The MegaM@Rt^2 ECSEL Project

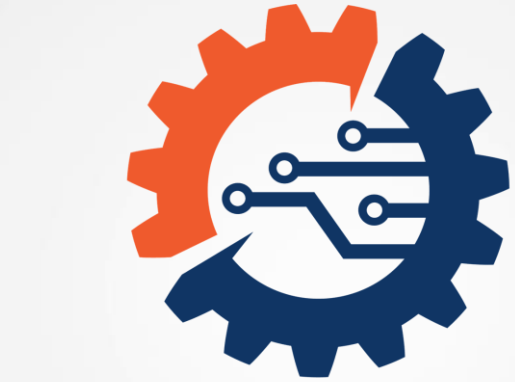
MegaModelling at Runtime – Scalable Model-based Framework for Continuous Development and Runtime Validation of Complex Systems

ECSEL JU

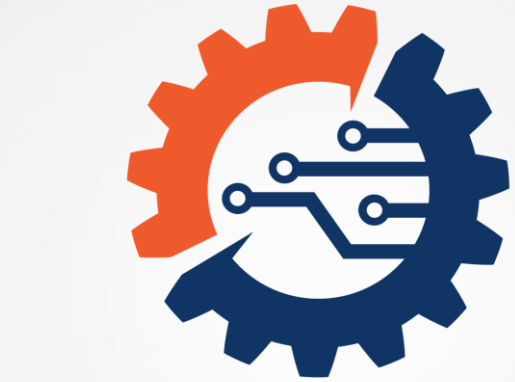
ECSEL Joint Undertaking

Electronic Components and Systems for European Leadership

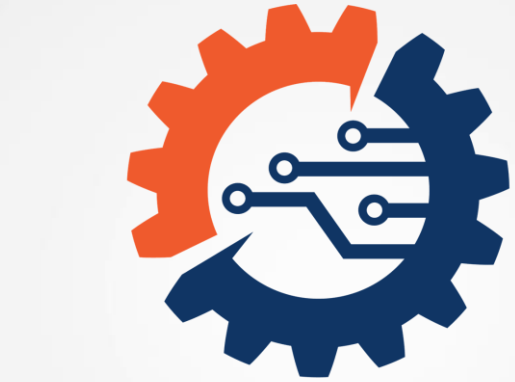
ECSEL Joint Undertaking is a EU-driven, public-private partnership, funding innovation in electronic components and systems.



MegaM@Rt²



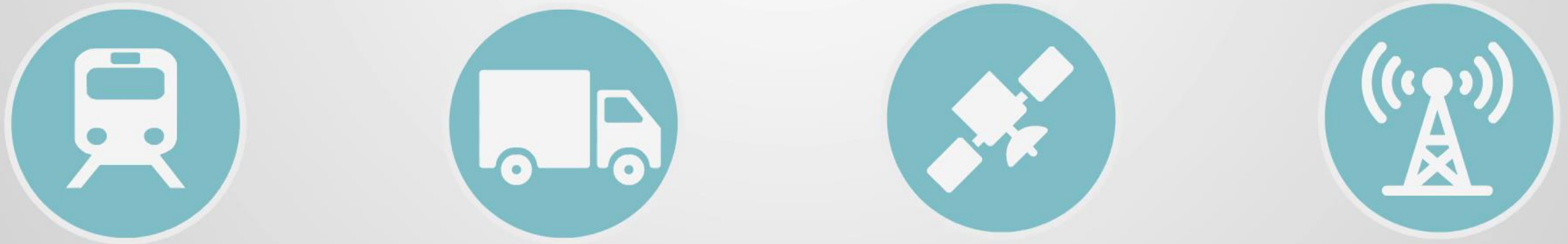
MegaM@Rt²

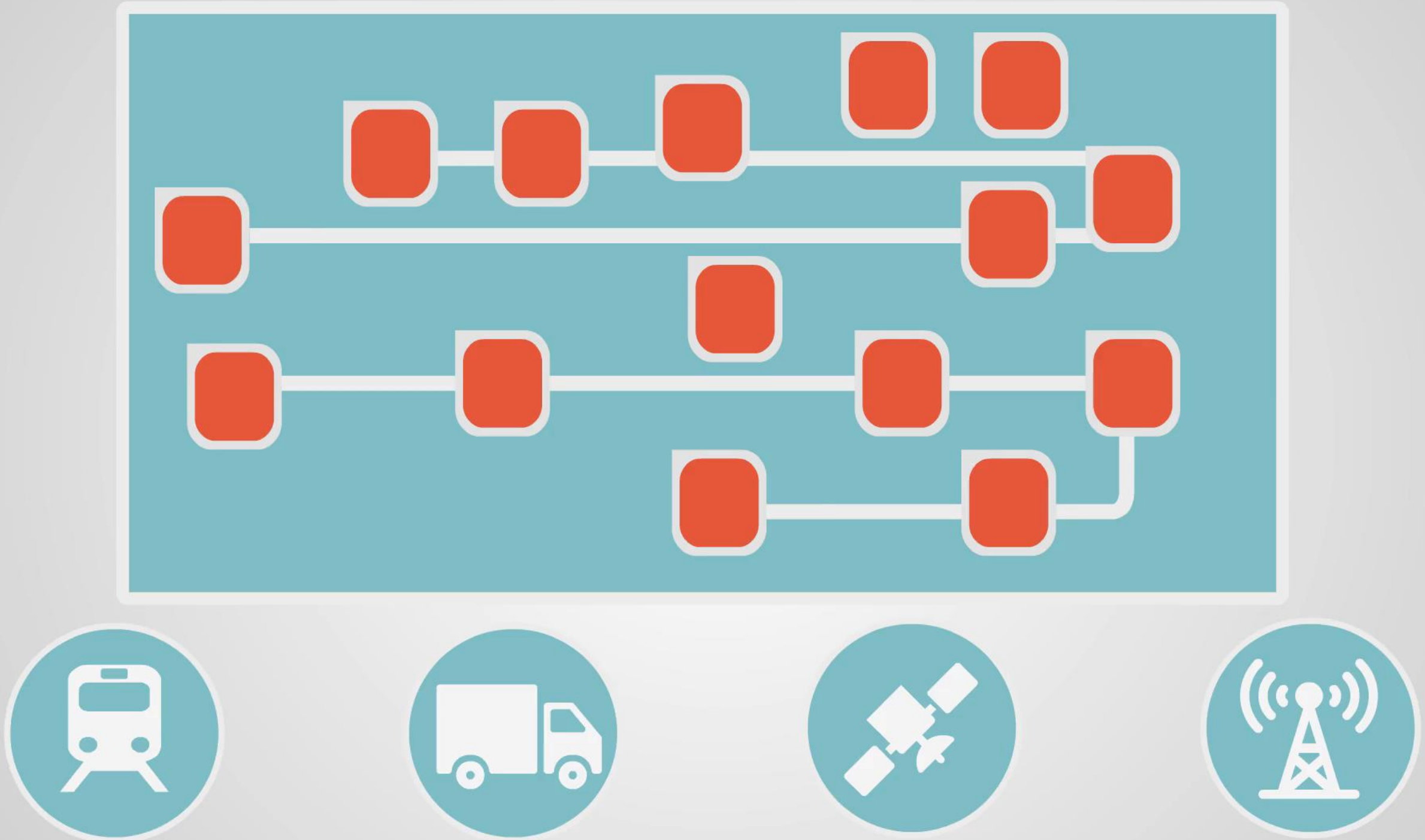


MegaM@Rt²

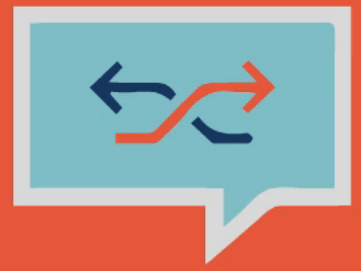
What do we propose?

