ARTEMIS BOOK OF PROJECTS
VOLUMETHREE

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Preface

It is with great pleasure that we present the third ARTEMIS Book of Projects, Volume 3.
In addition to Volume 1 & 2 – in which we highlighted Calls 2008, 2009, 2010 and 2011 – this book brings you an overview of what has been started and achieved in the ARTEMIS Calls of 2012 and 2013. The book gives you an update on the progress that has been made by the ARTEMIS Joint Undertaking: a public private partnership between the European Commission, the ARTEMIS member states and the ARTEMIS Industry Association on Embedded & Cyber-Physical Systems.

The projects within the ARTEMIS programme are intended to have a larger footprint, size and potential impact than other funded projects in this domain in Europe.
However, all projects showcased in Volume 3 are still in their start-up phase and as the impact of projects can often only be measured some years after completion, it is too early to fully predict their success. However, this book gives you an early indication of the potential of the projects and it inspires future projects to submit ideas that fit the Research Agenda of the ECSEL Joint Undertaking and its strategic goals in the forthcoming calls.

Heinrich Daembkes
President ARTEMIS Industry Association

Introduction

The first two "Books of Projects" described in total 44 projects from the previous four ARTEMIS Calls: They were selected through a rigorous, competitive and selective process and are thus the worthy pioneers within the ARTEMIS programme. It is now time to look at the third and last generation of ARTEMIS projects.

What has changed with this new group of projects? Well, it was a game changer time! ARTEMIS had, since its inception, promoted the idea that R&I results have a much higher value if they are carried by a broader cross-section of the interested industries – the so-called "Think Big" approach. Throughout the programme, projects had for the most part taken this to heart; either by being quite large projects in their own right or by assuring connections with these and other relevant projects. With Call 2012, a mechanism was introduced, analogous to the "Pilot Lines" of our sister programme ENIAC, that firmly put this approach into practice: the calls for "ARTEMIS Innovation Pilot Projects" (AIPPs).

In the Calls 2012 and 2013, the ARTEMIS Community again responded with project proposals of exceptional quality and value, out of which some very significant AIPPs and equally high-profile projects were finally selected for funding. In this book you can read all about Call 2012 and 2013 and the results they aim for.

The ARTEMIS programme of Calls is now complete, and we sincerely hope that this legacy of fine projects can serve as inspiration for future consortia to build further in the context of the new ECSEL-JU, keeping the vision of a better Europe for all in the forefront of their efforts.

Alun Foster
Executive Director ARTEMIS Joint Undertaking


ARTEMIS


CALL2012

Introduction: Call 2012

Game changer call. ARTEMIS had, since its inception, promoted the idea that R&I results have a much higher value if they are carried by a broader cross-section of the interested industries – the so-called 'Think Big' approach. Throughout the programme, projects had for the most part taken this to heart; either being quite large projects in their own right or by assuring connections with these and other relevant projects. With Call 2012, a mechanism was introduced that firmly put this approach into practice: the call for 'ARTEMIS Innovation Pilot Projects' (AIPPs). Inspired on the one hand by the success of our sister programme ENIAC in leveraging National funding for such large-scale actions (called 'Pilot Lines') and on the other the evident success of the 'Living Labs' model, these large initiatives were designed to bring together a significant cross-section of an industry, achieving the critical mass required to drive standardised approaches. And why? With standardised approaches for product definition, design, deployment etc… the door is not only opened for the engaged industries to access the markets represented by these applications, but also with a greatly reduced cost of entry onto a levelled playing-field. And that, ultimately, is what we are all working together to achieve.

The Call yielded not only a significant increase in the funding commitments from the participating ARTEMIS Member States but also our first two AIPPs – CRYSTAL and Arrowhead (oh! A name, not an acronym! Thank you !), respectively pulling together the prior work (in ARTEMIS and other programmes) on high-dependability design (CRYSTAL) and manufacturing and rational energy use (Arrowhead), both of which can stand as proud examples of what our very European model of collaboration can achieve.

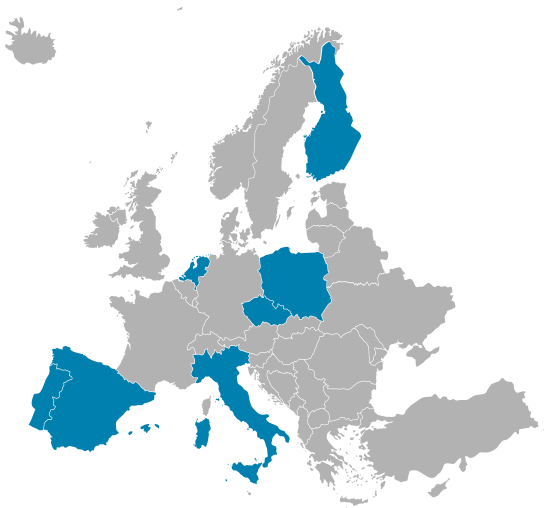
Alun Foster
Executive Director ARTEMIS Joint Undertaking

ACCUS

333020

Start date:	June 2013
Project duration (months):	36
Total investment:	€12.64 m
Number of participating organisations:	28
Number of countries:	8

ACCUS aims to provide an integration and coordination platform for urban systems, in order to optimise their combined performance in line with the System of Systems (SoS) paradigm. ACCUS addresses the efficient composition of Systems of Systems, thus achieving more flexible, more efficient, safer and more robust integrated urban systems and managing their emergent behaviours.



MARKET INNOVATION AND IMPACT

The three major innovations of ACCUS relate to the provision of an integration and coordination platform for urban subsystems, adaptive and cooperative control architecture and corresponding algorithms for urban subsystems, to optimise their combined performance, and methodologies and tools for creating real-time collaborative applications for System of Systems.

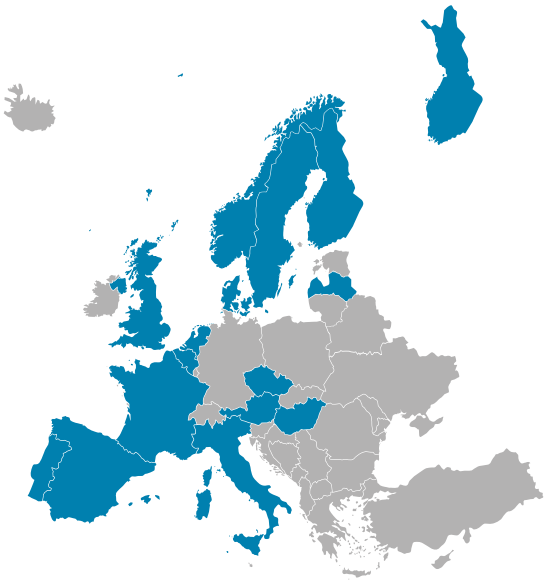
The ACCUS platform makes it possible to build applications across urban systems like monitoring, management and control that can reach beyond the borders of the individual subsystems. Cross-domain and cross-layer cooperation of urban subsystems will be realised and addressed by the interoperability aspects of semantics, pragmatics, information and knowledge discovery, as well as situational awareness within information, resource and time constraints. Fundamental control problems will focus on inherently stable closed-loop systems, controllability of networks of dynamic systems, robustness of control, robust topologies and dependable networked control. The methodologies and tools for creating real-time collaborative applications for System of Systems will include a reference system architecture, platform software, design tools for information extraction and control, a model-based design environment for application development, validation tools for application development, monitoring and visualisation tools to track the system-level operations.

The challenge is to provide short-term R&D results with commercial impact within a 3 to 5 year range and support the development of new applications, as well as propose open-platform and increased interoperability to the research and industrial community. ACCUS will generate strong impact in line with the new evolving Smart Cities concepts, thereby reinforcing EU industrial competitiveness in this area.

Arrowhead
332987

Start date:	March 2013
Project duration (months):	48
Total investment:	€70.40 m
Number of participating organisations:	78
Number of countries:	15

Arrowhead's vision is to enable collaborative automation by creating the Arrowhead interoperability framework, in response to societal challenges in terms of energy and competitiveness. Cooperative automation is enabled by the technology developed around the Internet of Things and Service Oriented Architectures. Arrowhead addresses efficiency and flexibility on a global scale, by means of collaborative automation for five application verticals: production (manufacturing, process, energy), smart buildings and infrastructures, electro-mobility, energy production and the energy virtual market.



MARKET INNOVATION AND IMPACT

The main objective of the technology innovation in Arrowhead is to provide the basic common interoperable technology, the Arrowhead interoperability framework, that makes it possible for systems and devices, new as well as legacy, to integrate and interact based on a loosely coupled service-based approach, thus enabling service-based collaborative automation.

The Arrowhead project will address the technical and applicative challenges associated with cooperative automation through the provision of a technical framework, adapted in terms of functions and performances, the proposal of solutions for integration with legacy systems, the implementation and evaluation of cooperative automation through real experiments in the five applicative domains. Additionally, new services will indicate the accessible innovations and further standardisation work will be signposted.

Arrowhead aims to build market trust and technology guidance, by using explicit innovation methodology, the provision of an interoperability test bed and tools, service business model understanding, the dissemination of result to relevant actors and by involvement in standardisation relevant to the Arrowhead vision. The strategy has four major dimensions: an innovation strategy based on business and technology gap analysis, paired with a market implementation strategy, application pilots with technology demonstrations in real working environments, a technology framework enabling collaborative automation and closing innovation-critical technology gaps, an innovation coordination methodology for complex innovation 'orchestration'.

ARROWHEAD

Collaborative automation by networked embedded devices

Arrowhead is an ARTEMIS Innovation Pilot Project (AIPP) which relates to the manufacturing, process and energy industries. Its aim is to find ways of improving communication between embedded automation systems, so-called Service-Oriented Architecture. Today, such systems require both advanced design and large staffing resources when a large number of devices are linked together to communicate. →

Simply, new technologies could improve and make production flows more effective, thus contributing to a more collaborative automation.

While several projects have already been completed in this area, the big, overarching issue has never been resolved. This project, launched in the first quarter of 2013, creates a step in that direction. Arrowhead will last for four years and has a budget of 69 million euros.

Arrowhead, like CRYSTAL, is an exciting next step in the journey along the ARTEMIS project evolution. The grand challenge is to enable the interoperability and integration of services provided by almost any device. If collaborative automation by networked embedded devices is successful, the reduction in the design and engineering efforts for the predicted multi-billion networked devices could be very significant reduction, 75 % or more.

The objective of the Arrowhead project is to address the technical and applicative challenges associated with cooperative automation by providing a technical framework adapted in terms of functions and performances, proposing solutions for integration with legacy systems, implementing and evaluating the cooperative automation through real experimentations in four applicative domains, indicating the accessible innovations through new services, and leading the way to further standardisation.
The strategy adopted in the project has four major dimensions:

- An innovation strategy based on business and technology gap analysis paired with a market
- implementation strategy based on end users' priorities and long-term technology strategies
- Application pilots with technology demonstrations in real working environments
- A technology framework that enables collaborative automation and closes innovation-critical technology gaps
- An innovation coordination methodology for complex innovation "orchestration"

COLLABORATIVE AUTOMATION

As suggested, the Arrowhead AIPP focuses on four domains. The first is production, or processing and manufacturing automation. Then there is the domain of smart cities, a central aspect of which is the third domain, electrical mobility and the question of whether this will be an interesting complication or addition to our energy distribution and production systems. Another focal domain concerns matching energy production and energy demand, or smart grids. Then there is the question of bringing the four focal domains into the marketplace. The wide geographical spread of interest suggests how European companies are lining up to bring things together and drive forward a number of existing projects and programmes that have not yet come to fruition in the market.

Europe's manufacturing, energy, process and logistics industry is a very important segment, by far the largest sector in terms of employment. Productivity improvements in this sector will therefore have a major impact on the European economy, its production and competitiveness. New and tougher challenges are emerging: efficient management of energy consumption, stricter environmental legislation, higher raw material yields, more productive and energy-efficient plants, higher product quality and better production processes, to name but a few. One of the key technologies in addressing these challenges is collaborative automation.

"In the future there will be billions of connected entities in the world. Arrowhead's purpose is to develop modern technology to enable these entities to communicate and automatically exchange services with one another, thereby helping to reduce society's energy and water consumption as well and its harmful effects on the environment. The core of our technology must be so simple that the same technology works in completely

different entities," says Jerker Delsing, Arrowhead project coordinator.

Through Arrowhead industrial manufacturing may become more flexible and efficient, without being detrimental to the environment. When different technological systems are able to automate their cooperation on different levels and take into account several parameters to optimise energy consumption based on the price of energy and the environmental impact, production will become cheaper. "Creating competitive advantages and, at the same time, enabling society to achieves its environmental targets."

ENERGY 'SWAPPING' GIVES BUILDINGS A REAL 'LIFT'

One of the demonstrations Arrowhead has been discussing for the future is to halve the energy use of Europe's 4.5 million lifts that consume a total of 16-17 GWh per year. By using a 'smart lift' as a generator. "Because lifts can independently communicate with the building or nearby charging stations for electric cars, they are able to borrow electricity in the morning and at the end of the working day act as a generator while carrying people down to ground floor by converting kinetic energy to electrical energy," Delsing explains. "Electricity from the lift is automatically transmitted back to the building's ventilation, cooling and heating systems and to electric cars, which get recharged."

Since energy is closely related to environmental issues like CO_2, if production and processing efficiency can be significantly boosted, and thus reduce their dependence on vast quantities of diminishing fossil fuels and raw materials, the impact this will have on a global scale will be considerable. By getting these common technologies adopted in the market, energy efficiency and utilisation will benefit. This is also a major argument for taking a cloud approach to collaborative automation.

MOVING TECHNOLOGY CLOSER TO THE MARKET

To ensure that such a wide-ranging and large project like this can be properly managed, a core team of people with considerable experience and expertise in projects of this nature has been formed so that the efforts to get the automation 'cloud' closer to reality can be galvanised. This reality is already taking shape, for example in the internet of energy project that is trying to sort out both technology and business bottlenecks as well as establish standardisation so that interoperability and integration can be achieved. And, of course, to demonstrate that these kinds of things work in real environments, not just in mock-ups. One of the reasons for opting for an AIPP project approach is driven by the wish of both large players and SMEs to move the technology closer to the market, to have a showcase window where they can actually demonstrate the actual impact in real life.

