# ITEA Impact stream

## Challenges & ITEA Impact stories

ITEA 4

eureka

## Colophon

Online version is available at https://itea4.org/impact-stream.html

Publisher
ITEA Office
High Tech Campus 69-3
5656 AG Eindhoven
The Netherlands

Text & copy
CPLS – Zoetermeer, the Netherlands

Design and creative layout
Studio Kraft – Veldhoven, the Netherlands

With thanks to the project consortia, ITEA Office and other ITEA-involved persons for any assistance and material provided in the production of this publication.

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## Challenges


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# Introduction

**ITEA is the EUREKA Cluster programme in the domain of Software Innovation, which supports companies and innovators to develop new partnerships, to access new customers & new markets and to develop new products and technologies in international, collaborative and industry-driven R&D projects with a focus on results.**

## Software Innovation is a prerequisite for maintaining global competitiveness

There is a wide consensus that from now to 2030 change and disruption will be permanent features in society, with the way of living and doing business becoming fundamentally different from what it was. Digital Technology has a major role in mastering the changes. And it is within this domain of Digital Technology that ITEA is addressing innovation in Software, IT Services, Internal IT and Embedded Software, collectively denoted as 'Software Innovation'. For Europe, an industry strong in Software Innovation is a prerequisite for maintaining global competitiveness and in securing high-value jobs in Digital Technology and in other, more traditional industries that are, or are becoming, dependent on Digital Technology.

## ITEA – focus on results, cooperation and customer needs

ITEA stimulates innovation projects in an open community of large industry, SMEs, universities, research institutes and user organisations. The ITEA community is founded in Europe but is open to participants worldwide. ITEA is managed by industry in close cooperation with the national public authorities of participating countries. Following the EUREKA structure, each ITEA project partner can apply for national funding in their own country – allowing a project idea to attract funding from all participating countries. ITEA's bottom-up project creation and approval process ensures that the project ideas are industry-driven and based on actual customer needs. ITEA focuses on supporting its projects as much as possible to maximise their impact, which is shown in its proven track record - since 1998 - with major success stories in Europe's most competitive industries like healthcare, automotive, communications and security.

## Impact as key ambition

Impact is one of the main ambitions in ITEA. Impact on business, on the market, on society. Without impact, a project will not be successful in ITEA. This is a key value in ITEA, and impact and potential impact are central during the project lifecycle: in project evaluation, monitoring, closure and in communication of the results.

Many ITEA projects have achieved incredible results and most of these successes could not have been achieved without the (financial) support of the national Public Authorities. They have put their trust in these projects and supported them with public funds, making it possible for the project partners to get the most out of it. In return, ITEA is now gathering project impact stories to show in what way they solve key societal challenges and have an impact on business, on the market and on society.

All impact stories will be collected in this ITEA Impact stream. The ITEA Impact stream is a living publication that consists of 2 main elements: 7 main societal challenges and a set of impact stories showcasing the impact highlights of successful ITEA projects. Over time more stories will be added, so keep an eye on: https://itea3.org/impact-stream.html

# ITEA – a EUREKA success story

*EUREKA is a publicly-funded, intergovernmental network, involving over 40 countries. Since 1985, EUREKA has been a leading open platform for international cooperation in innovation.*

*EUREKA Clusters, including ITEA, are a EUREKA success story. In terms of project funding, they represent about two thirds of the EUREKA portfolio. They feature a high industrial participation, with a considerable – and increasing – level of SME participation (between 30% and 50%). The success of the Clusters is due to their flexibility, enabling companies to share their pre-competitive R&D and innovation efforts through international cooperation supported by national governments in line with their respective national priorities. The continuous development of EUREKA Clusters, strongly supported by the European industry, EUREKA High Level Representatives and public authorities of participating members have made the Clusters what they are today: essential instruments for the global competitiveness of European industry.*

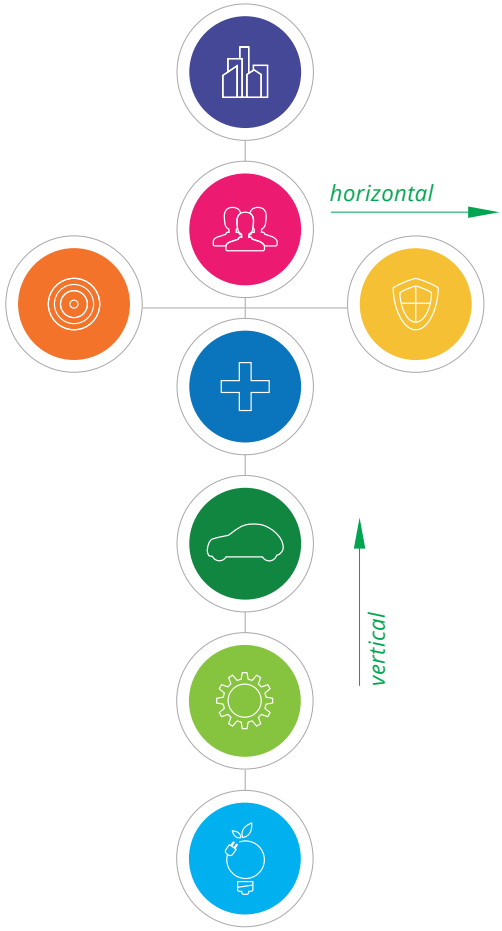
# Challenges

## A Global Village for Software Innovation …

ITEA today is a place where the community rolls up its sleeves and works on bringing dreams to life in an atmosphere of intensive and intimate international collaboration with a common goal – to turn innovative ideas into new companies, jobs, economic growth and benefits for society. ITEA is the Home of Software Innovation, close and personal to the customers in our projects; inviting existing and prospective customers to our workshops and to our projects to understand the key pain points for a successful and fast-tracked Digital Transition. To create innovation-driven growth, we need to focus on future markets and the challenges posed by a fast-changing world in which 'smart' is the key concept. In ITEA, we have a strong and happy community with a deep knowledge base, highly motivated to collaborate using the very latest technologies to create disruptive solutions that benefit countries and companies. ITEA truly is a Global Village for Software Innovation where past success stories have created trust in our drive towards a greener, more sustainable world.

## … that addresses the challenges of tomorrow

At present, we can see seven main challenges that the ITEA community addresses, areas in which our future success stories are hidden. Smart Cities is an area in which our projects have already made an impact. The need for 'smart' innovation in cities is evident from the demographics alone, with more than half the world's population urbanised and 80% of all GDP produced in cities. But we must be careful not to create a digital divide; smart villages will also be needed.
The flipside of urbanisation is that cities consume




70% of all energy and generate over 70% of global greenhouse gas emissions. To support the management of Smart Cities, Smart Communities must be able to learn from each other and make the right urban decisions online. And, of course, we are already creating Smart Health solutions that have to provide answers to manage health more effectively and efficiently in our cities and communities of the future. And in this world that is getting smaller and smarter, the need to mobilise people and goods increases. In fact, Smart Mobility is a prerequisite for Smart Industry as we are compelled to produce more, produce faster. We need to cooperate with traditional industries to digitalise their processes.

These are the five vertical challenges we have identified as important markets for our software innovation ambitions. But as we change and digitalise our lives, there are two horizontal challenges that are integral components of these five verticals. Smart Engineering is central to optimising our efforts to boost efficiency, reduce costs, accelerate agile development and impact on every industry. Safety and Security is the second horizontal challenge that is a vital aspect of the smart scenarios of today and tomorrow, from intelligent homes to satellites in space and from medical therapy to passport control. The urgency of the security challenge is underlined by the rising threat of terrorism and the growing vulnerability of our society as the digital transition becomes increasingly universal.

Smart Cities

There is an inevitability that we must face – urbanisation is an unstoppable demographic trend and cities will not get any smaller. With the number of megacities and the people living in them increasing exponentially, the question that arises is how can these cities be smarter with what they have at their disposal? Software platforms along with the massive deployment of wireless ICT will become key to supporting the management of cities, whether in terms of housing, energy, mobility or emergency services. ICT is an opportunity to solve many of the cities' problems: transportation, e-Government, Machine-to-Machine communication. How can the traffic intensity be managed, for example? What smart solutions can make the streets safer at night? And how can smart villages counteract the digital divide and prevent rural life becoming more difficult?

# Some facts and figures

- The United Nations estimates that by 2030 nearly 60% of the world's population will be living in an urban environment; in 1900, this number was only 13%. This rise in urbanisation affects not only industrialised nations (80% by 2030) but particularly developing countries (55% by 2030). All over the world, this creates political, scientific and economic challenges. There is a need for smart cities among the whole global community. [1]

- If reports are correct, cities would have to spend a staggering USD 350 trillion or almost 5 times current global GDP in the next 30 years on urban infrastructure. [2] But since this is not really feasible we need to find smart ways to address these urgent needs.

- Deploying smart technologies in key areas of electricity grids, transport, logistics, buildings and industrial motors could cut global emissions by 15% in 2020, and around USD 900 billion a year in energy savings for global industry by 2020. [2]

- As in many cities, the Dutch capital of The Hague wants to encourage citizens to engage with each other to influence how their city develops smart urban solutions. Democracy 3.0 is a tool to give citizens power over the allocation of 2-3% of local taxes by allowing their proposals to be voted on. [3]

- Big data and smart technologies can help engage citizens and business in the process of improving a city and its services. E.g.
  - in Boston, citizens use a digital application to register concerns about streets that need cleaning or potholes that need fixing, helping the city authorities to address the problems quickly without first having to dispatch employees to investigate. Potholes, for example, are detected by volunteer citizens who use a mobile app that applies an accelerometer and GPS to record and locate any bumps hit by the car the user is driving. [4]
  - Bucheon City in South Korea provides drivers with real-time traffic information from various sources, such as cameras and speed radars, helping drivers to avoid congested roads and city authorities to track traffic volumes and plan for new roads. [4]

# Imagine ...

*Imagine arriving at one of the airports that serve the megacity of the future. It's a daunting prospect if you don't know your way around. How can you get to your destination quickly and cheaply? And when you arrive, what kind of interesting cultural events might attract your interest or where is the best place to dine? We're not all the same. So how can you personalise your trip? How can you get the best out of the opportunity? And who can do what? Who takes the lead in developing solutions? Who innovates what? Communicates the possibilities?*

*Imagine what is possible when we dare to dream, when we reach for the stars in a galaxy full of opportunities ...*

ETWORK
CONTENT
PEOPLE
COMMUNITY
BACK
SOCIAL
MEDIA
GROUP
Smart
Communities

Each of us belongs to different communities: at work, leisure, politics, health … but the fact is that daily life is reducing physical contacts. By contrast, the numbers of digitally connected people are increasing exponentially. The challenge for the smart community is to find a way for these communities to allow more contacts with greater efficiency, more personalised and human, with more trust. Smart technology can help engage citizens, non-governmental organisations, businesses and the academic community in rising to the challenges and solving the problems, a community that is greater than the sum of its parts, a hub of innovation and economic growth, liveable, sustainable and resilient. The digital transition presents a big opportunity to invent new tools (just witness the incredible growth of the social network) to support this demand while being aware of the danger of substituting physical by virtual contacts. The art is to increase physical contacts through virtual tools.

# Some facts and figures

- The most “digitally-mature” companies have a revenue growth 6 times higher than that of the less mature companies. And beyond the strictly financial impact, it appears that the employees of the companies that are more advanced in their digital transformation feel more comfortable in their professional settings, with index levels of professional wellbeing 50% higher than for the less advanced ones. The culture of digital companies focuses strongly on the human factor: these companies understand that employees may be a source of constant improvement and even innovation. [8]

- In April 2017, 3.81 billion people were active internet users and 2.91 billion were social media users. [9]

- Every second, on average, around 6,000 tweets are tweeted on Twitter, which corresponds to over 350,000 tweets sent per minute, 500 million tweets per day and around 200 billion tweets per year. In Twitter’s short history, they went from 5,000 tweets per day in 2007 to 500,000,000 tweets per day in 2013. [10]

- As of July 2017, Spotify, the music streaming service originally founded in 2006 in Sweden, had 60 million paying subscribers worldwide, up from 30 million paying subscribers in March 2016. The number of active users (including free subscriptions) is even 140 million worldwide [11]. Music-streaming apps like Spotify create communities of users who share experiences, likes and dislikes.