DESIGN
RUNTIME PHASES
CLEARSY
SYSTEMS ENGINEERING
TEKNE
AINACOM
BOMBARDIER
IK4 IKERLAN
Research Alliance
THALES
NOKIA
MegaM@Rt2





EXECUTION PLATFORMS

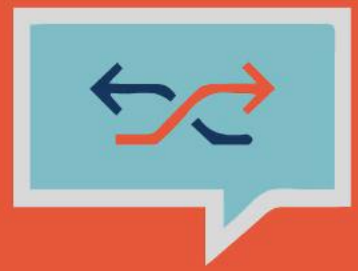


CONTINUOUS DEVELOPMENT

RUNTIME VALIDATION

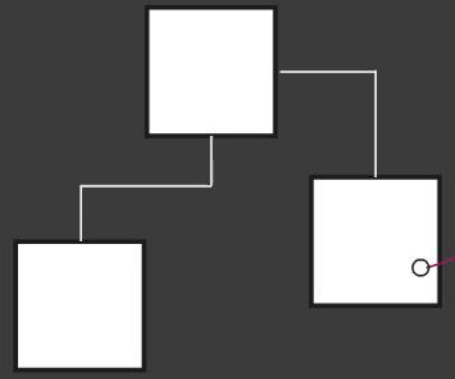
IMPLEMENTATION

EXECUTION PLATFORMS



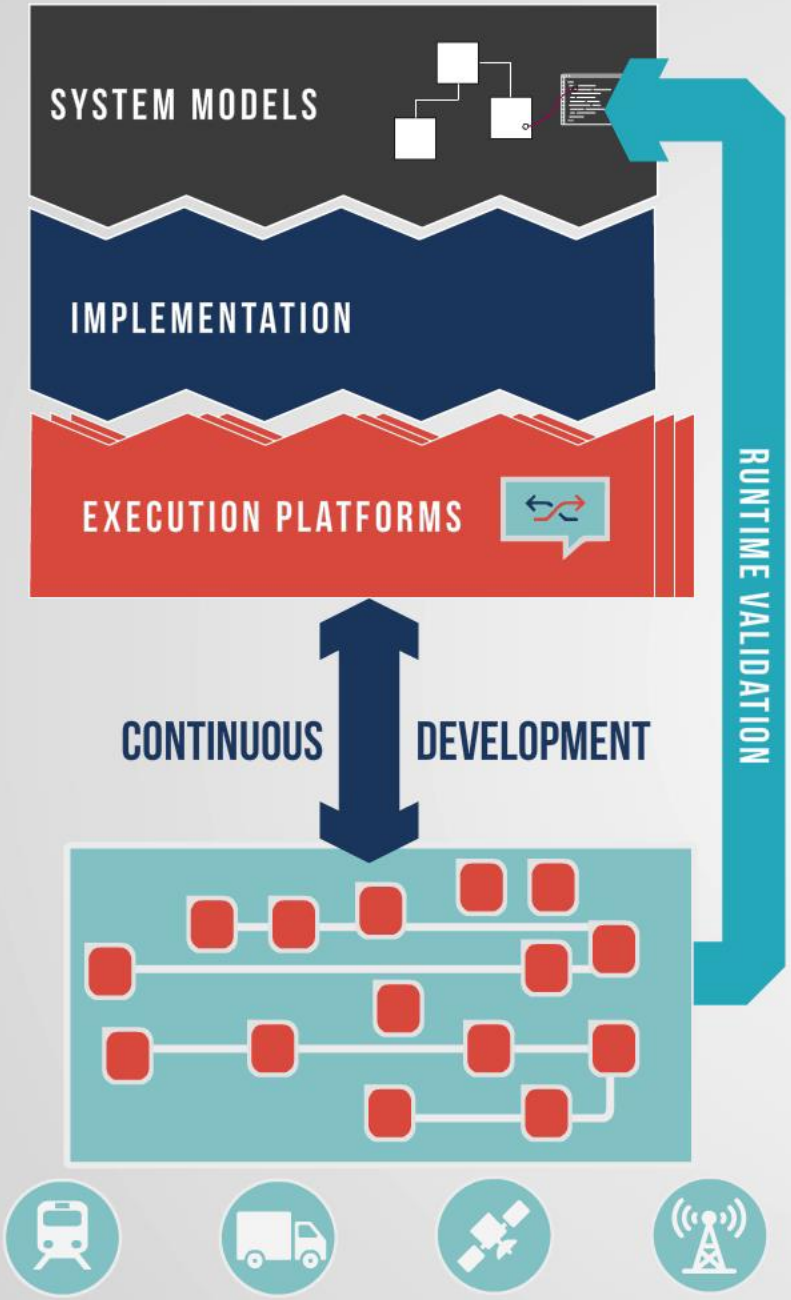
RUNTIME VALI

SYSTEM MODELS



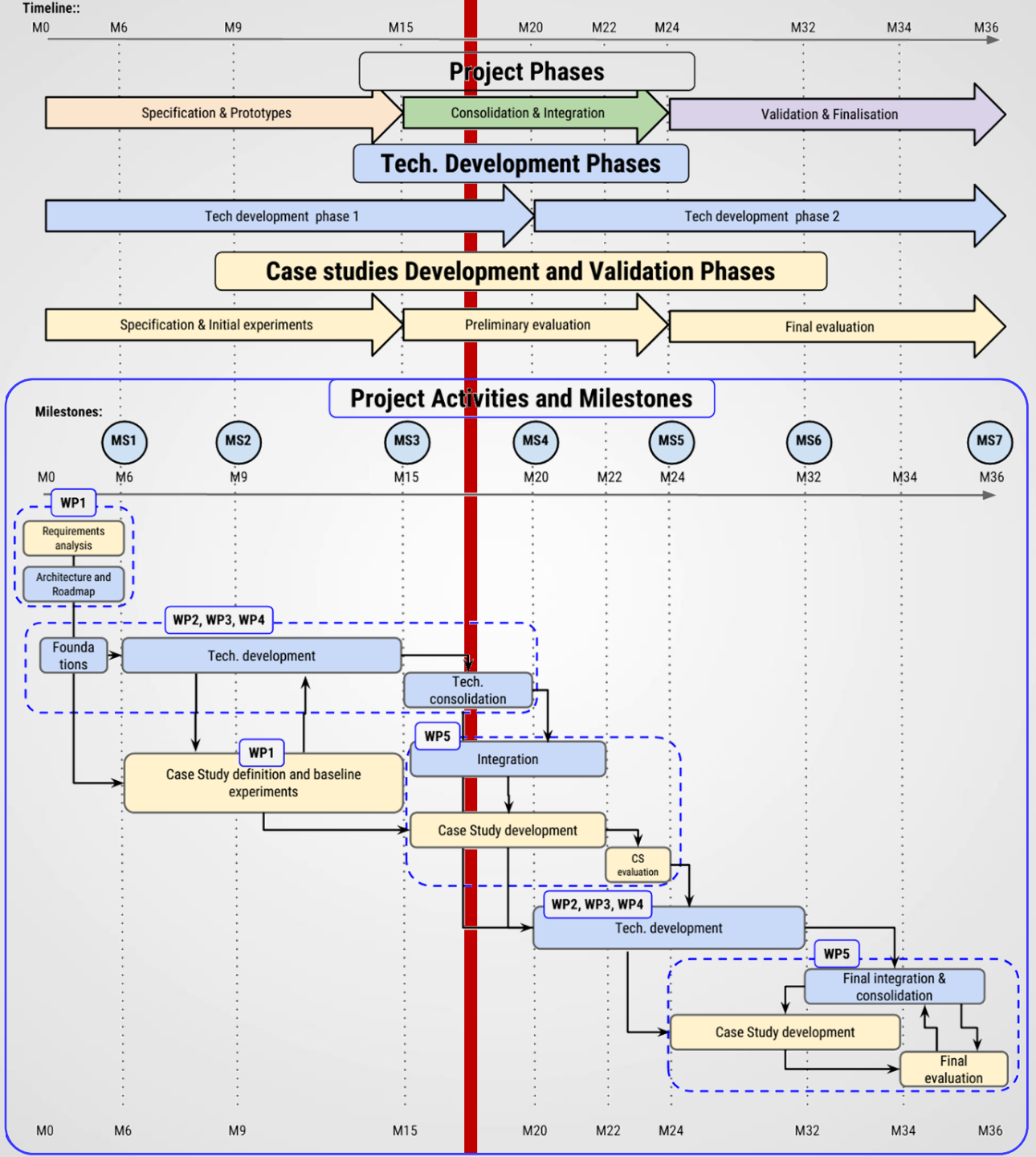