The momentum being created in Arrowhead contributes to fostering innovation excellence. As a big project, companies are fascinated by this interesting programme and asking how they can get on board. Just by creating that momentum, the level of innovation is boosted. The demonstration pilots will move the innovation closer and more quickly to the market while the exploitation plans of the industrial partners will have an impact on the market in terms of both quality and opportunity. The involvement of these partners, both large and small, will help drive this momentum and ensure that the project results are translated into benefits for both industry and society.

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December 2013 NO. 15

Article written by Chris Horgan

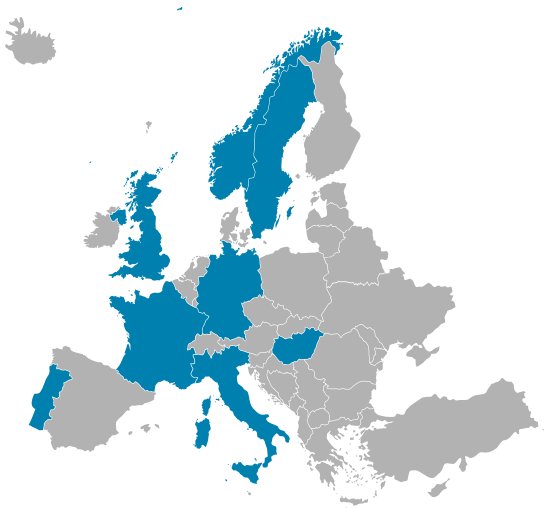
Website: www.arrowhead.eu

CONCERTO

333053

Start date:	May 2013
Project duration (months):	36
Total investment:	€9.65 m
Number of participating organisations:	15
Number of countries:	8

CONCERTO aims to improve Model Driven Engineering practices and technologies, to better address safety, reliability, performance, energy usage and other extra-functional concerns for embedded applications, while guaranteeing correctness as component-based systems are assembled.



MARKET INNOVATION AND IMPACT

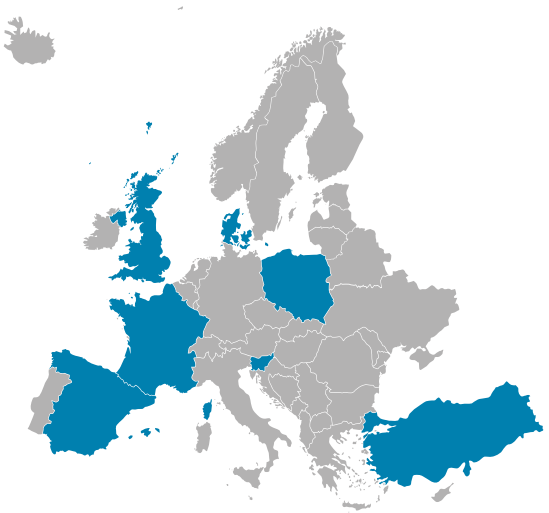
The CONCERTO framework will integrate correctness-by-construction for multicore systems with innovative model-to-code transformation techniques, targeted at their special characteristics, as well as a multi-view, hierarchical cross-domain design space, sufficiently rich to enable a compositional approach to the next generation of complex, heterogeneous platform architectures. The project will support the iterative and incremental development of multicore systems through simulation and early model-based analysis, with fully automated backward propagation of results to the user model. Hardware modelling facilities will be equipped to cope with the new generation of advanced, multicore platforms and advances will be made in run-time monitoring of mission- and operation-critical, non-functional properties, such as energy consumption, on partitioned and multicore processor architectures.

The applicability of the CONCERTO solutions to multiple industrial domains (including aerospace, telecoms, automotive, petroleum and medical) will be ensured through the elaboration of representative industrial use cases. CONCERTO will build on the results of CHESS (www.chess-project.org) and other projects.

CONCERTO takes on the challenge of mastering the foreseeable increase in the complexity of Embedded Systems, by elevating the level of abstraction at which applications are designed and by automating the feasibility analyses needed for verification. European technology providers will benefit from reduced time to market, despite the increasing contribution of Embedded Systems and software and their increasing size and complexity. Advanced hardware modelling capabilities to capture the full potential of new multicore platforms, while providing tools to ensure high quality and highly reliable systems, will increase the quality and reliability of European Embedded Systems-based products and services, while providing new and innovative functionalities for the user.

COPCAMS
332913

Start date:	April 2013
Project duration (months):	36
Total investment:	€15.51 m
Number of participating organisations:	19
Number of countries:	7



Vision systems analysing images from multiple cameras will become the norm in the future. COPCAMS leverages recent advances in embedded computing platforms to develop large-scale vision systems. It aims to exploit a new many-core programmable accelerator platform, to power a new generation of vision-related smart cameras and gateways.

MARKET INNOVATION AND IMPACT

COPCAMS many-core architecture and its flexible programming model will make the resulting solution more effective than today's systems based either on embedded processor and GPU or on FPGAs. The COPCAMS platform will be: cheaper, because of more efficient use of the silicon area; powerful and able to sustain complex vision analytics and video encoding functions; easier to program; more power efficient, thanks to the reduced area of processors and aggressive power management; open through the use of standard APIs.

COPCAMS will propose many-core variant techniques for image and video analysis, codecs and multi-sensors analysis, advancing the state of the art for embedded perception & vision algorithms mainly in two ways: adaptation of these techniques on many-core; the use of open-source libraries for efficient design and cost reduction. The COPCAMS platform will have significant impact on all applications addressed in the project: quality of goods and improved productivity, high flexibility through easy software customisation, larger systems with reduced communication requirements, better in-situ image/video analysis, and better precision and reliability of image/video processing.

By leveraging a large spectrum of innovative technologies in the field of low-power, high-performance Embedded Systems and perception/vision Embedded Systems, COPCAMS will enable innovative products (e.g. surveillance systems) and services (e.g. advanced manufacturing), the impact of which will be felt throughout the value chain and benefit all the players, from academia and SMEs to platform providers, system integrators and service providers.

COPCAMS

COgnitive & Perceptive CAMeraS

Vision systems analysing images from multiple cameras will become the norm in the future, be it in large-scale surveillance, advanced manufacturing or traffic monitoring. COPCAMS leverages recent advances in embedded computing platforms to develop large-scale, integrated vision systems. It aims to exploit new programmable accelerators, particularly many-cores, to power a new generation of greener, low-power smart cameras and gateways. →

This will be possible owing to a paradigm change: whereas previous generation of systems had simple cameras connected to powerful centralised computing servers through high-bandwidth networking, the COCPAMS vision is to push low-power, high-performance computing on the edge of the system and in the distributed aggregators. These "smart cameras" and "smart aggregators" will process video streams, extract significant semantic information and decide locally whether or not the streams' content is of interest and is worth propagating. The decentralised, distributed decision-making will save both energy and bandwidth, while opening up opportunities for new distributed applications.

ECOSYSTEM

This will be achieved by kick-starting a mixed hardware and software ecosystem, aimed at reducing costs and development cycles. On the hardware side, COPCAMS will use low-power consumption and high computing-power solutions, based on the latest advances in microelectronics and computing architectures, like many-cores. On the software side, the project will focus on established and emerging tools and libraries, like OpenCL and OpenMP, and programming interfaces proposed by industrial consortia. This will enable the COPCAMS ecosystem to cross-breed with other industrial sectors that share similar concerns. It is foreseen that such a rich and open ecosystem will foster the growth of a community of users which may easily share research efforts and, through composability and re-use of standardised components, allow for a dramatic reduction of development times and enable wide cross-domain deployment.

The impact of COPCAMS will cover the complete range of the value chain: academia and SMEs will have advanced many-core platforms, to test and optimise innovative vision, coding and cognitive algorithms. Platform providers will grow an ecosystem of users and will have the possibility to explore new market opportunities. System integrators will benefit from the powerful platforms being developed in COPCAMS and will be able to offer a new generation of vision-related products. And last, but not least, service providers will capitalise on the COPCAMS system, to provide value-added services to end users, way beyond what can be offered today.

FROM VERTICAL TO HORIZONTAL

COPCAMS leverages recent advances in embedded computing platforms to design, prototype and field-test full, large-scale vision systems. It aims to exploit both new, many-core platform and GPU-based embedded architectures, to power a new generation of vision-related devices that are able to extract relevant information from captured images and that autonomously react to the sensed environment by interoperating on a large scale in a distributed manner. COPCAMS will facilitate the transition from the highly vertically structured embedded vision systems market toward a more horizontal market, thereby creating new opportunities to be addressed more easily by SMEs and start-ups.

Due to both algorithmic and computational complexity, embedded vision systems are nowadays conceived as special-purpose devices, dedicated to quite narrow application domains. The COPCAMS solution will represent a significant step towards wider adoption of distributed, flexible embedded vision systems. COPCAMS will provide key enabling technologies to build smart environments, with a first application to surveillance of environments and advanced manufacturing. COPCAMS many-core architecture and its flexible programming model will make the resulting solution more effective than today's systems, that are based either on embedded processor and GPU or on FPGAs.

ADVANCING THE STATE OF THE ART

COPCAMS will propose: many-core and embedded GPU techniques for image and video analysis, codecs and multi-sensors analysis; pre-processing steps to improve the quality and usefulness of still images; image and video understanding,

object classification and recognition; video understanding; highly-parallel video coding schemes; sophisticated data fusion; detection and tacking. On all these fronts, COPCAMS will advance the state of the art for embedded perception and vision algorithms, mainly in two ways: the adaptation of these techniques on many-core and other low-power platforms and the use of open source libraries to enable efficient design and cost reduction.

COPCAMS will have significant impact on all the applications addressed: quality of goods and improved productivity, by better accuracy of inspection and more detailed assembly process monitoring; high flexibility through easy software customisation; larger systems with reduced communication requirements; better in situ image/video analysis, by porting server-class algorithms to embedded systems; better precision and reliability of image/video processing, by using higher spatial and time resolution.

One year after the start of the project, COPCAMS has defined its three mains demonstrators: large area surveillance, advanced manufacturing applications and indoor and outdoor surveillance. The set of target platforms has also been selected; it ranges from advanced low-power many-cores to embedded GPU-based architectures. Some early technology demonstrators have been completed and are already displayed in some international fairs and exhibitions.

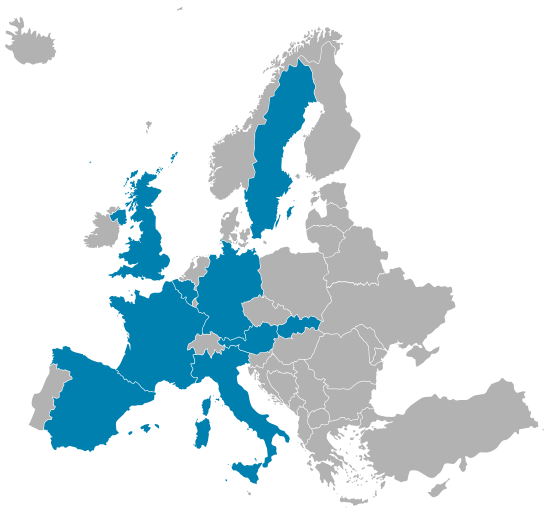
Article written by Christian Fabre

Website: http://copcams.eu

CRYSTAL
332830

Start date:	May 2013
Project duration (months):	36
Total investment:	€82.55 m
Number of participating organisations:	68
Number of countries:	10

CRYSTAL, as an ARTEMIS Innovation Pilot Project (AIPP), takes the research results of previous projects in the field of Reference Technology Platform (RTP) and Interoperability Specification (IOS) (e.g. CESAR, MBAT) and enhances and matures them, with the clear aim of industrialisation implementation.



MARKET INNOVATION AND IMPACT

CRYSTAL was designed as ARTEMIS Innovation Pilot Project, with the aim to establish collaboration schemes beyond individual projects and to speed up technology maturation cycles. Accordingly, the strategy for CRYSTAL technical innovation is based on four pillars: the maturing of existing concepts, developed by previous European and national projects for industrial application, the provision of high-maturity technical innovations to fill identified gaps ("technological bricks"), a contribution to the CRTP, pushing the Interoperability Specification towards standardisation, and support for SME integration in the Embedded Systems engineering ecosystem.

Today's ad-hoc tool integration by creating proprietary bridges between each pair of tools does not scale, since the number of required bridges grows exponentially with the number of employed tools. Moreover, the resulting system becomes extremely vulnerable to common changes, like version upgrades from tool vendors, and the efforts for maintaining a large set of bridges is sooner or later not acceptable. The main technical challenge in addressing this problem is the lack of open and common interoperability technologies supported by the different tools that generate and provide access to data covering the entire product lifecycle of safety-critical Embedded Systems.

Within and across the application domains of aerospace, automotive, healthcare and rail, CRYSTAL will cover the entire software product life cycle and support product line development towards ready-for-use industrial tool chains, to enable the processes of developing, governing and operating modern safety-critical Embedded Systems to become effective and efficient, through collaboration among the respective stakeholders and interoperability between the tools they are using.


CRYSTAL
CRitical sYSTems engineering
AcceLeration

CRYSTAL, as an ARTEMIS Innovation Pilot Project (AIPP), takes up the research results of previous Reference Technology Platform and Interoperability projects, in order to enhance and mature them, with the clear target of industrialisation take-up. →

Following the ARTEMIS mission to strengthen the European market for Embedded Systems, CRYSTAL fosters cross-domain reusability (Aerospace, Automotive, Health and Rail) and drives forward the Interoperability Specification towards standardisation.

CRYSTAL, as an AIPP project, is an exciting next step in the journey along the ARTEMIS project evolution. Having results from previous ARTEMIS projects like CESAR, MBAT and iFEST available, CRYSTAL is a challenging transformation from research into industrial application - challenging in terms of defining common objectives, topics and handling of consortium size.

MARKET INNOVATION

CRYSTAL will exploit industrial domain-specific insights into embedded system design and safety processes, to investigate and establish cross-domain synergies. Such a cross-domain approach fosters the exchange of knowledge between partners of different domains, creating synergies and hence strengthening the European market. CRYSTAL will reuse the results of previous European and national projects to focus on the improvement and industrialisation of the Reference Technology Platform (RTP): CESAR (1), MBAT (2), p/Nsafecer (3), SAFE (4), TIMMO-2-USE (5), OPENCOSS (6) … Additionally, CRYSTAL will push forward the Interoperability Specification (IOS) towards a European standard and will stay in close contact with standardisation bodies like ASAM, OASIS, OMG, CENELEC and others, in order to build on existing achievements and to join forces through collaboration in the standardisation process. The technologies provided in CRYSTAL, together with the maturation of RTP and IOS, will lead to faster development cycles, including early validation of design concepts, thus allowing faster demonstration of the feasibility of these concepts.

