



Project Results

# AMALTHEA4public

Open source, community extendable development platform

## EXECUTIVE SUMMARY

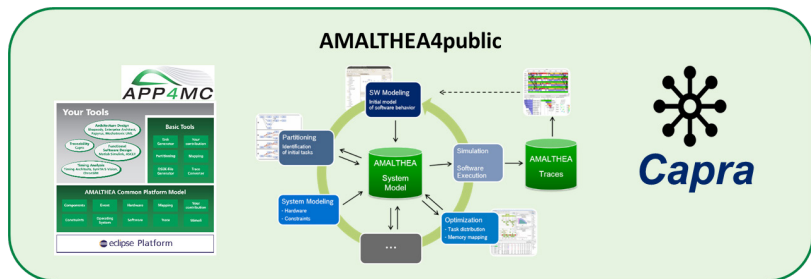
**AMALTHEA4public is an open source tool platform for engineering embedded multi- and many-core software systems. The platform enables the creation and management of complex tool chains including simulation and validation. As an open platform, it supports interoperability and extensibility as well as unifies data exchange in cross-organisational projects.**

## PROJECT ORIGINS

The functionality provided in automotive vehicles is growing substantially more complex with each vehicle generation. The increase of new assistance functions and the density of their integration pose challenges to the engineering process that require new architecture concepts and an intelligent combination of methods to provide the right information at the right time and also to trace problems back to their root causes. Additionally, existing and new tools have to be integrated so that these methods can be used in a routine engineering environment, ensuring that information within the supply chain is handled as smoothly as the information flow within the company. AMALTHEA4public has built on the results of its predecessor, AMALTHEA, and other projects to provide an open source tool platform containing features like testing, verification and validation, safety, systems engineering, product-line engineering and multi- and many-core support.

## TECHNOLOGY APPLIED

Founded on the 100% open-source tool chain built with the AMALTHEA platform, the extensions and enhancements provided by the AMALTHEA4public project include not only methods for systems engineering but also for verification and test generation as well as analyses of product lines. Although the initial focus of AMALTHEA4public was the development of embedded systems for the automotive industry, the capabilities and functions of the resulting platform have been demonstrated



AMALTHEA data format and adaptable/extendable FOSS tooling

using real-world applications not only from the automotive but also the ICT and automation domains.

The evolution of the AMALTHEA format in the ITEA AMALTHEA4public is a further and significant step to ensure interoperability among tools that are involved in the simulation of dynamic behaviour of software intensive systems. The interoperability also increases the level of automation and supports engineers to identify and focus on essential challenges in the development of hard real-time systems.

In addition, the work conducted in the domain of traceability, namely CAPRA, and providing capabilities to integrate the development and use of hardware, in particular Mechatronic UML, are sound bases for improving an integrated and seamless methodology in order to develop a multi-core based system in the industry. The

AMALTHEA4public framework was moved to the Eclipse open source project APP4MC, an open tool platform for modelling, analysis and optimisation of embedded multi- and many-core software.

## MAKING THE DIFFERENCE

Having achieved two new Eclipse projects, namely APP4MC (Application Platform Project for multi- and many-core development) and CAPRA (traceability management), the applicability of the project's results in industry were capably demonstrated by AVL, BHTC and Bosch. With several projects running with the different companies, the scheduled plan of 20 industry projects was exceeded. Continental Automotive GmbH, for example, is using commercial tools for simulation, optimisation and design space exploration purposes that support the format. Several other OEM's also use the format and the

APP4MC platform in cooperation with tool vendors and tier suppliers, such as the State University of Michigan with an OEM.

The open platform format gives tool vendors broad market access and the excellent research results provide a great platform for ongoing research and education. For example the Summer school activities in Dortmund where APP4MC is used for embedded systems training to give the students a broad overview of the challenges and possible solutions. A further research activity concerns EBEAS (Emergency Braking & Evasion Assistance System) which is provided by Fraunhofer IEM to demonstrate the entire system engineering development process. All these activities result in further growth of the developer and user community whereby users get a look and feel of the features and possibilities provided with APP4MC. At Bosch, for example, a complete development platform for multicore development

has been established on the basis of the APP4MC Eclipse project to satisfy the process needs for the internal user community.

