ARTEMIS

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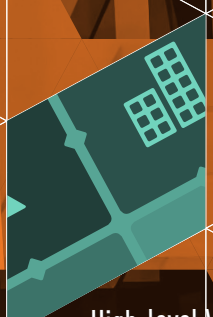
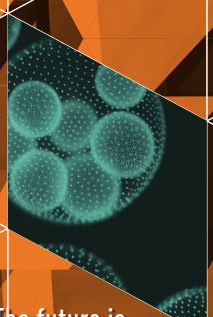
ARTEMIS magazine - December 2013

The importance of Embedded Systems for the future successes in the European industry





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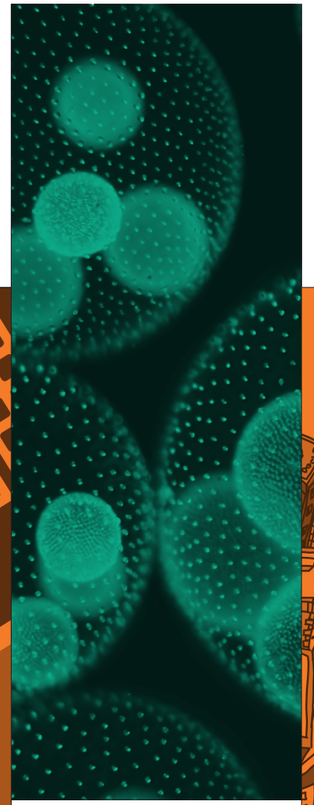
Content



FOREWORD

Jan Lohstroh
Secretary General
ARTEMIS Industry Association

Dear ARTEMIS Friends,

I now share the Foreword spread with Alun Foster, who succeeded Eric Schutz as Executive Director of the ARTEMIS Joint Undertaking in August of this year. Alun will be doing this job in the 'acting' mode, till the ARTEMIS-JU is absorbed by the new ECSEL Joint Undertaking at some moment in time in 2014. So welcome to Alun, and we wish him a lot of success in building the bridge from the ARTEMIS-JU to the ECSEL-JU.

As the Foreword in the previous Magazine already suggested, 2013 has been an extremely busy year working with the Commission, Member States and the AENEAS and EPoSS Associations on all the documents that are needed for the new ECSEL Joint Undertaking, whose first call we would like to see in 2014. At the same time we have been working on the update of the High-level Vision 2030 that will now contain a lot of figures about the size of markets and number of jobs in Europe. The update will be published to coincide with the Co-Summit with ITEA on 4-5 December in Stockholm. The theme of the Co-Summit is dedicated to "Software innovation, boosting high-tech employment and industry", so strongly related to the messages of the updated High Level vision 2030. We hope that you all can make it to attend the Co-Summit.

In this Magazine you find background information about the Co-Summit theme and some conclusions of the forthcoming High-level Vision 2030, followed by an interview with Heinrich Daembkes (President of ARTEMIS-IA) and Rudolf Haggenmüller (Chairman of ITEA) on the same topic. Three fascinating articles follow on the Arrowhead project, the future of Embedded Biology and the Pollux and Internet of Energy projects related to E-mobility.

There is also a short report of the JTI event that took place in the European Parliament from 30 September to 4October in Brussels and the ARTEMIS-IA Presidium give their various opinions on ARTEMIS and the future in ECSEL in a round-table interview.

Two articles explore the Smart Cities phenomenon and engineering resilient systems-of-systems. In respect of the building of the new ECSEL-JU, there are two articles, one containing information from the association (by myself) and one with viewpoints from the current ARTEMIS JU (by Alun Foster). The Magazine ends, familiarly, with the Baton Blue(s), with the guest this time Karlheinz Topp.

I wish you a lot of reading pleasure.

Jan Lohstroh

FOREWORD

Alun Foster
Acting Executive Director / Programme Manager
ARTEMIS Joint Undertaking

Hello, and welcome to our ARTEMIS magazine number 15. One constant in these magazines has been the articles about the projects and programme that make up the focal-point of our ARTEMIS community, and this magazine is no exception (I hope you enjoy the articles!). For the rest, the David Bowie song "Ch-ch-ch-ch Changes" comes immediately to mind. Why, for example, am I now writing this introduction instead of Eric Schutz? Having reached retirement age (an immovable barrier in the public sector, it seems) in July this year, Eric had to step down as Executive Director of ARTEMIS-JU so, in addition to being Programme Manager for the JU, I am now Acting Executive Director in his place (so, amongst other things, get to write this introduction). Fortunately, we have been able to retain Eric on a part-time basis as Special Advisor to the JU, so can still benefit from his knowledge and experience as we move towards a period of even more change.

Yes, even more change. With Call 2013 proposals now being negotiated as I write, with some hard deadlines to meet by the end of this year, the last Call of ARTEMIS-JU will by then be as-good-as-complete. The "Showroom" part of the ARTEMIS-JU can then shut up shop with the clear conscience of a job well done. The "After-Sales Service" department must, of course, still carry on, and in the previous ARTEMIS Magazine (and also increasingly in the press) you'll have read about the upcoming "ECSEL Joint Undertaking". In addition to its new and equally exciting charter, ECSEL will continue to support the ARTEMIS projects already launched:
All ARTEMIS projects – past and those just starting – have the right to expect equal care, attention and support.

While the precise details of the manner and timing of the change to ECSEL are still being worked on, there do remain a few certainties to carry us forward. Firstly, despite the administrative complexities and lower-than-expected funding in some quarters, the tri-partite PPP model has proven to be a success. Not because the technical topics the projects have addressed are particularly different – what is different is the way in which these projects are run. Being encouraged to look at a bigger picture, to form clusters, to grow these into "Pilot Lines" and "AIPPs" and from these seed "Innovation Ecosystems" in which companies can thrive means that the impact of the public funding, used as a trigger, can be visibly multiplied.
It is this kind of legacy that ECSEL can further build upon to secure the future for European businesses and citizens. And, after all, that is why we do all this…

Alun Foster

CO-SUMMIT 2013

Software innovation: boosting high-tech employment and industry

4 & 5 December

Scandic Infra City, Stockholm

HIGH-LEVEL VISION 2030 AND THE IMPACT OF SOFTWARE INNOVATION ON REVENUE AND JOBS IN EUROPE

THE MAIN THEME OF THE ARTEMIS-ITEA CO-SUMMIT IN DECEMBER

By Jan Lohstroh and Ad ten Berg

CO-SUMMIT 2013

Software innovation: boosting high-tech employment and industry

The ARTEMIS Industry Association and the ITEA Eureka initiative published their HIGH-LEVEL VISION 2030, version 2012 (downloadable from www.artemis-ia.eu/publications), in the autumn of 2013. It is an outlook of what ICT technology can do to give answers/solutions to global challenges in general and European challenges in particular.

This document describes seven areas of major change:

- Globalisation and demographic change
- Management of scarce resources
- Climate change
- Urbanisation
- Mobility
- Healthcare and nutrition
- Digital society

followed by the need for research and ICT-based innovation.

The strengths, weaknesses, opportunities and threats of the European ICT industry are outlined and, from this perspective, the message "One Mission, different instruments" for the ARTEMIS and ITEA programmes is made clear.

In the 2012 version of the document the impact of software innovation on revenue and jobs had been rather qualitative. Therefore, ARTEMIS-IA and ITEA actively gathered quantitative data in the last year to update the document to be issued in December 2013 during the ARTEMIS-ITEA Co-Summit.

As current public discussion does not always use the terms software, IT, ICT, semiconductors and embedded systems in a consistent way, the term "Digital Technology" will be introduced to encompass the notions of:

- Hardware
- Software
- IT services
- Internal IT
- Embedded software in 'vertical markets' like automotive, healthcare, etc.

Taking input from Roland Berger Strategy Consultants, among others, into account, key trends in Digital Technology, with respect to productivity, market size and job creation will be made visible in quantitative ways, as much as possible.

The penetration of Digital Technology in vertical markets will be described, including the scope and growth, and the impact on value creation as well as the gaps in Europe in terms of the impact of Digital Technology.

The main conclusions, in hard figures, will be:

- The global market of Digital Technology is estimated at USD 3,300 billion, corresponding to around 50 million jobs
- The share of Europe in Digital Technologies is about 9.1 million jobs
- Europe's position is characterised by a strong presence in vertical markets
- In Europe we have 0.2 million jobs in hardware, including semiconductors, and 8.9 million jobs in software and services

Within Digital Technology, ARTEMIS and ITEA are addressing innovation in Software, IT Services, Internal IT and Embedded Software. Under the collective term 'Software

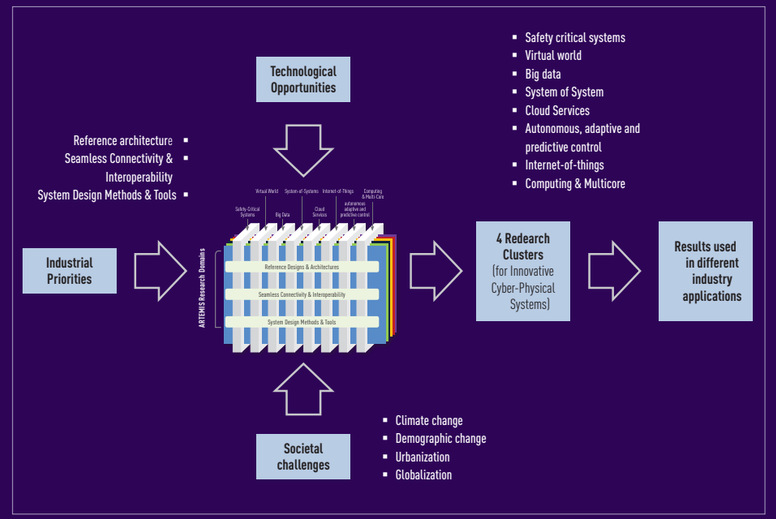


Fig. 1 The ARTEMIS WAY

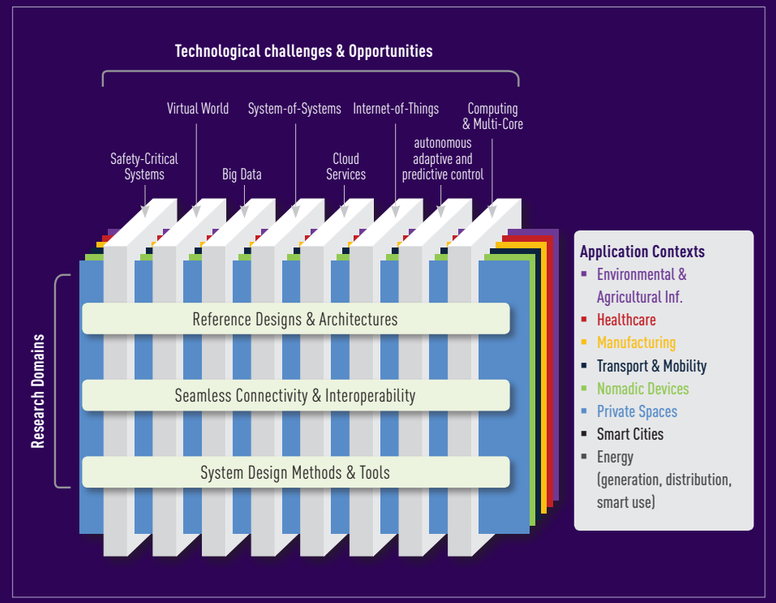


Fig. 2 Matrix 2.0

innovation', a global market of around USD 2,600 billion, corresponding to 44 million jobs is being addressed.