THE CRYSTAL CONSORTIUM

Creating and establishing a new standard on a large scale in an already consolidated market cannot be achieved by individual organisations. With a budget of more than €82m and 71 partners from 10 different European countries, CRYSTAL has the critical mass to accomplish this endeavour. The project consortium is made up of participants from all relevant stakeholders, including OEMs, supplier, tool vendors and academia, and will cooperate with established standardisation organisations.

TECHNICAL INNOVATION

CRYSTAL has been set up as an ARTEMIS Innovation Pilot Project to establish collaboration schemes on a large scale and to speed up technology maturation cycles. Accordingly, the strategy for CRYSTAL technical innovation is based on 4 pillars:

1. Apply engineering methods to industrially relevant use cases and increase the maturity of existing concepts developed in previous projects.
2. Provide technical innovations (“technology bricks”) with high maturity, to fill gaps identified in the use cases.
3. Contribute to the Cooperative RTP and push the Interoperability Specification towards standardisation.
4. Support SME integration into the embedded systems engineering ecosystem.

Within and across the industrial domains Aerospace, Automotive, Healthcare and Rail, CRYSTAL will cover the entire software product life cycle and support product line development towards ready-for-use industrial tool chains.

THE CRYSTAL USER DRIVEN APPROACH

Following the philosophy of the AIPPs, CRYSTAL focuses on verifying and improving the usability of project results already developed. With four industrial domains represented in this project, the user scenarios are manifold. The project has therefore developed a user-driven approach that is based on user stories, use cases and technology bricks. In this context, a user story describes a typical action pattern or work flow within

an industrial domain. These user stories are used to describe general processes that are at too high a level to directly derive development requirements. Hence, the use cases are a further refinement of the user story and represent a concrete company scenario. The requirements for the Reference Technology Platform and the Interoperability Specification are derived from these use cases, leading to technology bricks to fill the gaps identified in them. Such a brick may be a SW tool or product, a SW component to build a SW tool or product, a systems engineering methodology, an interface or a standard or means for establishing interoperability that is needed for the efficient development of safety-critical embedded systems.

CRYSTAL EXPLOITATION

CRYSTAL aims to reduce system design costs through the improvement and smart integration of system analysis, safety analysis and system exploration tools. In alignment with the RTP and IOS concepts, this leads to a reduction in development cycles and consequently a reduction in development time and effort. Two central topics of CRYSTAL are therefore (1) the further development of the Interoperability Specification towards a standard and (2) the maturation of integrated tool chains towards industrial application. Succeeding in the development of these two topics will lead to competitive advantages, when applied and tailored to the industrial domain and company-specific needs. The CRYSTAL consortium represents a well-balanced selection of relevant and important stakeholders in the European industry and research landscape, which will help to accomplish the ambitious objectives. During the project, a sustainability model will be developed that supports the handover of results to the ARTEMIS Innovation Environment, as well as to standardisation bodies that will enable and support further activities on the Cooperative RTP (CRTP) and the IOS. These concepts will further increase the flexibility for all stakeholders and have the potential to make a significant global impact on the market. OEMs can easily combine tools from different vendors and tool vendors will be able to find new market opportunities in an open and extendable environment.

The key elements for the integration strategy that CRYSTAL is following, are sustainability, openness, communication and contribution to the ARTEMIS Innovation Environment, as well as cooperation with completed, on-going and future projects in the field of embedded systems engineering.

Acknowledgement: The research leading to these results has received funding from the ARTEMIS Joint Undertaking under Grant Agreement N° 332830 and from specific national programmes and / or funding authorities.

(1) www.cesarproject.eu
(2) www.mbat-artemis.eu/home
(3) www.safecer.eu
(4) www.safe-project.eu
(5) www.timmo-2-use.org
(6) www.opencoss-project.eu

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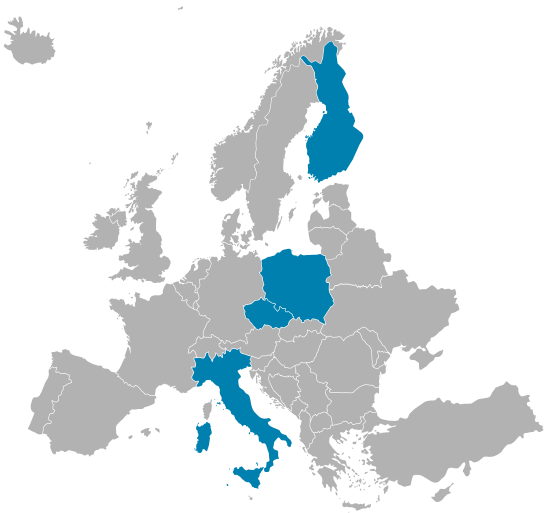
June 2013 NO. 14

Article written by Horst Pflügl, Christian El-Salloum and Ingrid Kundner

eScop
332946

Start date:	March 2013
Project duration (months):	36
Total investment:	€5.82 m
Number of participating organisations:	10
Number of countries:	4

Embedded systems for Service-based Control of Open manufacturing and Process automation, or eScop, aims to overcome the current problems of system integration at shop-floor control level, by semantically integrating embedded devices and applications based on open standards, allowing the addition of new stakeholders.

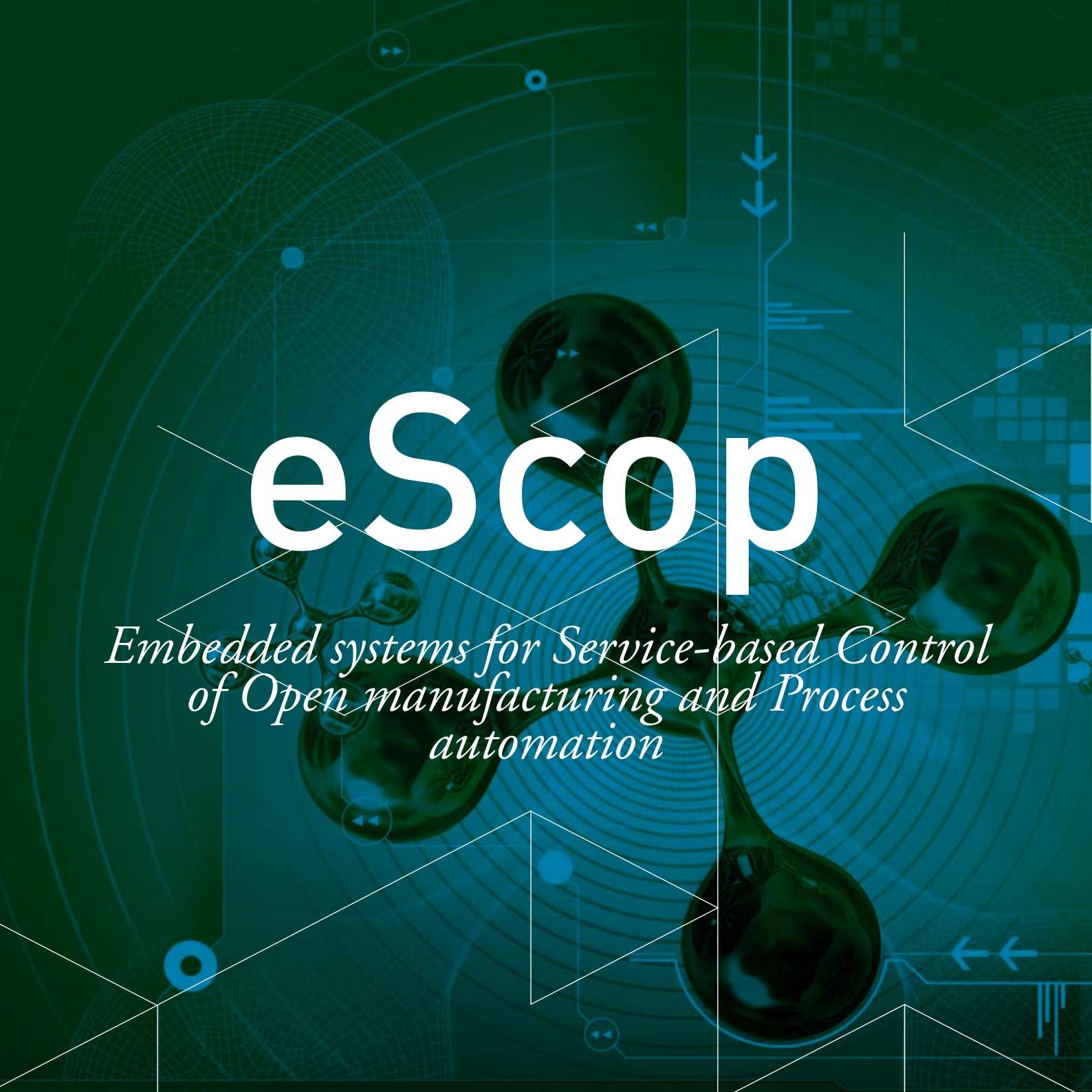


MARKET INNOVATION AND IMPACT

The central concept of eScop is to combine the power of Embedded Systems with an ontology-driven service-oriented architecture (SOA) for realising a fully open, automated manufacturing environment. The true innovation of the proposed solution lies in the convergence of the power of ontology knowledge and SOA control approaches that allow the control to be automatically based on the ontology, while Embedded Systems allow this architecture to work.

eScop aims to realise a modular, fully open solution for the operational control of manufacturing equipment, that allows easy and fast commissioning of new plants, "plug & produce" inclusion of new equipment, replacement of traditional control by a single level cohort of Embedded Systems and a series of software control levels. The eScop hardware and software platform will produce the following innovations: flexible re-configuration and knowledge update of newly plugged or unplugged equipment support, reduction of time and cost related to conventional manual reprogramming, facilitation of human-to-machine and machine-to-machine interactions, as well as new products with short-life cycles, without the need to totally restructure the production system, as well as the manufacture of customised products.

The eScop project results will impact the entire value chain of the production automation industry, with the stakeholder role shifting towards knowledge user/creator. Companies that require high productivity can certainly benefit from the project improvements on efficiency and transparency of shop floor information. Other important beneficiaries/customers for eScop results are companies that need to work with low volumes of different types of product, generally realised with job-shop production systems.


eScop
Embedded systems for Service-based Control of Open manufacturing and Process automation

Manufacturing and processing are the first industries to contribute to European economic growth, underpinning all economic activity. An increasingly competitive environment in the sector is waking many companies up to the need for appropriate management tools that allow them to reach higher productivity with better quality at lower costs. Proper information management systems can be divided, for example between business management and the factory floor.

The gap between the management and factory control level is traditionally filled by a software and hardware system, known as the Manufacturing Execution System (MES). MES helps directly run shop floor manufacturing operations – the core value-added processes in a manufacturing enterprise – and delivers information that enables the optimisation of production activities from order launch to finished products. The resulting rapid response to the changing conditions drives effective plant operations and processes.

ONTOLOGY-DRIVEN APPROACHES

The development of MES within the overall control architecture of production systems is relatively more advanced than others and many different solutions are presently available. The complexity of interfaces prevents software customisation and effective integration. Often, a new problem requires an ad hoc solution. A step towards a more open solution is now in progress. The current control architectures are not satisfying industrial enterprises that require agile and efficient tools to manage the changes at the factory or factory floor and then to react to the customer demands. A further possibility of improvement is seen in the use of ontology-driven approaches. The eScop, "Embedded systems for Service-based Control of Open manufacturing and Process automation", aims to develop an alternative MES solution, based on ontologies and service oriented architecture (SOA), which is defined as Open Knowledge-Driven Manufacturing Execution System.

The eScop project aims to integrate different existing software tools for creating an innovative solution that allows the supervisory and command capability of the manufacturing system. The innovation of the eScop MES platform is the merging of the power of ontology-driven knowledge and service-oriented approaches to embedded systems. The ontology of production systems is used to drive the service-oriented, architecture-based control of the production equipment by integrating multi-domain knowledge, allowing orchestration of networked embedded systems. eScop enables the flexible use of equipment and the capability to integrate a process or a machine with others. The solution allows the smart and easy reconfiguration of a process with shorter life cycles, without the need for the total restructuring of the production system. This can lead to the manufacturing of highly-customised products. The eScop solution will also reduce the wasted time and cost of conventional reprogramming and redefine the role of the main stakeholders as knowledge users and creators. These benefits are significant to the companies that require high productivity, or to the companies (SMEs) that need to work with low volumes of different types of products.

BETTER CONTROL CAPABILITIES

The main result of eScop is a service-oriented MES that allows the building and simulation of factory and process control systems. eScop provides an innovative system that might encourage increased investments in the automation industry. A competitive advantage comes from the improved control capabilities of the eScop solution and the enhanced possibility to dynamically configure a production system made of components coming from different providers. This dynamic configurability may significantly reduce the cost of changes in factories, allow out-of-the-box extensibility and scalability of MES and enable proper equipment and embedded systems to be selected, thereby enhancing sustainability in the manufacturing industry. In addition, the reduced costs to design will increase profit and allow the same solutions to be offered at a lower price. The eScop platform can bring a real breakthrough for the sector.

PROJECT ACCOMPLISHMENTS THUS FAR

The project activities were launched in March 2013 and the first requirements and specifications for both technology and concept were successfully provided in January 2014, thereby achieving the first project milestone. In addition, the knowledge-oriented approach to production system definition,

integration, execution and maintenance was presented during the ARTEMIS/ITEA2 Co-summit Event in December 2013. The focus was the use of the ontologies for the orchestration of production processes ranging from low-level (factory floor) to higher (application) levels. The online application, with explanations, model and concept presentation, is available from the project web page www.escop-project.eu/teaser. During the first year, a first eScop platform prototype was also developed, where the initial vision for the main eScop architecture blocks was tested.