- Gaming communities, or clans as they are known, are organised groups of players that regularly play together in multiplayer games. Games like Angry Birds and Pokemon Go have become global phenomena, the latter having 650 million downloads February 2017. [12]

- The modern massive open online course movement began late 2011. The spotlight on these companies has since dimmed, yet they continue to expand their footprint. In 2016, 23 million people registered for a course for the first time ever. The total of number of students who signed up for at least one course is 58 million. In 2016, 2,600 new courses were announced (up from 1,800 the previous year), taking the total number of MOOCs to 6,850 from over 700 universities [13]. Udemy.com is another learning platform for professional development; a global marketplace powered by over 16 million students, 20,000 instructors and 45,000 courses.

# Imagine ...

*Imagine being in touch with everyone and everything. The world and countless possibilities at your fingertips – no limits, no restrictions. Interacting with holograms of your colleagues, clients, friends, family. Solving problems, making plans, playing games, learning. Part of a digital community. All the options in the palm of your hand. From monitoring your health to managing stocks and shares, from watching your favourite sports to congratulating your grandmother on her 100th birthday. Neither out of sight nor out of mind. Inclusive not exclusive. "Imagine all the people sharing all the world."*

*Imagine what is possible when we dare to dream, when we reach for the stars in a galaxy full of opportunities ...*

Smart Health

Smart sports, smart foods, smart hospitals … there is a seemingly unending trend evident today as health and a healthy lifestyle have become paramount to keeping the healthcare system affordable and manageable. ‘Smart’ has become imperative in dealing with an ever-growing proportion of elderly people, increasing obesity and a doubling in the number of diabetic patients. How can Software Innovation help tackle the issues? Some of the answers lie in our ITEA projects. Global economic growth will see increased spending on health related services; in developed countries chronic diseases continue to increase and in developing countries a larger number of people will gain access to healthcare and more awareness of the healthcare options available to them. An ageing population will increase demand for healthcare as staffing capacity declines and lead to a greater need for software and embedded systems in healthcare support.

# Some facts and figures

- Across all the countries in our survey, more than 75% of respondents would like to use digital healthcare services, as long as those services meet their needs and provide the level of quality they expect. [14]

- Older patients (those over 50) want digital healthcare services nearly as much as their younger counterparts. More than 70% of all older patients in the United Kingdom and Germany want to use digital healthcare services; in Singapore, that number is even higher. [14]

- Poor access to healthcare currently affects one billion people, especially in developing countries where an extensive hospital/doctor network is hardly feasible: Nigeria, for example, would require 12 times as many doctors by 2030 as today's number just to reach OECD standards. Instead, this gap needs to be narrowed with innovative medical technologies allowing for remote medical analysis, diagnosis and, ultimately, treatment advice. [15]

- 63% of all deaths worldwide are caused by chronic diseases. Innovative companies should align their R&D portfolio accordingly and create innovations such as artificial organs or customised, 3D printed implants for individuals living in countries with a higher-level health system. [15]

- The number of fatalities caused by preventable medical error in the United States alone is the equivalent of two jumbo jets falling out of the sky every day [16]. This shows a lot can be improved in hospital management.

- A key topic for elderly people regarding their health is to keep them connected to society; having a social life, volunteering, prevention. Smart community tools can be used to work in this direction. [17]

# Imagine ...

*Imagine a hospital where you do not have to wait during multiple visits. Where your privacy and security are secured when doctors or health insurers share the data generated by wireless sensors to a computer that analyses your state of health, diagnoses problems and suggests a course of action. Where diagnosis by your doctor, specialist, clinic or hospital leads to personalised treatment, reducing your time spent in hospital and accelerating your recovery. Imagine a healthcare system that is more affordable, more customised, more effective, more comfortable, less painful. Where surgeons boldly go where no surgeon has gone before and the hardware tools are given a beating software heart. Where anxiety and risk are minimised and where health is a means to life not a goal in itself.*

*Imagine what is possible when we dare to dream, when we reach for the stars in a galaxy full of opportunities ...*

Smart Mobility

The more physically connected the world becomes, with 64 million km of roads, 4 million km of railways, 2 million km of pipelines, 1 million km of internet cables, and growing, the smaller it becomes and the more vital the need for smart mobility solutions. Take the mobility market. Its growth is outstripping that of the automotive industry. With the car seemingly losing its status symbol aura, consumers increasingly want to get from A to B efficiently, effectively, affordably and as ‘green’ as possible. This is both a challenge and a great opportunity for car manufacturers, OEMs and software companies to join in finding solutions. Rising traffic volumes require a sustainable approach to ensure that our transportation infrastructure is efficient, safe, environmentally friendly and reliable. This also goes for the vehicles, the communication, the services and traffic management.

# Some facts and figures

- Mobility is fundamental to our age. In 2010, an inconceivable amount of 6.4 trillion euros was spent on transporting humans and goods. Almost 1,000 euros per person on the planet. Mobility GDP has quadrupled in 40 years by outpacing global GDP growth and it now accounts for 13% of global GDP. The automotive industry has grown 1.5 % slower in the last 10 years compared to mobility. [18]

- The distances passengers travel will double to over 70 trillion km per year by 2050 while commuting delay will also double by 2050 to over 100 hours per capita per year. [19]

- The car-sharing segment is expanding at annual rates of as much as 30%. 50% of car owners in industrialised countries would, in principle, share their vehicle with others. [20]

- The Paris-based, long-distance ride sharing company BlaBlaCar currently has more than 30 million members in 22 countries and over 21 million downloaded apps. It claims an estimated 1 million tonnes less $CO_2$ emission with average car occupancy of 2.8 per car. [21]

- It has been thought that car-sharing would prompt a reduction in distance driven, but it has been found that 48% of car sharers are people who do not own cars and drive more than 1300 km annually. [18]

# Imagine ...

*Imagine reclining in the driving seat of your car, reading the news on your multimedia screen, safe in the knowledge that you will get to your destination safely, comfortably and on time. Or a platoon of self-driving trucks on a dedicated lane, nose-to-tail, pre-programmed to deliver to specified destinations at specific times. Or synchronised delivery of parcels whenever and wherever it suits the recipient. All coordinated, harmonised in perfect flows. And specially designed forms and modes of transport – mobility for manufacturing – that delivers parts in precisely the right quantity, quality and schedule. Imagine a stress-free, zero-emission, 100% reliable, intelligent world of mobility.*

*Imagine what is possible when we dare to dream, when we reach for the stars in a galaxy full of opportunities ...*

Smart Industry

After the steam engine, the assembly line and the success of digital technology, we are witnessing the 4th industrial revolution: the merging of real and virtual worlds. So Smart Industry is naturally one of our main challenges in ITEA. How do we cope with consumer demand for highly individualised products that are available fast, cheaply and with high-quality specs? What opportunities exist to integrate and effectively manage horizontal and vertical value chains? Where can digitalisation and connectivity be the allies of manufacturing and generate additional revenues? Just think of all the newly emerging, often disruptive, digital business models offering customers tailor-made solutions. If industrial software is the lubricant of Smart Industry, what are the smart innovations we need to secure a competitive and successful manufacturing industry in Europe?

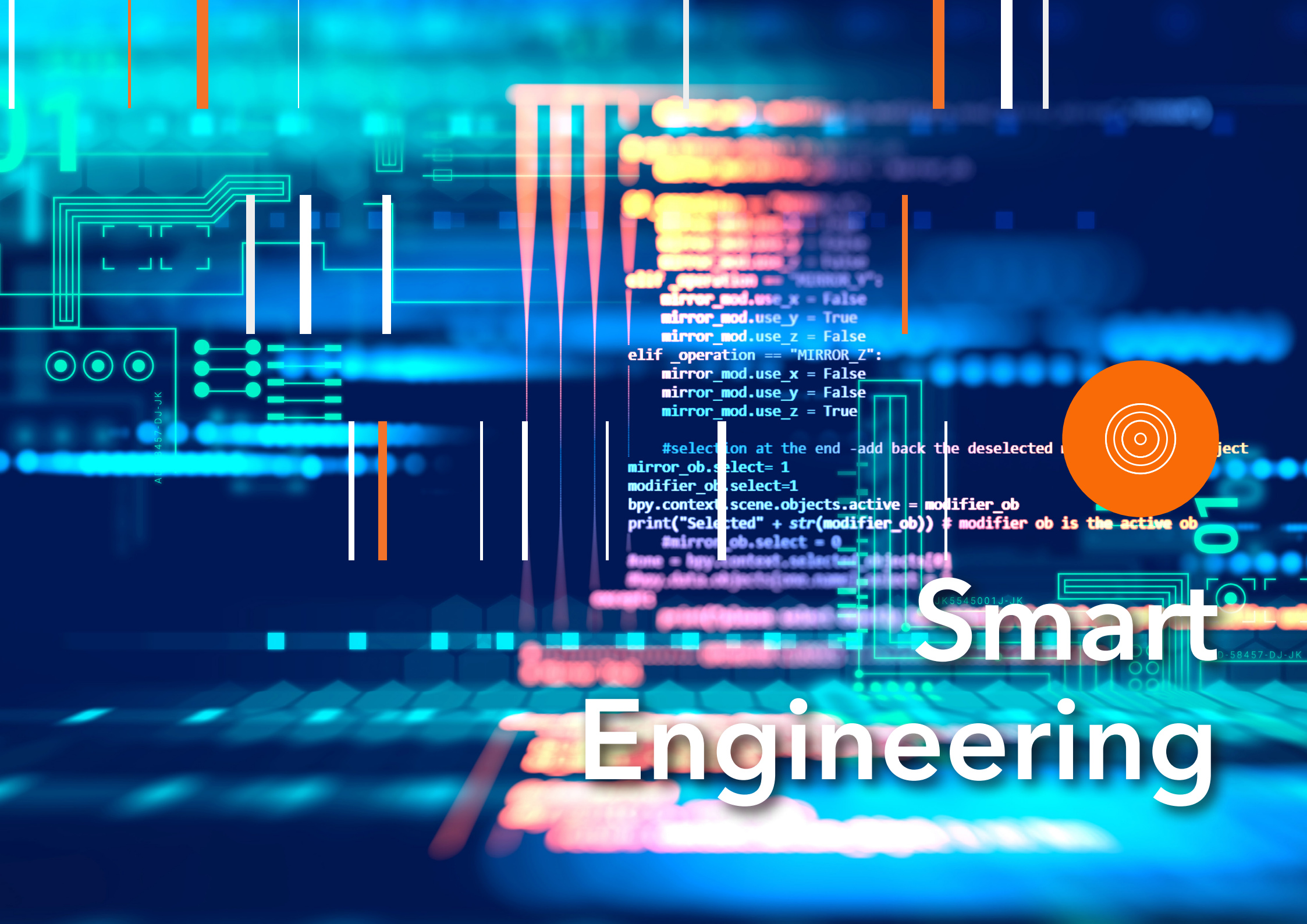
# Some facts and figures

- Manufacturing is very important all around the world:
  - Between 1990 and 2011, manufacturing value added saw robust growth, up to around EUR 6,577 billion. Over that period, the traditional industrialised countries saw their average manufacturing value added increase by 17%, while this figure was 179% in emerging industrial countries, which now represent 40% of the total manufacturing value added worldwide. [5]
  - Manufacturing is a hefty contributor to trade, R&D and productivity, generating 70% of exports in major manufacturing economies – both advanced and emerging – and up to 90% of business R&D spending. Driven by global competition in many subsectors, manufacturing's share of productivity growth is twice its share of employment in the EU-15 nations and three times its share of US employment. [6]
- Data is often referred to as the raw material of the 21st century. Indeed, the amount of data available to businesses is expected to double every 1.2 years. [5]
- The market for 3D printers and related services rose to EUR 1.6 billion in 2012, and is estimated to rise by about EUR 4.4 billion annually through to 2017. [5]
- The Siemens Amberg Electronics Plant Showcase: production is largely automated. Machines and computers handle 75% of the value chain on their own; a quarter of the work is done by people. Production volumes are up eightfold and production quality at EWA is at 99.9988 percent. [7]