IMPLEMENTATION

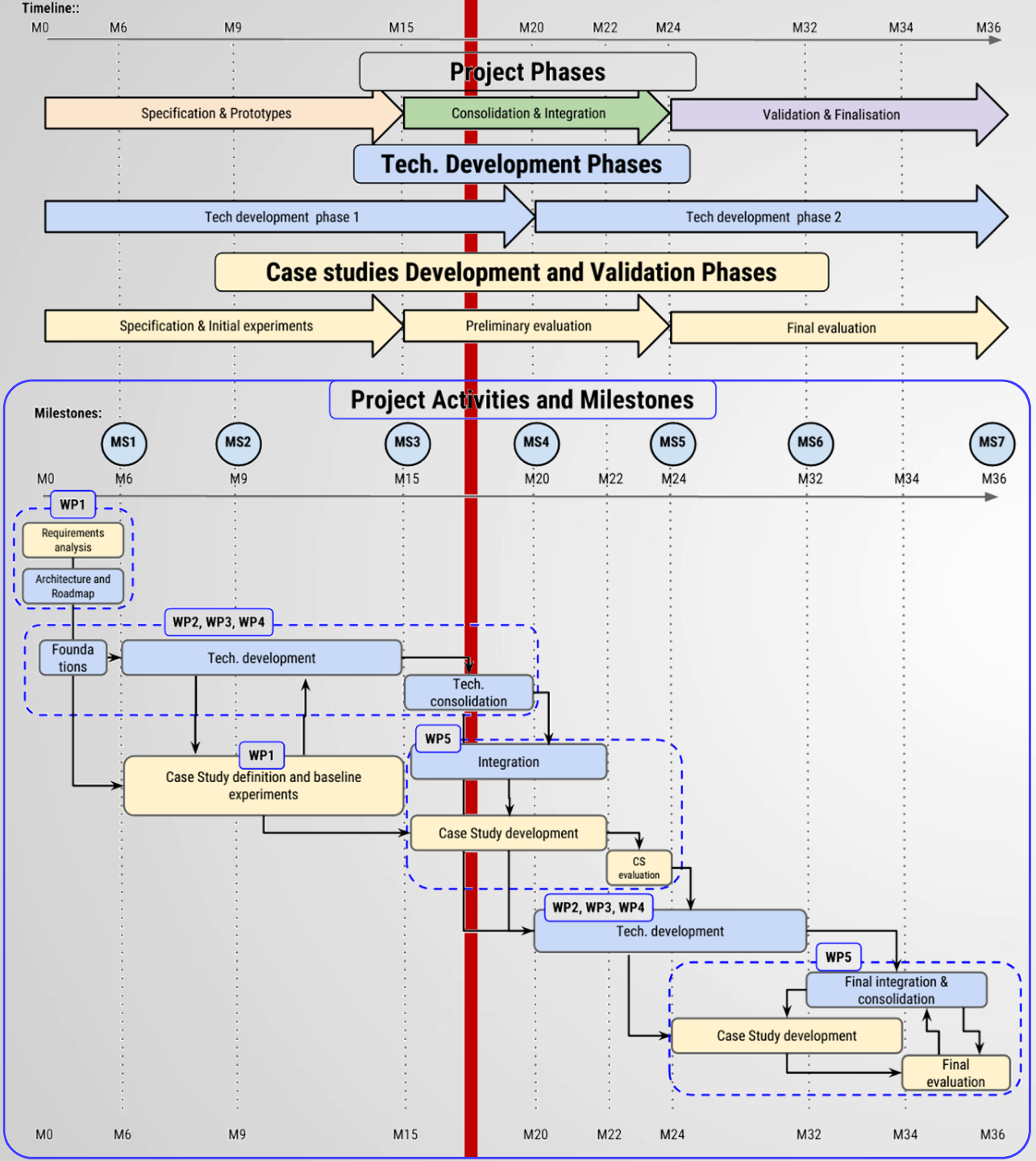
R



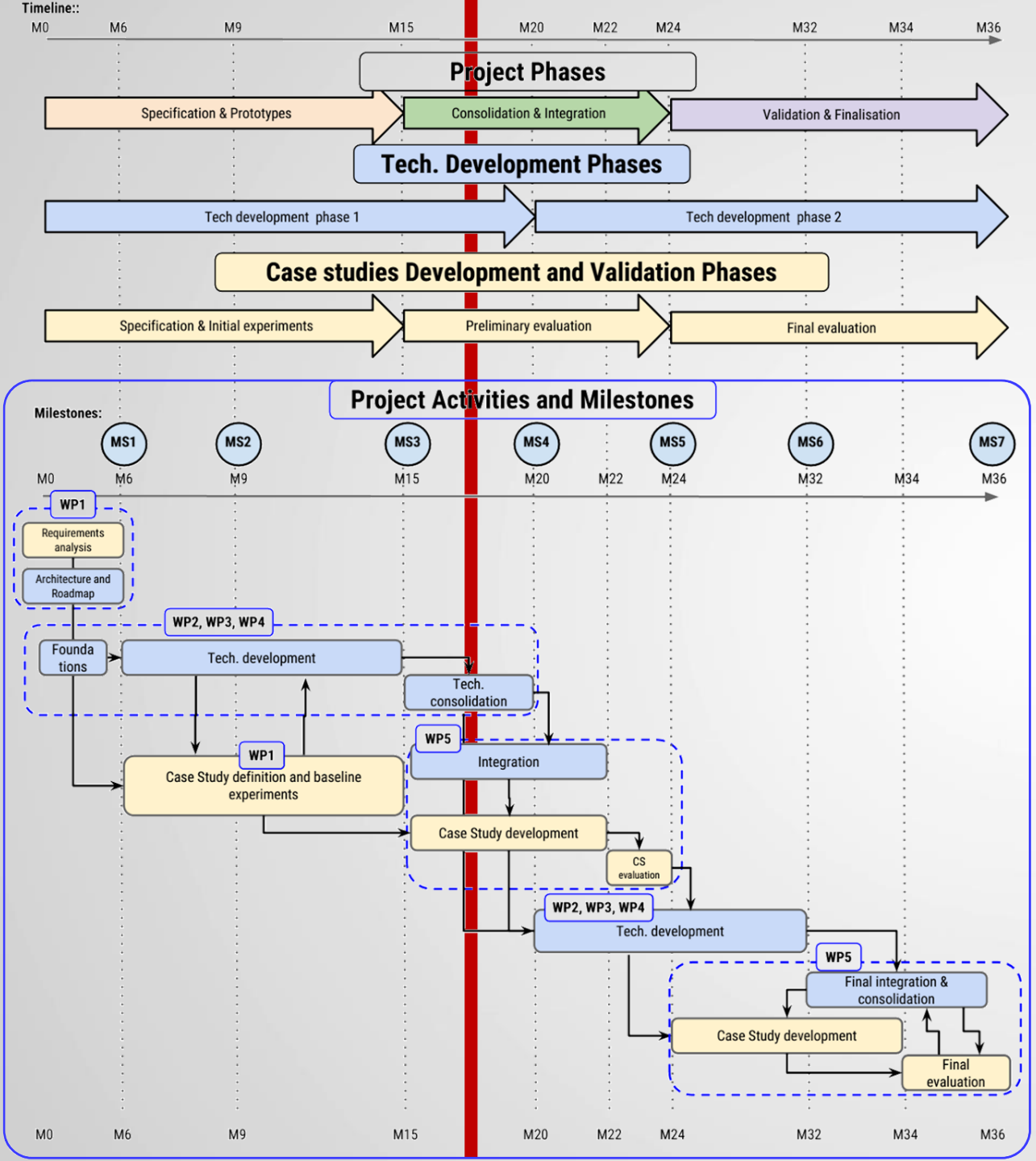
- WP1 Case Study Requirements Analysis & Architecture Specification
- WP2 MegaM@Rt2 System Engineering
- WP3 MegaM@Rt2 Runtime Analysis
- WP4 MegaM@Rt2 Global Model & Traceability Management
- WP5 Integration, Case Study Development & Evaluation
- WP6 Dissemination and Exploitation
- WP7 Management.

Where are we now?