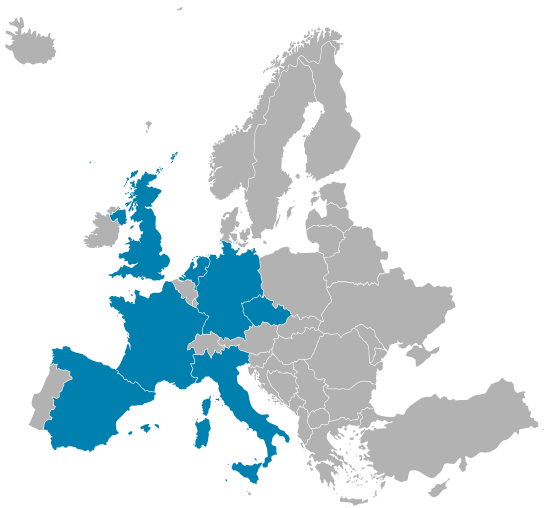
Article written by Sari Räsänen

Website: www.escop-project.eu

HoliDes
332933

Start date:	October 2013
Project duration (months):	36
Total investment:	€23.86 m
Number of participating organisations:	31
Number of countries:	7

HoliDes addresses development and qualification of Adaptive Cooperative Human-Machine Systems (AdCoS) where many humans and machines act together, cooperatively, in a highly adaptive way to guarantee fluent and cooperative task achievement. The objective is to develop processes, techniques and software tools that enable AdCoS development and qualification.

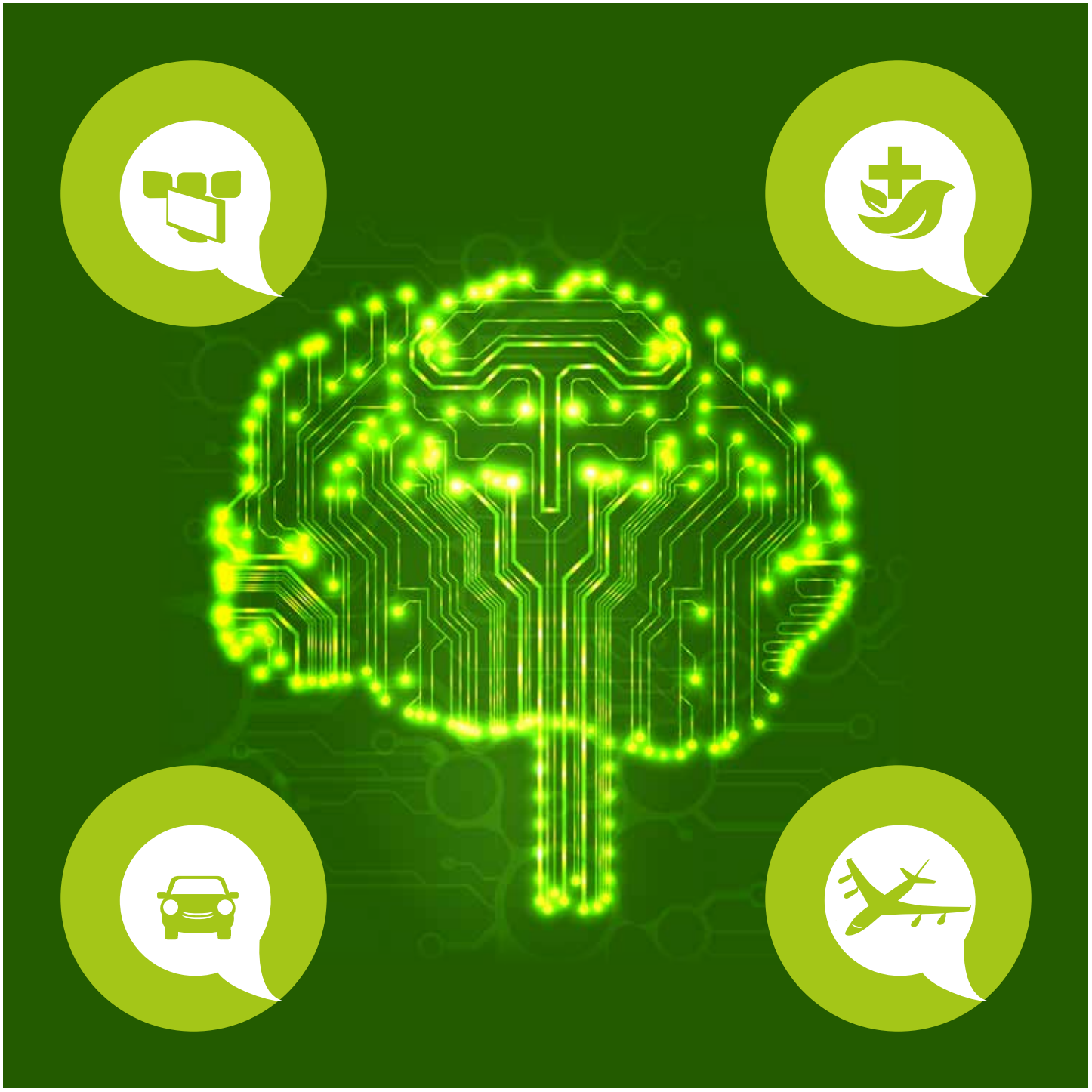


MARKET INNOVATION AND IMPACT

HoliDes will offer a combined model-based and empirical approach to the development and qualification of AdCoS, significantly easing compliance with human-factor and safety regulations, and will allow adaptation strategies to be realised in a transparent, fluent, explicit and controllable way.

The expected results include a methodology to facilitate the development & qualification of AdCoS in terms of regulations to formalise and extend the informal descriptions of human factors and safety standards, guidelines and best practices highlighting commonalities between health, aeronautics, control rooms and automotive. Empirical analysis will advance empirical techniques and adaptation on a global and local level will provide new real-time measurements of the external and internal AdCoS context and new reusable algorithms for re-configuration of tightly interconnected global and local AdCoS levels. A Human Factors Reference Technology Platform (HF-RTP) will integrate all the techniques and tools, allowing full interoperability across the whole industrial development and qualification life cycle.

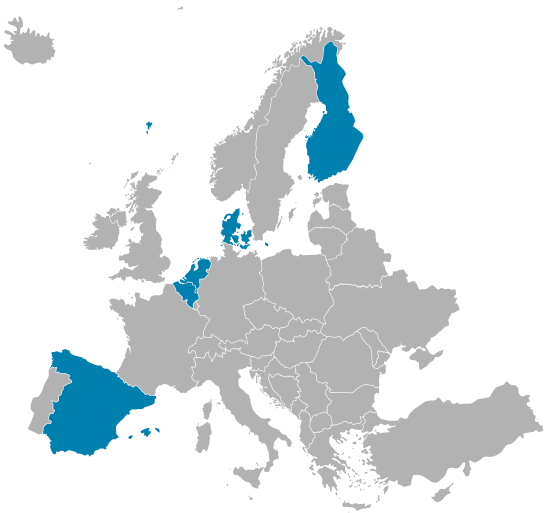
HoliDes will promote wider and more effective industrial competiveness, by striving to maintain Europe's lead regarding the competition from the US and the Far East in the transportation, control room and health markets. HoliDes will boost the cost efficiency of highly innovative adaptive cooperative human-machine system solutions involving several interactive Embedded Systems. It will also address and improve sustainability, by enhancing the efficiency and effectiveness of future transportation, control room and health systems. Finally, enabling new adaptive functionality and enlarging the user groups of automated technology will enable the emergence of new markets that address societal challenges.



With-Me
332885

Start date:	June 2013
Project duration (months):	36
Total investment:	€10.22 m
Number of participating organisations:	20
Number of countries:	5

The With-Me project will create the With-Me ecosystem: a collection of embedded devices including multi-purpose consumer electronics, dedicated health equipment and external information sources, as well as the required computational environment supporting services and applications. Deployment in real environment pilots will deliver the evidence that people's adherence to healthier behaviour will improve by using persuasive electronic services.



MARKET INNOVATION AND IMPACT

With-Me aims at providing a health prevention platform and personalised services to improve general health and to prevent risk from a range of diseases. For that purpose, With-Me is designed around three pillars: embedded platform for multivendor nomadic sensors, interoperable intelligent sensors for monitoring wellbeing and open architecture for persuasive electronic services.

The result of the With-Me project will be a customisable, adaptive, assistive and yet secure training/supporting solution according to user preferences and needs, a personalised assistant that provides mainly seamless guidance and promotion of physical activity, both indoors and outdoors, as well as healthy living. A complete and open solution with seamless integration of interoperable nomadic and home sensor devices and health services will be achieved through technological and application innovations, centred on the three pillars mentioned above. The clear market innovation is evident in the integration of information management in personal information spaces, the design of products with innovative user interfaces and improved support to the safety and efficiency of health monitoring and healthy living.

With-Me will provide consumers with a product suite that covers both healthcare and healthy lifestyle support, ensuring continuity of personalised assistance from lifestyle improvement to primary, secondary and tertiary prevention and care. In the medium to long term, impact can be expected in terms of fewer visits to doctors and hospitals, shorter hospitalisation periods, increased longevity with improved quality of life throughout and increased support to interdisciplinary care teams.


ARTEMIS


CAL2013

Introduction: Call 2013

Call 2013, the 6th and last Call of the ARTEMIS Joint Undertaking. I must admit to having been disappointed that the new impetus in Nation funding that had been apparent in the Call 2012 could not be sustained into our last Call. Still, rather to go out with a bang than a whimper, the ARTEMIS community again responded with project proposals of exceptional quality and value, out of which one very significant AIPP (EMC2, with its clear nod to Albert E.'s ground-breaking work) and three equally high-profile projects were finally selected for funding – you can of course read details in the following section.

Alun Foster
Executive Director ARTEMIS Joint Undertaking

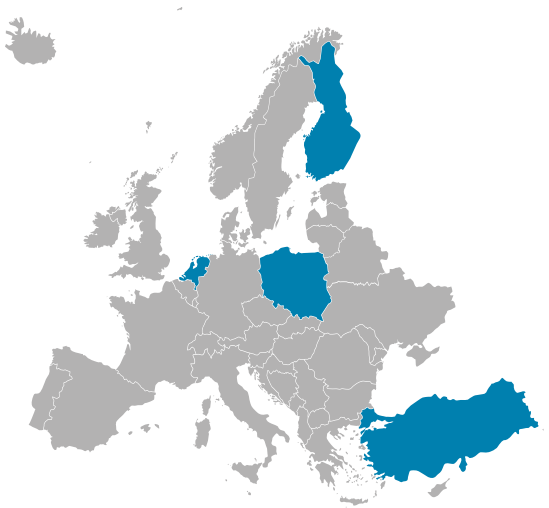
ALMARVI
621439

Start date:	April 2014
Project duration (months):	36
Total investment:	€16.68 m
Number of participating organisations:	16
Number of countries:	4

ALMARVI provides a cross-domain, many-core platform solution that includes a system software stack, tool chain and adaptive algorithms for massive data-rate image/video processing with high energy efficiency and adaptability.