# Imagine ...

*Imagine being the master of software development and continuously improving the efficiency, knowing we can forecast the user needs on the basis of his present pain points. Imagine a team of developers from different countries working cooperatively 24/7 creating substantial software with continuous integration that allows automatic testing every day and deployment in the hand of the end users and getting immediate feedback from these end users every week. Being able to continuously adapt the specifications on the basis of actual user feedback. A secure, resilient world of engineering that enables the engineer to concentrate on the engineering challenge without worrying about the operational issues of using the various engineering tools and the interfaces between them.*

*Imagine what is possible when we dare to dream, when we reach for the stars in a galaxy full of opportunities ...*


mirror_mod.use_x = False
mirror_mod.use_y = True
mirror_mod.use_z = False
elif _operation == "MIRROR_Z":
mirror_mod.use_x = False
mirror_mod.use_y = False
mirror_mod.use_z = True
#selection at the end -add back the deselected
mirror_ob.select= 1
modifier_ob.select=1
bpy.context.scene.objects.active = modifier_ob
print("Selected" + str(modifier_ob)) # modifier ob is the active ob
#mirror_ob.select = 0
Smart
Engineering

Engineering – smart engineering – is indispensable to the constantly evolving systems, products and applications we build. The lifecycle of engineering systems and software is expanding with more and more stakeholders, more roles in development, deployment, manufacturing and operations, extending further back into design and further forward into operations. We need to bridge the gaps in the lifecycle with solutions in analytics, business with a social objective, agility and scalability. We must also be aware of the growing tendency of the blurring border between data and engineering that is due to behaviour data dependent systems. Simulation and software engineering provide cost-effective, time-reducing options. The open source business model complements other business models that coexist to sustain the tools and services market as a promising way to disseminate and exploit results, provided the ecosystem is sufficiently structured and sustained. We need smart engineering solutions to remain globally competitive by continuously improving performance, reducing costs and boosting quality, security and safety in a value chain that is becoming ever more complex.

# Some facts and figures

- Today, high-end cars can have more than 10 million lines of code, and aircraft engine controls incorporate several thousand input and output parameters. [22]

- The security of a software-intensive system is directly related to the quality of its software. Over 90% of software security incidents are caused by attackers exploiting known software defects. Analysis of 45 e-business applications showed that 70% of security defects were design defects. [23]

- The take-up of agile development methods over recent years has seen an increase in success rates compared with traditional waterfall projects, with 39% successful projects (against 11% for waterfall) and fewer outright failures (9% against 29%). [24]

- According to Gartner, open source relational database management systems (OSDBMSs) have matured significantly over the years. They predict that by 2018, more than 70% of new in-house applications will be developed on an OSDBMS and that 50% of existing commercial relational database management system instances will have been converted or will be in process. [25]

# Imagine ...

*Imagine being the master of software development and continuously improving the efficiency, knowing we can forecast the user needs on the basis of his present pain points. Imagine a team of developers from different countries working cooperatively 24/7 creating substantial software with continuous integration that allows automatic testing every day and deployment in the hand of the end users and getting immediate feedback from these end users every week. Being able to continuously adapt the specifications on the basis of actual user feedback. A secure, resilient world of engineering that enables the engineer to concentrate on the engineering challenge without worrying about the operational issues of using the various engineering tools and the interfaces between them.*

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Safety
and Security

Digital literacy encounters the challenge of moving from searching, finding and understanding digital information to managing digital footprints, being aware of copyright issues and behaving ethically in crediting ownership, cognisant of the lasting imprint of information online and managing issues of privacy and constructive presence.
Safety and security have become critical issues. In adopting cloud services, robust and efficient identity management is a key business necessity for both cloud service providers and cloud consumers.
In the energy domain Europe is transforming a current traditional electricity network into an advanced, digitised and more efficient Smart Grid. However, both here and in the ever more connected automotive domain, massive data collection also creates new security challenges that have to be tackled. The digital transition is reshaping all of society, exercising control through data flows. Anything arising from these data flows (attacks, bugs) may generate significant damage to our society in the physical sense, too. For all the benefits the digital world brings, there are always threats, and there lies the challenge for Safety and Security.

# Some facts and figures

- In 2014, CSIS & McAfee estimated that the likely annual cost to the global economy from cybercrime is more than USD 400 billion. A conservative estimate would be USD 375 billion in losses, while the maximum could be as much as USD 575 billion. [26]

- Businesses suffered nearly 43 million known security incidents in 2014. This increased by 48% compared with 2013 and equals some 117,000 attacks daily. [27]

- In 2016, email posed a dangerous and efficient threat to users: one in 131 emails contained malware, the highest rate in five years. And Business Email Compromise (BEC) scams, relying on spear-phishing emails, targeted over 400 businesses every day, draining USD 3 billion over the last three years. [28]

- Ransomware has escalated across the globe as a profit centre for criminals. In 2016, Symantec identified 100 new malware families released into the wild, more than triple the amount seen previously, and a 36% increase in ransomware attacks worldwide. [28]

- It's only a matter of time until we see major industrial control system (ICS) attacks. Attacks on ecommerce stores, social media platforms and others have become so commonplace that we've almost grown cold to them. Bad guys will move onto bigger targets: dams, water treatment facilities and other critical systems to gain recognition. [29]

# Imagine ...

*Imagine investing a huge amount of effort in the digital transition of society, a transformation that will generate huge quantities of data flows that contain everything you are doing and all the command & control signals of society worldwide. These data flows will be susceptible to thieves, terrorists and uninhibited businessman to spy on you, blackmail or intimidate you, or even to command & control the different systems such that they destroy the quality of lives or even lives themselves. The dream of developing some new engineering tools to reduce the number of breaches in the software, to protect access to the data flows for those who need to know and exclusively for them. To have dynamic agents continuously analysing how the data are used and detecting any misuse or bugs so that they can react in real time and adapt the software to protect the end users. Imagine keeping all your data digitally without having the worry of it being misused, stolen or monitored.*

*Imagine what is possible when we dare to dream, when we reach for the stars in a galaxy full of opportunities ...*

# Impact stories

# C³PO

## C³PO democratises City Planning

*Published November 2020*

**For centuries, many residents have come to know their cities, towns and villages like the back of their hands. They know the shortcuts, the hot spots and problem zones. However, before the age of social networks, city planners would first hire architects and contractors for new urban developments and improvements and, once the plans had been finalised and a 3D scale model produced, they would consult their voters. Today, the ITEA C³PO project has found ways for city planners and designers to consult citizens throughout the urban transformation process and thereby give citizens a better say in urban developments. The aim of the project was to set up a common digital platform that connects all the tools for collaborative urban development. This includes available (open) data sources, 3D models and visualisations as well as opinions and insights from citizens and interest groups.**

## Impact highlights

- Thanks to the enhanced collaborative capabilities developed by Noesis in the C³PO project, aerospace and automotive engineers from different teams worldwide benefit from the possibility to share engineering workflows, data and knowledge related to common design projects, enabling them to improve product performance by 10% or more and save on average over 30% in engineering time.
- For Studio Dott, the C³PO project gave access to a new market of citizen's involvement and this is reflected in a projected revenue growth of €1.7 m within 5 years.
- The resulting demonstrator TCAVE helps Barco to sell its 'Group VR' solutions to the market. Barco's annual revenue on this type of product is about €20 m. In addition, it will also further help Barco in commercialising other solutions such as PowerWalls and CANVAS, the latter addressing a new market segment, the Architecture, Engineering and Construction (AEC) industry, where Barco expects annual growth of about 10% in the coming three to five years.
- The new solutions developed by Mantis in the C³PO project pushed up their annual revenue by almost 15%. The know-how has also been used in other projects after C³PO.
- Netcad developped Netigma and Netcad Digital Universe which are marketed and sold in Turkey and in the Middle East region yielding in a revenue increase of 30%. Netigma is used extensively by local authorities (1000+ municipalities).
- The project also supported FCG's expansion in three channels of its digital business: solution development, platform economy and SDK sharing. Between 2018-2022 this will result in an annual revenue growth of 5%. During C³PO, a computer scientist was hired who finalised his MSc in support of the project.

## Project results

The project developed a cloud platform based on existing technologies and applications, as well as new products for the Smart Cities market. The project was strengthened by the involvement of the cities of Brussels, Kortrijk, Kouvola, Oulu and the Municipality of Pendik (a district of Istanbul).

Trials in Finland and Turkey demonstrated the value of markerless Augmented Reality (AR) for new urbanisation areas and 3D mock-ups for table-top urban planning and visualisation. Virtual Reality (VR) was demonstrated in virtual tours in case studies in Oulu and Kouvola, while the new Pendik Municipality building provided a setting for selecting different options. The trials in the city of Brussels focused on accessibility and were used as proof of concept of the codesign process using data integration, and the different C³PO tools and methods. The cooperation with the city of Oulu and other stakeholders has continued after project completion to further develop AR services in city planning.

## Exploitation

In addition to these trials, the different partners benefited in their own way from the C³PO project. For example, **Noesis** developed the Noesis Process Portal and Semantic Workflows, which are key components that complement every co-design activity from city co-design to aircraft and automotive. The portal and the underlying workflows allow the setup of a true collaborative multidisciplinary design process and optimisation.

The Belgian design agency **Studio Dott** is commercialising a physical installation, the 'Participation pavilion' that can be placed anywhere by local authorities that want to collect a citizen-centred view on an urban design proposal.
One demonstrator created by **Barco** was the Transportable CAVE (TCAVE), a professional collaborative VR solution - a mobile setting that offers companies better immersive VR experiences. Citizens step inside the TCAVE wearing 3D glasses to see what a developed space would look like.
Belgian SME **Createlli** commercialised a participation platform and services. It has been used in 80+ projects so far in Belgium, Spain, France, the Netherlands and the UK.

Turkish company **ERARGE** developed a semantic framework that relies on the Urban Transformation and Transportation Ontology (UTTO). This approach enabled a data-driven and semantic traffic monitoring solution in Pendik to simulate how the city traffic may be affected by the urban transformation processes.

**Mantis** developed a screen that allows local authorities to showcase what people are saying on social media and an ontology platform where the data coming from different sources of a smart city can be managed by a single platform.
**Netcad**, another Turkish SME, is now commercialising a map and GIS-based platform called Netigma, helping local authorities and designers to analyse data, e.g. the density of urban traffic. Experience gained in C³PO led Netcad to join another project called ASUA and develop a state-of-the-art smart city platform called Netcad Digital Universe.

The Finnish **FCG** created the MAPGETS platform for interactive urban planning and the RAKSITE solution for interactive construction site management.
Finally, **Playsign** turns urban plans into immersive environments for better communication and co-design. It is an efficient tool for drafting, testing, communicating and creating future plans with citizens and other stakeholders.