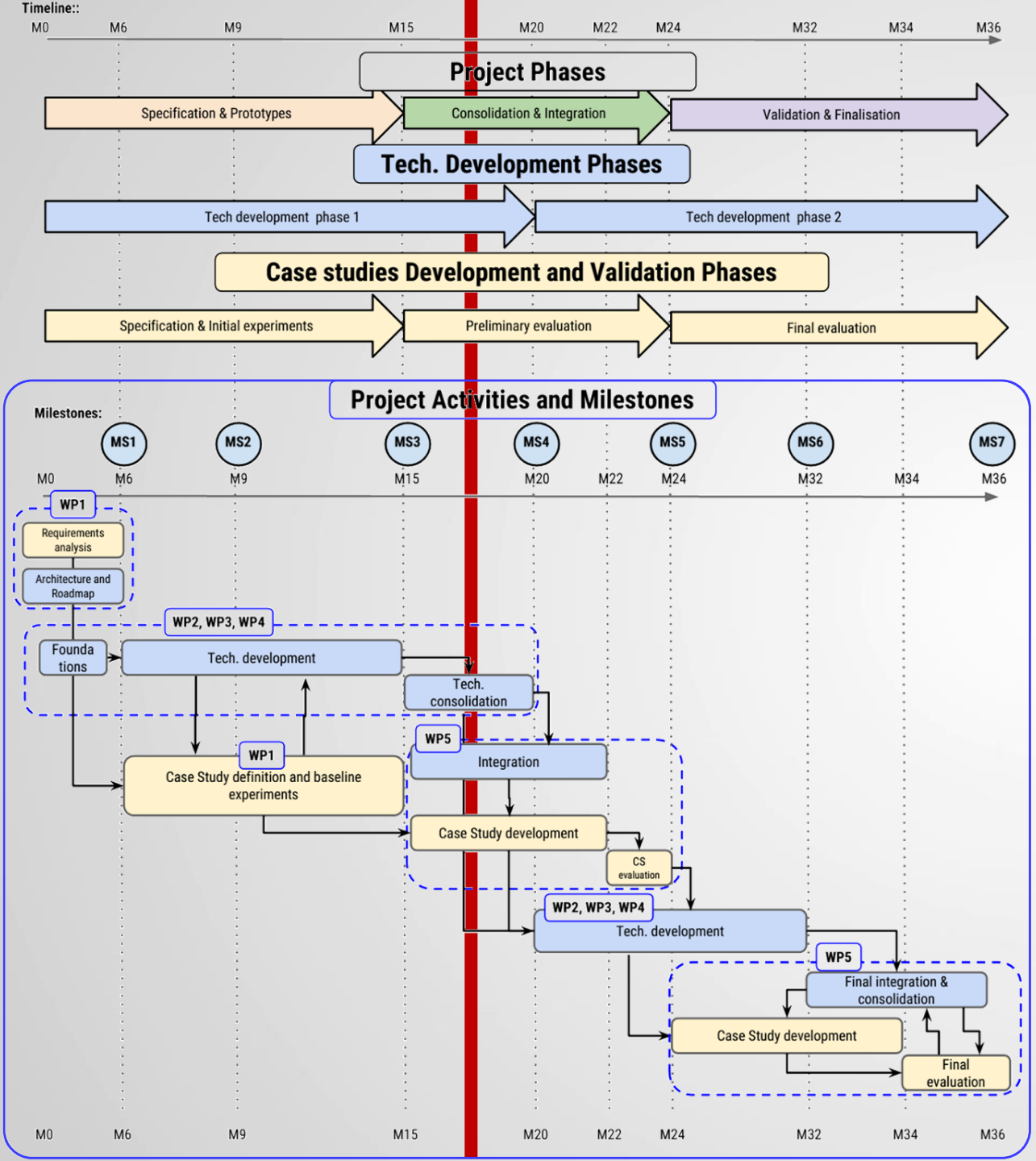

Timeline::
M0
M6
M9
M15
M20
M22
M24
M32
M34
M36
Project Phases
Specification & Prototypes
Consolidation & Integration
Validation & Finalisation
Tech. Development Phases
Tech development phase 1
Tech development phase 2
Case studies Development and Validation Phases
Specification & Initial experiments
Preliminary evaluation
Final evaluation
Project Activities and Milestones
Milestones:
MS1
MS2
MS3
MS4
MS5
MS6
MS7
WP1
Requirements analysis
Architecture and Roadmap
WP2, WP3, WP4
Founda tions
Tech. development
Tech. consolidation
WP5
Integration
WP1
Case Study definition and baseline experiments
Case Study development
CS evaluation
WP2, WP3, WP4
Tech. development
WP5
Final integration & consolidation
Case Study development
Final evaluation



- **D1.1 Industry requirements specification**
- **D1.2 Architecture specification and roadmap (Initial version)**
- **D1.3 Case studies scenarios definition**
- **D1.4 Architecture specification and roadmap (Final version)**
- D2.1 Foundations for Model-driven Design Methods
- D2.2 MegaM@Rt2 design tool set specification
- D2.3 MegaM@Rt2 design tool set (Initial version)
- D3.1 Foundations for Model-Based Runtime Methods
- D3.2 Specification of the MegaM@Rt2 Runtime Analysis tool set
- D3.3 MegaM@Rt2 Runtime tool set (Initial version)
- D4.1 Foundations for Model Management and Traceability
- D4.2 Specification of the MegaM@Rt Model Management & Traceability tool set

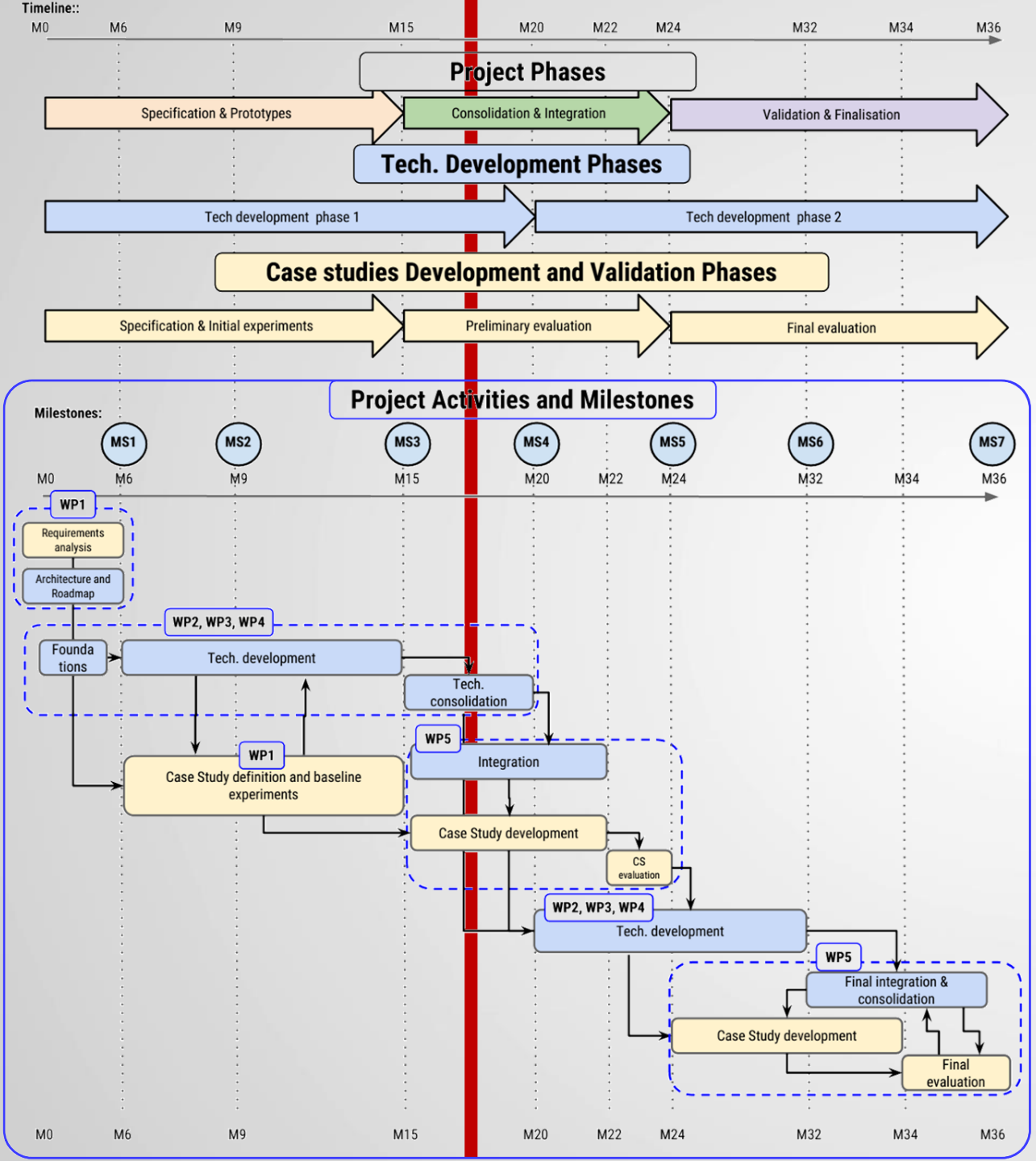


- D1.1 Industry requirements specification
- D1.2 Architecture specification and roadmap (Initial version)
- D1.3 Case studies scenarios definition
- D1.4 Architecture specification and roadmap (Final version)
- **D2.1 Foundations for Model-driven Design Methods**
- D2.2 MegaM@Rt2 design tool set specification
- D2.3 MegaM@Rt2 design tool set (Initial version)
- **D3.1 Foundations for Model-Based Runtime Methods**
- D3.2 Specification of the MegaM@Rt2 Runtime Analysis tool set
- D3.3 MegaM@Rt2 Runtime tool set (Initial version)
- **D4.1 Foundations for Model Management and Traceability**
- D4.2 Specification of the MegaM@Rt Model Management & Traceability tool set