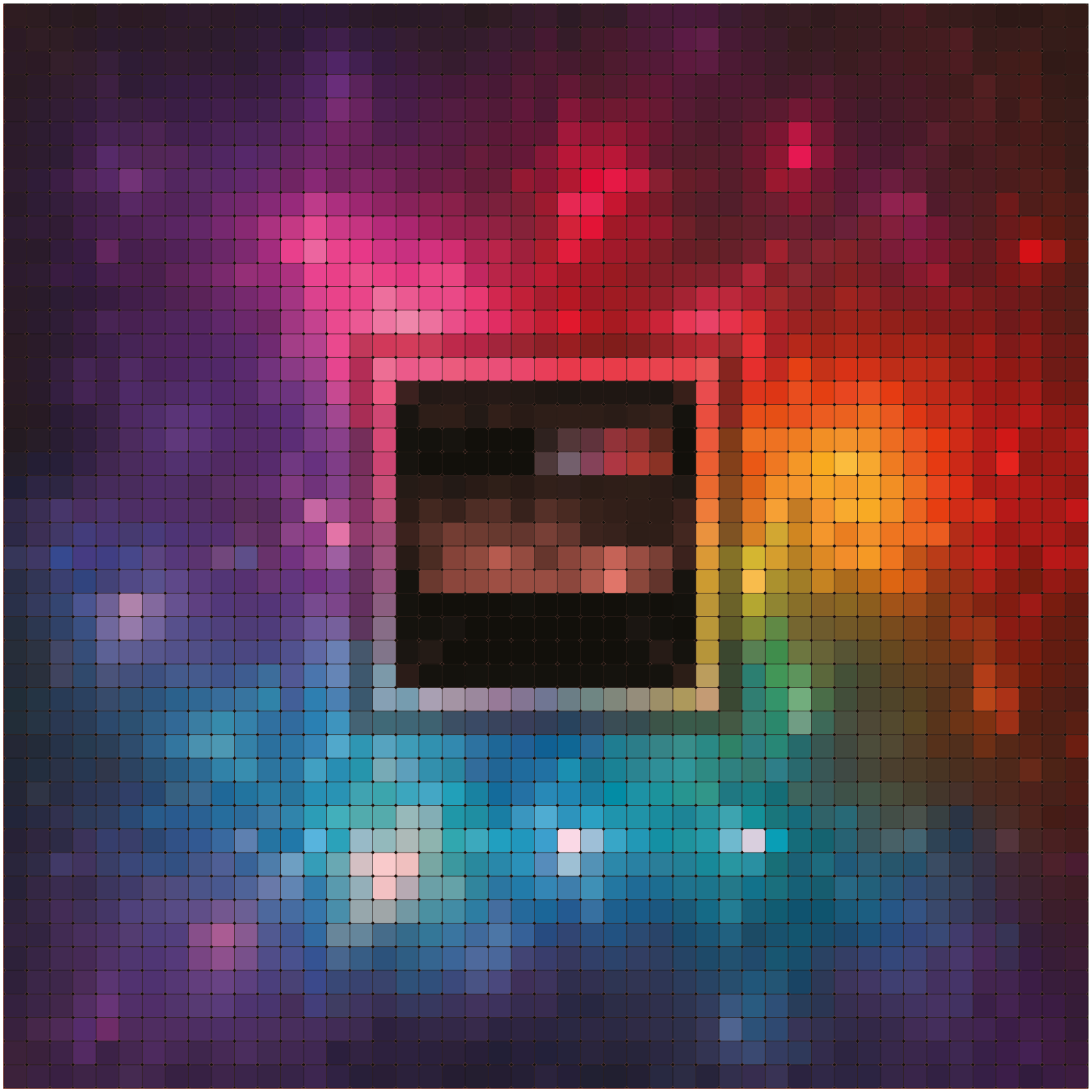
MARKET INNOVATION AND IMPACT

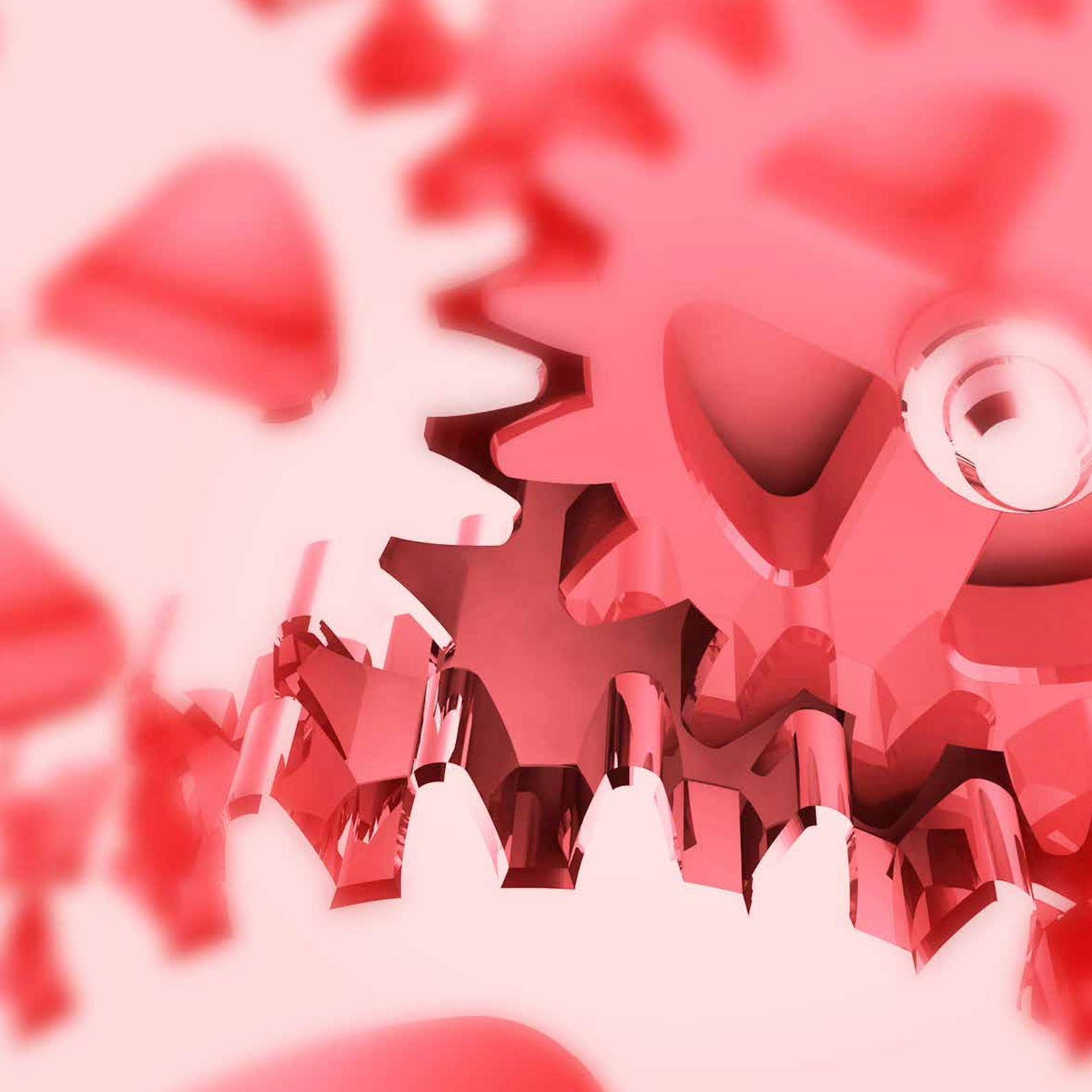
The key lies in leveraging the properties of image/video content, while adapting algorithms and hardware at the same time, to boost power savings and enable massive data-rate processing. At the application layer, the goal is to adapt algorithms to the architectures, while at the system software stack layer, the adaptive run-time system allocates resources to different applications with simultaneous, energy-efficient execution. At the hardware layer, the ALMARVI's many-core execution platform provides the computing capabilities to diverse image/video processing applications.



The crux of the project is enhanced resource and power management, whereby resource/power requirements are derived from image/video processing algorithms and forwarded to the hardware layer. In the event that the underlying hardware does not provide the required performance/power efficiency, the algorithms will self-adapt to curtail their computational requirements, while trading off the quality requirements.

With advanced image and video processing systems becoming a crucial and resource-consuming central feature of embedded applications in many sectors, this project facilitates the transition from a vertically structured to a horizontally structured market by reducing overall system design cost and time-to-market, enabling low-cost solutions for high-volume markets in different industrial domains, and creating new market opportunities, in particular for SMEs. The demonstrators for the healthcare, security/surveillance/monitoring and mobile use cases will directly lead to marketable applications and products in their respective domains. Integrated releases of the image/video processing algorithm libraries, reference design tools and platforms, along with system software stack solutions, will be made available, as will their evaluation for the demonstrated use cases. Cross-domain applicability will reduce fragmentation, thus increasing the market share of the European supplier industry.





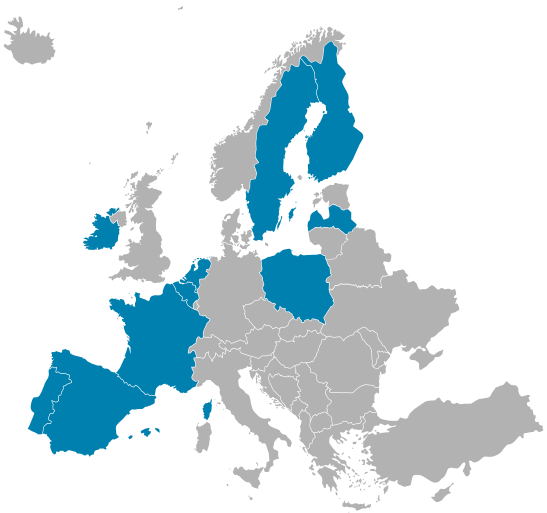
DEWI
621353

Start date:	March 2014
Project duration (months):	36
Total investment:	€39.61 m
Number of participating organisations:	58
Number of countries:	11

DEWI will provide key solutions for wireless seamless connectivity and interoperability in smart cities and infrastructures, by considering everyday physical environments of citizens in buildings, cars, trains and aeroplanes, thereby significantly contributing to the emerging smart home and smart public space.

MARKET INNOVATION AND IMPACT

DEWI, with its four industrial domains (Aeronautics, Automotive, Rail, Building) will add clear interoperability and cross-domain benefits in the area of wireless sensor networks and wireless communication, in terms of re-usability of technological building bricks and architecture, processes and methods.



The key results of DEWI will be shown in the attractive real-life demonstrators of the DEWI "sensor & communication bubble", such as wireless sensor networks for civil rocket launchers or an off-highway vehicle for wireless vibration monitoring on operators. The concept of a locally adaptable wireless "sensor & communication bubble" will feature: locally confined wireless internal and external access; secure and dependable wireless communication and safe operation; fast, easy and stress-free access to smart environments; flexible self-organisation, re-configuration, resilience and adaptability; open solutions and standards for cross-domain reusability and interoperability.

Based on more than thirty clear business needs identified by DEWI industrial partners, the concept of the "sensor & communication bubble" is being realised in twenty-one industry-driven use cases, aimed at tackling dependable, auto-configurable, optionally secure, short-range communication, local energy-management, the localisation of sensors and mobile devices, and the smart composability and integration of wireless sensor networks.

The project will contribute to emerging international standards, influence new regulations and lay the basis for efficient certification processes. In addition, DEWI will make a significant contribution to and benefit from existing ARTEMIS Tool Platforms, the ARTEMIS Repository and ARTEMIS sub-programmes, providing not only concrete input through its well-defined technology items, but also strategic input to other fields of application, such as healthcare.


DEWI
Dependable Embedded Wireless Infrastructure

Today, wireless communication has found its way into the everyday life of almost all citizens, be it in private, in public or in business. Embedded devices like mobile phones, WLAN routers, high-speed home entertainment connections or navigation systems are familiar to everyone. It is evident that the presence of this wireless technology has significantly eased the lives of citizens, by providing connectivity. →

However, wireless connections can reach far beyond mere communication needs of citizens. In combination with information retrieval from one's surroundings via wireless sensor networks, this can significantly increase flexibility for both citizens and professional users in their environments. Here, wired technologies still dominate, mainly due to the lack of dependability (reliability, safety, security etc.), privacy and auto-configurability of wireless networks. Furthermore, current wireless solutions do not have the common reference design and service-oriented architecture needed to build a market environment where competition enables lower prices for citizens.

To make this possible, DEWI will provide key solutions for wireless seamless connectivity and interoperability in smart cities and infrastructures, by considering everyday physical environments of citizens in buildings, cars, trains and aeroplanes, which will significantly contribute to the emerging smart home and smart public space. For this purpose, DEWI introduces the concept of a locally adaptable wireless "sensor & communication bubble", featuring: locally confined wireless internal and external access; secure and dependable wireless communication and safe operation; fast, easy and stress-free access to smart environments; flexible self-organisation, reconfiguration, resilience and adaptability; open solutions and standards for cross-domain reusability and interoperability.

SENSOR & COMMUNICATION BUBBLE

Based on more than 30 clear business needs identified by DEWI industrial partners, the concept of the "sensor & communication bubble" will be realised in 21 industry-driven use cases, tackling challenges such as dependable, auto-configurable, optionally secure, short-range communication, local energy management (efficiency, harvesting, storage), the localisation of sensors and mobile devices or the smart composability and integration of wireless sensor networks. These many and various use cases of DEWI will clearly highlight the advantages of replacing wired by wireless solutions. Some of the benefits are lower weight in weight-sensitive environments, more flexibility and reconfigurability, easy, cost-effective feature updates, novel "bring your own device" applications, error elimination -caused by faulty wiring- by self-managed wireless networks, the reduction of installation costs by simplified deployment procedures, and easy switching of network topologies.

The key results of DEWI will be shown in attractive real-life demonstrators of the DEWI "sensor & communication bubble", such as wireless sensor networks for civil rocket launchers, off-highway vehicle for wireless vibration monitoring on operators, wireless technology for easier rolling stock maintenance and wireless sensor networks for improving building energy efficiency, for operation, maintenance and access control.

ADDRESSING SOCIETAL CHALLENGES

The application innovations provided by DEWI fully address specific societal challenges, as supported by ARTEMIS, such as "Green, safe & supportive transportation" and "Smart buildings & communities of the future". These solutions will allow citizens (both private and professional) more local personal control, less stress, lower overhead and increased comfort and safety in everyday life. With its four industrial domains (Aeronautics, Automotive, Rail and Building), DEWI will add clear benefits to interoperability and cross-domain issues in the area of wireless sensor networks and wireless communication, in terms of the reusability of technological bricks, as well as architecture, processes and methods. Consequently, the currently fragmented research results will be integrated into a harmonised architecture for dependable wireless systems development, building on and extending existing domain-specific and domain-independent standards.

DEWI will also contribute to emerging international standards, will influence upcoming regulations and will lay the basis for efficient certification processes. DEWI will significantly

contribute to and benefit from existing ARTEMIS Tool Platforms, the ARTEMIS Repository and ARTEMIS sub-programmes, with its well-defined technology items providing concrete input and applications such as embedded systems for healthcare profiting from strategic input.

CRITICAL MASS AND STRONG SYMBIOSIS

As a large and strategic initiative, DEWI involves 58 key European Embedded Systems players in transportation and building automation – both LEs, SMEs and academia – from 11 EU countries. This creates the necessary critical mass to achieve both societal impact regarding future safer transport and building and technological advances in terms of cross-domain, platform-based reusability. In general, DEWI will raise awareness, as well as prepare the ground, for the broad introduction of wireless sensor networks and wireless communication. This is made possible by a strong symbiosis between industry, research, and education and is underpinned by the equivalent of 130 dedicated persons working full-time for 3 years in the DEWI project.

DEWI will really help boost employability in Europe, by opening up novel business opportunities and new markets, in particular for European SMEs in cooperation with LEs having direct global market access (DEWI has an outstanding ratio of SMEs to LEs of 2:3). Thus, DEWI will create new high-quality sustainable jobs and will promote academic education in the area of wireless sensor networks & wireless communication. Eventually, DEWI wants to foster Europe's leading edge position in the design, development and deployment of smart dependable wireless environments, in particular regarding quality, cost effectiveness, composability, flexibility, reusability, acceleration of time-to-market, continuous integration of innovations and sustainability. It will strengthen European competitiveness and will increase the reliability of wireless communication, to enable new markets and societal applications for citizens.

ACCOMPLISHMENTS SO FAR

Some 15 journalists and more than 90 DEWI project partners attended a successful official kick-off meeting on 27–28 March 2014 in the Stadthalle Graz, Austria. Both the DEWI homepage (www.dewi-project.eu) and the DEWI leaflet were presented. The media gave the project a profiling boost. In the first two months of the project, DEWI partners have started their work on different project levels, building up all their required internal working relationships. Besides this, the members of the main DEWI governance boards (Technical Board, Steering Board, General Assembly) have been appointed, to focus on DEWI technical progress monitoring methodology, requirements management and elaborating basic documents/deliverables, such as a project handbook, dissemination plan and quality plan.