# C³PO

13016

**PROJECT LEADER**

Andy De Mets, Barco

**PROJECT START**

December 2014

**PROJECT END**

November 2017

**PROJECT WEBSITE**

https://itea4.org/project/c3po.html

**PARTNERS**

*Belgium*

| | |
|---|---|
| ASSAR ARCHITECTS | ⊙ |
| Barco N.V. | ◉ |
| Centre d'Informatique pour la Région Bruxelles | ● |
| City of Kortrijk | ● |
| Createlli nv | ⊙ |
| NOESIS Solutions N.V. | ◉ |
| SIRRIS | ○ |
| Studio Dott | ⊙ |

*Finland*

| | |
|---|---|
| City of Kouvola | ● |
| City of Oulu | ● |
| FCG City Portal Oy | ◉ |
| FCG Design and Engineering Ltd | ◉ |
| Lappeenranta University of Technology | ◉ |
| Playsign Oy | ⊙ |
| Tekla | ◉ |
| VTT Technical Research Centre of Finland Ltd. | ○ |

*Turkey*

| | |
|---|---|
| Bahcesehir University | ◉ |
| ERARGE | ⊙ |
| Mantis Software | ⊙ |
| Netcad | ⊙ |
| Pendik Municipality | ● |



◉ (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# FUSE-IT

## Enhanced connectivity and security for building management at lower costs

*Published November 2020*

**Imagine a malicious hacker taking over the heating, ventilation and air conditioning system of a hospital. With all of the equipment and facilities becoming more and more connected in order to make the systems smart and save energy, this has become a serious threat. Luckily cyber security is also becoming increasingly successful in addressing these issues. And one of these success stories can be found in the FUSE-IT project.**

**FUSE-IT, gathering 20 strong partners from France, Belgium, Portugal and Turkey, addressed the need for sustainable, reliable, user-friendly, efficient, safe and secure Building Management Systems in the context of smart critical sites, like hospitals. From a site management perspective, it solves the dilemma of efficiency and security in intelligent buildings. At the user level, a smart unified building management interface enables the daily monitoring and control of a building, while a full security management interface enables the supervision of both physical and logical security throughout the premises. And at the end-user level, this can save both energy and lives.**

## Impact highlights

- A new (and misunderstood) topic when the project idea was first introduced back in 2013 was the protection of smart infrastructures against combined cyber and physical threats. This now appears in the top three areas of investment by public and private actors. From this perspective, FUSE-IT has been a pioneer project, enabling the consortium members to take a strategic lead.
- Since 2017, about €48 million in revenue has been reported in direct relation to the project results. The most striking commercial successes include:
  - 17 system integration operation contracts in the field of smart building management and optimisation
  - 25 contracts won in the field of critical infrastructure protection against cyber and physical threats
  - the successful market introduction of a start-up company delivering SaaS platform services for enhanced control and management of sensitive building information
- The project has led to the acceptance of four patents.
- Airbus CyberSecurity has been awarded a €740,000 contract to fulfil risk assessment surveys on 14 sites of Airbus Defence and Space in Spain, France, the UK and Germany and a contract worth €500,000 to secure a data centre organisation against cyber and physical threats. In addition, Airbus CyberSecurity has been awarded a multimillion-euro contract with an important gas transportation company, an integration contract for the protection of a large data centre's infrastructure and several contracts with large energy production utilities and distribution system operators in the UK, France and Germany.
- The FUSE-IT project allowed Niko to grow faster and to become more attractive to other companies. The team is still growing and has had double-digit growth during the last five years.

## Project results

To achieve this, the project developed a Smart Secured Building System resulting from cross-domain innovation between energy and security activities that are traditionally very segmented. The system can be deployed as standalone components, as a fully-integrated system or as a service. The innovation proposal of FUSE-IT resides in five key capacities:

1 - Secure shared sensors, effectors and devices
2 - Trusted, federated energy and information networks
3 - Core building data processing and analysis
4 - Smart unified building management interface
5 - Full security management interface

## Exploitation

On the back of the project results, Airbus CyberSecurity has successfully filed a patent on a method for securing and authenticating telecommunication. Overall, the project has led to the acceptance of four patents. Next to this patent, Airbus has been awarded with several multi-million euro contracts, both inside and outside its organisation.

In Q2 2018, the French SME VTREEM launched a new SaaS product named 'BIMValue' to enhance, control and manage sensitive data using semantic BIM (Building Information Modelling). Thanks to this development, VTREEM was acquired by Catenda in 2019. This Norwegian software editor is specialised in BIM.

For the Belgian consortium, Niko has created the nextgeneration Niko Home Control platform NHC 2.0 , which now has more open API interfaces . Additionally, all of their new wireless products will be based on the open standard Zigbee instead of only proprietary protocols. All of these changes will make Niko Home Control more open and available for fast and smooth integration by third parties. The FUSE-IT project has helped Niko to create a new architecture and move to said open standards, allowing them to grow faster and to become more attractive to other companies.

Using the knowledge and developments of FUSE-IT, the Portuguese consortium was able to create a new solution for intelligent building management focused on a semanticbased approach to fault detection in cyber-physical environments. The C2C (Click to Control) solution is now entering TRL 8 after having been demonstrated in an operational environment. Moreover, the alarm and warning mechanisms developed in FUSE-IT were integrated in a commercial product by IPBRICK targeting critical buildings. EVOLEO developed a middleware solution that allowed it to interface with the legacy control systems of the building, including HVAC, oxygen and room pressure, thanks to upto-date IT systems to implement new functionalities and optimisations. These developments are of great important for EVOLEO as several legacy systems can be turned into smart systems without the need for replacements or very demanding customisations or retrofits.

A new (and misunderstood) topic when the project idea was first introduced back in 2013 was the protection of smart infrastructures against combined cyber and physical threats. This now appears in the top three areas of investment by public and private actors. From this perspective, FUSE-IT has been a pioneer project, enabling the consortium members to take a strategic lead.

# FUSE-IT

13023

**PROJECT LEADER**

Adrien Bécue, Airbus CyberSecurity

**PROJECT START**

October 2014

**PROJECT END**

December 2017

**PROJECT WEBSITE**

https://itea4.org/project/fuse-it.html

**PARTNERS**

*Belgium*

- IMEC - Ghent University ○
- linkID ⊙
- Niko NV ●

*France*

- Airbus CyberSecurity SAS ●
- ARC Informatique S.A.S. ⊙
- CEA LIST ○
- ICAM ◉
- Institut Mines-Télécom ◉
- Sogeti High Tech ●
- Thales ●
- THALES Service SAS ●
- University of Burgundy ◉
- University of La Rochelle ◉
- VTREEM ⊙

*Portugal*

- Centro Hospitalar São João ○
- Evoleo Technologies ⊙
- Instituto Superior de Engenharia do Porto (ISEP) /IPP-GECAD ◉
- IPBRICK ⊙

*Turkey*

- CTech ●
- ForteArGe Informatics, Engineering Consultancy Ltd. Co ⊙



● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# IMPONET

## Big data technology for a more efficient electricity supply

*Published December 2017*

**Reliability and consistency of electricity supply is critical to many industrial and service activities: when the power quality is inadequate, business suffers. To operate the power network in a more efficient manner, it is necessary to exploit data from a huge number of electronic devices involved in the control and protection of power systems in a systematic and standardised way. With issues such as smart metering and real-time monitoring becoming crucial, the ITEA 2 IMPONET project addressed the modelling, design and implementation of a comprehensive, flexible and configurable information eco-system to meet the most complex and advanced requirements in electrical energy management.**

## Impact highlights

- The IMPONET project enabled higher energy efficiencies for utilities of between 5 and 10% with cost saving for consumers of around 10% through benefiting from access to hourly energy information and therefore the ability to adjust consumption, depending on the price of energy.
- Indra's Web Portal for Residential Customer Meter Data was deployed for the overall customer base of Gas Natural Fenosa, which is in excess of 3 million customers, representing a sizable portion of the total Spanish market. In the future, Gas Natural Fenosa will be rolling out this platform for other market segments and foresees future deployment in other parts of the world, mainly in South America.
- Indra's iSPEED platform was implemented and is currently in use by Elektro (Brazil) for the monitoring and control of the entire distribution network, which is comprised of more than 170,000 transformers and serves more than 2.4 million customers in a rural and urban hybrid environment. Elektro is a subsidiary of Iberdrola, which is currently evaluating the extension of the use of iSPEED to other subsidiaries and to Iberdrola itself. In this future short-term scenario, the combined number of customers for the Iberdrola group indirectly served by this platform, will be in excess of 25 million worldwide.
- Indra's advanced Meter Data Management platform which was built on top of the IMPONET results, has already been successfully implemented in the largest utility company in Uruguay (UTE) and is currently being deployed in ENEA in Poland.
- Indra hired roughly thirty new analysts/ programmers because of all these new business developments. These are conservative figures and INDRA plans to significantly enhance the business in the coming years.

## Project results

IMPONET investigated the business challenges and opportunities in the electrical distribution domain, identifying and describing requirements for Advanced Metering and Power Quality Monitoring. Elaboration of the system architecture focused on the ability to process massive amounts of information in real-time while maintaining bi-directional communications through the use of several communication technologies and common standards like IEC 61850 and CIM. The implementation of several Meter Data Management (MDM) use cases made extensive use of the storage and processing architecture for handling massive amounts of information. Several platforms for the visualisation of customer energy data were developed according to the needs of different stakeholders. The Power Quality concepts and use cases focused on short duration disturbances in four main sub-areas (processing, modelling, management and reporting) and the corresponding methods and tools for power quality monitoring in the electrical distribution domain were further developed. 15 demonstrations were carried out and produced the actual integration of the global architecture developed within the project in a controlled workbench environment that covered several available scenarios of an electricity network.

The main innovation generated by IMPONET laid in the advanced real-time architecture that contained a dual model of publish/subscribe and request/response data exchange mechanisms in which data access allowed interoperability between the different data models, while making extensive use of big data technologies for the processing of huge volumes of information gathered from the electricity grid.

## Exploitation

Reusing part of the IMPONET results, Indra developed a Web Portal for Residential Customer Meter Data, which is implemented by e.g. Gas Natural Fenosa, the third largest utility company in Spain. Secondly, Indra's advanced MDM platform was built on top of the results of the IMPONET project, in particular the use cases related to smart metering, making extensive use of the expertise gathered in applying big data technologies to this domain. Furthermore, developing a real-time data integration platform as part of the IMPONET project has resulted in Indra's product iSPEED – a Smart Platform for Efficient Electrical Distribution. It is being implemented in utility companies all over the world, such as Elektro in Brazil, or generating interest in organisations such as NRECA (National Rural Electric Organisation) or the SGIP (Smart Grid Interoperability Panel) in the USA, among others.
Wooam used the project results to help establish a smart grid test bed in Jeju for the KEPCO (Korea Electric Power Corporation) consortium for the development of an Electric Vehicle Charge Infrastructure Unified Management System and the AMI (Advanced Metering Infrastructure).
Kema (currently DNV GL) has benefited from lessons learned and value-added knowledge from IMPONET for its utility advisory services that include a Smart Metering & Distribution Automation lab, DMS & MDM Requirements Specifications and its integration.
Answare has developed new services for the home user, applying its expertise in mobility technologies like Android and iOS to exploit new markets in mobile applications and expert systems applied to the energy sector. IMPONET has also enabled Answare to enter the Big Data sector. As co-founder of the Big Data Value Association (www.bdva.eu), they are active in developing Data Visualisation and Data Analytics solutions for use in the energy industrial sector.