The goal of Software Innovation in Europe is to get as many of these 44 million jobs into Europe.

The programmes of ARTEMIS and ITEA are and will be instrumental in helping to achieve this, but there is a need to double investment compared to 2013 to ensure that there is enough impact!

Details of the updated HIGH-LEVEL VISION 2030 report (version 2014) will be presented and discussed during the ARTEMIS-ITEA Co-Summit in December.

The message "One mission, different instruments" will remain unchanged. As the ARTEMIS-JU will be absorbed by the ECSEL Joint Undertaking in 2014 (see page 40 in this Magazine), the ARTEMIS programme will be continued as an Embedded/Cyber-Physical Systems programme in ECSEL with input from the ARTEMIS Industry Association by a dedicated section in the MultiAnnual Strategic Research and Innovation Agenda (MASRIA) and a dedicated section in the Research and Innovation Activities Plan (RIAP).

In 2013 ARTEMIS-IA has worked on an addendum of its 2011 ARTEMIS-SRA and will, based on this addendum, profile itself in the 2014 MASRIA and 2014 of the ECSEL Joint Undertaking with an updated "ARTEMIS WAY" including 4 Research and Innovation Clusters for innovative Embedded/Cyber-Physical Systems (See Fig. 1). The heart of the updated ARTEMIS WAY is a three dimensional matrix (Matrix 2.0), see Fig. 2.

The 2013 SRA addendum will be published soon on the ARTEMIS-IA website and the 2014 MASRIA and 2014 RIAP will be published on the website of the ECSEL-JU as soon they are adopted by the Governing Board of the ECSEL-JU.

SOFTWARE INNOVATION: OPPORTUNITY FOR BUSINESS AND EMPLOYMENT IN EUROPE

Heinrich Daembkes and Rudolf Hagenmuller interviewed by Chris Horgan

In this interview, the two 'captains' of ARTEMIS and ITEA take the opportunity to underline the benefits that each programme generates for industry and society both now and in the future. Also in hard facts and figures.

Heinrich Daembkes and Rudolf Haggenmüller reflect on the refreshed Vision 2030 document and the real, evidence-based prospects for Europe to flourish in a way that benefits both industry and society. Prospects that have been boosted by the ARTEMIS and ITEA programmes. In the ARTEMIS-ITEA Co-Summit in Stockholm this December, the hard facts presented in the Vision 2030 document are given a showcase through the exhibition of projects and a series of fascinating keynote speeches, presentations, panel discussions and plenary sessions.

The latest version of the vision document, called *"High-level Vision 2030: Opportunities for Europe - the impact of software innovation on revenue and jobs"* has been updated to include real, hard facts about the impact that ARTEMIS and ITEA are having on industry and society in Europe in terms of employment and business opportunity. And the prospects for even more impact in future if, of course, the financial commitment and momentum can be sustained. Invest now and very rich rewards can be reaped.

'Both this positioning paper – the Vision 2030 document – and the forthcoming Co-Summit deviate somewhat from our traditional stance in which we emphasised the qualitative aspect,' Rudolf explains. 'We have shifted the focus very emphatically towards the quantitative aspect. What does all our work and innovation mean in terms of revenue and jobs. You only have to consider the fact that 37% of growth in Europe depends on digital technology to realise the importance of the kind of impact that our innovation can have.'

'Yes,' Heinrich goes on to say, 'this new version of our Vision 2030 document now contains the hard and measurable facts about the impact of our sector on the economy. An independent survey of the facts and figures along with interviews with key industry representatives make it very clear that our industry not only plays a crucial role in the business success in Europe today but will become even more important in the future.'

'Let's take a look at the big picture,' Rudolf says. 'The global market for digital technology is estimated at 3,300 billion US dollars and 50 million jobs. The industry ranges from hardware to software, services and embedded software. ARTEMIS and ITEA address the software and services component, and that's worth 2,600 billion US dollars and 44 million jobs. The majority of the market therefore. Our goal is to get as much of this revenue and employment to Europe. Results from the EUREKA Impact Assessment working groups and econometric impact studies of EUREKA show that a million euros of funding creates ten million euros of revenue and generates 37 jobs. Total it

> EMBEDDED AND CYBER PHYSICAL SYSTEMS WILL BOOST THE INTELLIGENCE OF OUR PRODUCTS TO THE BENEFIT OF OUR CUSTOMERS.
>
> ~ Heinrich Daembkes

up for the ITEA programme in the time to come and you create a further 44,000 jobs and 11 billion euros of revenue. And the benefits are felt throughout the industry, from large to small companies. An example is the Digital Cinema project. Ten years ago analogue ruled the roost. Then the company Barco engaged in funded research to develop digital technology for cinema. Today close to 10% of Barco's workforce in Europe is active in the area of Digital Cinema (direct and indirect). This is a concrete example where €1 million of funding contributed to generating and supporting approximately 350 jobs in Belgium.'

'In the field of embedded software,' Heinrich adds, 'Europe employees about 1.1 million people. If we just take average growth rates and apply those to embedded systems and software, then we see that 50,000 jobs are generated each year through the impact of embedded systems. This means sustaining jobs that would otherwise be lost and creating new jobs. An important change in the Vision 2030 from an ARTEMIS perspective is the coverage in emphasis to cyber-physical systems, which are a natural extension of the embedded systems we already know. The field of cyber-physical systems is an area in which investment is not only worthwhile but crucial in creating jobs and lubricating the engine of Europe's economy. If we look at the impact of digital technology on productivity, as evidenced by the Roland Berger data, we see a need to increase investment. The impact of digital technology on productivity in the United States is 1.8% whereas in a significant part of Europe this figure is just 0.5%. If we were to invest to the same degree as across the Atlantic, our economy would grow by 5% per year. The Digital Agenda for Europe also backs up this claim by appealing to Member States to double their investment in digital technology R&D. this also means, that industry must also double its share. In fact, when we asked industry about the impact of digital technology on its products, the figures came as a surprise even though we knew the impact was considerable. They reported the impact of Embedded Systems on the key selling features of their products today was 50% but the impact in five to seven years' time would be as high as 75%. A very clear message. And a message that needs to be made equally clear concerns the competitiveness of Europe. I cannot stress enough that the performance of the products we make will be determined by what is built in, or embedded.'

'ITEA 3 will address all categories of Digital Technology which are needed to master the changes ahead of us:

> Industrialised non-differentiating services
> Customised services
> Smart products
> Smart services
> Innovative engineering
> Smart infrastructure
> Security of systems and services

We focus on seizing the high ground and happiness,' Rudolf says. 'Happiness in terms of our communities and happiness in society. By generating jobs and revenue, the results of our projects will help to make this happen.'

Heinrich: 'For ARTEMIS the Vision is more current than ever. We believe the that all objects will become increasingly intelligent and be present everywhere in cyberspace. Which must not be confused with the cloud, by the way. If we can create and exploit services for the user around this presence in cyberspace, then we can enable the users and society to reap the benefits. Whereas such elements are already present in domains like automotive and aerospace, the future will see consumer goods, like clothing or furniture embodying such embedded intelligence. Sensors, perhaps, that will help you better monitor your health. And even there, you see the potential for huge healthcare savings to be made. We need to build new economic eco-systems and communities that can explore and exploit these opportunities. To achieve this, we need to help the user to get the best out of such opportunities. This is our vision. And it is based on three priorities: to build on our strengths in Europe, to enter new areas of opportunity and to regain the ground that Europe has lost.'

SOFTWARE INNOVATION IS THE WAY TO CREATE EMPLOYMENT AND REVENUE IN EUROPE.

~ Rudolf Haggenmüller

'And the Co-Summit in Stockholm is the place to be to see the proof of the pudding,' Rudolf stresses. 'The theme of this Co-Summit concerns the role of software innovation in boosting high-tech employment and industry. The Vision 2030 looks at the impact on revenue and jobs in Europe. In a time of crisis and unemployment, especially among younger people, Stockholm will be an opportunity to look at the initiatives being taken to address this issue.'

'The Co-Summit is a double header of the same coin, Heinrich adds, 'two instruments striving for results in the same domain. Industry, Member States and the Public Authorities get the possibility to see the overview, the greater picture and demonstrations of the results of the projects of this joint initiative and of the common goal of both programmes, which is to boost European competitiveness.'

ARROWHEAD - COLLABORATIVE AUTOMATION BY NETWORKED EMBEDDED DEVICES

ARROWHEAD – AHEAD OF THE FUTURE

By Chris Horgan

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.

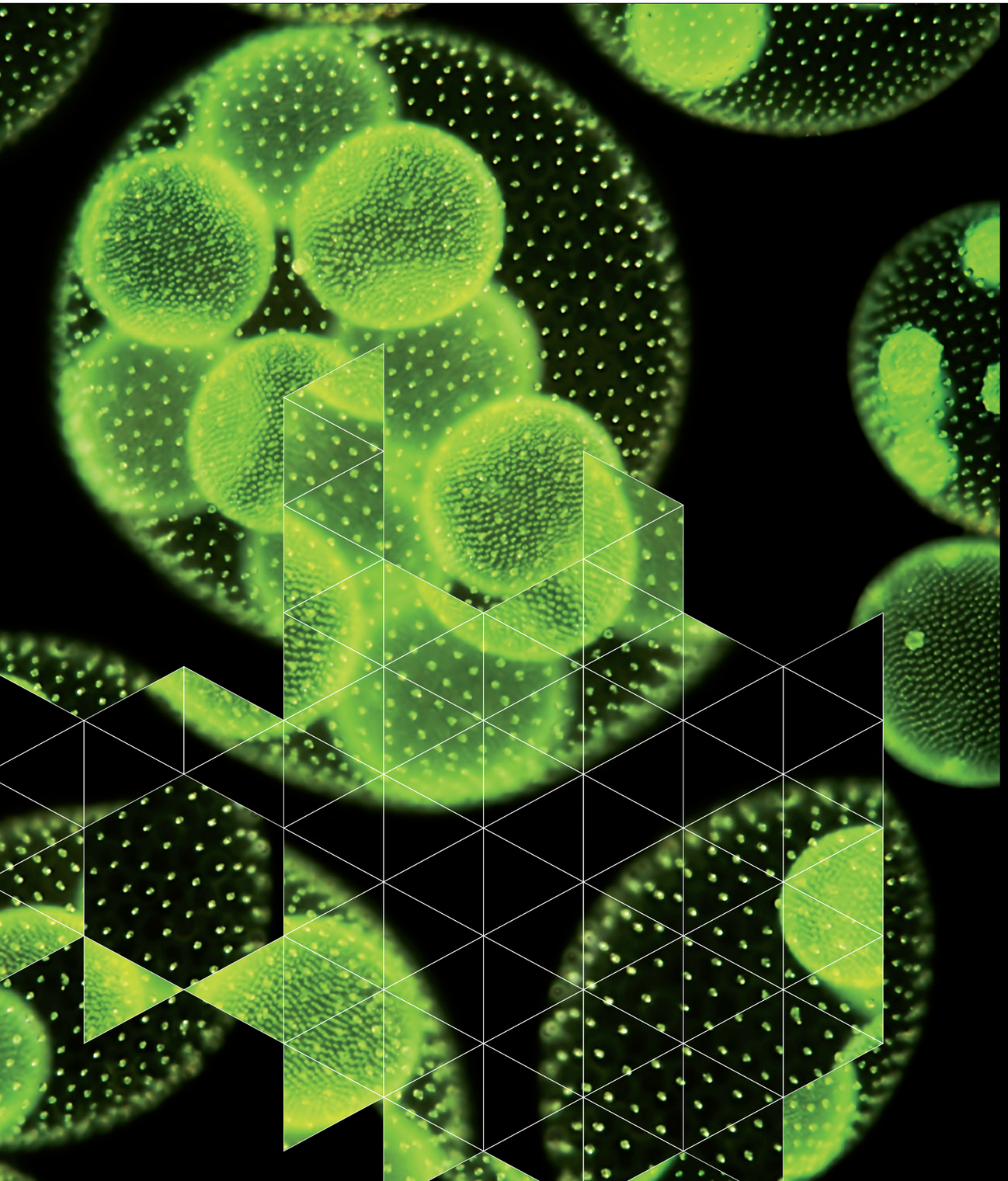
MOVING TECHNOLOGY CLOSER TO THE MARKET

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 CORE OF OUR TECHNOLOGY MUST BE SO SIMPLE THAT THE SAME TECHNOLOGY WORKS IN COMPLETELY DIFFERENT ENTITIES."