Finally, community building is ongoing via the Eclipse Open Source network to different communities (committers, providers, users, research, contributors and commercial). This has led to a healthy community that collaborates with several outside open source/Eclipse projects and individuals. It has now grown from 6 to 12 committers and a three-month release cycle has been achieved to keep the software up to date. External contributions with developments suitable for all APP4MC users not only keep the system vibrant but can also be enhanced in the growing community. Finally, there is cooperation within the Eclipse community, like the Polarsys consortium, where the different development steps were achieved by the developed FOSS tools and have been demonstrated on a small Rover vehicle.

## MAJOR PROJECT OUTCOMES

### Dissemination

- More than 30 publications at various journals and conferences (e.g., Journal of Software Evolution and Process (JSEP), ICSSP, ICPDSSE, IESS, ESLsyn, DesIRE, SysInt, ASE, RE, PROFES, MODELWARD, DATE, IDAACS, SWQD and ICIST)
- Three best paper awards at ICSSP 2015, SWQD 2017, and ICIST 2017
- Several presentations and demos at international fairs, e.g., ARTEMIS-IA & ITEA Digital Innovation Forum, CeBIT, Eclipse (Un)Conference, Embedded World Conference, Embedded Software Engineering Kongress, Parallel Konferenz and the EUREKA Innovation Week
- Articles in online magazines like heise.de, elektroniknet.de, embedded-linux.de, hanser-automotive.de

### Exploitation (so far)

- Eclipse APP4MC: an open platform for engineering embedded multi- and many-core software systems (<https://www.eclipse.org/app4mc/>)
- Eclipse Capra: an open, dedicated traceability management tool that allows the creation, management, visualisation, and analysis of trace links within Eclipse (<https://projects.eclipse.org/projects/modeling.capra>)
- Multicore Tooling platform PLAT4MC for analysing, evaluation, reasoning and optimization of embedded systems for internal use or in cooperation with partners based on APP4MC

### Spin-offs

AMALTHEA4public contributed to the foundation of two new research institutes:

- The Fraunhofer Institute for Mechatronic Systems Design IEM explores innovative methods and tools for the development of intelligent products, production systems and services. Underlying core competencies are intelligence in mechatronic systems, Systems Engineering and Virtual Prototyping
- IDiAL (Institute for Digital Transformation of Application and Living Domains) is a joint and interdisciplinary initiative of Dortmund University of Applied Sciences and Arts' Information Technology and Electrical Engineering and Computer Science faculties. IDiAL addresses processes, methods, and tools for the development of Intelligent Technical Systems - primarily for mechatronic and embedded systems

ITEA is a transnational and industry-driven R&D&I programme in the domain of software innovation. ITEA is a EUREKA Cluster programme, enabling a global and knowledgeable community of large industry, SMEs, start-ups, academia and customer organisations, to collaborate in funded projects that turn innovative ideas into new businesses, jobs, economic growth and benefits for society.

<https://itea3.org>

## AMALTHEA4public 13017

### Partners

*Germany*

BHTC

Dortmund University of Applied Sciences  
and Arts

Eclipse Foundation Europe GmbH  
Fraunhofer

Institut für Automation und  
Kommunikation (ifak)

Itemis

OFFIS

Regensburg University of Applied Science  
Robert Bosch GmbH

TWT GmbH Science & Innovation

Timing Architects

University of Paderborn

*Spain*

CBT

Carsa

Engine Power Components

Innovalia

Software Quality Systems S.A.

*Sweden*

University of Gothenburg

rt-labs AB

*Turkey*

AVL Turkey

### Project start

September 2014

### Project end

August 2017

### Project leader

Jörg Teßmer, Robert Bosch GmbH

### Project email

[joerg.tessmer@de.bosch.com](mailto:joerg.tessmer@de.bosch.com)

### Project website

<http://www.amalthea-project.org/>