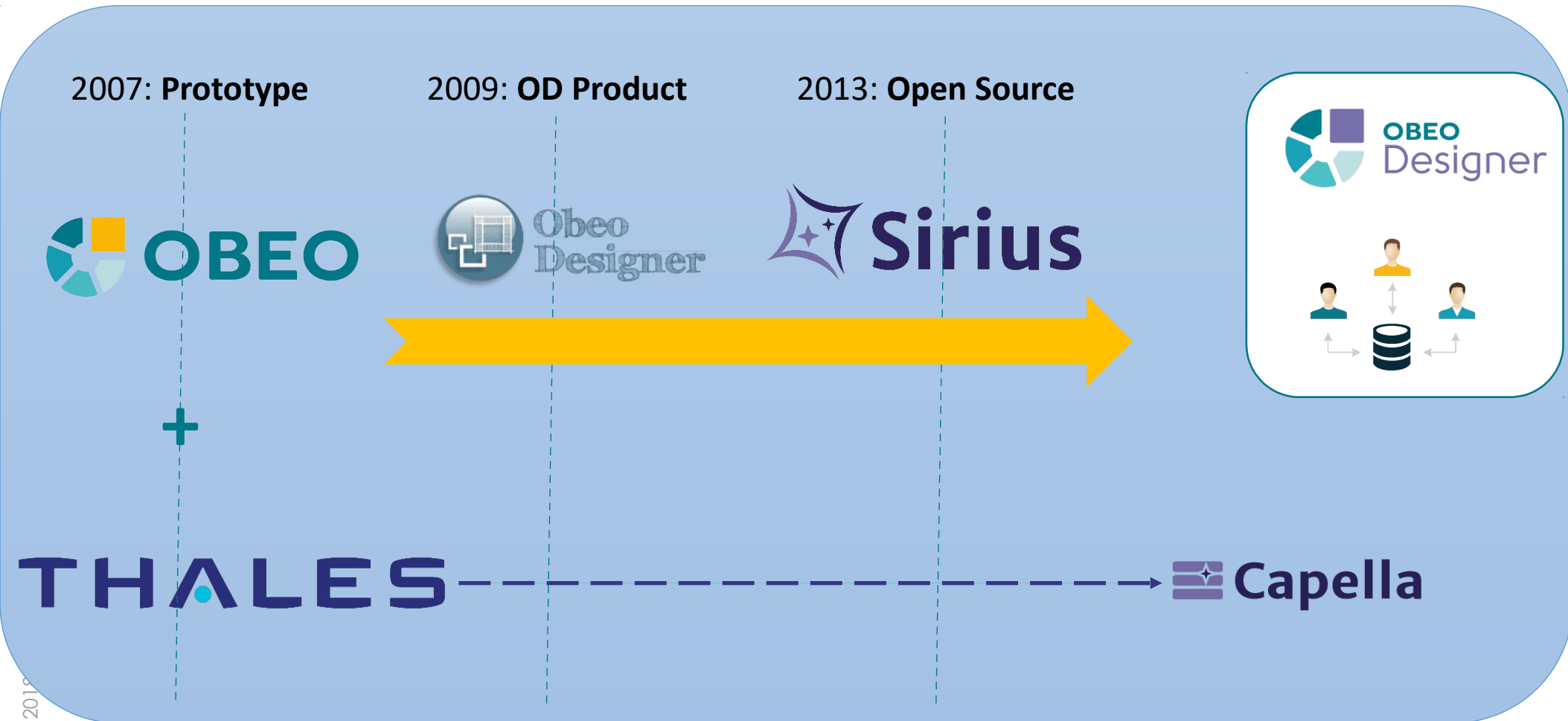
3 - Champion



Maturity Model



4 – Strategic – Offering solutions



Open sourcing **Sirius**

Goals

Benefits

Risks and difficulties

Open sourcing Capella

Share engineering environnements

Standardization

Share investments

Good timing



come in we're

OPEN

Measuring the success

- More than 100 organizations are already using Capella



- System Modeling Workbench for Teamcenter

Siemens PLM Software



CASE-STUDIES



AEROSPACE

ArianeGroup

Model-Based Systems Engineering
must become a team sport!!