~ Jerker Delsing
ARROWHEAD coordinator

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.



THE FUTURE IS EMBEDDED BIOLOGY

By Jan Madsen

When we hear the word embedded systems, we think of programming advanced electronic platforms to process large amounts of data and control sophisticated mechanical machines - but in the future it may be miniaturised biochemical laboratories and even the machinery of life itself!

Our societies are undergoing major changes; our world is becoming increasingly supported by intelligent embedded systems. It is a world where all systems, machines and objects are smart, are present in cyberspace, exploiting the digital information and services around them. They communicate with each other, with the world and with people, and manage their resources single-handedly without human interference. The Internet enables 'things' to communicate with each other - through the Internet-of-Things. Our society, including our safety and security, will increasingly depend on embedded technologies. Embedded systems have become the neural system of our society.

MAKE THE WORLD "SMART"

Embedded systems are electronic products, equipment or more complex systems containing dedicated computer systems designed to perform specific control functions of the system in which they are embedded. Embedded systems are increasingly used to make products smarter and to enable them to communicate with other smart products. They are used in a wide range of domains that are central to our modern society; they unite the virtual objects in cyberspace with real objects in the physical world.

TWO TRENDS

Two technology trends based on Moore's Law will affect the development of future embedded systems:

- **More-Moore**, the continued miniaturisation of the physical geometries and the materials to be used allow increasingly complex computer systems implemented on a single chip. This trend has led to multi-core computers, where hundreds of small computers are integrated on a single chip and where performance is improved through massive parallelisation.
- **More-than-Moore**, the increased integration of different technologies on a single chip allows not only digital systems but also analogue, mechanical and biological systems to be integrated. It is now possible to integrate micromechanical sensors/actuators,

About Jan Madsen

Professor Jan Madsen is Deputy Director of the Department of Applied Mathematics and Computer Science (DTU Compute) at the Technical University of Denmark, where he is also heading the Embedded Systems Engineering Section. He has participated in several ARTEMIS projects (SYSMODEL, SMECY, RECOMP, ASAM, and MC2). From 2008 to 2012, he was the lead delegate for Denmark in the Governing Board of ARTEMIS JU.

wireless radio modules and energy harvesters, along with the computer on a single chip.

While ARTEMIS has largely focused on More-Moore, the trend of More-than-Moore holds the potential to radically change our view on embedded systems and the way we program them.

PROGRAMMING ROBOTS

Embedded systems have played a significant role in the automation of industrial production. The manual processes have been automated and have resulted in faster and better production and, hence, in cheaper and higher quality products. In particular, embedded computing systems are used to control the functions of industrial robots. A compiler translates a high-level description of the robot's desired behaviour and responses to input from the environment into sequences of detailed robot instructions. This robot-based automation is used in many other domains, e.g., in modern biochemical laboratories where laboratory robots the size of a table can handle the processes traditionally performed by the lab assistant, such as mixing, diluting, heating and analysing reagents. The embedded computer system controls the sequence of the robot instructions, which leads to the desired biochemical processes. But it does not end here - why not take advantage of more-than-Moore to integrate the biochemical processes along with the embedded computer on a single chip - called a biochip?

PROGRAMMING BIOCHIPS

It is possible to fabricate micro valves, pumps and channels and integrate them on a biochip not more than a few cm^2 in size. This allows the creation of complex systems that can support complete biochemical processes and produce a complete biochemical laboratory on a single chip, also called Lab-on-a-Chip or LoC. The biochip has many advantages over existing biochemical analysis. For example, they use much smaller volumes (down to nanolitres), have quicker reactions, more accurate detection, less exposure to environmental contamination, and allow parallel operations of several (different) biochemical processes. Finally, the small form factor makes it possible to create highly sophisticated point-of-care devices - small wearable biochemical laboratories.

In October 2013, the Nanobiosym Health RADAR was awarded the first Nokia Sensing XCHALLENGE prize of USD 525,000 for its Gene-RADAR platform. This platform is able to analyse a drop of blood, saliva or other body fluid placed on a biochip and inserted into a mobile device, which then detects the presence or absence of a disease's pathogen in less than an hour, with the same accuracy available only in a diagnostic lab. In January 2012, Peter Diamandis launched the Qualcomm Tricoder XPRIZE, which will award USD 10 million to the team that can achieve the highest diagnostic score of 15 distinct diseases in a group of 15-30 people in three days. The diagnosis must be performed by a handset point-of-care device developed by the team and operated by a consumer, independently of a healthcare worker or facility.

In 2002 a biochip with 2,065 valves was successfully fabricated. This was similar in complexity to the first integrated computer, the Intel 4004 from 1971, which had 2,300 transistors. The research team of Stephen Quake at Stanford University have shown that today it is possible to produce 1,000,000 valves on 1 cm^2! This makes it possible to create very complex biochemical systems and require advanced computer systems for both designing the biochip and controlling the many valves. Researchers are working on the development of a "biocompiler" that can translate a high-level description of the biochemical processes into detailed control of valves and other components.

Biochips cover a wide range of possible applications, including the field of clinical diagnosis, the development of new drugs, DNA screening, environmental monitoring and the manipulation of living cells.

The "smart pill" is a good example of the integration of a more traditional embedded computer system with a biochip. On the way down through the digestive system, the pill takes pictures and makes a biochemical analysis of body fluids. The results are analysed in the on-board computer and transmitted wirelessly to a device outside the body and then on to a doctor.

If a biochip can be used to manipulate and clone living cells, the biochip may be used as a tool to program individual cells? In other words, the individual cell or bacterium is the platform of the embedded system!

PROGRAMMING LIFE

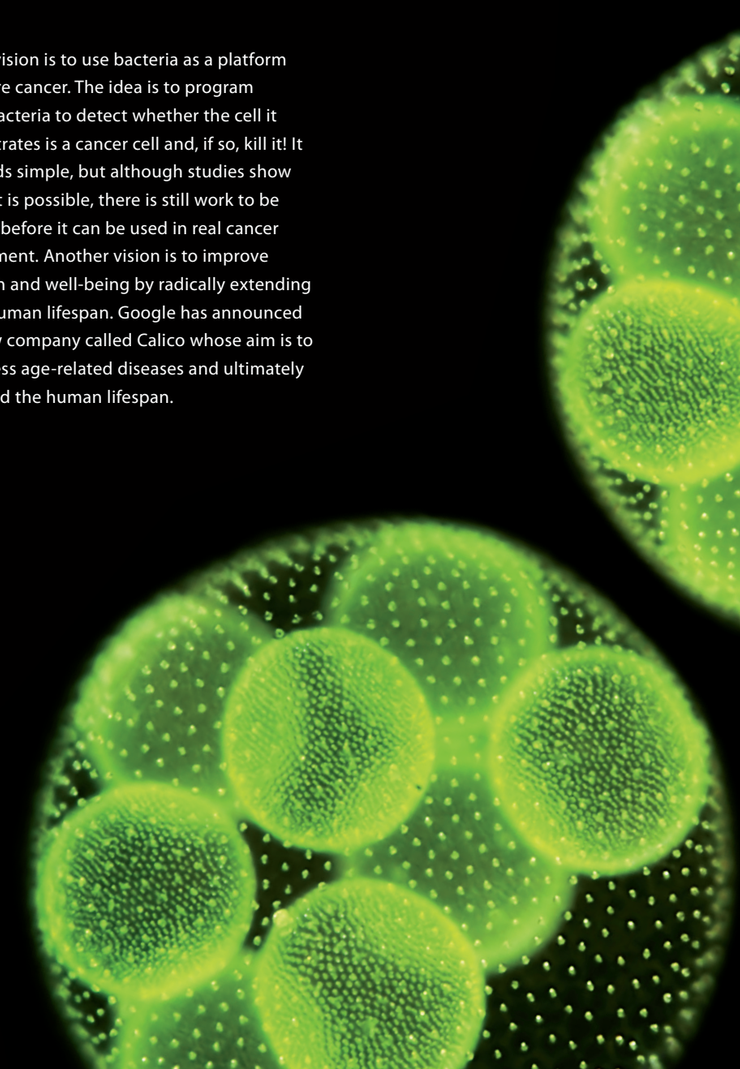
It is possible to insert fragments of artificial DNA sequences in a living cell and get the cell to produce a useful product that can help us combat some of our major societal challenges. Malaria kills more than one million people every year. In Africa alone around 2,000 children die every day from malaria! Malaria is preventable and curable, but treatment is very expensive. It is based on the substance arteminisinin, extracted from the leaves of the Chinese Wormwood plant. This is a costly and time-consuming process, which makes the medicine extremely costly and basically out of reach for many people in the third world. In 2006, the research team of Jay Keasling at UC Berkeley succeeded in modifying yeast cells to produce artemisinin. Keasling founded the company Amyris to optimise the process for production. In April 2013, the company Sanofi announced the launch of a production facility in Italy to produce the malaria drug on a large scale, making the medicine far cheaper and more accessible.

This is an example of a new and rapidly growing field of research called synthetic biology. Synthetic biology creates new biological systems in order to assess how life works or how it can be used for the benefit of society - visions are great and many.

Researchers are working on the development of a "biocompiler" that can translate a high-level description of the desired behaviour of a cell/bacteria into a DNA sequence that can then be synthesised to the actual DNA. The high-level description is translated into a genetic regulatory circuit where the final DNA sequence is pieced together from small parts of DNA selected from a database that contains proven and fully functionally characterised parts of the DNA. It is possible today to make relatively simple logic circuits, such as AND and OR gates, toggle switches and simple memory circuit - and it is possible also to program the communication between cells.

One vision is to use bacteria as a platform to cure cancer. The idea is to program the bacteria to detect whether the cell it penetrates is a cancer cell and, if so, kill it! It sounds simple, but although studies show that it is possible, there is still work to be done before it can be used in real cancer treatment. Another vision is to improve health and well-being by radically extending the human lifespan. Google has announced a new company called Calico whose aim is to address age-related diseases and ultimately extend the human lifespan.