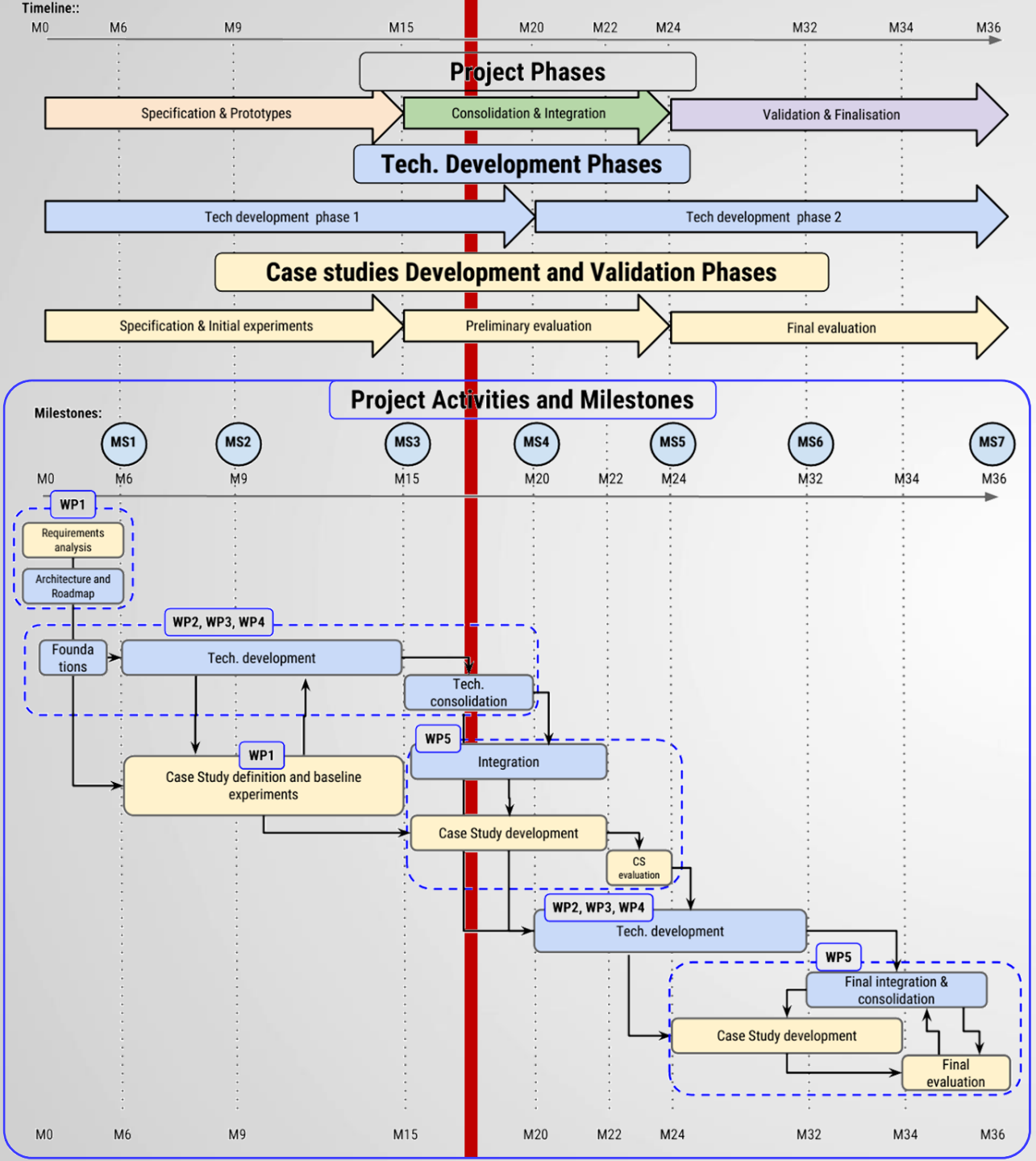


- D1.1 Industry requirements specification
- D1.2 Architecture specification and roadmap (Initial version)
- D1.3 Case studies scenarios definition
- D1.4 Architecture specification and roadmap (Final version)
- D2.1 Foundations for Model-driven Design Methods
- **D2.2 MegaM@Rt2 design tool set specification**
- **D2.3 MegaM@Rt2 design tool set (Initial version)**
- D3.1 Foundations for Model-Based Runtime Methods
- **D3.2 Specification of the MegaM@Rt2 Runtime Analysis tool set**
- **D3.3 MegaM@Rt2 Runtime tool set (Initial version)**
- D4.1 Foundations for Model Management and Traceability
- **D4.2 Specification of the MegaM@Rt Model Management & Traceability tool set**

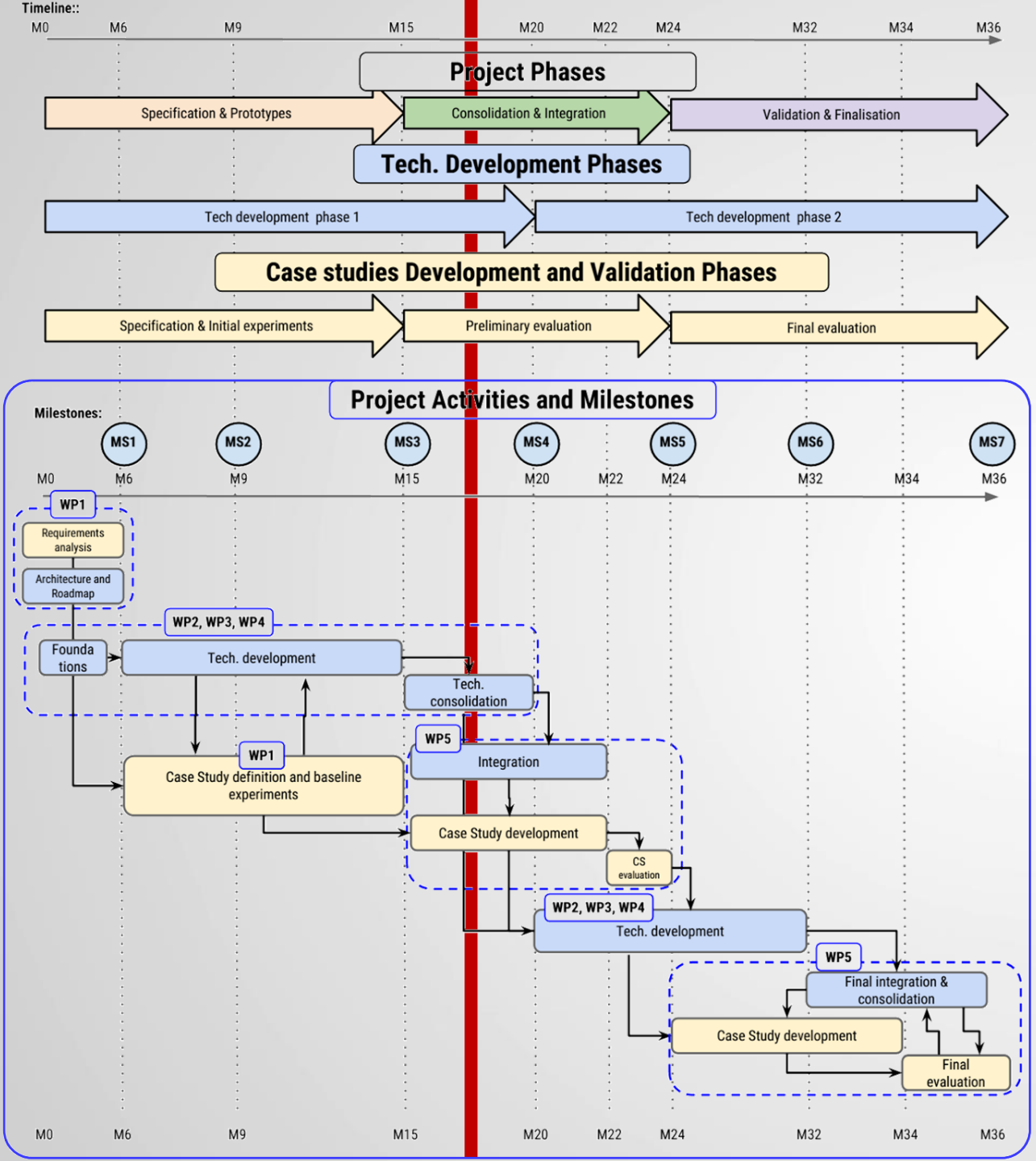
What's next?