# IMPONET

09030

**PROJECT LEADER**

Eloy Gonzalez Ortega, Indra

**PROJECT START**

December 2010

**PROJECT END**

February 2013

**PROJECT WEBSITE**

https://itea4.org/project/imponet.html

**PARTNERS**

| *Republic of Korea* | | *Spain* | | *Slovenia* | | *Turkey* | |
|---|---|---|---|---|---|---|---|
| Wooam | ⊙ | Answare | ⊙ | Kapion | ⊙ | Innova IT Solutions | ● |
| | | Indra Sistemas | ● | University of Ljubljana | ◉ | LNL | ⊙ |
| | | Indra Software Labs | ● | | | | |
| | | Kema (currently DNV GL) | ⊙ | | | | |
| | | Prodevelop | ⊙ | | | | |
| | | Tecnalia | ○ | | | | |
| | | Technical University of Madrid (UPM) | ◉ | | | | |
| | | Unión Fenosa Distribución | ● | | | | |
| | | University of Deusto | ◉ | | | | |
| | | University of Girona | ◉ | | | | |

● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# M2MGrids

## From vertical M2M silos towards smart interoperable Cyber-Physical Systems

*Published September 2020*

**The M2MGrids project aimed at creating enablers for a dynamic cyber-physical information ecosystem that would interoperate in real time with the business processes of companies with real-life objects, people and things. M2MGrids focused on major disruptions in targeted energy and mobility domains. The disruption in the energy domain was related to operating models and the high cost of peak hours in energy grids. To make more efficient use of the energy grid, there needed to be a flexible and automated means by which to control both consumption and generation between multiple energy stakeholders and prosumers. The inability of multiple stakeholder systems to exchange information in dynamic situations (such as in a traffic accident) was leading to disruptions in the mobility domain.**

## Impact highlights

- The World Wide Streams (WWS) horizontal service platform developed by Nokia Bell Labs can, already today, be considered to enable a 20-30% higher business growth in application-enabling Digital Value Platform (DVP) projects for these segments worldwide.
- For Tracker, the commercialisation impact estimation of the M2MGrids project including device and related services sales is about €3 m in 2020. The development is essential in Tracker growth, and four persons were employed permanently even after the project, with market share potentially increasing in future.
- Slimmer AI developed machine-learning knowledge of short-term energy consumption forecasting from daily down to 15-minutes horizons (called nowcasting) within M2MGrids. Slimmer AI expects to employ up to 10 colleagues on the basis of this M2MGrids technology within three years.
- LiveU has opened significant market opportunities, having won a tender for the next Olympic games with the Japanese police department and also having collaborated with Associated Press on a new live video exchange newsgathering platform: AP Live Community, an app based on M2M.
- Several new research opportunities were identified during the project and these have led to the preparation of EU-wide research and national coinnovation projects including e.g. INTERRFACE (flexibility markets), TIoCPS (trustworthy communities), iFLEX (end-user perspective for flexibility markets) and OneNet (scaling of flexibility market mechanisms).

## Project results

The project developed a horizontal M2MGrids architecture framework, with a set of novel horizontal capabilities related to information models, algorithmic operation, stream processing, communication overlays, security, and specific capabilities of horizontal platforms that enable embedded products to be part of the cyber-world. These novel capabilities were evaluated in the energy flexibility and traffic accident use cases.

The demonstration of the energy flexibility use case included an evaluation of the World Wide Streams (WWS) horizontal service platform developed by Nokia Bell Labs. In the demonstration, WWS acted as a key horizontal enabler for a set of energy flexibility services interacting to balance the power level and reduce the peak loads in the distribution grid. The demonstration of the traffic accident use case included an evaluation of the virtual CPS communication hub, realised by VTT, which enables mobile embedded products and services of multiple stakeholders to horizontally interact and exchange information in a controlled and secure way.

## Exploitation

The Nokia World Wide Streams (WWS) platform, as matured for distributed multi-actor automation scenarios in M2MGrids, is now enabling a Nokia Enterprise business unit product, and is regularly used in customer trials. The Nokia Enterprise TEPS (Transport, Energy and Public Sector) segment sales unit promotes WWS as an enabler for flexible launching of services as part of segment solution toolkits.

The knowledge developed by Empower IM has led to activities for preparation of national infrastructure for energy flexibility in Finland targeted to new flexibility markets with national TSOs and local DSOs of the energy ecosystem. Bittium created a Medical Analysis cloud ('MA-Cloud') solution, which was the basis for Bittium's neurology businesses in the Medical business area, enabling quick measurement in field conditions as well as in hospitals, thus making the treatment process of the patient faster. Tracker developed a low-power development platform for new products, applications and services for monitoring, tracking and control in M2MGrids. The platform led to the development of the Tracker Artemis product, the world's first 4G IoT dog tracking collar, which is now generally available. Technolution developed a sensor prototype for sensing power quality as well as congestion analysis and prediction in M2MGrids, which led to the Technolution LS/MS sensor product, which is now offered in different markets for non-intrusive, cost-effective and high-quality sensing. For Slimmer AI (formerly Target Holding) the knowledge developed during the project has boosted the development of new, AI-powered forecasting and balancing solutions. Arcelik was first to introduce new, automated demand/response compatible household appliance products. KoçSistem enabled energy management of adaptive demand-supply household and industry devices as well as energy grid adaptive demand-supply gateways. Eteration developed a Complex Event Processor that manages real-time events within big data according to the execution plans.

The M2MGrids project contributed strongly towards shifting from vertical use towards more horizontal capabilities in the IoT product development. It also contributed to the development of smartness and interoperability for CPS.

# M2MGrids

13011

**PROJECT LEADER**

Juhani Latvakoski, VTT

**PROJECT START**

November 2014

**PROJECT END**

May 2018

**PROJECT WEBSITE**

https://itea4.org/project/m2mgrids.html

**PARTNERS**

*Belgium*
- Nokia ●
- Sony Depthsensing Solutions ⊙
- Spikes ⊙

*Finland*
- Aidon ⊙
- Bittium Wireless ●
- Empower IM ●
- Polar Electro ●
- Tracker ⊙
- Valopaa ⊙
- VTT Technical Research Centre of Finland ○

*Israel*
- LiveU ⊙
- Starhome ●

*The Netherlands*
- Alliander ●
- Delft University of Technology ◉
- Eindhoven University of Technology ◉
- IMEC ○
- Neroa ⊙
- Slimmer.AI ⊙
- Technolution ⊙
- TNO ○

*Portugal*
- Evoleo Technologies ⊙
- ISEP/IPP-GECAD ◉
- ISQ ●

*Turkey*
- Arcelik ●
- Eteration Bilisim Cozumleri ve Ticaret ⊙
- KoçSistem Information and Communication Services ●
- Phaymobile ⊙
- Vektor Telekom ⊙

● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

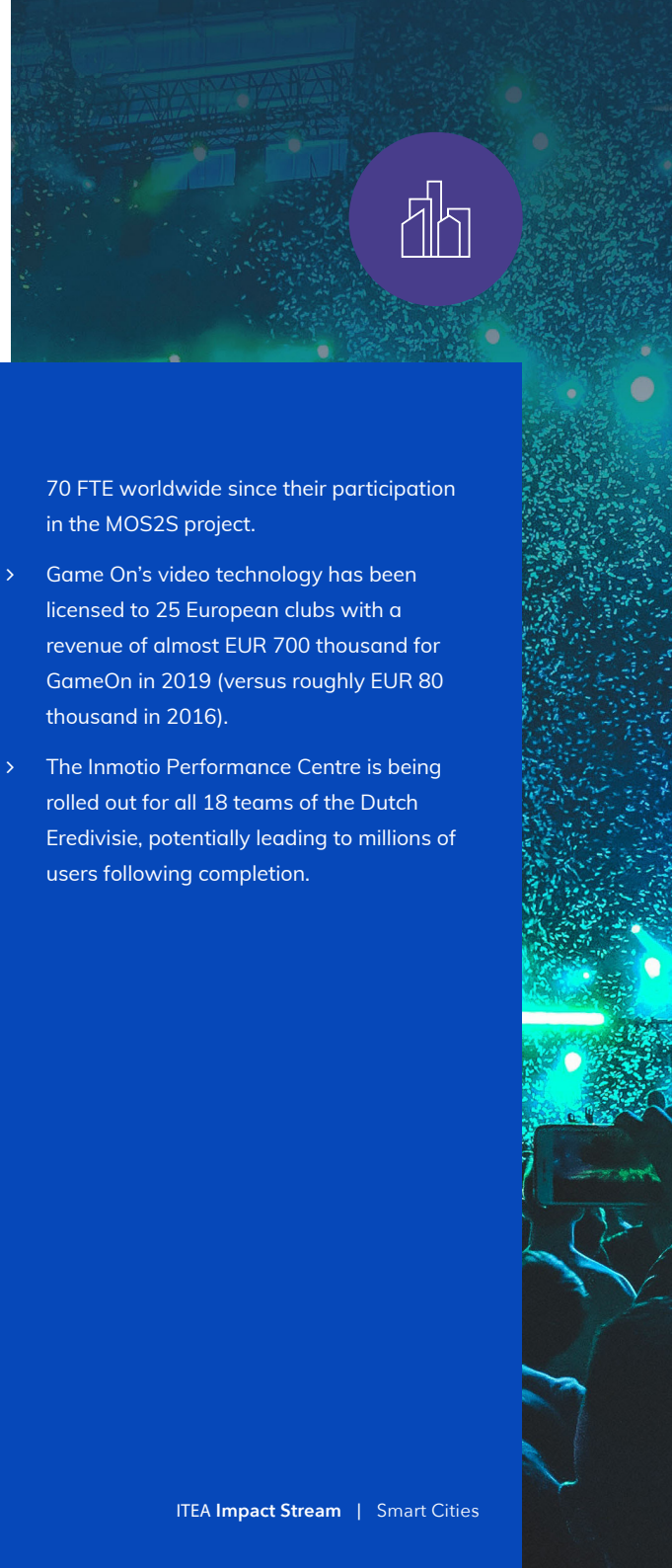
# MOS2S

## New forms of engagement in entertainment and society

Published October 2022

**Traditional media is losing ground to personalised experiences. Children of today, for example, don't even know what it's like to have a set of TV channels with fixed broadcasting timeslots for your favourite shows; they choose what to watch at the time they want. And they even produce thousands of pieces of content on their own each day. This trend in the entertainment business can also be seen in society, where city representatives no longer make decisions on their own. Everybody wants to be involved, or at least can be.**

**With many different innovations and high-level sensor applications, the MOS2S (Media Orchestration — Sensor to Screen) project took the outdated broadcasting concept to the next level, adding a completely different dimension with features such as instant live broadcasting. The aim of the project was to capture as much sensor data as possible and use this data in various applications in order to eventually enhance the experiences of people.**



## Impact highlights

- Thanks to MOS2S, for the first time in the world, a football match in the Johan Cruijff ArenA was broadcast in real time with only a 0.3-second delay from the pitch in Amsterdam to a viewing area in South Korea. Combining new Ultra-Wide Vision technology with a super-fast data connection enabled a crowd of South Koreans to experience the live event in an unmatched way.
- As the first stadium in the world to adopt the innovative technologies developed in the MOS2S project, the Johan Cruijff ArenA is boosting its reputation for innovation and opening up a new consultancy market, in turn making the technology accessible to new and existing sports hubs.
- Since the MOS2S project, Kiswe has been working with multiple sports leagues and entertainment and media companies worldwide, like K-pop group BTS, NBA, Universal Music Group and the Tour of Flanders to name a few. In 2021, Kiswe was named one of the World's Most Innovative Companies by Fast Company and the company has grown by more than 70 FTE worldwide since their participation in the MOS2S project.
- Game On's video technology has been licensed to 25 European clubs with a revenue of almost EUR 700 thousand for GameOn in 2019 (versus roughly EUR 80 thousand in 2016).
- The Inmotio Performance Centre is being rolled out for all 18 teams of the Dutch Eredivisie, potentially leading to millions of users following completion.

## Project results

To bring engagement to a higher level, 17 partners from four countries came together in MOS2S and have created world-first ways to engage with citizens and audiences of live events. MOS2S was centred around two use-cases: crowdsourced journalism and (sports) entertainment. The project focused on technologies that allow data and media streams to be orchestrated into an all-encompassing experience on various types of end-user devices. The common denominator in MOS2S is the media processing platform, which combines multimedia streams from different domains.

## Exploitation

For **e-Democracy**, four components were developed by the MOS2S project in which each partner provided another step of the value chain.

VRT's Babbelbox, a mobile interaction booth, has been used in 2019 by reporter and photographer Yassine Atari and Belgian journalist Rudi Vranckx and in multiple media campaingns, in search of the voice of citizens and selected content was used in live debates. In the follow-up ITEA project CityStory, the Babbelbox technology has been upgraded and extended with video-based questionnaires in order to provide users with a more personal and inclusive interaction.

Gerade Software's Online Debate and Online Debate Replay, two tools for editing and broadcasting debates, have been implemented in Türkiye and were eventually sold to an investor.

Hangouts, a video chat system, co-developed by VRT and Kiswe, enabled listeners and absent campaigners to dial in live and bring their story to air from anywhere in the world. The workflow ran completely automatically, saving the editorial team time and manpower and allowing customers Studio Brussel and Sporza to increase listener and viewer interactions.