If researchers in this multidisciplinary field of study are successful in handling all the challenges, there are almost no limits to the opportunities this technology opens up - and it may well be the key to solving many of our societal problems, such as the production of medicine, food and energy, to name just a few of the key challenges. And it will give a whole new dimension to embedded systems - where the future is truly embedded biology.



BUILDING THE FUTURE OF ELECTRIC VEHICLE ARCHITECTURE

POLLUX AND IOE AT E-MOBILITY EVENT

By Ovidiu Vermesan

Next generation EVs will see the convergence of computer and automotive architectures, with future cars mechatronic systems that comprise a multitude of embedded systems containing hardware, algorithms and software. POLLUX is an ARTEMIS pan-European project that aims to reduce the development time and cost of the complex, high reliability mechatronic systems needed for the mass deployment of electric vehicles (EVs) through new EV architectures and of a common reference architecture for distributed embedded systems, including real-time middleware, and multicore hardware and in-vehicle communication.

The ARTEMIS POLLUX consortium, a €33 million collaborative initiative, involving 35 partners from 10 European countries, has galvanised many of Europe's best capabilities (industry, research and academia) in the area of nanoelectronics and embedded systems, microcontroller architectures and communication modules to create a common reference architecture for distributed embedded systems for next generation EV architectures. This initiative directly supports the European semiconductor and embedded systems industry to expand its leadership position in More-than-Moore technologies. Pollux provides novel and optimised systems solutions adapted to the demand of European original equipment manufacturer (OEM) leaders in the new emerging markets such as electric mobility, renewable energy and the integration of EVs into the new communication and energy infrastructure.

EUROPEAN COOPERATION KEY ELEMENT FOR SUCCESS

Embedded systems are an essential part of EVs and the supporting infrastructure (charging stations, traffic management systems, road- and rail-side sensors, signals, etc.). The ARTEMIS JU "Think Big" model has inspired the POLLUX partners to coordinate the research and development efforts by building a strong cooperation between the POLLUX partners and a cluster of ARTEMIS, ENIAC and FP7 projects to develop a common roadmap for the sector. This approach has created the possibility to address the development of the enabling technologies across many funding schemes (ARTEMIS, ENIAC, ITEA2, EPoSS, National, etc.) and feed the results into major European initiatives (Green Car Initiative, Fuel Cells and Hydrogen JTI, etc.). Within the framework of POLLUX, a true innovation ecosystem has been established to foster cross-domain research, development and innovation through harmonised road mapping, technology development and coordination of standardisation activities.

In this context, POLLUX was selected along with the ENIAC E3Car and ARTEMIS IoE (Internet of Energy) for Electric Mobility projects to be part of the exhibition "Made in Europe – ICT building blocks tackling societal challenges", a unique event organised at the European Parliament, focusing on how research contributes to real-life health, sustainability and mobility applications

"THE RESEARCH CONDUCTED IN THE POLLUX PROJECT IS A POWERFUL DRIVER OF INNOVATION FOR THE EUROPEAN SEMICONDUCTOR, EMBEDDED SYSTEMS AND AUTOMOTIVE INDUSTRIES AND THE CREATION OF AN ELECTRIC MOBILITY ECOSYSTEM THAT OPENS THE MARKET FOR NEW TECHNOLOGIES"

~ Ovidiu Vermesan

and services. The exhibition was opened by European Commission Vice-President Neelie Kroes, Commissioner for the Digital Agenda, who commented in her blog: "Yesterday I was at the European Parliament – opening an exhibition to showcase the great projects the EU has been funding in the area of mobility, health and sustainability. Looking at those projects fills me with hope about the difference tech can make to our futures. Investing in research is a great way to boost growth; and ICT investment is among the most productive there is. But these new technologies would not just boost our economy: they would build a better society, and help governments offer better services at less taxpayer cost."

ARTEMIS POLLUX: RESULTS AT A GLANCE

The *European Conference on Nanoelectronics and Embedded Systems for Electric Mobility – eMobility eMotion* (NESEM) on 25 and 26 September 2013 in Toulouse, France was the venue for POLLUX to present the most recent work in the field of electric vehicle architecture and the research highlights of the consortium partners (www.artemis-ioe.eu/events). NESEM provides a true pan-European platform to exchange information among projects addressing the fast-growing electric mobility ecosystem.

One of the main achievements of the POLLUX project is a roadmap (figure 1) for EV development in the next decade in cooperation with the cluster of ARTEMIS, ENIAC and FP7 projects. Future EV architectures will move in the direction of virtualisation with a transformation of the hardware architectures into scalable functional architectures.

Another important finding of the project is the need for architecture layering in terms of both the electric vehicle itself (electronics, communication, energy management, software layers) and the individual layers in the architecture (i.e. communication layer with Ethernet backbone), opening the way to implementing the concept of Internet of Vehicles (IoV). This layering concept allows the move from off-the-shelf

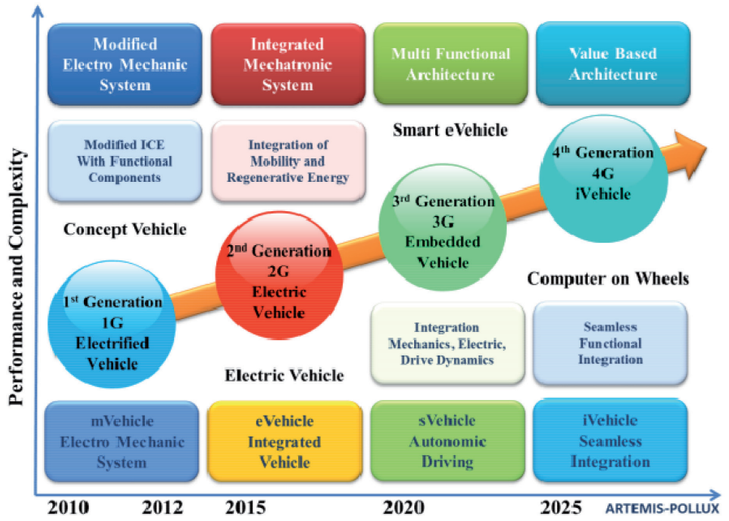


Figure 1 Electric vehicles generations

INNOVATION IN *ACTION*

JTI EVENT 2013

Read the article on page 29

Alun Foster hands over the Book of Successes to Maria da Graça Carvalho, MEP.

INNOVATION IN *ACTION*

JTI EVENT 2013

Read the article on page 29

hardware to off-the-shelf functionality embedded in the layered architecture and thus the possibility to provide new ICT architecture that enables the HW-based functionality to be incorporated into the electric vehicle over the vehicle life cycle. The architecture concept will offer a reliable supply of electrical energy for the electrically controlled and powered systems for braking, steering, stabilisation, etc. and an intelligent integration of the storage medium into the overall concept of the vehicle energy management architecture.

The multicore microcontroller platforms developed in POLLUX address the data-processing in distributed complex and safety-critical systems, and were used in the development of safety-critical applications designed to meet safety integrity levels according to ISO26262. The microcontroller platforms were demonstrated in a number of different functional domains ranging from drive controls, multi-propulsion to battery management systems. POLLUX has also developed a powertrain computer and motor control scalable platform using the multicore microcontroller technologies and simulation models for fast prototyping of EV systems. In respect of in-vehicle communication, power-saving methodologies through the communication environment reduce the costs of components needed in communication and enable the development of products to make the in-vehicle communication ready for the EV environment in terms of reliability and safety.

STANDARDISATION IS KEY FOR EMBEDDED SYSTEM INNOVATION IN ELECTRIC MOBILITY

The POLLUX has presented the convergence of heterogeneous technologies, novel applications, emerging services and the need for new business models for electric mobility. The demonstrators presented by the project partners at NESEM 2013 demonstrated the convergence of electronic, controls and software with traditional automotive engineering. Automotive electronics, control software and novel E/E architectural concepts are seen as a strong growth area for electric mobility applications. The project has clearly shown that many of the automotive sector innovations are and will be driven by electronics, embedded systems, communication and software with up to 60 % of the costs of electric vehicles determined by battery systems, electronics, communication, software and algorithms.

In this context standards play a key role in the development and deployment of battery, electronics, communication, software and algorithms technology for electric mobility. They provide an indispensable basis for widespread market uptake of EVs and the associated electric mobility services. POLLUX has taken a number of steps to address the standardisation challenges for nanoelectronics, embedded systems, communication technologies and electric and electronics architectures related to electric vehicles, electric mobility infrastructure and integration with the smart grid.

By combining applied research and product development strengths, POLLUX partners have been able to explore the emerging nanoelectronics and embedded systems communication technologies for electric mobility as well as anticipate and transfer innovations into market-ready prototypes, product enhancements, E/E electric vehicle architectural concepts and new solutions. All this has been made possible by the creation of a strong European technology innovation platform, with the staunch support from ARTEMIS, ENIAC and FP7 projects. The research conducted in the POLLUX project is a powerful driver of innovation for the European semiconductor, embedded systems and automotive industries and the creation of an electric mobility ecosystem that opens the market for new technologies.

JTI EVENT

By Iris Hamelink

Photos of the event can be found on page 24-26

From 30 September till 4 October 2013, the five Joint Technology Initiatives – Clean Sky, Innovative Medicines Initiative, Fuel Cells and Hydrogen, ENIAC and ARTEMIS – hosted a joint event on the future of R&D and innovation in Europe at the European Parliament building. The event comprised an exhibition and several thematic sessions.

The opening ceremony was held on the evening of Tuesday 1 October with Michel Goldman, IMI's Executive Director giving a speech on behalf of all five JTIs. This was following by contributions from Maria da Graça Carvalho, MEP, and Antonio Fernando Correia de Campos, MEP & Chairman of STOA (the Science and Technology Options Assessment Unit of the European Parliament). Around 60 people attended the official opening ceremony, which was held in the exhibition area.

GOALS

The goal of this JTI event was to demonstrate the importance of the JTIs and how they see the future, a goal that appears to have been achieved, especially in view of the statements made during the press breakfast in the European Parliament on Wednesday 3 October when Vittorio Prodi, MEP, commented: *'The results presented this week demonstrate that JTIs are now an essential part of the European research landscape, fulfilling a key role by bringing together the major players in their respective sectors and so speeding up the delivery of results that will have a real impact on quality of life and competitiveness in Europe.' Maria da Graça Carvalho, MEP, confirmed the view of her colleague when she said, 'By leveraging funds from the private sector, the JTIs are actively helping to increase Europe's total research investment – an investment which is essential if Europe is to tackle the many challenges it faces.'*

These statements served as appetisers to the journalists attending the event who had interesting questions of their own and were keen to find out the exact numbers relating to each programme, our future plans and connection to Horizon 2020. One can certainly conclude that this press breakfast was productive, inspiring and even innovating.