[READ MORE](#)



ENERGY

Framatome

Progressive deployment of MBSE methods
in French nuclear industry

[READ MORE](#)



AUTOMOTIVE

Continental Automotive

Driving intelligent transportation systems
with Capella

[READ MORE](#)

Benefits for companies adopting Capella

Maturity and comprehensiveness

Easy Access

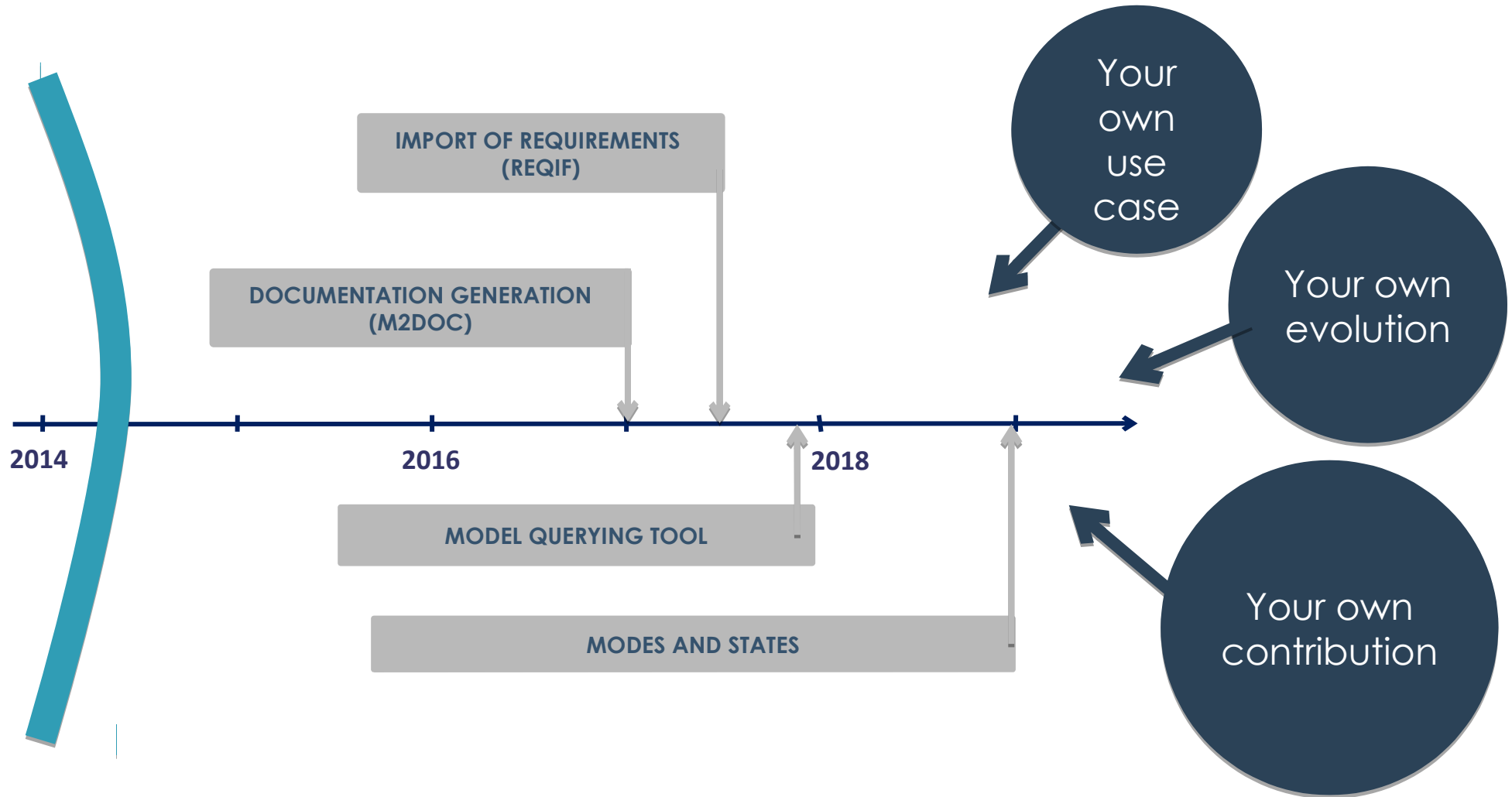
Comercial offers

Openness



The Capella IC hosts the Capella ecosystem stakeholders in a vendor neutral way with an open governance.

Getting contributions



Thank you !



Capella website:

<https://polarsys.org/capella>

Discover Capella:

<https://www.linkedin.com/pulse/discovering-what-capella-arcadia-st%C3%A9phane-lacrampe/>

Stéphane LACRAMPE – ObeoSoft
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