In the **sports and entertainement domain**, several unique innovations were also developed.

First of all, in September 2018, MOS2S's project leader TNO and a number of partners presented a world first: the match between the Dutch and Peruvian national soccer teams was played live in the Johan Cruijff ArenA in Amsterdam, and watched in real life and real time in Daejeon, South Korea, thanks to Ultra-Wide Vision technology.

Furthermore, the Hangouts technology of VRT and Kiswe was used at the Olympic Games in Tokyo 2020 (2021) and the Winter Olympic Games in Beijing 2022 through the novel media format 'Athlete Moment'.

And through an exceptional SME collaboration, Game On and Inmotio have implemented their video and sensor technologies in the Johan Cruijff ArenA. Thanks to this, visitors can get much closer to the spectacle, even from a distance. In addition, the technology is interesting for coaches because player movements can be easily analysed for training purposes.

Finally, MOS2S's technology was selected, out of 209 applications from 39 countries, to be demonstrated during the Eurovision Song Contest of 2020, which was unfortunately cancelled afterwards due to COVID-19. Eventually, three finalists were selected to actually implement their solution at the Eurovision Song Contest and two of these three solutions were derived MOS2S.

MOS2S's applications have been tested in a Smart City Playground. The next step is to implement them on a wider scale to further revolutionise the role of citizens in both politics and entertainment.

# MOS2S

15022

**PROJECT LEADER**

Gjalt Loots, TNO

**PROJECT START**

October 2016

**PROJECT END**

Juli 2020

**PROJECT WEBSITE**

https://itea4.org/project/mos2s.html

**PARTNERS**

| *Belgium* | | *Republic of Korea* | | *The Netherlands* | | *Türkiye* | |
|---|---|---|---|---|---|---|---|
| imec | ○ | ETRI | ○ | Bosch Security Systems | ◉ | DIA Yazilim San. ve Tic. | ⊙ |
| KISWE | ⊙ | jdisystem | ⊙ | Game On | ⊙ | Gerade Software | ⊙ |
| Nokia Bell | ◉ | Moover | ⊙ | Inmotio Object Tracking | ⊙ | KoçSistem | ◉ |
| VRT | ◉ | Samsung Electronics | ◉ | Johan Cruijff ArenA | ⊙ | | |
| | | | | Koninklijke KPN | ◉ | | |
| | | | | TNO | ○ | | |



◉ (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# PS-CRIMSON

## A one-look overview of the city in 5 seconds

*Published October 2022*

**Nowadays, cities are digitalising more and more services, like data gathering for mobility, safety and communication with citizens. This data is required to be able to govern an increasingly complex and dynamic city. However, authorities still need to tackle information fragmentation caused by separated data per department and a lack of common platforms and toolsets.**

**The ITEA project PS-CRIMSON, a collaboration between six academic and industrial partners from the Netherlands and Canada, developed a unique 3D smart digital model that combines all of the gathered data on one common platform. With this platform, public safety and disaster management can be improved, as pilot projects in Eindhoven and Vancouver have shown.**

## Impact highlights

- Thanks to PS-CRIMSON, a city representative responsible for video surveillance can now work with one single screen and, once logged in, take a virtual walk through a 3D model of the city and see everything which is happening in a single view. This facilitates his/her work a lot compared to the previous situation where (s)he needed to monitor up to 60 live screens in the control room and handle dozens of calls during the day from local citizens and officers regarding suspicious events.
- Thanks to AI image technology developed by project partner Eindhoven University of Technology, the search engine can determine where an incident is taking place to an accuracy of 10 meters, when somone sends a mobile picture to the police.
- Thanks to the 3D smart model of Esri Canada, developed within PS-CRIMSON, city representatives can now see the effects of an earthquake down to the level of interior units in the damaged buildings and the different levels of flooding that would follow.
- PS-CRIMSON project partners won a tender for Smart City Hilversum, which is now being deployed to create insights on traffic.
- ViNotion has sold PS-CRIMSON results to other cities, including Amsterdam, ‘s-Hertogenbosch and Bruges.
- Atos is in the lead for a smart city project in Germany.

## Project results

The PS-CRIMSON consortium has delivered a platform that serves as a single entry point for city representatives. This facilitates data collection, sharing, management, analysis and dissemination from public and private urban infrastructures and resources. This single entry point to a smart city platform provides access to the information of different types of systems from different departments. It saves city representatives a lot of time and money and gives them one view of all of the data they are gathering, enabling them to combine these and act upon them quickly. A focus lies on the public safety and disaster management domains, where the platform's benefits are extremely important.

For public safety, in the background of the platform, software is monitoring all of the city data and filtering out relevant events that require attention. This preprocessed information allows the city representative to make splitsecond decisions, see connections between the different data and, most importantly, feel in control, even in an emergency.

For disaster management, the PS-CRIMSON application and model is able to show the effect of an earthquake on a densely populated downtown. The application and model can simulate the different scenarios and enable the city to predict and pre-assess the damage with a much greater level of detail and accuracy.

The partners showed a unique complementarity in their collaboration: Atos and Esri Canada offer the integrated platform, ViNotion and Sorama are experts on sensors, Esri Canada created the digital twin for indoor city modelling, Cyclomedia is responsible for the photorealistic 3D texturing and the Eindhoven University of Technology supports this with innovative solutions on AI. Together, they cover the full value chain for a smart city solution, integrating the different silos of data and technology together in one common platform.

## Exploitation

By offering a complete smart city solution which is valued by cities, the project has already had its first commercial successes.

The project partners won a tender for Smart City Hilversum, which is now being deployed to create insights on traffic. They are now the first adopters of the PS-CRIMSON platform to share valuable public data between different departments.

Similar projects are being tendered by other cities in the Netherlands, Germany, Belgium and Canada, where the partners are offering all or part of the PS-CRIMSON results. Atos is in the lead for a smart city project in Germany and ViNotion has sold PS-CRIMSON results to other cities, including Amsterdam, 's-Hertogenbosch and Bruges.

PS-CRIMSON's offerings enable the platform's users to detect suspicious situations, localise them, follow the subjects involved and intervene before escalation takes place. Thanks to the project's world-class technology results that can be extended to many other domains, this can now all be done with a high performance and accuracy which is two to three years ahead of the market, making cities a better and safer place to live in!

# PS-CRIMSON

15026

**PROJECT LEADER**

Egbert Jaspers, ViNotion

**PROJECT START**

September 2016

**PROJECT END**

March 2020

**PROJECT WEBSITE**

https://itea4.org/project/ps-crimson.html

**PARTNERS**

| *The Netherlands* | | *Canada* | |
|---|---|---|---|
| Atos Nederland | ● | Esri Canada | ⊙ |
| Cyclomedia Technology | ⊙ | | |
| Eindhoven University of Technology | ◉ | | |
| Philips Lighting | ● | | |
| Sorama | ⊙ | | |
| ViNotion | ⊙ | | |



● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# SEAS

## Smart Energy Aware System

Published September 2017

**The SEAS project is at the heart of the energy transition. The project set out to enable interworking of energy, ICT and automation systems at consumption sites, introducing dynamic and intricate ICT-based solutions to control, monitor and estimate energy consumption. It also explored business models and solutions to enable energy market participants to incorporate microgrid environments and active customers. The SEAS revolution: more cost-effective, more environmentally friendly and more customer focused energy streams through efficient interaction between providers and prosumers … everywhere.**

## Impact highlights

- In terms of revenues, exploitation short-term (2017) is expected to be €2 million, with medium-term exploitation (2018) anticipated to be €25 million and long-term revenues (2019 to 2021) as much as €600 million.
- The DAPM architecture has been chosen by ENGIE as the reference architecture for the company's overall service platform. The market potential using the service platform including the applications (cumulative from 2017 to 2020) is approx. $70 billion for the geographical regions where the ENGIE competence already exists.
- Empower has incorporated dynamic microgrid strategies into its future roadmap and has enabled interaction of flexible energy resources with the Enerim EMS solution used to prototype future interactions in the SEAS project. The Enerim CIS solution that builds on SEAS knowledge in connectivity, is gaining ground as the premier new energy customer information management and billing solution. It is deployed now to enable upcoming datahub enabled retail markets in Finland with over 45% of the national distribution metering points being managed by it in the next years.
- Asema's IT solutions now use the Smart API to coordinate and share information between resourcing and planning systems used by cities. Coordination between departments and organisations can now be made much more effortlessly and automatically. For instance cities can combine the routes and tasks of people managing infrastructure.
- A public repository in W3C and alignment with standards supported by M2M, ETSI & AIOTI.

## Project results

The objective of SEAS was to model energy related IT systems so that meaningful, efficient and expandable information exchange can be standardised between market players in a field traditionally riddled by a lack of system interoperability. This work resulted in three main outcomes:

1. The Smart Energy API Standard, a semantic information model, which serves as a means for energy IT systems to connect intelligently to each other and transparently to users.
2. The Smart API software development kit (SDK), which makes it possible for system manufacturers, IT integrators and the like to apply this Smart Energy API Standard in an out-of-the-box fashion
3. The Smart API Services reference framework, which is the reference design model for compatible IT systems and a highly innovative, future-proof open architecture that allows for interoperability, innovation and different kinds of business models based on an advanced dynamic ontology dedicated to the smart energy grid.

The scope and breadth of the project is evident from 120 use cases classified in six main categories along with 30 ontologies for the energy domain. In addition to two demonstrator scenarios defined on autonomous buildings and microgrids, 16 pilots in four different countries and distributed data platforms were installed, supplemented with a Microgrid Context Awareness Framework, including algorithms.

## Exploitation

ENGIE introduced the DAPM (data access point manager), a dedicated middleware & appstore for city areas, open to third party applications and data. This new “City as a Service” model breaks down not only the energy silos but also other verticals in a first step towards interoperability. Data management thus operates horizontally across domains – transport, water, heating, lighting, even weather information and traffic regulation, bringing urban management to a higher level. DAPM has already been taken up by Aubagne (for public lighting) and is being considered in Rennes, Dijon, Marseille, Saint Nazaire in France and Barcelona in Spain. A partnership for prototyping has already been signed between ENGIE and Intel who will provide dedicated chipsets, cybersecurity and artificial intelligence solutions for large-scale industrialisation.

Asema Electronics markets the Smart API SDK and its specification. Furthermore, Asema IoT Central is a software that embeds the functionality of the Smart API into a development platform that can be used by organisations who want to implement their own energy and mobility IoT solutions. Asema IoT Central is used in smart cities for smart waste management, smart lighting, vehicle sharing, smart charging, and building management offering one holistic view to all city data across various departments and organisations within the city.

The Empower Enerim EMS – Energy Management System builds on the SEAS results. It is an energy domain network and market process orchestration system that allows balancing of the network with market and control functionalities. Enerim EMS enables energy companies and energy intensive communities or industrial customers to manage their energy assets and market positions more efficiently.