DEBATE

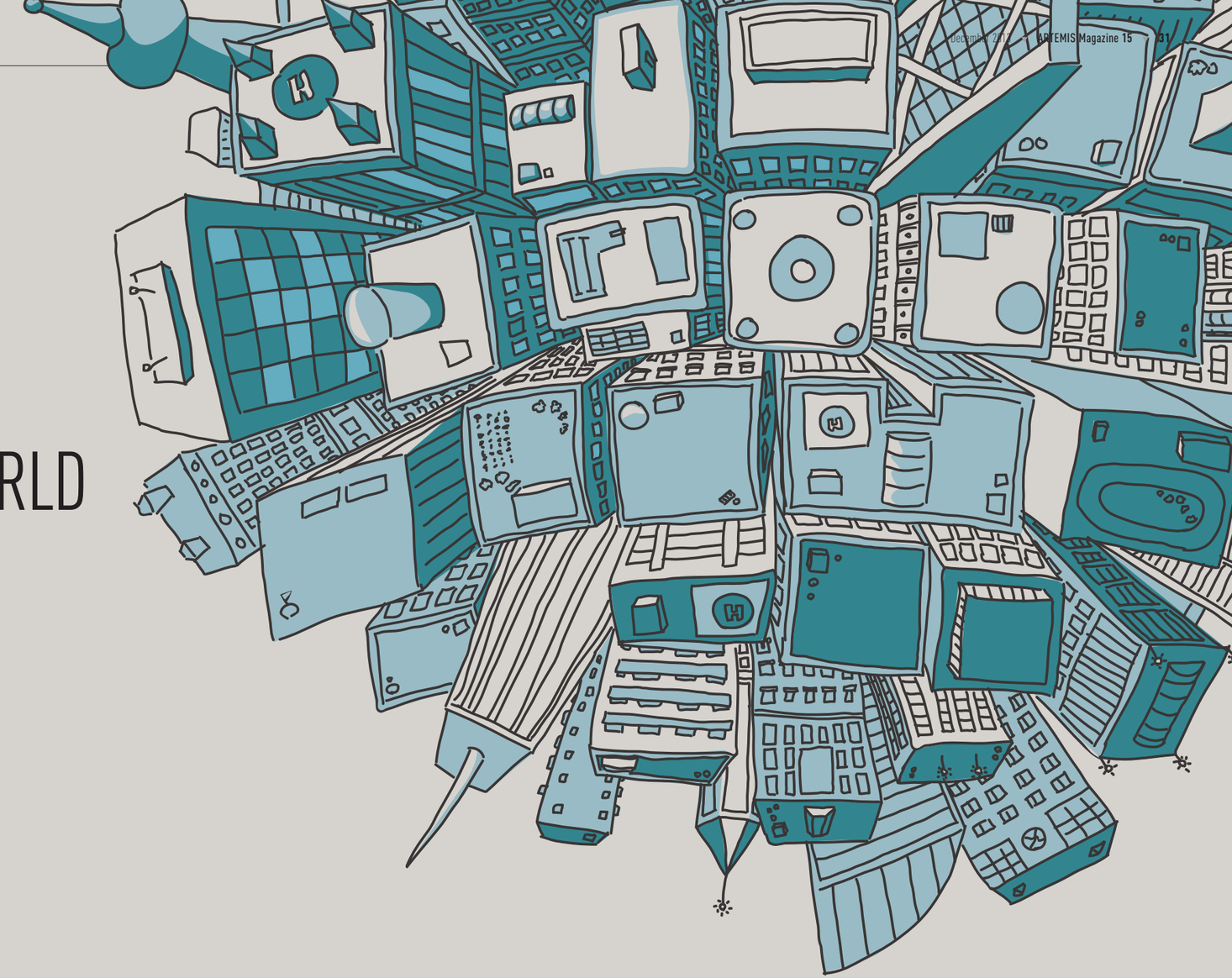
The same day, Wednesday 2 October, saw the 'Innovation in Action' debate that was co-chaired by Maria da Graça Carvalho and Antonio Fernando Correia de Campos. It included presentations from each JTI and a lively panel discussion with contributions from Christian Ehler *(MEP & Member of ITRE Committee)*, Rudolf Strohmeier *(Deputy Director General, DG Research & Innovation)*, Willy Van Puymbroeck *(Head of Unit - Components, DG CONNECT)* and Florence Lefebvre-Joud *(Chair of the FCH JU Scientific Committee)*. The discussion was followed by a Q&A session, moderated by Mr Correia de Campos.

Overall, it is clear that this event was fruitful and brought greater awareness about the JTIs, their successes and future plans.

SMART CITIES

DISCUSSING SOLUTIONS TO AN INCREASINGLY URBANISED WORLD

By Patrick Pype and Gerard Beenker



Urbanisation is a seemingly unstoppable wave that brings significant challenges to how we structure and organise the social and industrial landscape. Aspects such as mobility, energy, security, eGovernment and health are major challenges in terms of affordability, efficiency and effectiveness. Solutions have to be found in 'smart' ways, not just technologically but also from a human perspective, with protection of privacy a prevailing thorn in the side. The world of semi-conductors and embedded systems has a key role to play in establishing the bedrock of tomorrow's world and laying the foundation for a sustainable society.

NXP Semiconductors creates solutions that enable secure connections for a smarter world. Building on its expertise in High Performance Mixed Signal electronics, NXP drives innovation in the automotive, identification and mobile industries, and in application areas including wireless infrastructure, lighting, healthcare, industrial, consumer tech and computing. NXP's VP and Scientific Director, Gerard Beenker, and Director of European Affairs, Patrick Pype, are therefore very well placed to consider the prevailing and future trends in smart technology that will become essential if, as predicted, cities are to be able to sustainably support 80% of the world's population by the middle of this century.

So, what do we mean when we talk about 'smart cities'?

"Good question," Gerard says, "because if you ask this same question to different people, you will get different answers. But the basic answer is quite simple. Technology. With such a concentration of people in a relatively confined area, major challenges arise. And we need to develop technology to help us cope with these challenges. Take mobility, for example. Just getting from A to B in such a congested environment will require smart solutions. In terms of private and public transport. Or energy. How can we come to the least possible energy for the highest level of performance and comfort? And, of course, the overriding consideration is the aspect

of safety and security. For example, if you are walking along the street at night, it should be well lit for a sense of safety. But if areas are not being used, then there is no need for lighting. So, intelligent lighting solutions should be found from both an energy and safety perspective. And we can go further. In the Internet-of-Things world, integrity of data and authentication of persons as well as devices (who is who) are very relevant issues that need to be addressed. It is about secure connections for a smarter world. So what you have is an increasingly complex social environment, and the semi-conductor and embedded systems industries can help provide solutions. Of course, in their turn, the solutions will be complex and the art lies in ensuring that such solutions are 100% reliable and available."

A sort of intelligent automation, then?
"Not only automation," Patrick points out. "It's also the additional services that can be provided. For example, not only will your portable device such as a smartphone help you get from A to B but it will also give you the options – what is the best way of getting from here to there. It may be in the form of apps but equally it could be in the form of individual recognition. You arrive at the station and you, as the individual traveller, are informed about the choices that are open to you."

Gerard: "But then the issue of privacy crops up again. There is the Big Brother fear of being monitored. Orwell's 1984. How much personal information is needed for us to get from A to B. That is something we are developing solutions for together with universities. We need to be clear about what information is allowed to be shared. The extent to which one needs to reveal one's identity and other personal data will depend on the situation. The travel advisor or the police officer."

How do we do this?
Gerard: "It has to be a gradual process. Let's take transport. In the future, cars will be able to drive autonomously. But people have to be convinced of the reliability and safety of such a system. But already aeroplanes fly most of their journeys on automatic pilot – it's just take-off and landing, or an emergency situation, that the pilot really has any task to perform. Cars will do the same, and do a much better job. Car-to-car and car-to-infrastructure communication will enable very fast reaction speed and improve traffic flow. Lane departure warning systems can already intervene when a driver is not paying full attention."

Patrick: "I always say that the car will become the flexible train of the future. They will be the wagons that will be conducted by a GPS- and safety-supported system to a specific route for a specific journey."

But driving a car is a very emotive experience – will the driver accept this?
Gerard: "Of course, this is something that will take time and, as I said earlier, will be part of a gradual process. We already have adaptive cruise control, and that is well accepted. One of the challenges we face is to design safe, reliable and secure systems We don't want malevolent hackers on the side of the road interfering with the software and causing mayhem in the traffic. Of course, like the aeroplane pilot, the driver is always there to intervene and take over manual control in the event of disruption. The system needs to be there for driver support to enable the driver, or traveller for that matter, to make a choice, safely and reliably."

Patrick: "Such systems will become increasingly essential in a more urbanised world. Imagine the traffic congestion that could arise if thousands of drivers are looking for a parking spot in the city centre. Studies by IBM have shown that this is the case in New York, where 45% of the cars driving around are looking for a parking space[1]. A parking support system that automatically guides drivers to the next available parking spot can dramatically reduce such urban congestion, especially when you can reserve your parking at the start of your journey. This is a good, clear example, I think, of what we mean by a 'smart city' and where such a software-hardware combination can help solve a mobility issue like this."

Will the mobility issue change the way we organise our lives?
Gerard: "It's already happening. People are increasingly using alternative working practices.. So, then again, we come back to the implications of a smart city. The facilities have to be in place for us to reorganise our day effectively and efficiently. But we cannot forget that we are living, breathing human beings and virtual contact should therefore be an option rather than a compulsion."

Patrick: "But we can't escape the fact that the world is changing and that in the future virtual contact will become a necessity in a number of situations. The more sophisticated it becomes, the more 'tangible' it will feel. A transatlantic virtual conference can save significant time and money."

Of course, integration of all these components and systems will be crucial.

Patrick: "Absolutely. Take intelligent homes, for instance. When you are travelling home from your work or the airport, you can switch on the climate control at home using your smartphone so that it's nice and warm when you get home. At home there may be more parameters you would like to measure and control, like humidity or CO2 levels. What we need to do is to step up a level and start applying this to buildings, both residential and commercial. With the local, decentralised energy generation systems like solar panels, a smarter grid is needed to make energy supply more efficient, secure, with less peak loading, cheaper, comfortable – you name it."

Gerard: "The question is about how all this will evolve. At the ARTEMIS Summer Camp we had a debate about Smart Cities and I don't believe there will be any master plan that brings everything together under a single umbrella. The different domains will address their common problems and come up with solutions. Once we have the solutions, then I'm sure the issue of integration will be addressed and solved."

Patrick: "If you think about the identification issue, you have identity cards, bank cards, health cards, transport cards … eventually all this identification will be reduced to a single device, possibly integrated into another device like your smartphone or, more accurately, mobile device."

Gerard: "And here we touch upon the crucial matter of security. Whether you make a payment at the cash counter or send information about your health status via the digital infrastructure, protection of personal data is paramount. There is a significant amount of identity theft these days – a figure of 10% has been mooted. So you can imagine the chaos this can cause, in particular when financial transactions are concerned. It's with good reason, therefore, that there is plenty of R&D going on in this security area in both hardware and software. For example, car number plate chips are one way of making car theft more difficult. This method could be applied to almost any owner-item combination. If the link is broken, a mismatch can be registered and the criminal tracked down. Here, too, secure connections are a relevant enabler for smart applications."

Patrick: "Something that is music to the ears of insurance companies!"

Will we be chipped in future in the same way as our domestic pets are chipped?
Patrick: "It already happens. There are health & fitness clubs where you can only gain entry by chip identification. Such a chip can also be used for health monitoring. With the costs of healthcare continuing to rise – in the US figures[2] suggest that by 2020 healthcare costs will make up 30% of a family's budget – wireless sensor based chips could enable people to take more proactive care of themselves and so avoid or reduce treatment. At the moment we see individual devices entering the market – in the future I think there will be much more integration."