- D2.4 MegaM@Rt design tool set (intermediate version)
- D3.4 MegaM@Rt Runtime Analysis tool set (intermediate version)
- **D4.3 Model Management & Traceability tool set (initial version)**
- D5.1 MegaM@Rt Integration Approach
- D5.2 MegaM@Rt Integrated Framework (initial version)
- D5.4 Case study development report (Phase 1)



- **D2.4 MegaM@Rt design tool set (intermediate version)**
- **D3.4 MegaM@Rt Runtime Analysis tool set (intermediate version)**
- D4.3 Model Management & Traceability tool set (initial version)
- D5.1 MegaM@Rt Integration Approach
- D5.2 MegaM@Rt Integrated Framework (initial version)
- D5.4 Case study development report (Phase 1)

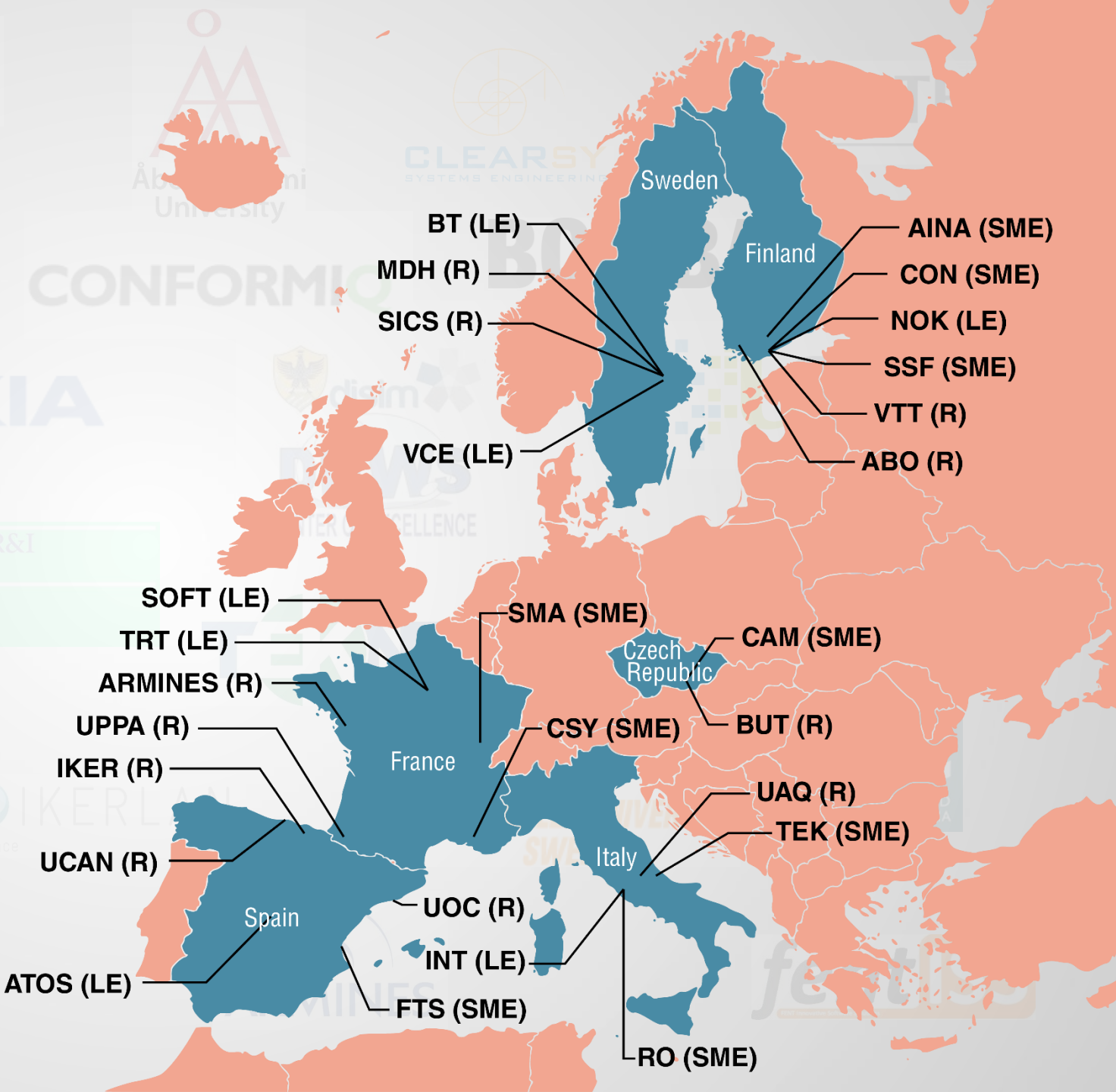


- D2.4 MegaM@Rt design tool set (intermediate version)
- D3.4 MegaM@Rt Runtime Analysis tool set (intermediate version)
- D4.3 Model Management & Traceability tool set (initial version)
- **D5.1 MegaM@Rt Integration Approach**
- **D5.2 MegaM@Rt Integrated Framework (initial version)**
- **D5.4 Case study development report (Phase 1)**

Who are we?

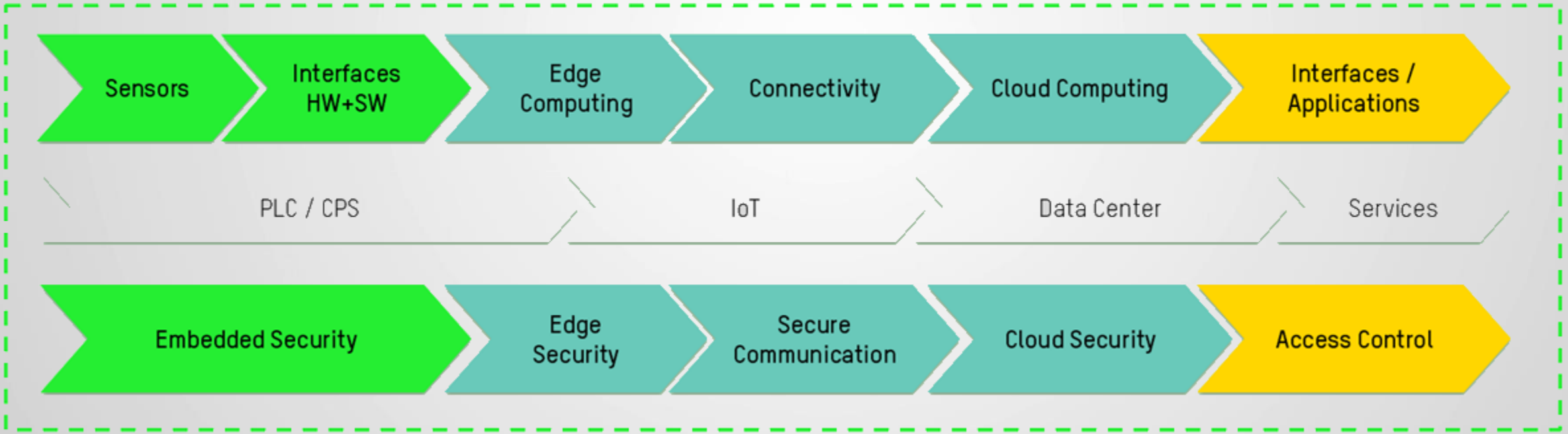
BRNO UNIVERSITY OF TECHNOLOGY
camea
RI SE
Åbo Akademi University
CLEARSY SYSTEMS ENGINEERING
SOFTEAM Think Object
THALES
CONFORMIQ
BOMBARDIER
Atos
NOKIA
disim
DEWS CENTER OF EXCELLENCE
UNIVERSITÉ DE PAU ET DES PAYS DE L'ADOUR
SSF
UOC R&I
AINACOM
VOLVO Construction Equipment
TEKNE
VTT
IK4 IKERLAN Research Alliance
MÄLARDALEN UNIVERSITY SWEDEN
UC UNIVERSIDAD DE CANTABRIA
Smartesting Solutions & Services
ptechnology
intecs Solutions the Brainware company
ARMINES
fentISS

- 27 Partners from 6 European countries
  - 7 Large Enterprises
  - 9 Small and Medium Enterprises
  - 11 Universities or Research Centers