# SEAS

12004

**PROJECT LEADER**

Philippe Bourguignon, ENGIE

**PROJECT START**

February 2014

**PROJECT END**

December 2016

**PROJECT WEBSITE**

https://itea4.org/project/seas.html

**PARTNERS**

*Belgium*
- SOLTECH ⊙

*Finland*
- Asema Electronics ⊙
- EKE-Finance ⊙
- Empower IM Oy ●
- Foreca Oy ⊙
- Fortum ●
- VTT Technical Research Centre of Finland ○

*France*
- ARMINES ○
- BeNomad ⊙
- CEA LIST & LITEN ○
- Clipsol ⊙
- CNR ⊙
- ECOMETERING ●
- ENGIE ●
- GAC Group ●
- ICAM ◉
- Institut Mines-Télécom ◉
- ITRON ●
- Kerlink ⊙
- UBIANT ⊙

*Portugal*
- Evoleo Technologies ⊙
- ISEP/IPP-GECAD ◉
- Virtual Power Solutions S.A. ⊙

*Romania*
- ECRO SRL ⊙
- Siveco Romania S.A. ●

*Spain*
- Answare ⊙
- Universidad Politécnica de Valencia ◉
- University of Girona ◉

*Turkey*
- Defne ⊙
- Enerjisa Baskent Elektrik ⊙
- Innova IT Solutions Inc ●
- LNL Technologyk ⊙
- SimBT Inc ⊙

● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# ACCELERATE

## A go-to-market acceleration platform for ICT

*Published December 2019*

**Innovation is about much more than creating technology; it must 'go to market'. Many companies need new ways to rapidly validate the match between the market and their innovative ICT-intensive technology. The ITEA project ACCELERATE took up the challenge of enabling European technology companies to adopt acceleration knowhow by focusing on two goals: the transfer of knowledge on a massive scale and the introduction of a new type of product development, the so-called validated learning process that systematically searches for the technology-market match by validating the mechanics of a business model. This way ACCELERATE set out to shorten the innovation cycle and time-to-market, and to increase the number of new products or solutions as well as the number of ideas that are accelerated and/or created.**

## Impact highlights

- The ACCELERATE platform created by all the partners is now the meeting point for 15 investors and 105 users registered as start-ups. The platform is currently hosting over 60 project ideas.
- During 2015-2018, Bittium grew significantly and evolved to a clearly more product and innovation-driven company than previously, which is also shown in the revenue share; the product-based net sales rose from 37% in 2H.2017 to 56% in 1H.2019 and the net sales increased by about 16% between 1H.2018 and 1H.2019.
- Based on the ACCELERATE results, the level of automation for the Finnish industry partner, AAC Global, has increased significantly from where they started; in a typical process, the estimated increase of automated steps is 15%. The turnaround times and go-to-market of the new services and updates to existing services are 20% shorter than before participation in the project. AAC Global most likely would not have reached this level of automation and systematic approach without ACCELERATE.
- The start-up BEIA Telemetry has witnessed huge growth; from the end of the project until now the hiring rate has gone up by 10% and, in terms of partnerships, three more manufacturers have been contracted with BEIA now offering more precise solutions for indoor and outdoor measurements, like air and water quality, weather forecasts, using on-site sensors and satellite scans.
- The e-books created by SIRRIS have been used in coaching programmes and so far about 80 companies have been coached.
- For Mondragon University, company's requests for projects have increased yearly. Often those projects are adopted by the company as solutions to their needs and about 15-20% of the students end up working there.

## Project results

The method created in ACCELERATE was presented by the Belgian partner SIRRIS. It generated one book, “From Idea to Product/Market Fit”, on the basis of different e-books. This book provides guidance, insights, perspective and inspiration to go from idea to product/market fit in three stages: Idea, Problem/Solution and Product/Market Fit.

The ACCELERATE partners from Belgium, Finland, France, Romania and Spain created a platform that eases and facilitates interactions between start-ups and investors for business and product ideas or just an idea that can become marketable. The platform was built on Drupal 7 CMS, an enterprise-level open source solution for anything that implies content, user profiles, user roles and access permissions. Start-ups can communicate on the platform, access all the information sections and contribute to the library of resources by adding/publishing tools, methodologies, KPIs, success stories and lessons learnt. Most importantly, they have the possibility to add/edit/remove ideas. Investors can also use these features; for private ideas they must request access from the idea owner in order to view its details.

## Exploitation

ACCELERATE immediately had an impact on the project’s partners, during and after the project. E.g. in Finland, Elektrobit (since 2015 Bittium) deployed an innovation management information system tool for collecting all ideas and covering the innovation process from idea harvesting to the business validation. Several new business innovations led to either improvement of the products or to completely new innovations, however, the biggest change made was to evolve the company’s innovation culture.

Based on the ACCELERATE results, the level of automation for the Finnish industry partner, AAC Global, has increased significantly. AAC Global can also integrate seamlessly the customers’ processes and hence increase automation and smart processes even more. In the project, they created completely new service channels and services for their customers, monitoring closely the customer feedback and ROI. This year, the customer portal and backend processes that were a part of the ACCELERATE project will be shared with the global group of companies, Acolad Group, of which AAC Global is part now. The efficiency increase gained from ACCELERATE is thus planned to be scaled up to other entities in the group.

BEIA’s telemetry start-up in Romania has been improved through the project by increasing the awareness of telemetry systems among potential clients, as well as increasing the visibility of the solutions in both online and offline environments. The start-up has expanded its telemonitoring solutions from agriculture fields to heliports, photovoltaic parks and smart buildings. In addition, BEIA has become a reseller in Romania for F-Secure, one of the partners from ACCELERATE.

For Mondragon University in Spain, the methodologies and tools identified and designed in ACCELERATE to address the original objectives/challenges have been continuously implemented since the project’s end. Every year, 2-3 contests are organised at the university involving different groups of students, companies and territorial agencies. These projects are initiated based on active methodologies (Problem-oriented Project Based Learning (PoPBL).

# ACCELERATE

12014

**PROJECT LEADER**

Päivi Jaring, VTT

**PROJECT START**

November 2013

**PROJECT END**

November 2016

**PROJECT WEBSITE**

https://itea4.org/project/accelerate.html

**PARTNERS**

*Belgium*

- CogniStream ⊙
- CommScope Connectivity Belgium ●
- SIRRIS ○
- Zenjoy ⊙

*Finland*

- AAC Global ●
- Aptual ⊙
- Bittium Wireless ●
- F-Secure ●
- Inno-W ⊙
- Lappeenranta University of Technology ◉
- VTT Technical Research Centre of Finland ○

*France*

- Tobagos ⊙
- VIFIB ⊙

*Romania*

- BEIA Consult International ⊙
- Siveco Romania ◉

*Spain*

- PLANET MEDIA ⊙
- SIVSA SOLUCIONES INFORMATICAS ⊙
- University of Mondragón ◉



● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# BaaS

## Blueprint for Building automation and Management ecosystems

*Published September 2018*

**Smart buildings of the future need comprehensive and extendible cross-domain management and control functionality that today's building automation and management systems (BAS) do not adequately provide. These buildings should not only create an environment that optimises the conditions in which people can work and live in comfort and with security but should also ensure that management and maintenance are performed effectively and efficiently. The BaaS (Building as a Service) project set out to tackle these challenges by introducing a novel semantic IoT service framework for commercial buildings along with a reference architecture and corresponding software platform as a basis for current and future commercial building automation and management technologies.**

## Impact highlights

- In Materna, IoT has recently been elected as one of the company's key innovation areas. The results from the BaaS project can be considered as preparatory activities to this, and the knowledge part gained in BaaS will definitely be a basis for Materna's future activities.
- Materna's Open Source JMEDS platform, which was further developed in BaaS, has been downloaded more than 31,000 times all over the world (87 countries) since its publication.
- BOR Software started the project as the smallest SME participant (2 people) and now has 15 people working in BaaS-based IoT products and services. The income resulting from the project is estimated at around 1.5 million euros for the period 2017-2020. Spin-off companies IOTIQ GmbH and ERSTE Software Ltd were recently founded under the guidance of BOR, inspired by the gained BaaS knowledge and its IoT focus.

## Project results

The BaaS Reference Architecture provides common concepts and guidance for the development of concrete BaaS platforms. In particular, the BaaS Information Model facilitates the semantic modelling of devices, functions and data and thus provides a blueprint for the specification and generation of BaaS services. The establishment of a BaaS system follows a service lifecycle model that covers the phases of Design, Development, Engineering, Commissioning, Operation and Optimisation. The BaaS platform provides a number of tools and methodologies supporting the first phases of this lifecycle while the BaaS runtime facilitates the capabilities needed to operate a system of BaaS services. A technical management system monitors the services and ensures their proper operation.

The benefits of the BaaS platform and runtime have been shown in various application demos, including an Emergency Evacuation demonstrator and a Smart Workplace demonstrator. Building automation engineers benefit from BaaS tools that facilitate easy and flexible modelling, development, engineering and commissioning of services while tenants benefit from enhanced comfort, better customisation of services and energy savings through presence detection and environment awareness. Essentially, the BaaS approach can serve as a blueprint for stakeholders in future BAS ecosystems and provides for promising exploitation options.

## Exploitation

Project leader Materna continued to develop its Open Source JMEDS (Java Multi Edition Device Stack) framework based on DPWS (Devices Profile for Web Services) in BaaS. The foundations for JMEDS were laid in the ITEA projects SIRENA and OSAmI. JMEDS implements an abstraction layer for the integration of diverse device technologies as used and found in BAS.

BOR Software generated a commercial product from the BaaS results: BEY, a Building Inventory Management tool for commissioning, operating and monitoring BAS. After BaaS, BOR has established a new division for Smart Environment Engineering releasing commercial products and professional services. In 2013, BOR was not familiar with smart environments, but now the company has a strong business in this field. BaaS gave BOR a fast learning curve to convert knowledge into commercial exploitation and new opportunities.

Prodevelop provided the prototype 3D Web Visualisation for Real-Time Maintenance of Smart Buildings in BaaS. The company has used BAS added-value services to enhance its POSIDONIA Space © (Smart maintenance of harbour infrastructures) and POSIDONIA Safety © (Emergency plan specification and execution based on outdoor and indoor location systems) solutions.

Siemens has taken advantage of the results of the BaaS project for supporting the development of new BACnet standards (a data communication protocol for Building Automation and Control networks) together with Siemens Building Technologies. Ideas from the BaaS project have contributed to the Technical Working Group of the Fairhair Alliance, launched in 2015, to adopt and develop IoT technologies for Building Automation Systems, with Siemens, Philips and NXP as members.

# BaaS

12011

**PROJECT LEADER**

Franz-Josef Stewing, Materna

**PROJECT START**

November 2013

**PROJECT END**

November 2016

**PROJECT WEBSITE**

https://itea4.org/project/baas.html

**PARTNERS**

*Czech Republic*

- Masaryk University Institute of Computer Science ◉
- MDS Computer s.r.o. ⊙
- X-COM BASE Praha ⊙

*Germany*

- Fraunhofer Gesellschaft E.V. ○
- Kieback&Peter GmbH & Co KG ●
- Materna GmbH ●
- Siemens AG ●
- TU Dortmund ◉
- TWT GmbH Science & Innovation ●
- University of Rostock ◉
- University of Technology in Munich ◉

*Spain*

- Everis ●
- Prodevelop ⊙

*Turkey*

- Defne Bilgi Islem Ürünleri San. ve Tic. Ltd. S ⊙
- Gerade Software ⊙
- Kartek Kart ve Bilisim Teknolojileri Tic. A.S. SmartSoft ⊙
- KoçSistem Information Communications Services ●



● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# CAP

## Making a valuable asset out of Big Data

Published September 2018

**While the arrival of enabling technologies has made a wealth of public and organisational data available for analytic processing, access to the data and to efficient analytic tools is often difficult. Furthermore, combining such sources of massive data can yield much richer applications and greater insights into intelligence reporting. This requires a collaborative platform, which makes it easy for the participants to share data securely and to easily gain access to the latest technology tools. By positioning the target open-source architecture to support Big Data, ecosystems and value chains, the ITEA CAP (Collaborative Analytic Platform) project contributed to the development of new but sustainable business models and laid the foundation for a market value proposition of 'Big Data as a Service'.**

## Impact highlights

- Turkcell Technology and KoçSistem created a partnership with a large industry company and established a real-time IoT data flow from fuse boards. Turkcell Technology developed predictive models by getting electric consumption values from these fuse boards and developed a trendtracking dashboard that will enable near realtime energy-saving actions to be taken. There are plans to integrate this same model for restaurant and market chains, which is a great opportunity for Turkcell Technology to enter new markets, with more than 20,000 market chains and 5,000 restaurant chains as potential users.
- During the CAP project, the French La Poste Group examined fraud on franking marks by targeting the customers and/or the products where the legal manual controls may be the most cost-effective. These same control mechanisms may enable several million euros to be recovered. Furthermore, in 2016 La Poste Group decided to invest in Probayes, a very successful French data science SME , to accelerate the digital transition.
- Through the CAP project, VTT has been able to create the world's first public in-cloud icing atlas (WIceAtlas) for identifying icing risks for wind power and potentially other tall man-made structures. WIceAtlas has proven to be highly accurate according to 3rd party assessment: over 80% of all analysed wind farms globally have been correctly identified regarding icing losses with WIceAtlas.
- Innodep attracted great interest in introducing its interactive CCTV monitoring service, which is based on CAP results, to several exhibitions and local district surveillance centres in Korea and has been implementing the steps for its commercial product.