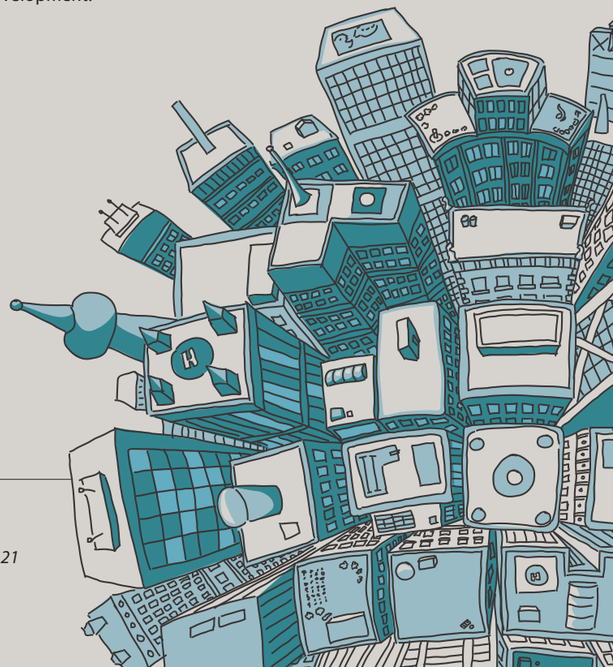
Gerard: "Once again, you have to be careful about the Big Brother syndrome. The fear of misuse of your information."

And what about the Smart City resident or consumer. What kind of say will he or she have in the progress of technology?
Gerard: "I was recently asked exactly this kind of question at a Smart City event. How do you know that the people want what you are giving them? Are you involving sociologists in your research programmes? And, of course, this is a valid point."

Patrick: "This is already happening at the University of Leuven where the technology teams are complemented by the input and insights of sociologists. In the city's ambition to become a climate-neutral city within twenty years from now, a think tank has been installed and it comprises engineers, sociologists, economists and others to brainstorm the options. So it's a wider social perspective that is needed before we look at where the technology can solve specific problems."

Would it be right to suggest that Smart Cities aim to assist rather than control people's lives?
Gerard: "Yes, it's the assisted part that is the important aspect. The art is finding the balance between assistance and intervention. When you're driving, you want your system to warn you of potential hazards but you are also thankful if the system intervenes and saves you life if you fall asleep at the wheel. Or prevents you suffering a heart attack."

Patrick: "If you look in terms of what is technologically possible, then we can see that the technical realisation of Smart Cities is not too far off. The issue lies in transferring the technology into the social systems. That step is as important as any next technological development."



[1] *see www-03.ibm.com/press/us/en/pressrelease/35515.wss*
[2] *Estimates based on CPS ASEC 2001-12, Kaiser/HRET 2001-12, CMS OACT 2012-21*

ENGINEERING RESILIENT SYSTEMS-OF-SYSTEMS

BY MICHAEL BORTH, EMBEDDED SYSTEMS INNOVATION BY TNO,
IN COLLABORATION WITH SJIR VAN LOO, PHILIPS RESEARCH

Networked cyber-physical systems-of-systems are on the horizon to realise many advanced applications, e.g., smart and sustainable mobility or situation awareness for safety and security. The increasing reach, information demands and decision power of such systems-of-systems (SoS) pose a challenge to engineering; in fact, developing SoS is partly outside the scope of traditional system design, with further challenges for businesses and legislative bodies. We approach tomorrow's systems with information-centric architectures and an inbuilt resilience against many pitfalls typical in this domain – a necessity since we all have to rely on these systems and their ability to change and to adapt.

BUILDING SYSTEMS-OF-SYSTEMS...

We distinguish between three types of systems-of-systems, which vary in design, purpose and the assumptions made during both their engineering and operation. First, there are cooperative systems designed for a known environment, e.g., intelligent lighting and air conditioning within a smart building. The systems within the resulting SoS are service providers and consumer for a known set-up. While they often employ self-configuration to fit in, initiating internal changes with communication about configuration and parameters, they are within reach of traditional engineering with extra efforts for, e.g., standardisation or distributed control. Second, there are collaborative systems in federative SoS, e.g., traffic and infrastructure control for smart mobility. Here, systems become contributors for known high-level goals. They negotiate about incentives and ways to collaborate as they are truly operational independent, with a resulting self-organisation on SoS-level for optimal benefits. Third, there are technology visions for adaptive systems in evolving SoS, e.g., swarm intelligence for adaptive autonomous exploration, but we consider these out of scope for us and most, if not all, industrial partners within Artemis. Our focus is instead on the second type of systems.

REFLECTION ON THE HEALTH AND CONTRIBUTION TO SOS GOALS ENABLES RESILIENCE.

... IS ABOUT ENGINEERING WHAT YOU DO NOT CONTROL

When charged with building a collaborative system in a federative SoS, or even the SoS itself, we have to acknowledge that *this is about engineering what you do not control*: you follow a goal or an ambition, but the definition is often soft or even contradictory, e.g., with smart mobility that demands high throughput (dense and fast traffic) without dangers (the opposite) or pollution (to be optimised). The design of key elements is possible, but due to the long lifecycle and sheer size of the SoS plus the number of stakeholders involved, there is no single party that could design all the systems. In fact, this is not even desired, as it cancels any benefits due to the distribution of efforts. Instead, one has to design for joint operation with black-box systems and unanticipated configurations, leaving it for the systems to negotiate contributions, behaviours, resource usage, etc. This is rather different from established system engineering, but it also contradicts common legal procedures. There is no knowledge and no control over the whole. Consequently, design decisions are no longer monotonic; techniques for design, integration and testing fail if they are based on divide-and-conquer (most are), and the future consequences of faults or change are not understood, as there is no precognition. Furthermore, today's engineering follows a signalling paradigm that seems ill-suited for negotiations, incentives and the respective uncertainty. Likewise, how could one ever guarantee performance and functionality in a legally binding way, with this lack of exact specifications, opportunities to test in advance, control, etc.?

RESILIENCE: THE POSITIVE AND ACTIVE ABILITY TO COPE WITH FAULTS, FAILURES AND NEGATIVE EFFECTS OF CHANGE, E.G., BY ADAPTING TO A NEW CONTEXT, SITUATION, CONFIGURATION, TASK.

RESILIENCE AND REFLECTION

To successfully build tomorrow's systems-of-systems, tackling high complexity while lacking the aforementioned control, pre-cognition and understanding, we need to counter the ill-effects that can and will arise from less optimal interactions between systems or with the environment. Instead of assuming that such effects might ever be prevented totally, or at least constrained in a foreseen manner, we seek an inbuilt resilience. We claim that to heighten resilience, to enable a complex system to cope and to recover, for it to be less vulnerable, an inner system awareness, i.e., reflection, is key. We investigated this in our industry-as-lab projects Trader (reflection inside complex systems, with NXP), Poseidon and Metis (inside SoS, with Thales)[1].

In Trader, reflection directed recovery, as an awareness framework compared the input and output of the system with a high-level model of user expectations and the impact of possible failures. Whenever a discrepancy between output and expectations indicated a necessary correction, the reflection determined the actions to take, e.g., to restart or reconfigure components. In the other two projects on dynamic awareness systems, we set up reflection to cope with variations in the quality-of-service of sensors and information providers, plus the join-and-leave of whole systems, thus a dynamic reconfiguration of the SoS. Here, we worked with a cybernetic approach for resilience: circular causal feedback on a system's actions is used – after reflection – to change and adapt all parts of the SoS. Within the reflection, we advise computing a notion of system health that includes the contribution to the SoS goals, e.g., a reduction of uncertainty within awareness systems. This allows for both local feedback and diagnosis, as well as for SoS-level insights, which trigger, e.g., reconfiguration strategies to optimise performance.

We find that the implementation of reflection to improve resilience works best with information-centric architectures and operations of the cyber-physical SoS[2], centred on the information's health plus contribution (integrity, certainty, usefulness, …) and flow (right place, right time). While this requires an innovative mesh-up of informatics with embedded engineering science, we argue that tomorrow's systems' impact and ability will operate in new contexts based on information – and their required ability, resilience based on reflection, should be founded in the same way as well.

About the author:
Dr. Michael Borth *works as senior researcher and system architect for TNO-ESI, focusing on information-centric systems-of-systems and their smart operations. He is with Artemis since he contributed to the very first Strategic Research Agenda, back while he was with Daimler Research and Technology.*

Embedded Systems Innovation by TNO *(TNO-ESI, formerly the Embedded Systems Institute) is the leading Dutch research organisation for high-tech systems, their design and engineering. With its national and international network of industrial and academic partners, TNO-ESI provides industry a unique hub for cooperative research, innovation support, competence development and transfer of know-how and expertise.*

[1] *TNO-ESI: Applied Research Projects at www.esi.nl/research/applied-research/*

[2] *Borth, M: On the Architecture of Systems for Situation Awareness; in van de Laar, P, Tretmans, J, Borth, M: Situation Awareness with Systems of Systems, Springer, NY, 2013*

ARTEMIS-IA PRESIDIUM AROUND THE TABLE

Interview by Chris Horgan

For this issue, the Presidium got around the table to consider a number of questions in a retrospective of the ARTEMIS programme, acknowledging both the significant challenges that have been faced and the tremendous progress that has been made.

"ARTEMIS HAS BUILT A NETWORK OF ORGANISATIONS THAT ARE INTERESTED AND WILLING TO ACTIVELY PROMOTE R&D&I ON EMBEDDED SYSTEMS AND NOW ALSO ON CYBER PHYSICAL SYSTEMS IN EUROPE. THIS PAVES THE WAY FOR ENSURING EUROPE'S COMPETITIVENESS AND SUCCESS IN THIS EXTREMELY IMPORTANT DOMAIN OF TECHNOLOGY"

~ Heinrich Daembkes

ARTEMIS has produced a number of important successes to date. In what ways can these successes be carried through into the new Horizon 2020 period?

Heinrich: ARTEMIS has built a network of organisations that are interested and willing to actively promote R&D&I on Embedded Systems and now also on Cyber Physical Systems in Europe. This paves the way for ensuring Europe's competitiveness and success in this extremely important domain of technology. We need to continue in this way, following the three priorities as pointed out in the new SRA addendum 2013: to concentrate and focus on areas of strength, to exploit new business and to recover domains in lost markets.

Gerard: For me cooperation is the name of the ARTEMIS game. Many companies all over Europe, large as well as SMEs, and research institutes have grouped around a common strategic research agenda and experienced the value of jointly addressing important themes of Embedded Systems. This network will certainly be very valuable to continue addressing the challenges of new, even more complex embedded and cyber-physical systems.

Irene: I agree. We should definitely aim for cross-pollination, developing synergies with other communities and funding mechanisms that relate to the Cyber Physical Systems area – Robotics PPP, FoF PPP, other parts of H2020 – and transfer the knowledge in Embedded Systems developed throughout the ARTEMIS programme.

Pauli: Collaboration has been and will remain the key to the successes. Companies collaborating with each other, large and small, companies with universities, universities with research institutes, countries with each other, even the EU with the USA and Asia, the ARTEMIS-IA office with the ECSEL-JU office, ARTEMIS-IA with ITEA, national instruments with ECSEL, etc.

Giovanni: There is certainly a continuum between the Artemis JU activities carried out in FP7 and those expected in H2020. It will then be important to maintain a close link between the results already achieved and future challenges. This is probably going to happen in areas like safety-critical systems and, to a lesser extent, in computing platforms. However, technological progress and evolving market demand will require new approaches and further efforts in application areas like smart environments and security solutions. In the evolution towards CPS, we can also expects a growing tendency to explore large, highly distributed, secure, real-time based systems (even systems of systems).

