

The time for talking is over

In a recent high-level conference on the digital transformation of European industry and enterprises, speed was underlined as an essential component in Europe's competitiveness and much needed economic growth and jobs. The message to Europe's policy makers and industry leaders was a clear call for immediate and bold action to accelerate the digital transformation and seize business opportunities, or risk getting left behind in the wash of the fourth industrial revolution.

On 13 April 2016, the ARTEMIS Industry Association presented its Strategic Research Agenda (SRA) 2016 in Vienna. The aim of this SRA is to create the pathway to digital transformation, enabling a more agile and shorter development cycle of embedded intelligent systems through the adoption of design-by-composition and correct-by-construction principles. It also aims to overcome fragmentation in the European supply base for design and engineering components and tools. By focusing on providing strong technological capability over the whole value chain, barriers can be removed between application contexts to yield multi-domain, reusable components ('building blocks') for embedded intelligent systems, extending the use of digital platforms to build the stronger ecosystems that are needed to accelerate innovation and create new business models.

Silent revolution

The digital evolution, or digitisation, is a silent revolution that is transforming our way of living and of doing business. Cyberphysical systems technology is nowadays widely recognised as a core enabling technology that lies at the heart of the development of many innovative products and services. The digital transformation provides a great opportunity to open new markets to every business in Europe and beyond.

We believe that technologies should not be considered in isolation and that by breaking down such 'artificial' barriers new innovative businesses will emerge. These will bring to market a new and wider variety of smarter products and services that will reshape the future and create new unprecedented opportunities. Empowered by digital investments, disruptive business models and improved production processes, European companies can generate international market opportunities with new products and services. From engineering and automotive to healthcare and pharmaceuticals, all industrial sectors are being impacted as value shifts rapidly along the value chain.

So Europe cannot linger in using this leadership in cyberphysical systems, these embedded intelligent ICT systems that make products smarter, more interconnected, interdependent, collaborative and autonomous. They provide computing and communication, monitoring and control of physical components and processes in various applications. Harnessing



Heinrich Daembkes



Laila Gide

these capabilities in time and across space creates applications with enormous and disruptive new functionalities with unprecedented societal impact and economic benefit for citizens and societies. In the future, cyberphysical systems will manage complex systems (e.g. smart grids, transport or water management systems) and will make everyday objects intelligent (e.g. homes, offices, cars, trains, cities and clothes), the latter being connected to the internet, leading to a network of physical objects – the internet of things (IoT).

Combining technologies

The major power of the fourth industrial revolution lies in combining digital technologies with other advanced and leading-edge technologies for maximum resource efficiency and EU competitiveness. Creating suitable architectures and services as well as corresponding innovation strategies and new business models is helping to modernise Europe's manufacturing capabilities; in the near future, traditional factories will increasingly be transformed into smart digital manufacturing environments.

Arrowhead

Such is the collaborative automation approach that has been embraced by the ARTEMIS Innovation Pilot Project known as Arrowhead. Driven by software (systems) and connected through the internet of things, collaborative automation, of course, knows no borders. The significant gains in productivity (higher efficiency, lower costs) of this approach have already been demonstrated, especially in production, smart buildings and infrastructures, electromobility, and the virtual market of energy. The Arrowhead community is growing in size and strength, demand is tangible, and the foundation has been laid for collaborative automation to have widespread, real business impact. By creating a wiki page, which contains links to architecture, code examples, working code, and working systems, as well as

documentation on how to use the Arrowhead Framework and how to implement your own IoT automation services and systems, something of a meeting place has been established to share ideas and facilitate organic growth and change. This really is a case of a key digital transformation in action, one that is attracting interest not only in Europe but even as far afield as Japan.

This collaborative and cross-domain approach must be complemented by the development of common building blocks to make significant advances in design-by-composition. This will also accelerate the development cycle, maximise the reuse and the time to market, be more cost efficient in the adoption and deployment of technological solutions, master their growing complexity, ensure safety, security and privacy, allow flexibility, and facilitate interoperability between the various systems.

The emancipation of information

If we take a moment to pause and think about this whole evolutionary process from the mechanical to the digitised ecosystem, we could do worse than to consider photography as an illustration. The first products existed in a mechanical or analogue (physical) form. These were then transformed into a digital form in the evolution from integrated electronic components to embedded software. The next step was integration into the digital mobile phone, as photography and music converged into one device, the internet-connected smartphone, and consequently a system in a large system with cloud storage and computing, and satisfying a wide range of functional and non-functional properties.

There has been a shift from systems to system of systems where interoperability, particularly semantic interoperability, will be an essential ingredient in enabling users of physical artefacts and their embedded intelligence to use the different languages of different domains but nevertheless still 'understand' each other. The emancipation of embedded information with semantics creates possibilities for completely new types of application that have not been possible to date.

Unprecedented potential

Thus, as cyberphysical systems of systems emerge, characterised by a large number of physical devices and computing elements that are interconnected in both physical and



Spring Event 2016: From left to right: **Laila Gide** (vice-president, ARTEMIS-IA), **Ben Ruck** (head, Public Authorities Board, ECSEL), **Heinrich Daembkes** (president, ARTEMIS-IA), **Michael Wiesmüller** (PA Austria) and **Dr Max Lemke** (head of unit, CONNECT-A3, European Commission)

informational terms, the vastly increased amount of information and the new level of connectivity offer unprecedented potential for more efficient operation, higher flexibility and adaptability, improved levels of reliability, and better quality of products and services. Connectivity provided by the internet of things will become an enabling technology for cyberphysical systems of systems that close the loop from the sensor information to actions performed by physical systems in transportation, energy systems, production plants, logistics, smart buildings, etc.

In the aerospace domain, for instance, aircraft (manned and unmanned) in an all-connected environment will no longer be the sort of high-tech vehicles that are isolated from the rest of the world. Airborne crews – and also the automated systems – will require real-time connection to download the latest flight and service details, and passengers will demand an internet connection or want to be streamed from the moment they board, while on-board systems will need to communicate with the ground for mission or maintenance reasons. Everything that can be automated will be automated and will embed a higher level of intelligence and acquire greater cognitive capabilities.

Once again, echoing the call to Europe's policy makers and industry leaders, we must seize the tremendous opportunity we have to make the digital transformation happen. Greater pan-European collaboration will help overcome the barriers to digital growth, with joint cross-border programmes and investments able to give the digitisation of industry at local and regional level a real boost. And 'open innovation' can accelerate the process, bring new thinking into organisations, and ensure that the best ideas are implemented and successfully brought to market.

Heinrich Daembkes
Laila Gide
ARTEMIS Industry Association

<https://artemis-ia.eu/>