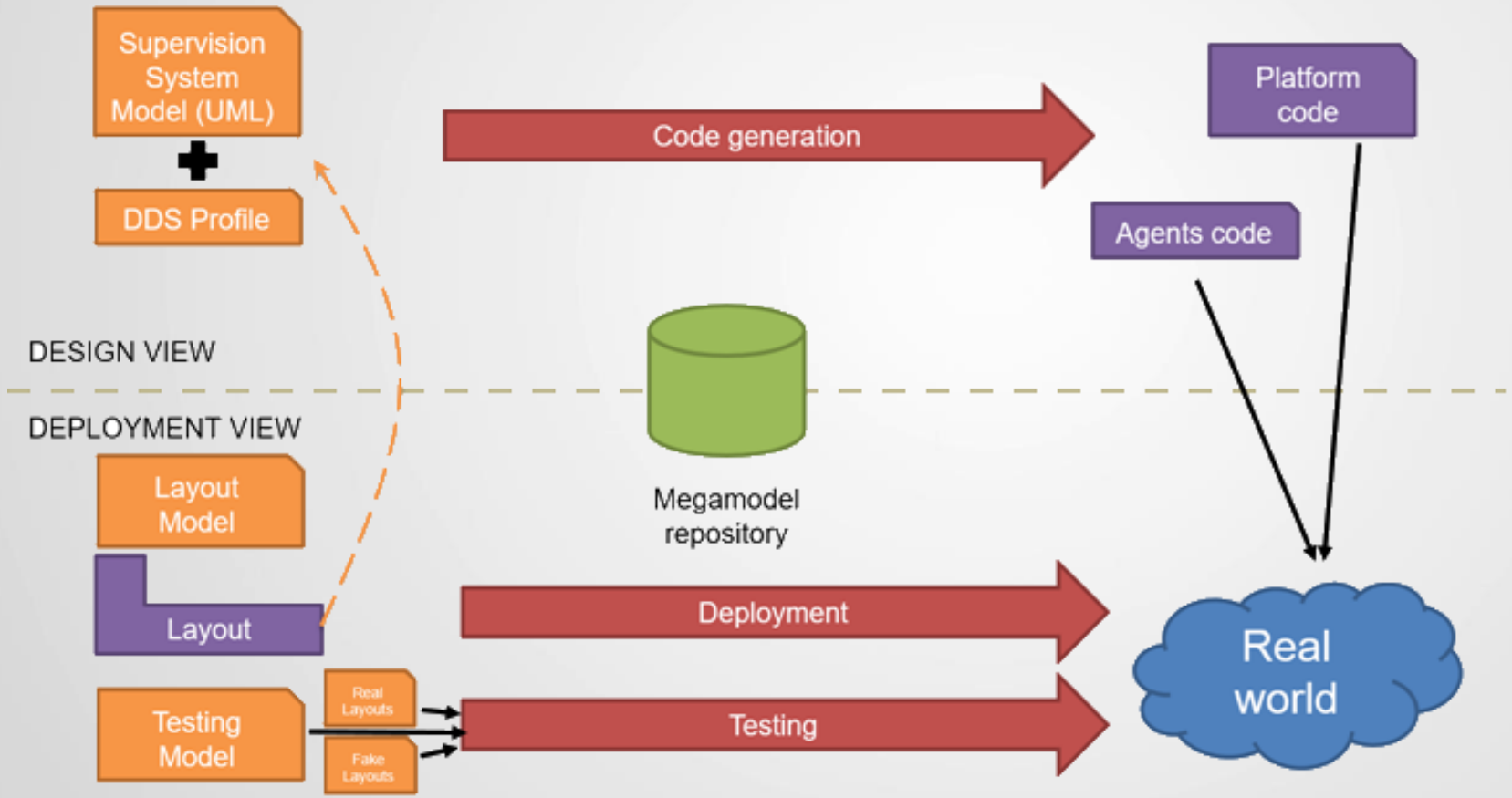


Selected case studies

IKERLAN KONNEKT



Workflow



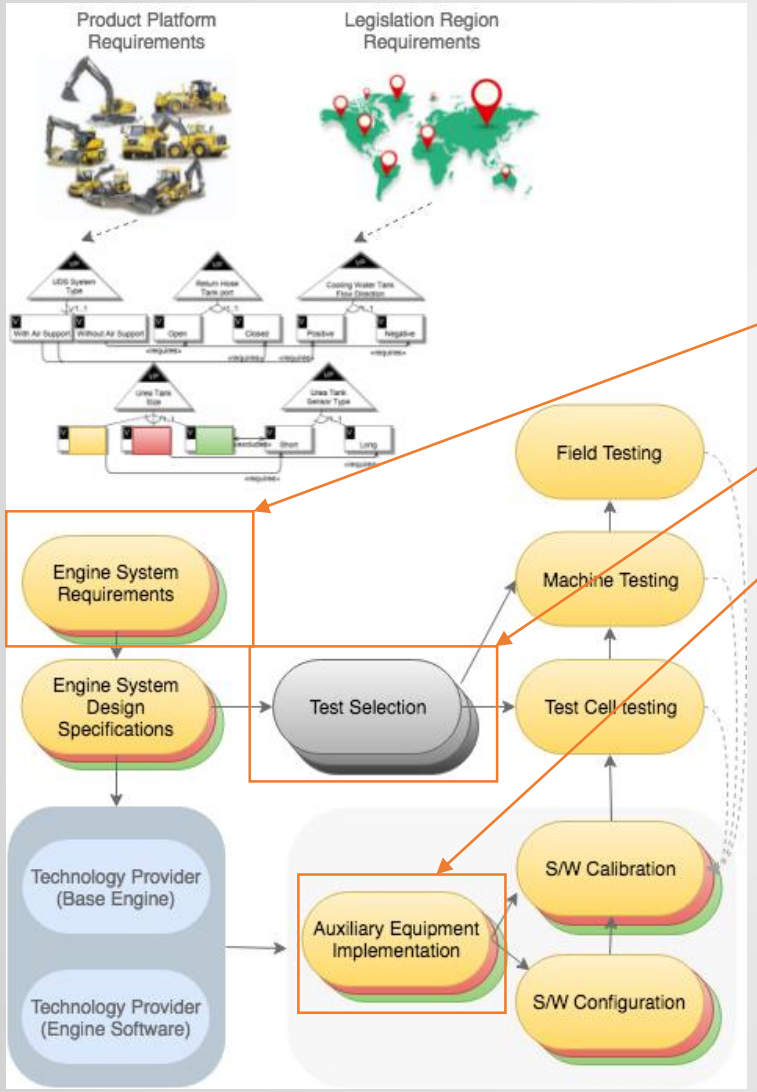
Smartesting

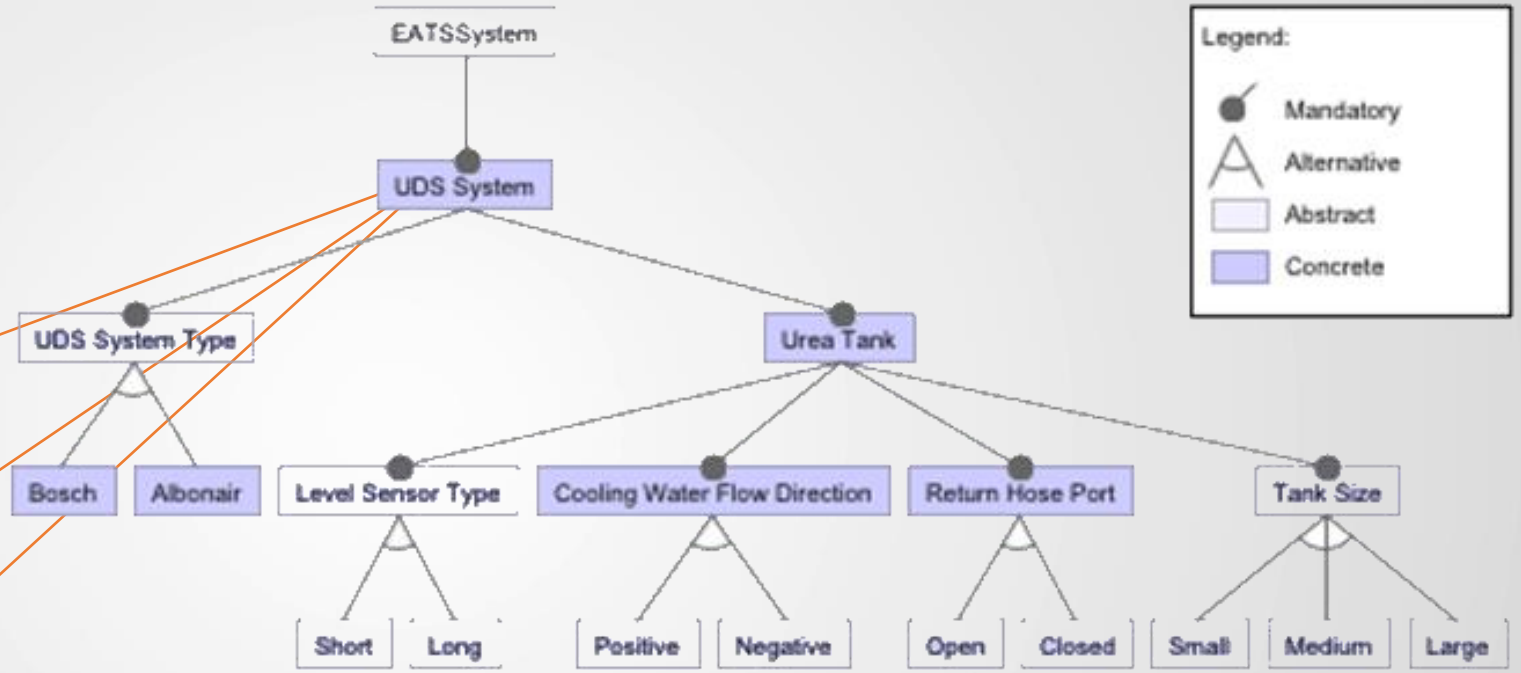
SOFTEAM Cadextan

Université de Pau et des Pays de l'Adour

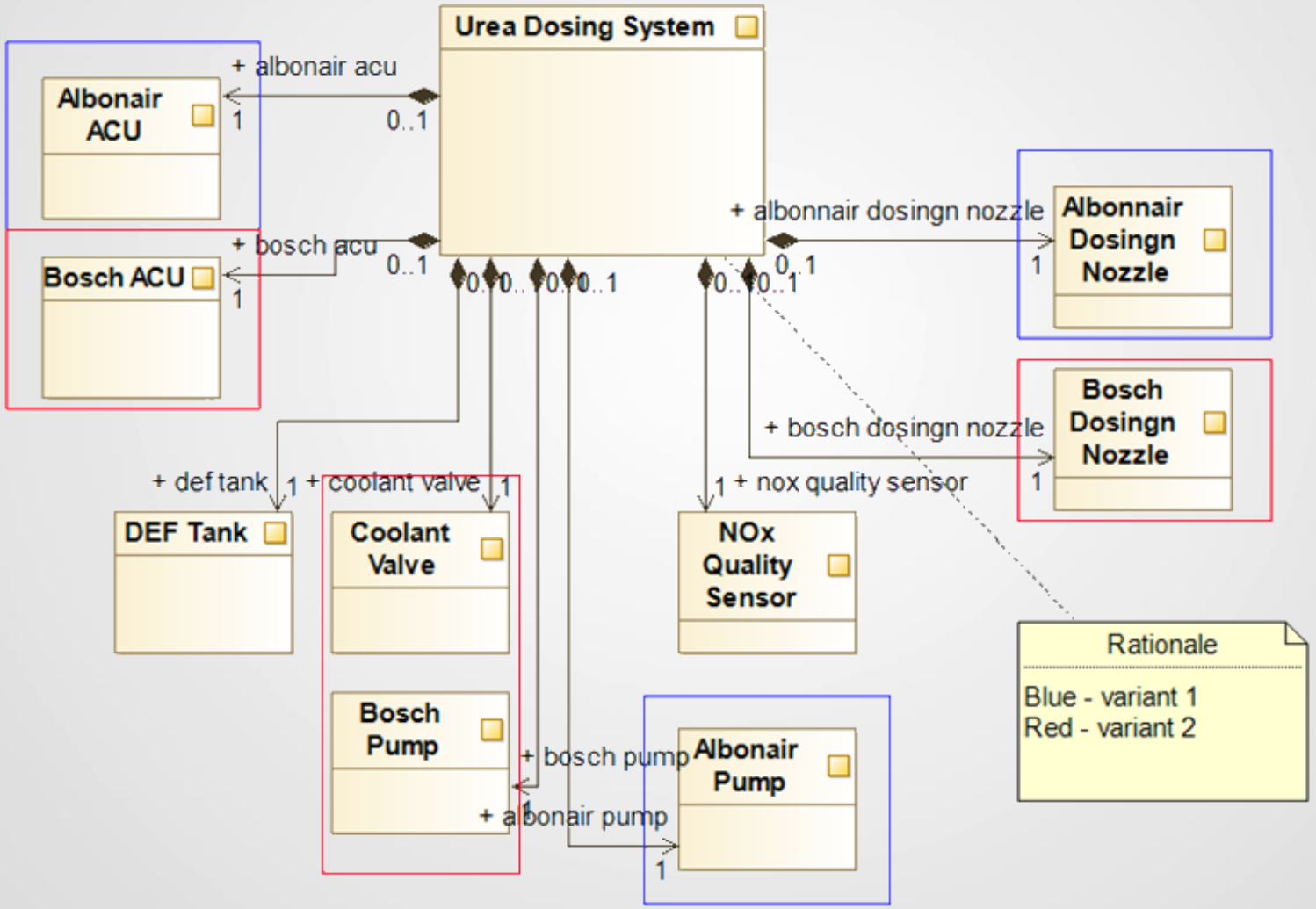
Universitat Oberta de Catalunya

Volvo


Product Platform Requirements
Legislation Region Requirements
Field Testing
Engine System Requirements
Machine Testing
Engine System Design Specifications
Test Selection
Test Cell testing
Technology Provider (Base Engine)
Technology Provider (Engine Software)
Auxiliary Equipment Implementation
S/W Calibration
S/W Configuration

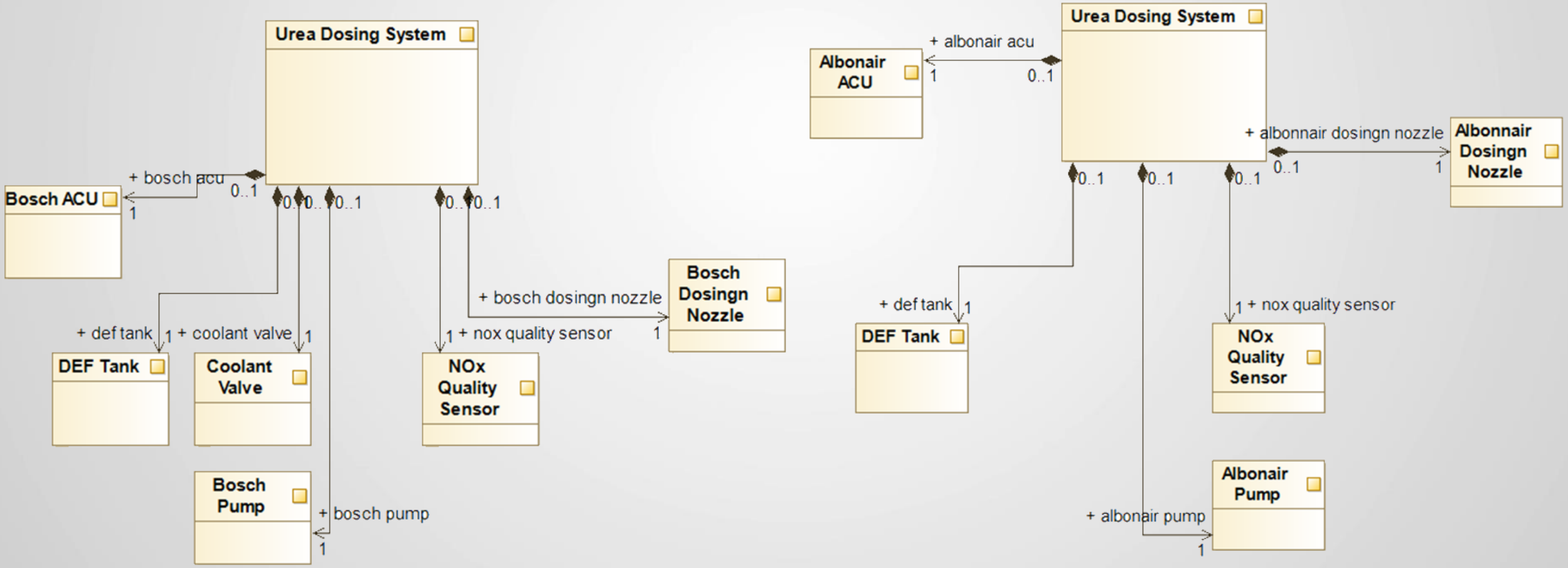

EATSSystem
UDS System
UDS System Type
Urea Tank
Bosch
Albonair
Level Sensor Type
Cooling Water Flow Direction
Return Hose Port
Tank Size
Short
Long
Positive
Negative
Open
Closed
Small
Medium
Large
Legend:
Mandatory
Alternative
Abstract
Concrete

SysML Model


Urea Dosing System
+ albonair acu
Albonair ACU
1
0..1
+ bosch acu
Bosch ACU
1
0..1
+ albonnair dosingn nozzle
0..1
1
Albonnair Dosingn Nozzle
+ bosch dosingn nozzle
1
Bosch Dosingn Nozzle
+ def tank
1
DEF Tank
+ coolant valve
1
Coolant Valve
1
+ nox quality sensor
NOx Quality Sensor
Bosch Pump
+ bosch pump
+ albonair pump
Albonair Pump
1
Rationale
Blue - variant 1
Red - variant 2

SysML variants

— According to some inputs (system req, tests, functionalities, etc.)



Results and Future works

- Contribution to several standards
  - UML, SysML, CTF, VEL

- Increasing tool usage in different use cases
- Defining unified environment
- Defining unified methodology

MegaM@Rt²

WWW megamart2-ecsel.eu

@megamart2-ecsel

This Project has received funding from the Electronic Component Systems for European Leadership Joint Undertaking under grant agreement No. 737494. This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation program and from Sweden, France, Spain, Italy, Finland & Czech Republic.