Article written by Werner Rom

Website: www.dewi-project.eu

EMC²

621429

Start date:	April 2014
Project duration (months):	36
Total investment:	€93.92 m
Number of participating organisations:	100
Number of countries:	16

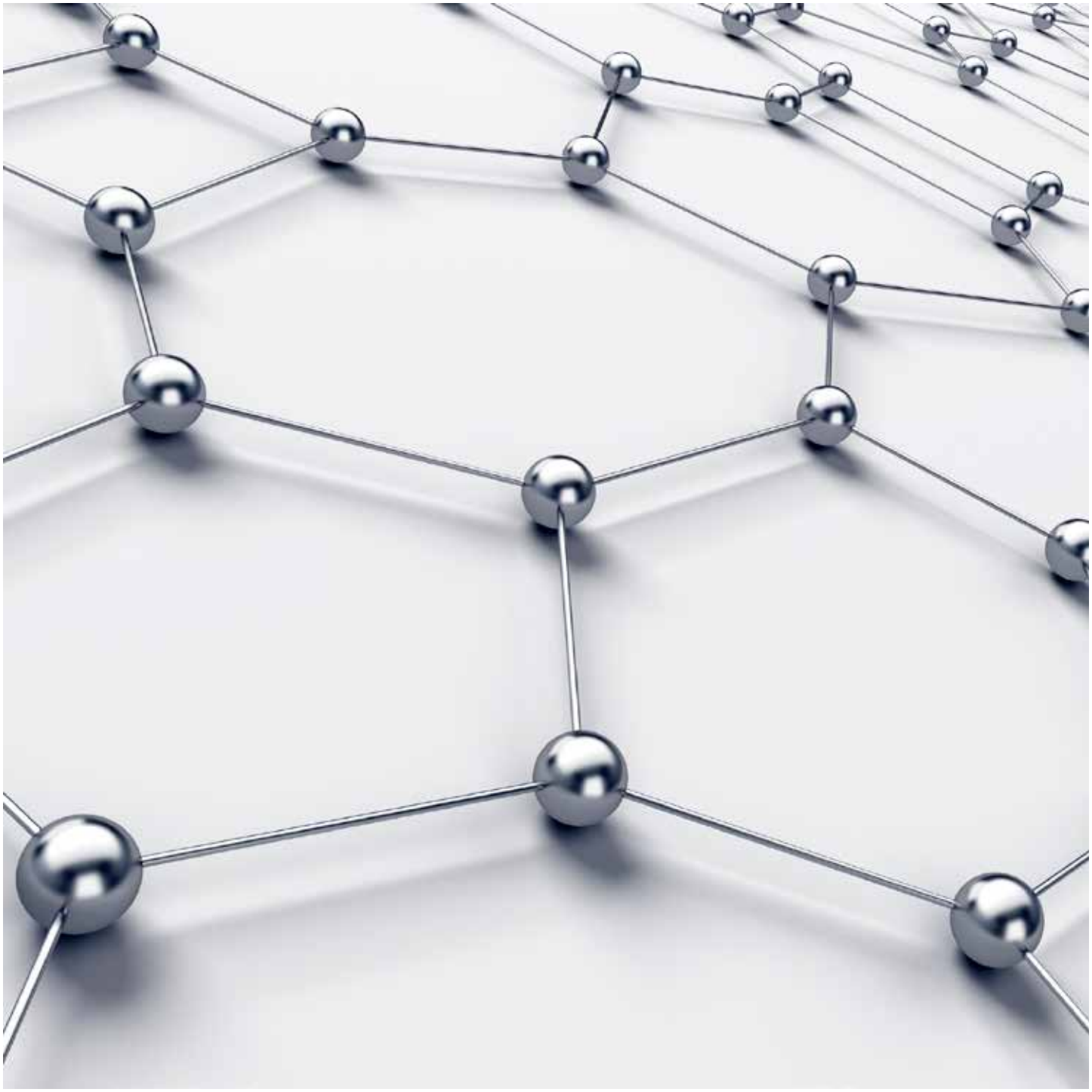
EMC² finds solutions for dynamic adaptability in open systems. It provides handling of mixed criticality applications in real-time conditions, with scalability and utmost flexibility, full-scale deployment and management of integrated tool chains, throughout the lifecycle.

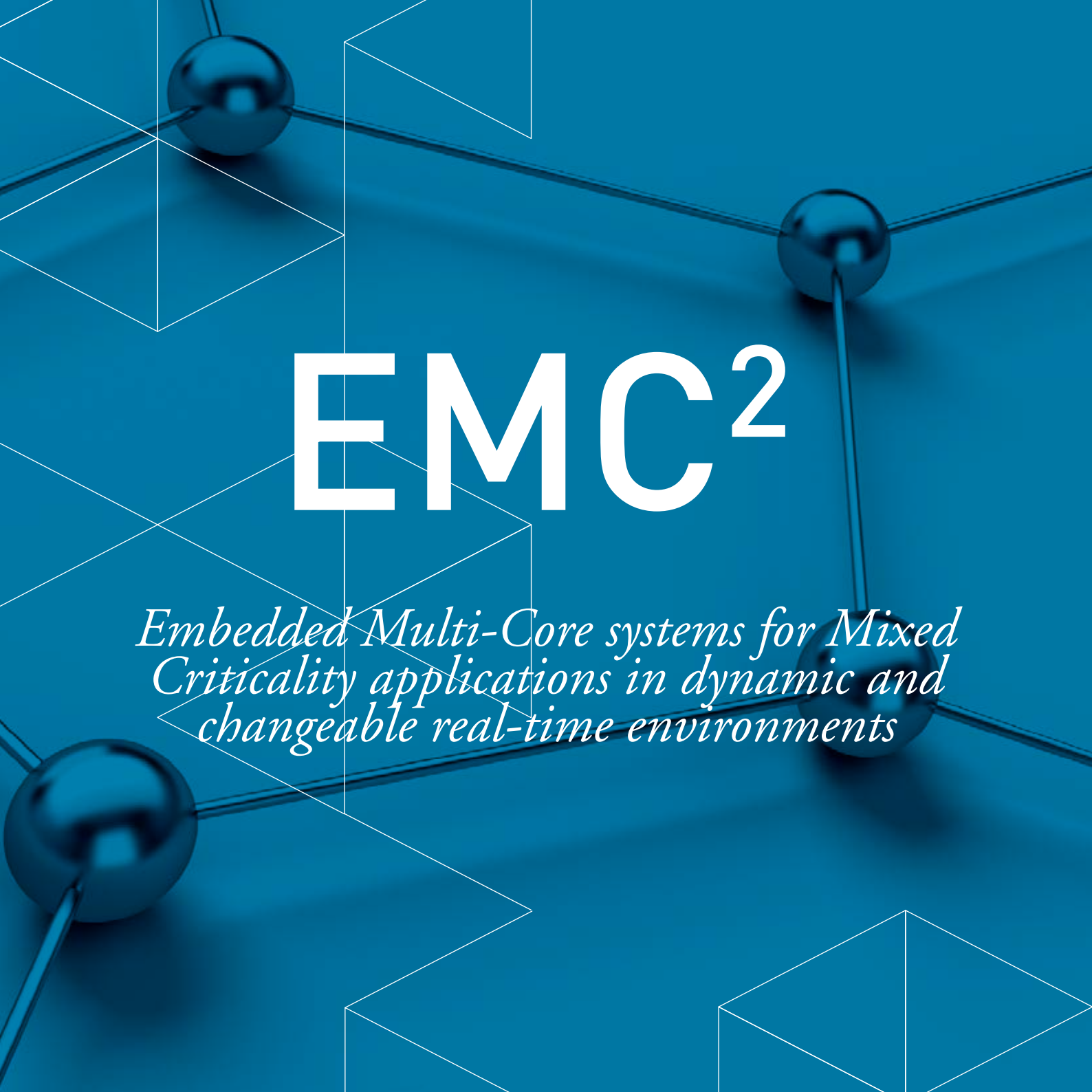
MARKET INNOVATION AND IMPACT

Due to the size of the EMC² project, each work package was designed with its own unique objectives, task descriptions, deliverables, milestones, schedule, etc., fitting seamlessly into the overall EMC² plan. This Embedded System approach will force the breakthrough and deployment of multi-core technology in almost all application domains – Avionics, Space, Automotive, Railway, Shipping, Medical, Energy and Industrial Factory Automation – where real-time and mixed-criticality are issues, and therefore strengthen the competitiveness of the European Embedded Systems industry.

The project's matrix structure has closely linked horizontal and vertical activities. The horizontal activities will develop dedicated technologies required for the implementation of embedded, mixed-criticality multi-core systems, while the vertical activities will employ living labs to focus on the same application domain. The technologies developed in the horizontal activities will be applied and evaluated in the dedicated use cases of the living labs.

EMC² expects to facilitate the EU's ability to deploy and use embedded systems across important European market sectors. In the Automotive market, embedded systems are the key innovation driver, enabling >90% of the innovations. For Avionics, the main challenges relate to accelerating technology cycles and reducing software development costs, while the Space market wants to increase performance/weight ratio, reliability and lifetime. Energy efficiency and sustainability will be key to industrial control and factory automation. In Healthcare, the challenges are related to work flow efficiency, integration of diagnosis and treatment, and quality assurance. Finally, the Internet of Things will need to handle the increased amount of data available, as well as safety and security issues.




EMC²
Embedded Multi-Core systems for Mixed Criticality applications in dynamic and changeable real-time environments

Embedded systems are the key innovation driver to improve almost all products with cheaper and even new functionalities. Furthermore, they strongly support today's information society as an inter-system communication enabler. Consequently, the boundaries of application domains are fading, with ad-hoc connections and interoperability playing an increasing role. →

At the same time, multi-core and many-core computing platforms are becoming available, with the promise of a breakthrough for system (and application) integration, efficiency and performance. A major industrial challenge is posed by the cost-efficient integration of different applications with different levels of safety and security on a single computing platform in an open context.

The objective of the EMC^2 project is to foster these changes, through an innovative and sustainable service-oriented architecture approach for mixed criticality applications in dynamic and changeable real-time environments. EMC^2 will cluster the power for innovation of 99 partners from the Embedded Systems industry and research from 19 European countries. It will entail about 800 person years and a total budget of about 100 million euros, as part of the European Embedded Systems industry strategy to maintain its leading edge position.

RELEVANCE TO ARTEMIS STRATEGIC GOALS

The EMC^2 project takes account of the ARTEMIS strategic targets of reducing the cost of system design and development cycles by 15%, reducing the effort and time required for the re-validation and recertification of systems after making changes, also by 15%, managing a complexity increase of 25% with 10% reduced effort. Furthermore, by addressing the topic of industrial-strength tools, the project contributes to the ARTEMIS tool Repository. The flexible Multi-Processor System on Chip (MPSoC) architecture that will be developed, can be tailored by middleware to the needs of a particular application domain, to substantially reduce the non-recurring development costs and time to market. Also, driven by the application needs, EMC^2 puts a strong focus on reconfigurablity and adaptability. The project is in line with the ARTEMIS promotion of the concept of reference designs and architectures that provide solutions to key technical challenges – such as composability, networking, security, robustness, diagnosis, maintenance, integrated resource management, evolvability, self-organisation, and dynamic adjustments in changing systems.

R&D&I AND TECHNICAL EXCELLENCE

The embedded systems segment is presently undergoing a disruptive innovation process, in which previously closed systems are being forced to open up. The current multi-core and many-core processors are too slow, inefficient and expensive for critical and real-time applications. EMC^2 takes an innovative and sustainable service-oriented architecture approach for mixed criticality applications in dynamic and changeable real-time environments, that will force the breakthrough and deployment of multi-core technology in almost all application domains – Space, Transport, Medical, Energy and Industry – where real-time and mixed-criticality are an issue. A project structure has been adopted to produce both technological and application innovations.

TECHNOLOGICAL INNOVATIONS

System Architectures will be combined with new explorations of scalability and system compatibility, with a system for a dynamic multi-core multi-criticality software platform where multiple applications can share the same virtual machine (VM), and hardware virtualisation will be extended to multi-core systems. Executable application models and design tools for mixed-critical, multi-core embedded systems will be developed, by building on the well-established, rigorous system design and automated flows and extending them towards dynamic, heterogeneous, compute-intensive and mixed-critical systems.

In terms of dynamic runtime environments and services, existing knowledge in relevant mechanisms and architectures will be enhanced, to support mixed-critical systems, security techniques, safety and real-time properties. The development of multi-core hardware architectures and concepts with partial reconfiguration for application specific acceleration will open up a new era of time multiplexed hardware co-processors, reducing power and improving efficiency in computational

intensive applications. A non-monolithic integration framework generalises the concept of "Internet of Things", bridging the gap between business and engineering, while system qualification and certification are enhanced by software-based fault-tolerant algorithms and architectures for multi-cores, safety and security assurance methodologies.

APPLICATION RELATED INNOVATIONS

These technological advances are leveraged by six living labs that cover Automotive, Avionics,
Space, Industrial Manufacturing and Logistics, Internet of Things and, finally, Cross-domain applications in which the results of previous research projects and the EMC^2 technology innovation are used in innovative ways to prepare the ground for future multi-core applications.