What have been the unique selling points of the ARTEMIS programme and how will these enable the Embedded Systems industry in Europe to achieve success in the future?

"WE ARE ALREADY LIVING IN A WORLD WITH TENS OF BILLIONS EMBEDDED SYSTEMS USED IN EVERY INDUSTRY. LIKE OUR OWN NEURAL SYSTEM, THEY PREDOMINANTLY WORK INVISIBLE TO US; WE JUST SEE THE END SERVICES AS THEIR MANIFESTATIONS."

~ Pauli Kuosmanen

Gerard Beenker

Giovanni Barontini

Heinrich Daembkes

Pauli Kuosmanen

Irene Lopez De Vallejo

Pauli: For SMEs the unique selling points have been many, including the possibility to join big, leading-edge projects aimed at new revenue, reasonable funding mechanisms for SMEs, the SME-friendliness of ARTEMIS-IA, and the chance to participate in "thinking big" projects.

Giovanni: In my opinion, we can find the uniqueness in the long-term research nature of the ARTEMIS programme driven by a slowly changing research agenda that builds on previous results to meet market requirements across industry segments Europe-wide and so maximising impact for the future of the European ES industry.

Heinrich: We have built a strong community and we are generating a growing awareness of the impact and importance of ES and CPS. This will help us to support European economic competitiveness! But besides the big projects, like the AIPPs, we engage in a lot of supporting activities to build solid foundations through ARTEMIS Working Groups, such as the WG SRA that collects all relevant inputs that will impact our future and builds a strategy to deal with this. Our Centres of Innovation Excellence create new ecosystems around our technologies, addressing the entire value chain. We focus on Standardisation to build a defragmented European approach. And much more.

Irene: I feel that the strategic reach of the research topics coupled with a clear focus on applications that span sectors and large pan-European consortiums that target gradual changes in technology development are the unique selling points of the ARTEMIS programme that will enable success for the European ES industry in future.

Gerard: The commonly defined strategic research agenda describing the challenges that need to be tackled, the networks of excellences in which partners have found each other around common themes, the scientific and technical skills of the partners, and the ambition to strengthen each other's capabilities – these are all essential ARTEMIS characteristics. The funding has proven to be an enabler in bringing partners together and challenging them to address the research topics they most probably would not have addressed on their own.

In what ways do you see Embedded Systems becoming the 'neural' system of tomorrow's world?
Giovanni: The future computing infrastructure should combine large data centres for cloud computing with personal devices (e.g. smartphones, tablets, wearable computers) and a wide range of smart networks embedded in our living environments – the home, workplaces, transport systems, hospitals, leisure places and so on. To build effective, affordable and secure smart networks, research and innovation in ES will be key.

Gerard: Europe has to address many grand challenges, like ageing, energy generation and distribution, mobility, security and privacy, urbanisation, etc. Many, if not all, of the perceived solutions will be based on embedded or cyber-physical systems. Hence embedded systems will be needed everywhere. So I think we can rightly call them the neural system of tomorrow's world.

Heinrich: The key performance features of the technical products determine whether they will be attractive for customers or not. Today more than 50% of the key features of our technical products are determined by embedded systems. The ES and CPS extract information from sensors or databases, evaluate it and then define how the system reacts, determining and controlling the reaction via actors. Then the entire loop is closed by observing the response of the environmental system to that reaction. Which is exactly how a human brain behaves with its neural system.

Pauli: We are already living in a world with tens of billions embedded systems used in every industry. Like our own neural system, they predominantly work invisible to us; we just see the end services as their manifestations. Furthermore, without them the society would collapse in a similar manner as you and I would collapse due to a malfunction in our neural systems.

Irene: ES are already the neural system of our electronics and communications reality. Full stop.

Can programme integration (as in ECSEL) also serve to foster greater integration in the European Embedded Systems industry?
Gerard: I am strongly convinced that breakthroughs are needed to address the future problems of society. Breakthroughs often occur at the boundaries between various disciplines. Moreover ENIAC, EPoSS and ARTEMIS address almost the same set of applications. Hence the programme integration as targeted in ECSEL can bring a lot of additional value.
Giovanni: It might, to the extent that the European microelectronics industry and the system and software industry will be able to combine to create critical mass in high priority research areas. A common agenda, with a balanced approach among its different components will be an important factor in this respect.

Irene: I personally believe this is most definitely a great opportunity to technologically enrich these three already overlapping communities. Through generating more ambitious, far reaching projects and a unique opportunity to take European research to a global audience, taking advantage of those opportunities particularly from the SME community.

Heinrich: Embedded Systems are the core differentiating factor for all new systems, driving economic positioning and enabling solutions to Grand Challenges. Joining forces in ECSEL will enable a holistic approach to the full innovation chain through aligned policies and equal access to funding and resources.

Pauli: Yes, now we have a chance to create a broader strategy, avoid gaps in a better way and create synergy. Once again, collaboration will be the key. But if ARTEMIS-IA, AENEAS and EpoSS are just playing power games between each other, separation rather than integration will take place.

Looking back in seven years' time, what do you think will have been achieved by the European Embedded Systems industry?
Irene: The creation of wealth in a gloomy period.
Heinrich: We will have created a more holistic approach, benefiting from the close interaction and the dependence between HW and SW and especially systems design know-how. Our products will be determined in their function and behaviour by the smart embedded electronics systems, and the users will be increasingly unaware of the "Embedded Intelligence".

Gerard: I have high expectations in the various application domains. I am convinced that mobility, smart energy systems, security and privacy, manufacturing systems, etc. will be significantly improved. Also in the embedded system domain I expect that we will have made major steps towards highly distributed architectures as foreseen in the Internet of Things. We will have found breakthroughs in the domain of safety-critical systems bringing the autonomous driving of cars close to reality.

Pauli: ARTEMIS projects have created a remarkable set of success stories. The projects are based on a common European level strategic research agenda, created by major stakeholders. This agenda in itself is an achievement. New forms of collaboration have taken place. Despite the period being really turbulent in Europe in a number of ways, Europe's competiveness in the field of embedded systems has been maintained.

Giovanni: Probably the main achievement will not be technical but socio-economic. In 2020, the importance for European industry to have a world-leading capability in ES as a product differentiator will be much better understood as a way to open up new business opportunities and achieve economic growth in creating the neural networks of our society. While European industry may be traditionally weak in cloud computing and personal devices, it will have gained a great chance to lead in the creation of Cyber-Physical-Systems and the deployment of smart networks. What is required to boost success in this endeavour will be better identified, and this will be a great achievement for the future leadership of our industry.

BUILDING ECSEL

by Jan Lohstroh

Secretary General ARTEMIS Industry Association

As mentioned in the previous Magazine, 2013 was and still is a busy year in the building of the new Joint Undertaking ECSEL (Electronic Components and Systems for European Leadership) that is intended to become functional at some point during the first quarter of 2014. The Commission worked very hard on a proposal for a Council Regulation and published its proposal on 10 July of this year. It will be a tri-partite Public Private Partnership between the Commission and a number of Member States (the Public partners) and three industry associations (AENEAS, ARTEMIS-IA and EPoSS). The three associations will not only be a member of the ECSEL Joint Undertaking but also continue to embody the respective ENIAC, ARTEMIS and EPoSS ETPs.

Although the Commission has been listening to input from the three associations and the relevant Member States, the proposed Council Regulation, dated 10 July 2013, contains some citations, articles and clauses that are not in line with the wishes/expectations of the associations and/or Member States.

The current stage is that a Council Working Group under Lithuanian chairmanship is consulting with the Commission to adopt amendments from the Member States before the text is finally adopted by the Competitiveness Council in November or December of this year. According to the rules of the EU, the three industry associations that are the intended partners in the ECSEL JU are not allowed to be present in the meetings of the Council Working Group, so we can only indirectly influence the final text of the Council Regulation by lobbying the Member States and/or the Commission, which is a not very transparent and satisfactory process.
In the meantime the European parliament will issue a recommendation about the proposed ECSEL Council Regulation. The Council Working Group has to take this recommendation as input but does not have to implement it.

In the proposed Council Regulation the Commission will support the ECSEL JU with €1.2 billion and expects from the Member States a similar amount. The in-kind contribution of the project consortia is expected to be about €2.4 billion for a total programme of about €4.8 billion over 7 calls.

The administrative costs of the JU office should be a maximum of €40 million, half of which has to be paid by the three associations together.

The proposed JU will have a Governing Board in which the three associations will have a seat and a third of the voting rights, the same proportion of voting rights as the Commission and the Member States (together).

The proposed JU will have a body called the Private Members Board that will be comprised of representatives from the three associations. The main tasks of the PMB are to produce each year a Multi Annual Strategic Research and Innovation Agenda (MASRIA) and a Research and Innovation Programme (RIAP). The MASRIA should look ahead some 5 years, whereas the RIAP should define the basis and give recommendations for selection criteria for the calls of the coming two years.

At the moment the new JU is in place, the ARTEMIS-JU and ENIAC-JU will be adsorbed on the same date by the new organisation. So the support and reviews of the projects selected by the ARTEMIS-JU and ENIAC-JU during the calls of 2010, 2011, 2012 and 2013 will be carried out by the ECSEL-JU.

ARTEMIS-IA, AENEAS and EPoSS have already been working on a first draft of the 2014 ECSEL MASRIA as well as starting discussions on how to divide the 33.3% voting rights in the Governing Board between them and how to split up the €20 million bill for the administrative costs of the JU office.

Furthermore, ARTEMIS-IA and AENEAS are working on updates of their Articles of Associations because the current texts do not provide for a membership other than of the ARTEMIS-JU and ENIAC-JU respectively. EPoSS amended its Articles of Association on 18 September 2013.

The three associations hope that the final version of the Council Regulation for ECSEL will be satisfactory for all the stakeholders and hope that the first call of ECSEL will be organised not too late during 2014 so that the first ECSEL projects can start in January 2015!

Jan Lohstroh

ARTEMIS EVENTS CALENDAR

PECCS 2014

International Conference on Pervasive and Embedded Computing and Communication Systems

Date
7-9 January 2014
Location
Lisbon, Portugal

DATE

The DATE conference addresses all aspects of research into technologies for electronic and embedded system engineering.

Date
12-20 June 2013
Location
Budva, Montenegro

BROKERAGE 2014 IN BRUSSELS ON 4,5,6, FEBRUARY

PREPARING FOR ECSEL

AN INSIDE VIEW BY THE ARTEMIS-JU

By Alun Foster

Acting Executive Director ARTEMIS Joint Undertaking

It's been talked about for a while, but now it's actually starting to happen – the "merger" of ARTEMIS and ENIAC JUs and the addition of the Technology Platform EPoSS is starting to take shape. As I write this, a formal proposal from the European Commission about creating the "Electronic Components and Systems for European Leadership" Joint Undertaking (ECSEL) as a continuation of ARTEMIS and ENIAC is being discussed by the European Council and decisions are expected soon. Indeed, things are moving. ARTEMIS Magazine #14 carried two especially interesting articles in this respect, one giving an industry view and another a more technical description of "Cyber-Physical Systems" – the rather more academic description of what these advanced electronics systems are. At an event held in the European Parliament building in Brussels in the first week of October 2013, ARTEMIS and ENIAC, together with the other JTIs, presented to an important audience of political decision-makers what they have achieved so far (I say "so far" quite intentionally, as these two sibling initiatives still have an important life ahead of them) and why it is so important to continue their work. But what about the view from within, so to say, from the existing ARTEMIS Joint Undertaking?