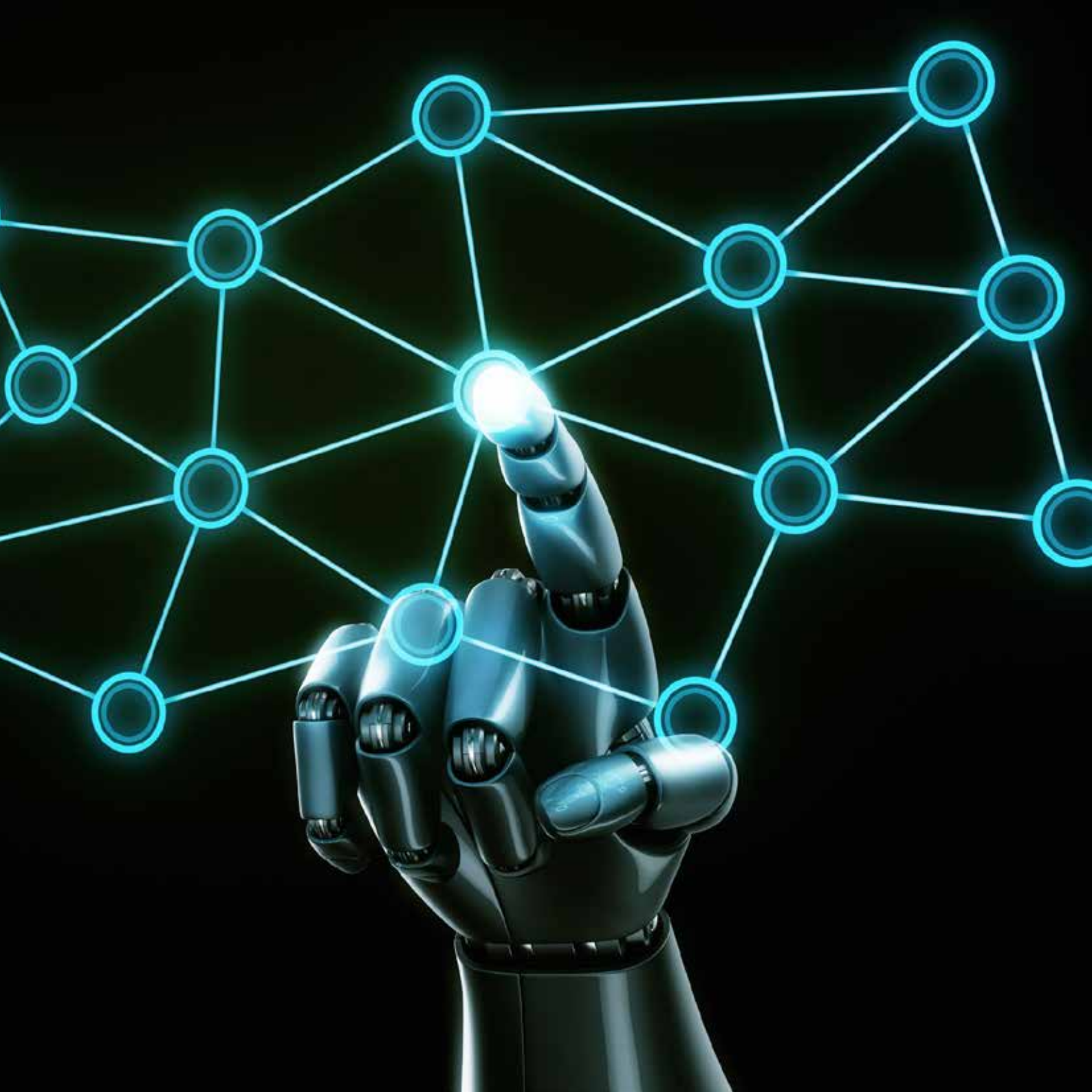
MARKET INNOVATION AND MARKET IMPACT

The EMC^2 project expects to facilitate a positive shift in the EU's ability to deploy and use embedded systems across many important European market sectors. Multi-core processors are expected to be one of the key technical solutions in the Embedded Systems market in these domains, as they provide increased performance, less size, weight and power consumption and, at the same time, more safety and security compared with the legacy single-core processors.

EMC^2 will reinforce and sustain European excellence in multi-core embedded systems and components, while opening up new potential markets of complex heterogeneous Systems of Systems and Connected Things. EMC^2 will significantly strengthen Europe's economy and contribute to the strategic objective of ARTEMIS of promoting the cross-fertilisation and reuse of technology results in different application domains.

Article written by Chris Horgan

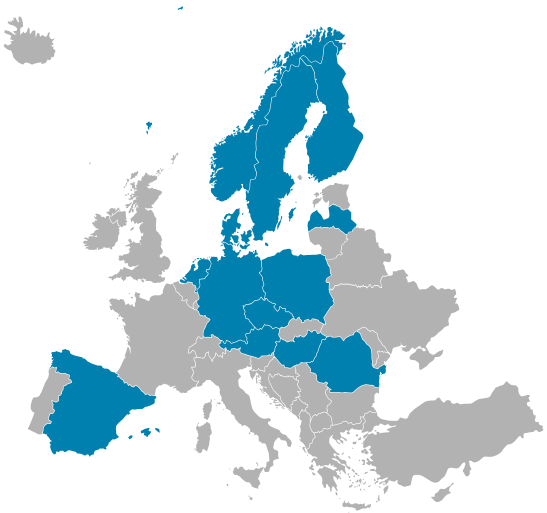
Website: www.emc2-project.eu



R5-COP
621447

Start date:	February 2014
Project duration (months):	36
Total investment:	€13.15 m
Number of participating organisations:	31
Number of countries:	13

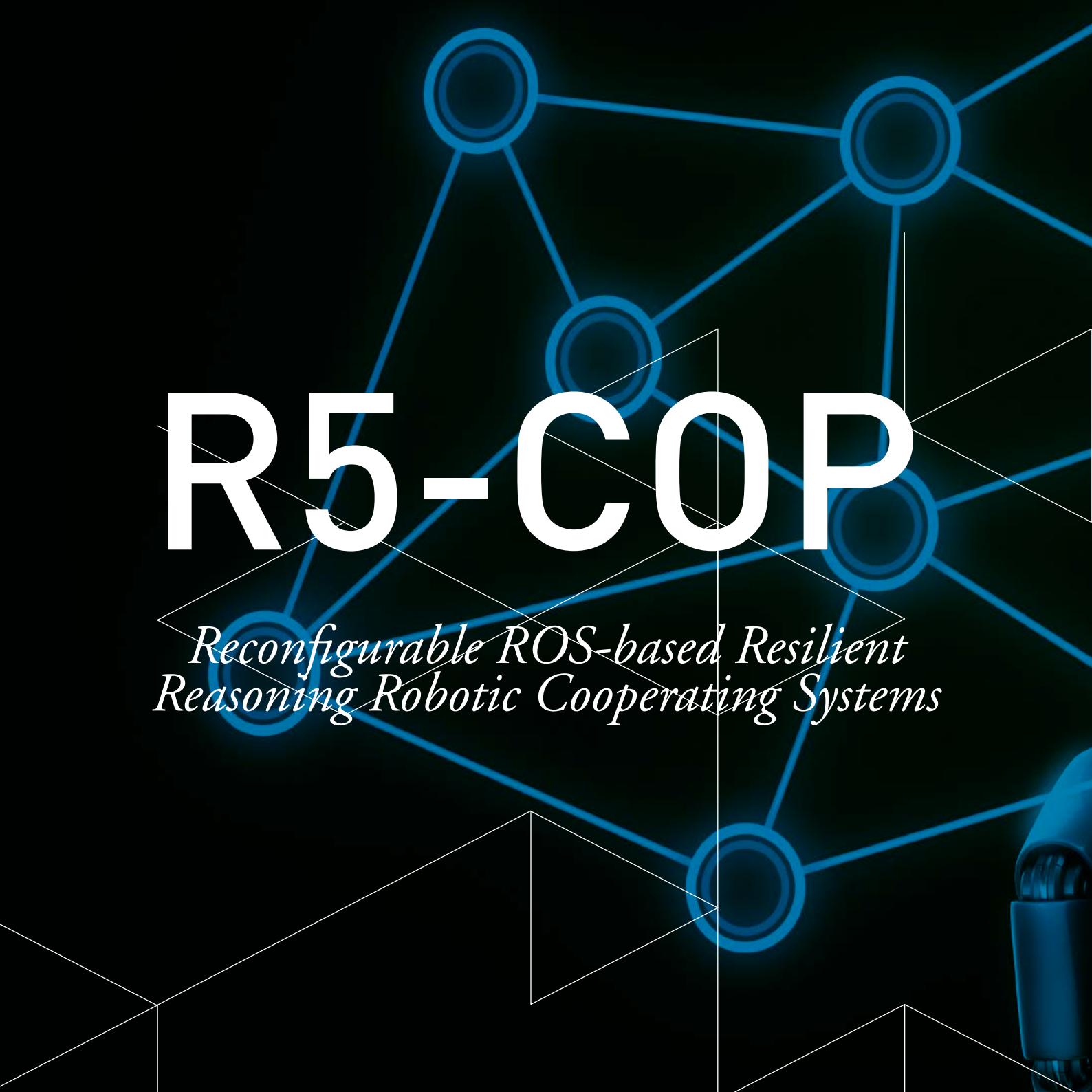
R5-COP focuses on agile manufacturing paradigms and specifically on modular robotic systems. Based on existing and newly developed methods for the formal modelling of hardware and software components, R5-COP will support model-based design, engineering, validation and fast commissioning. Using existing interface and middleware standards, R5-COP will be a strong facilitator of the integration of components from various suppliers.



MARKET INNOVATION AND IMPACT

The main objective of the R5-COP project is to provide the means for fast and flexible adaption of robots to quickly changing environments and conditions, and to enable safe and direct human-robot cooperation and interaction on an industrial scale. It aims to enable fast and flexible re-composition of software and hardware components of robotic systems, while ensuring robust and safe operation, through the modular design of components with formalised specifications and standardised interfaces. Standardised yet simple design and implementation of software components will be complemented by standardised yet flexible (re)configuration, using ontologies of configurable components for modelling hardware and modelling applications on an app or skill level. Dedicated verification and validation techniques will support component and system certification for safe human/robot cooperation, while dedicated use cases from industrial and service domains will identify, model, develop and evaluate key hardware and software components.

The focus on agile manufacturing paradigms, and specifically on modular robotic systems, will firstly identify and extend suitable existing methods and, where required, develop new ones to formally model hardware and software components. Using existing interface and middleware standards, such as ROS, will strongly facilitate the integration of components from various suppliers. Such a modular approach is not only flexible, but will also reduce design, setup and maintenance costs. Living labs will be employed to show the feasibility and capability in manufacturing and service demonstrator environments.


R5-COP
Reconfigurable ROS-based Resilient
Reasoning Robotic Cooperating Systems

Industrial robotic systems and recent developments in the area of service robots have opened a wide range of new application scenarios, especially where human/robot cooperation is required. However, the current state of the art still lacks suitable methods that enable easy adaption and reconfiguration of such systems, as it does not yet support straightforward and efficient engineering, set-up and deployment of them. →

The R5-COP project tackles these problems with a holistic approach, applied to various system levels.

PROJECT GOALS AND SRA CONTRIBUTION

R5-COP focuses on agile manufacturing paradigms and specifically on modular robotic systems. Based on existing and newly developed methods for formal modelling of hardware and software components, R5-COP will support model-based design, engineering, validation and fast commissioning. Using existing interface and middleware standards, R5-COP will strongly facilitate the integration of components from various suppliers.

R5-COP will be providing a platform and toolset containing methods, algorithms, prototypes and living lab solutions for cross-domain reusability, scalability and open interface standards for robotic and autonomous systems. It will contribute to the ARTEMIS Repository, by connecting to other ASP and AIPP initiatives, to ensure long-term sustainability and impact towards society. The key results of R5-COP will be demonstrated in a set of showcases, displaying high relevance to industrial and manufacturing issues and cross-domain applicability. Regarding interoperability, R5-COP will also contribute to establishing a standard for robust, reliable reconfigurable robot systems, using common interfaces in a certification and safety context, which entails conformity to both domain-specific and international domain-independent standards. By enabling the use of highly flexible robots in safety-critical (fenceless) environments, the project fosters a significant increase in market potential. The actual impact of R5-COP will be evaluated against its influences on the standards, scientific-technological viewpoints towards reconfiguration in SMEs and paradigm change towards using reliable, safe, and easily reconfigurable robotics.

PROJECT HISTORY AND FORMATION

To reach these ambitious goals, the R5-COP project builds upon the results of its ARTEMIS Call 2009 ancestor R3-COP, which particularly dealt with aspects of autonomous behaviour, most notably orientation and autonomous task-execution in a safe, resilient and fault-tolerant manner. In order to achieve wide applicability of the developed approaches, a software-modular approach was already employed, ensuring the successful application of core results in the project's wide variety of demonstrator platforms.

With R3-COP having successfully ended in October 2013, R5-COP – starting February 2014 for a 36-month period – picks up the modular approach and goes further, by introducing advanced flexibility. Featuring the use of the Robot Operating System (ROS) enables enhanced modularity, by the functionality being encapsulated in so-called ROS nodes (software modules) and ROS modules (hardware modules).

With 31 partners from 13 countries, R5-COP features an even bigger consortium than its predecessor. This is particularly noteworthy, given that R5-COP was struck with depletion of national funding in several partner countries, lowering the project's original planned budget by more than 42%. However, R5-COP was and is of the highest relevance, so a number of partners accepted participation at reduced, or even without, national funding. Where this led to vacancies within the project due to the accordingly reduced work effort, R5-COP was able to gain additional partners from other countries, not only filling these vacancies, but even taking over key roles within the project, hence furthermore emphasising the relevance of R5-COP's topics.

R5-COP INNOVATION AT A GLANCE

The European manufacturing industry faces increasing demand for high product variance, small product series, shorter production cycles and cost reduction. However, few robotic components are designed for easy adaptation and reuse. R5-COP focuses on agile manufacturing paradigms and specifically on modular robotic systems, to overcome the shortcomings

of the existing solutions. It starts by identifying and extending suitable existing methods and, where required, developing new ones to formally model hardware and software components. Since the flexible use of robots includes their close cooperation with humans, robustness and safety are crucial requirements, which will be assured by dedicated verification and validation methodologies. The formal specification framework will support component suppliers in efficiently verifying and certifying their modules. This project will help to identify and develop reconfigurable key hardware and software components, and to show the feasibility and capability of the approach in living labs in manufacturing and service demonstrator environments.

MAIN OBJECTIVES

The R5-COP project aims to provide the means for the fast and flexible adaption of robots to quickly changing environments and conditions, to enable safe and direct human/robot cooperation and interaction at industrial scale. To overcome the shortcomings of existing robotic solutions, it aims to enable fast and flexible re-composition of software and hardware components of robotic systems, and ensure their robust and safe operation through modular component design with formalised specifications and standardised interfaces. This will be complemented by standardised yet simple design and implementation of software components using ROS Industrial for software deployment and SDKs for software development. Standardised yet flexible (re)configuration will be achieved using the ontologies of configurable components for modelling hardware, and modelling applications on an app or skill level, while the use of advanced reconfigurable sensor systems modules will ensure robust perception. Component and system certification for safe human-robot cooperation will be assured by using dedicated V&V techniques and the identification, modelling, development and evaluation of key hardware and software components will employ dedicated use cases from industrial and service domains.

ARTEMIS SUB-PROGRAMMES

The R5-COP project addresses the ARTEMIS sub-programs ASP4 (“Embedded Systems for manufacturing and process automation”), ASP1 (“Methods and processes for safety-relevant embedded systems”), and ASP5 (“Computing platforms for embedded systems”).