From a technical programme standpoint, the merger of ARTEMIS and ENIAC and the addition of the EPoSS technologies makes eminent sense. For a while now, the term "Cyber-Physical Systems" (or CPS to their friends) has been used to describe increasing complex electronic systems, all networked together to offer more and better of what they are designed to do. You can find references to these (though without that complicated name) in the very first ARTEMIS Strategic Research Agenda. Broadly put, with ENIAC developing chips (the actual computers), ARTEMIS developing the software and intelligence to make the chips come to life, and EPoSS developing the smart bits that connect these electronic "things" to the real things in the physical world, all the elements of CPS are now brought together. Though the specialisations of each of these three domains will be continued in each of the three associations, bringing them together under one "funding machine" – the ECSEL JU – will make it a lot easier to coordinate their projects, ensure cross-fertilisation between the domains and further reduce the fragmentation of effort and resources.

From a strategic standpoint, the interaction of the public and private sectors in the new JU will build further on the clustering of projects in a coordinated way, generating the critical mass necessary to create active ecosystems across supply chains, which is essential for keeping Europe's businesses ahead of the competition from outside. Bringing the three initiatives together also creates a larger and potentially more effective lever for focusing the ever-scarce public investments into societally vital technological domains. This is important not only for the potential to keep and create jobs for European employees, but also to ensure that Europe will not be forced to rely on "outside sources" for these important technologies. After all, our society is, out of necessity, becoming increasingly reliant on them to provide answers to some pretty difficult issues.

C O L U M N

BATON BLUE(S)

This column is the fourth in a series in which various members of the ARTEMIS community pick up the baton and have a say on developments from a personal perspective and in their own way before passing the baton on. In this edition ***Karlheinz Topp****.*

Can you please introduce yourself?
Well, I have been at Bosch for thirty-five years now. Bosch is a company that has a very wide spread of interests and so I had the possibility to work in various domains within one company. I started building head-up displays for aircraft, have made avionic computers, software and hardware, and I provided software engineering support in the telecommunication section before moving into corporate R&D. Now I am responsible for coordinating public-funded projects in the area of embedded systems. Besides the ARTEMIS-IA steering board, I am also on the steering boards of ITEA and EICOSE as well as the Bosch representative in the SAFETRANS association. In fact, I was involved in writing the first ARTEMIS SRA but then slipped into the background before becoming a Steering Board member two years ago.

What was your core motivation to join the Steering Board?
Well, first of all, I succeeded my colleague, Wolfgang Klingenberg. We had worked very closely together so the idea that I would be his successor was a rather natural one. I was also interested in taking over from him to see the differences between ITEA and ARTEMIS , or even looking at the possibility to influence their processes a little bit with good practices from each other, because by being active in both, you have this possibility.

And what motivates you in your own professional life?
I suppose it all began 48 years ago when electrical or electronic systems became my hobby. I wanted to see how I could make daily life a little easier, more comfortable. So I started with building electrical equipment and stepped into electrical engineering. And even today I think this is what drives me, the desire to make life easier. This is what I am now trying to do in the world of embedded systems. I think one of the biggest challenges we face today is to try to 'hide' all this growing complexity and make our systems more user-friendly. We can conceive of all and every kind of functionality and build it but if the user interface is too complex nobody can use it. So my approach is to try to move the focus from the technical to the user perspective – the man in the street, as it were. Even myself. I may be fascinated by the technical complexity but when I use something I want to be able to do it without having to study manuals and such like. Plug and play, no delay.

What are important focus points for Bosch in the ARTEMIS programme?
Bosch has no specific focus – as a large multi-domain company, Bosch is interested in almost every aspect of the ARTEMIS programme. Everything apart from healthcare, which is not one of our own focal areas. So it is ARTEMIS as a whole that appeals. We are interested to see what is happening in the various work packages and work programmes.

What are important achievements of ARTEMIS in your view?
Community building is what I see as the major achievement. As in the reference technology platforms or in the smart cities programme. So this is certainly something that was not there in the first place and is there now. Like the CESAR RTP. It leads the way as a technology-based community and others are now developing. Bosch is very interested in such developments and we are using the results they produce.

Josef Affenzeller handed over the baton to you and he has a particular question to you: You are active in ARTEMIS, CATRENE, ENIAC and ITEA. What are your thoughts about the future of these parallel activities?
Just to clarify, Josef may have got a bit too enthusiastic about my participation. I'm not actually active in ENIAC and CATRENE. I think anyway it's a good thing that is happening, this merging of the parallel activities of ARTEMIS, ENIAC and EPoSS in ECSEL. It will give us great opportunities to generate new projects that will deliver really complete embedded systems, so having the whole chain in a single project. This is a big advantage of the new construction. But there is, of course, a flipside. We have to be careful that the embedded system software development does not get run over by the wheels of hardware! After all, chips are useless without the right software!

What do you believe is the biggest challenge in the R&D of Embedded Systems for the coming years?
As I've suggested, we must handle the increasing complexity. So we will need to develop a lot of new methodologies, good tool environments to get rid of the error-prone manual activities of the developers. And we have to take a much closer look at the user-friendliness aspect of these increasingly complex systems. And that's a tough one that will take some time to resolve.

To whom do you wish to hand over the baton/column and why? What particular question do you have for this person?
Knut Hufeld of Infineon would be my choice. I would like to hear his view, as a component and chip developer, from the other side. So, what is his view of this new combination of ARTEMIS, ENIAC and EPoSS under the ECSEL flag?

What music goes together with reading of the column?
This is a really difficult one for me to answer because music has no real place in my life. I guess if I ever listen to music it may be in the car but even then I am more likely to listen to the news. So I can't really answer this one.

EDITORIAL INFORMATION

ARTEMIS Magazine is published by ARTEMIS Industry Association and ARTEMIS Joint Undertaking.

ARTEMIS aims to tackle the research and structural challenges faced by European industry by defining and implementing a coherent research agenda for embedded computing systems. Its ambition is to help European industry consolidate and reinforce its world leadership in embedded computing technologies.

ARTEMIS Industry Association is the association for R&D actors in embedded systems with 200+ members around Europa. The Industry Association is the private partner in the ARTEMIS Joint Undertaking. It continues the work of the European Technology Platform and is therefore responsible for the ARTEMIS Strategic Research Agenda. The Industry Association creates the meeting place where the stakeholders identify topics for major R&D projects that they want to pursue together, form consortia and initiate project proposals for joint collaboration, and building of ecosystems for embedded intelligence.

The ARTEMIS Joint Undertaking is a Brussels based organisation legally established in February 2008 and gaining autonomy in October 2009. It is a Public Private Partnership with the EC and 23 participating Member States. The ARTEMIS Joint Undertaking adopts a commonly agreed research agenda closely following the recommendations of the Strategic Research Agenda developed by the members of ARTEMIS Industry Association. The ARTEMIS JU will manage and co-ordinate research activities through open calls for project proposals through a 10-year, €2.5 billion research programme on embedded systems.

ARTEMIS Magazine provides information on the developments within the ARTEMIS community. Its aim is to keep the ARTEMIS community and beyond updated about the Association, Joint Undertaking, programme status & progress, achievements and events in embedded systems. An online version of ARTEMIS Magazine is available on www.artemis-ia.eu and www.artemis-ju.eu

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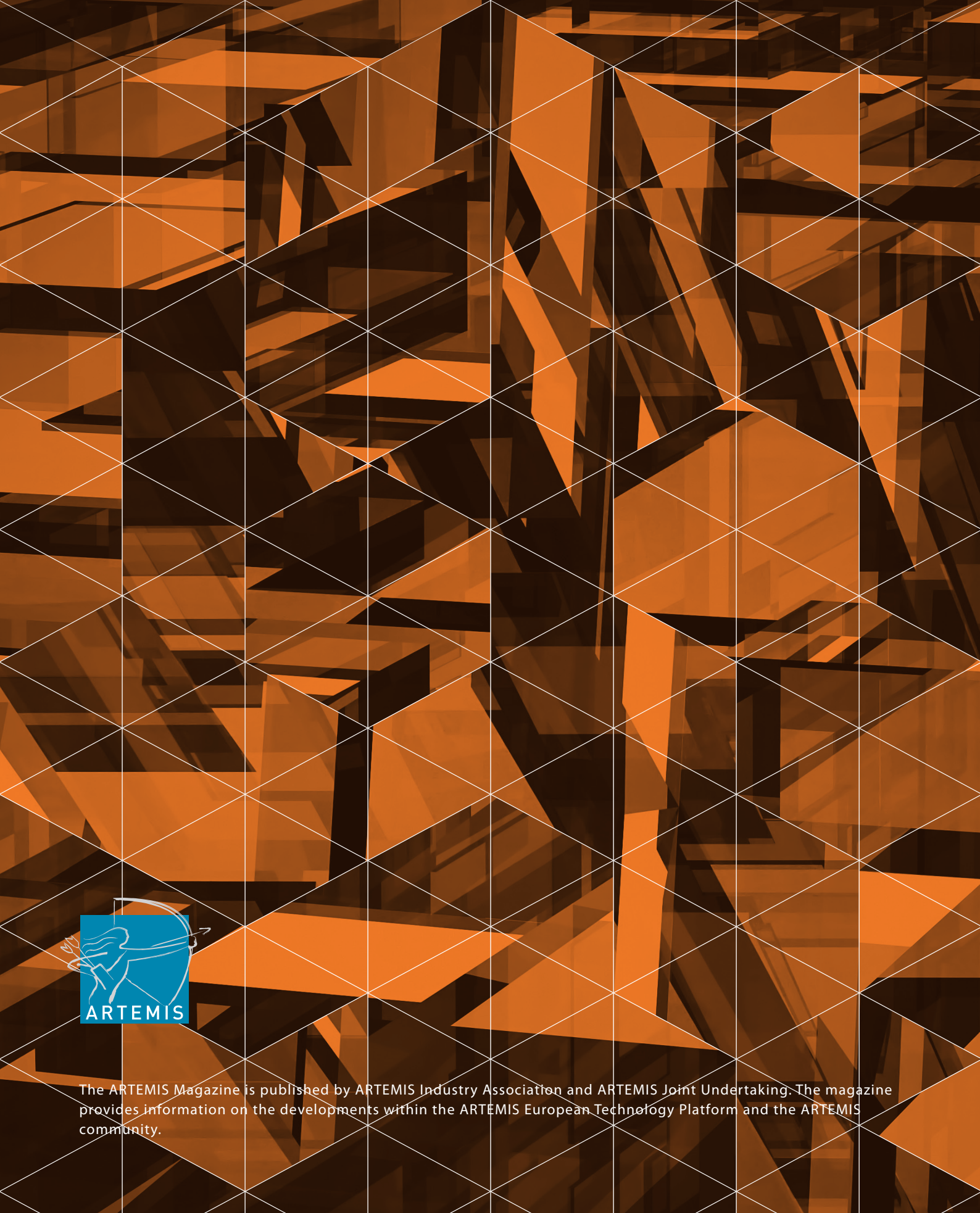

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