In terms of ASP4, the sub-programme primarily addressed, it specifically relates to: improved methods and technologies for automation model life-cycle management; online real-time quality assurance of measurement data; robustness of sensor and actuator technology, e.g. calibration, energy harvesting, and disposability; automation system human-user interface context awareness and information timing; automated device configuration. Due to the delicate nature of robot and automation systems, there is strong focus on safety and security. Hence, the project also addresses core ASP1 topics, which are: requirement management; architecture modelling and exploration; analysis methods; component-based design, particularly building reliable systems out of unreliable components.

Technology-wise, it is closely tied to work in the field of ASP5, especially with respect to complex distributed heterogeneous systems supporting real-time awareness, safety protection and cyber-physical properties such as complex real-time sensor-data fusion. We aim to target ASP5’s main goal of enabling an increase of cross-domain re-use and interoperation, thus leading to lower costs of ownership and wider applicability.

Furthermore, R5-COP covers aspects of ASP8 with respect to human-centred design of human-machine interfaces, object recognition, scene analysis, real-time image processing and cognitive assistance. It is motivated by usage scenarios from ASP2, ASP3, and ASP6.

INITIAL PROJECT OUTCOME

One of the focal goals of R5-COP is "programming by demonstration". The concept that it proposes, as enabler of more flexible robotics, is the combination of imitation learning and reinforcement learning. Imitation learning is a method by which a robot learns new skills through human guidance and imitation. The purpose of imitation learning is to perform a task by generalising from observations. The power of imitation learning is that the robot is programmed in an intuitive way, while the insight of the teacher is incorporated in the execution of the task.

In this work, a combination of imitation and reinforcement learning is prepared for a grasping application in an industrial setting. The robot generalises movements from observations of human operators and optimises these for energy-efficiency and time using reinforcement learning. During the first months of the project, project partners Alten and TU Eindhoven presented initial ideas to a potential user, Philips Consumer Lifestyle, which adopted this as a serious use case to consider for future use in their shaver factory. One of the process steps in the production of a Philips consumer product is the painting of plastic parts. In the current situation, parts are placed manually on a painting carousel. There are several reasons why this process has not been automated yet: the parts are fragile and not easy to grasp, there are several different geometries, detailed visual inspection is required, and new parts are often introduced in the system. Using the proposed solution, the robot could directly learn an efficient grasping strategy from an operator, saving the time and expense of conventional reprogramming.

For the Vision and Robotics conference on 11-12 June 2014, co-organised with the RoboNED conference, in Veldhoven, Netherlands [1], project partner Alten prepared a workshop on the use of ROS Industrial (ROS-I) [2] . Its purpose was to introduce new users from industry to ROS-I, by means of a practical training. Furthermore, this event targeted potential users of the R5-COP project results, and informed them on its aims and objectives.

As one further example of ROS employment, the robotic platforms of project partner BUT are ready for running the latest ROS release (also known as Hydro Medusa). BUT is currently working on initial test bed set-ups for an indoor environment focused on house and workshop scenarios, with the goal of making the transfer of task solutions from simulation to real environment faster, easier and more effective.

[1] http://www.vision-robotics.nl

[2] http://wiki.ros.org/Industrial

Article written by Rainer Buchty, with additional input from Heico Sandee, Mark Geelen and Vítězslav Beran.

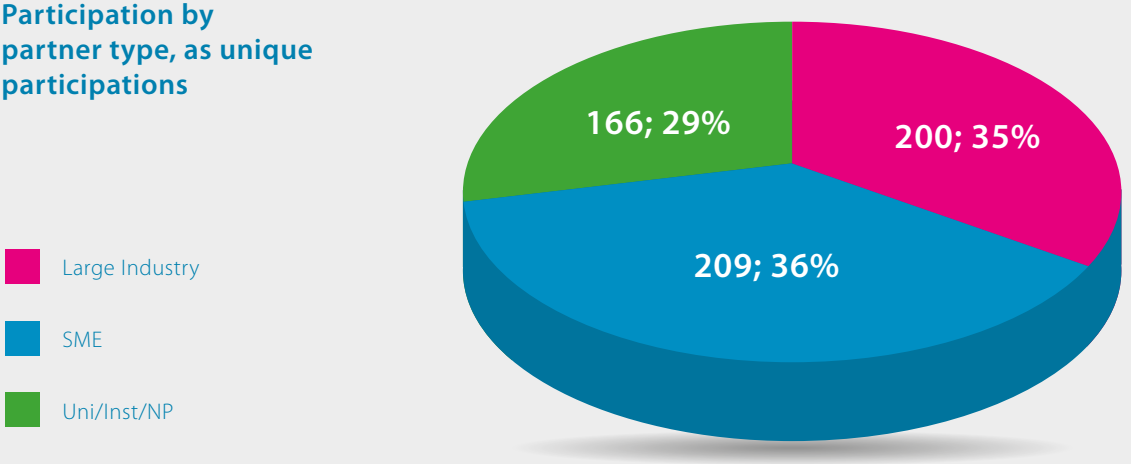
Website: www.r5-cop.eu

Conclusions

And with this, the portfolio of fifty-six ARTEMIS-JU funded projects is complete and an (equally) complete overview is in preparation, to be made available as an addendum to the already published ARTEMIS Book of Successes. The table shows the overview per call, with for each of the six calls the division of funding over the stakeholders, JU, Member States and R&D actors. Together the projects added to a total of close to 1.1 billion Euro of eligible cost. That ARTEMIS has become a real industry driven programme becomes clear from the pie-chart showing the distribution over partner types that shows the balance between SME's, Large industries and Research institutes.

But is this the end? By no means!! The projects launched under ARTEMIS continue under that flag, but equally importantly, ARTEMIS has succeeded in building a strong community that shares a common vision for the embedded systems industries in Europe (and by extension, the electronics industry more generally) – industries, including some of Europe's leading groups, that were previously fragmented and dispersed have unified on common goals. This ARTEMIS legacy sets a strong basis for the future success of the ECSEL Joint Undertaking – the successor programme that unites the communities of ARTEMIS, ENIAC and the Technology Platform EPoSS in driving forward the Electronic Components and Systems industries in Europe.

Participation by partner type, as unique participations



number of partners & percentage of total partners

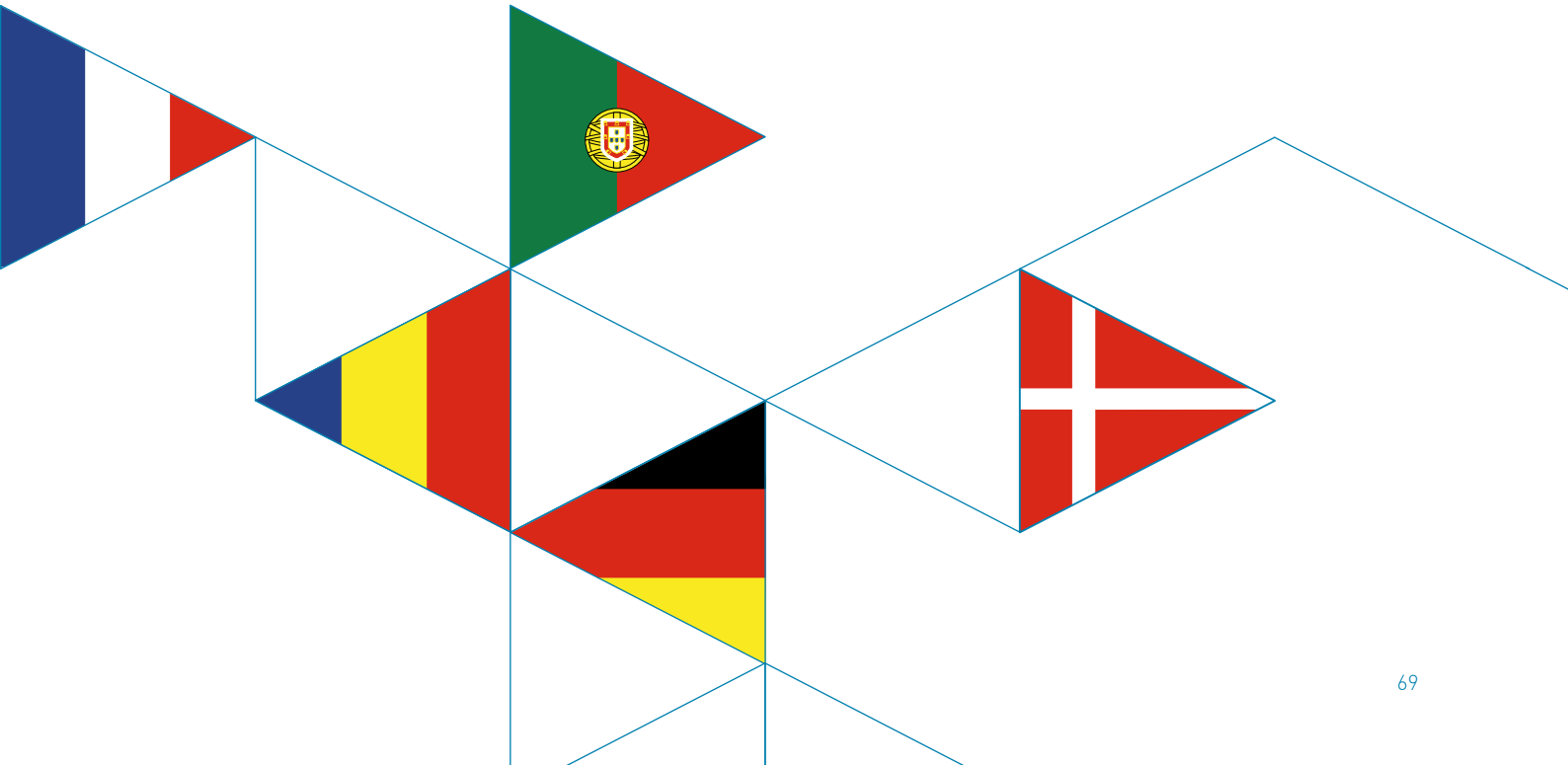
ARTEMIS-JU Programme

Editorial Information

ABOUT ARTEMIS

Advanced Research & Technology for Embedded Intelligence and Systems

Partnerships between EU Member States, EU-industry and European Commission, implemented as Joint Technology Initiatives (JTIs), are the most effective way of boosting Europe's electronics design and manufacturing capabilities in economic sectors such as cars, planes, trains, medical equipment, home appliances, energy networks and security systems. Between 2008 and 2012, the ARTEMIS JTI has achieved; 52 projects worth 935 M€ with public funding 448 M€ (EU + Member States) involving more than 720 organisations (with more than 1200 project participations) of which around 39% are SMEs, 33% large enterprises and 28% research organisations. In 2014 ARTEMIS-JU, ENIAC-JU and EPoSS will join forces and merge into, one stronger JTI on Electronic Components and Systems called ECSEL (Electronic Components and Systems for European Leadership)."



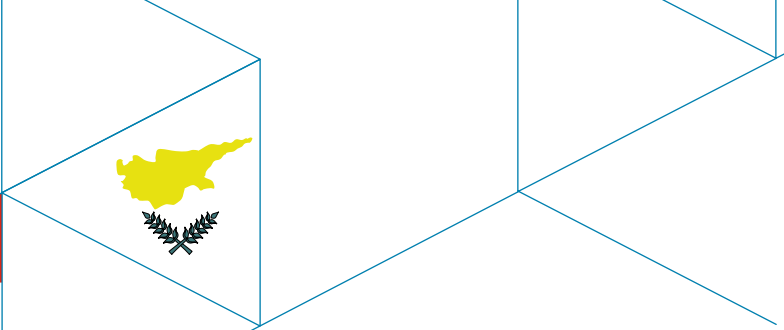
In recognition of the strategic importance of embedded computing systems the European Union launched the ARTEMIS Joint Technology Initiative (JTI) as a Joint Undertaking (JU), or public-private partnership, between:

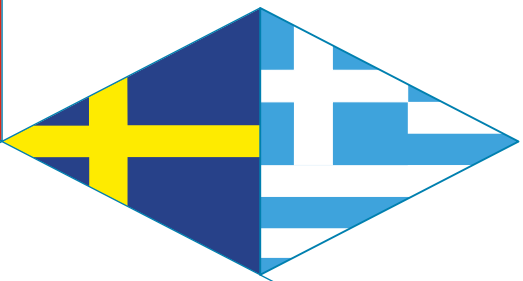
- The European Commission
- Member States (23 countries)
- ARTEMIS Industry Association

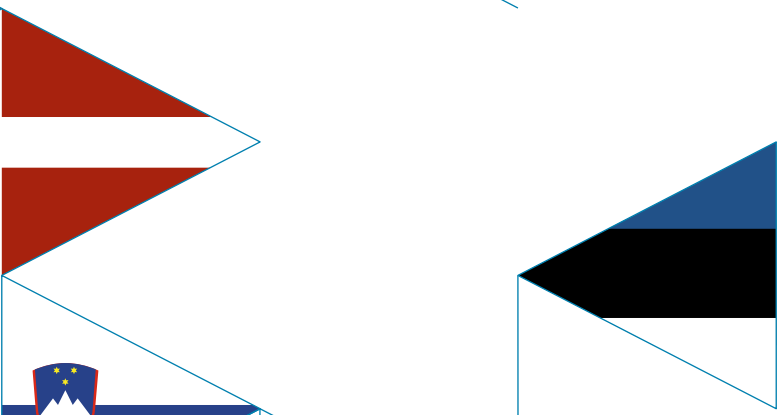
The ARTEMIS Industry Association, a non-profit association for the European R&D&I actors and private partner in the ARTEMIS Joint Undertaking, supports formation of consortia and initiation of project proposals for joint collaboration and creates the meeting place where key industry players and other R&D&I actors identify strategic high priority topics for collaborative R&D&I projects. It represents an influential network of organisations focused on the innovation and development of embedded systems in Europe with about 180 members.

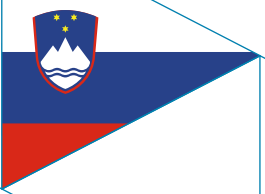
Its ambition is to help European industry consolidate and reinforce its world leadership in embedded computing technologies.

More information about ARTEMIS:
www.artemis-ia.eu | www.artemis-ju.eu | www.artemis.eu









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