## Project results

The CAP consortium defined standard, extensible data models and interfaces for the exchange of data between the data owners, platform operators, cloud infrastructure operators and data scientists. The platform incorporated open Big Data tools and features that all participants can use and enhance, thus enabling access to data, sharing and processing in real time facilitated by a single platform. A key deliverable was the new range of business models that established metrics for the value of Big Data. These features enabled CAP to regulate the stakeholders' collaboration and develop a new innovative business environment based on shared data and knowledge in a secure setting – the Big Data Marketplace – where data owners have the opportunity to valorise their data across other domains. CAP delivered industry-based use cases that demonstrate how an enabling platform can generate remarkable benefits in response to a highly diverse range of industrial and commercial needs. The demonstration of instantiations of the platform model and the interoperability tests proved that the standard tools for Big Data can operate as a common service platform across Europe and beyond.

## Exploitation

Turkcell Technology and KoçSistem created a partnership with a large industry company and established a real-time IoT data flow from fuse boards. Once the integration was completed, Turkcell Technology developed predictive models by getting electric consumption values from these fuse boards and developed a trend tracking dashboard that will enable near real-time energy-saving actions to be taken, such as improving refrigerators that consume a lot of energy. In addition, Turkcell and Ericsson have been testing the applications of Narrow Band IoT in LTE networks since the beginning of 2017 with contributions from their own engineers and their local business partners. During the project, KoçSistem started to build new product lines such as IoT, Mobile Business and Big Data Analytic Platforms.

Participation in the CAP project has focused the mail division of the French La Poste Group on the real value of the data collected by its mail sorting machines. Several terabytes were analysed to qualify the quality of the data and then to extract useful conclusions about the processes.

Through the CAP project, VTT has been able to create the world's first public in-cloud icing atlas (WIceAtlas), providing information on in-cloud icing severities for existing and planned wind farms worldwide. WIceAtlas consists of over 4500 meteorological stations worldwide with over 20 years of observation data and 35 years of MERRA reanalysis data.

Thanks to the CAP results, NetMan created services focused on entities needing a high level of automation and data exploitation. NetMan was acquired by MPY in 2017.

ETRI developed a concrete CAP platform with multitenant architecture. Based on this platform, Innodep developed the interactive CCTV monitoring service which analysed CCTV metadata together with data from external systems (e.g. weather, traffic, accident, etc.) and recommended more important CCTV videos and situations to focus observer attention on them.

# CAP

12010

**PROJECT LEADER**

Bülent Kirval, Turkcell Teknoloji

**PROJECT START**

November 2013

**PROJECT END**

October 2016

**PROJECT WEBSITE**

https://itea4.org/project/cap.html

**PARTNERS**

*Belgium*
- Amplidata ⊙
- Picanol ●
- SIRRIS ○
- Sogeti Belgium ●

*Finland*
- Absent Oy ⊙
- Flo Apps Ltd ⊙
- Moventas Gears Oy ●
- Netman Oy ●
- VTT Technical Research Centre of Finland Ltd. ○

*France*
- Ernst & Young Advisory ●
- Institut Mines-Télécom ◉
- La Poste ●
- Squid Solutions ⊙
- Thales Communications and Security ●

*Republic of Korea*
- ETRI ○
- Feelingk Co., Ltd. ⊙
- INNODEP INC. ⊙
- Mobigen Co., Ltd. ⊙

*Spain*
- Asociación de empresas tecnológicas Innovalia ○
- DATAPIXEL ⊙
- Instituto de Medicina Genomica ⊙
- Unimetrik ⊙
- Universidad Politécnica de Valencia (UPV) ◉

*Turkey*
- CTECH ⊙
- Ericsson Arastirma Gelistirme ve Bilisim Hizmetle ●
- KoçSistem Information Communications Services ●
- Plaza Turkcell Teknoloji ●



● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# Digital Cinema

## Defining the architecture of today's digital cinema

*Published September 2018*

**The paradigm shift in the film industry to enable digital distribution was a major and risky step to produce change in a century-old industry that required a universal, long-term digital cinema standard that meets the needs of exhibitors, studios, equipment manufacturers and others involved in this effort. The ITEA Digital Cinema project developed the key components for this transition of the movie industry from analogue 35mm film to digital technology. Within the project, a system solution was developed, covering all elements of film production, distribution, storage and replay, including alternative uses for digital infrastructure.**

## Impact highlights

- The results of the Digital Cinema project were integrated in the Barco Digital Projection product line and provided Barco with the basis for taking a leading position in 2012, with close to 30% market share that has continued growing since. Annual capture rates of around 50% have strengthened Barco's number 1 position, and with over 80,000 projectors deployed, Barco now has a global market share of close to 50% with annual revenues in excess of 300m euros.
- Barco achieved a #1 worldwide position with overwhelming market shares in China and Latin America of 60% and higher, a leading position in Europe with around 40% of market shares and a strong position in US and the rest of the world with market shares varying between 25% and 35%.
- In Barco, more than 350 additional people were hired to cope with the demand created by digital cinema. While Barco had previously built up to 100 (other purpose) projectors every month, thanks to the results of digital projection, the production including the digital projectors is now over 660 units per month. With peaks to 1,500 digital projectors per month, more people are required in the plant.
- XDC, a spin-off from project partner EVS, grew from 20 to 70 people between 2005 and 2011. It installed more than 1000 playback servers all over Europe and 200 central control systems in multiplexes, both fully derived from the architecture and technologies designed and developed during the Digital Cinema project.

## Project results

During the Digital Cinema project, the consortium studied the complete digital cinema chain including production, content mastering, colour management, compression, data storage, security, multilingual sound, subtitling and alternative uses for digital theatres. The main innovation in this project centred on projectors, communicator software, alternative content interfaces and internally overlaying subtitling.

These technological developments paved the way for a new generation of film distribution. Now, as a result of the project, with digital cinema, we can all watch movies with a much better image quality, wherever and whenever the movie is watched. Smaller cinemas can have access to movies of the same quality. Moreover, the new system developed during the project enabled 3D movies to achieve commercial success. Besides, movies can now be released all over the world at the same time.

In addition, digital cinema also supports services such as streaming live shows (music, sport events) or company presentations, which enables theatres to be operational outside the usual movie projection time slots. All this had not been possible with the previous 35 mm technology. Digital cinema has made distribution much cheaper and deploys technologies such as hard drives and satellite streaming. This technological switch represented a significant saving for the studios and triggered a new value chain and new business models for the sector.

## Exploitation

The results of the project were integrated in the Barco Digital Projection product line; the company was able to develop a Digital Cinema product family ranging from the first DP30 to the DP100 projector, which was Barco's first 2K digital projector to support the Digital Cinema Initiatives (DCI) standard drafted at the time. Barco is now moving to a new generation of projectors based on laser and laser phosphor technology, which is beneficial as the new technology is 40% more energy efficient and eliminates the need for xenon and conventional bulbs, the latter containing toxic components and requiring frequent replacement.

EVS brought Mpeg-2 playback server expertise, from its small EVS Digital Cinema cell inside the bigger slow-motion TV company. This cell started from a few persons. The success of digital cinema playback server was so good that EVS created a spin-off fully dedicated to Digital Cinema in 2005, called XDC.

The business success of the Digital Cinema project was such that some partners merged after the completion of the project to better access the market: Octalis was acquired by Technicolor and Barco decided to acquire the whole R&D, products and technology of XDC in 2011, with the ambition to further integrate the external Digital Cinema server inside the projector. This acquisition was a huge success with today more than 20.000 integrated playback servers inside Barco projectors worldwide.

# Digital Cinema

00005

**PROJECT LEADER**

Dirk Maes, Barco

**PROJECT START**

June 2001

**PROJECT END**

July 2003

**PROJECT WEBSITE**

https://itea4.org/project/digital-cinema.html

**PARTNERS**

*Belgium*

- Barco N.V. ◉
- EVS Digital Cinema ⊙
- Octalis S.A. ⊙

*Finland*

- Sublime Software ⊙

*Germany*

- Kinoton GmbH ⊙

*The Netherlands*

- Philips ◉
- Stage Accompany ⊙

*United Kingdom*

- Computer Film Company ◉
- University of Derby ◉



◉ (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# EPAS

## Ensuring interoperability of card payments across Europe and beyond

*Published August 2018*

**Several years ago, the European card payment industry, terminal manufacturers, processors and payment system providers worked together - in line with the preference given by the European Central Bank and the European Commission for ISO 20022 standards - to implement SEPA, the Single Euro Payments Area. SEPA aimed at facilitating payments in Europe beyond national borders in order to achieve a single domestic market of payments. However, this requires the full harmonisation of payment-card use – a necessary step to ensure the complete interoperability of national card payment schemes. The ITEA EPAS project (2006-2008) aimed to involve the main actors of the card payment industry to deliver global standards that would enable European retailers to rely on common specifications for their card acquiring operations. The EPAS project gathered together various actors belonging to the European card payment industry such as Groupement des Cartes Bancaires, Ingenico, ATOS Worldline, Verifone, Wincor-Nixdorf, Total, Equens and many others.**

## Impact highlights

- EPAS has paved the way to a series of universal ISO standardised specifications for European card payments free of royalty and charges. Ultimately, this has been extended worldwide with the endorsement of the EPAS specifications (CAPE) as a global ISO 20022 message standard.
- ISO 20022 is today 'the' reference in standardisation in finance. Instant payment solutions are being developed today based on ISO 20022 credit transfer standards which may, in the future, facilitate the development of hybrid card and credit transfer payment solutions.
- EPAS has been targeted by Groupement des Cartes Bancaires as a unique opportunity for its members to address the need for a unified European market for payments as set out by the European Commission. It also provides an appropriate way to rely on open royalty-free standards ensuring robust independence vis-à-vis some proprietary norms owned by and under the control of other industry stakeholders. Such independence is viewed as the only way to maintain today's domestic scheme autonomy vis-à-vis the influence of some major global networks.
- EPAS provides a major competitive advantage to retailers operating card payments in different countries, such as:
  - Total S.A., operating and managing 8 different electronic payment systems in Europe, selected EPAS to reduce its heavy dependence on terminal manufacturers and payment solution providers.
  - AccorHotels found in EPAS standards the ability to overcome the deployment complexity and the costs related to heterogeneous standards among European countries.

## Project results

EPAS contributed to the achievement of SEPA by delivering a series of specifications that enable a smooth migration from non-interoperable proprietary solutions with dedicated interfaces to an open environment based on interoperable hardware and software components from different manufacturers. This work resulted in three major components for point-of-interaction (POI) transactions:

1. An acceptor-acquirer protocol covering authorisation, completion, rejection, reconciliation, diagnostic and specific service exchanges between an acceptor (merchant) and an acquirer (bank of the merchant) of card payment transactions.
2. A terminal management system (TMS) between a card payment terminal and the bank of the merchant for the management and the downloading of software and functional/security parameters into the terminal.
3. A retailer protocol covering a series of administrative, payment-services and device-services exchanges between a sales application controlled by a merchant (retailer) and a payment application; ensuring a clear separation between sales and payment functions.

A first working demonstration of the EPAS standard took place in November 2008.

## Exploitation

After the project end, a formal not-for-profit legal structure - EPASOrg - was set up with the aim of providing a global platform for the evolution and further maintenance of the standards. A year later (November 2010), EPASOrg delivered the very first series of universal ISO 20022 standards for card payments.

In October 2014, the OSCar consortium and CIR SEPA-Fast technical working group joined EPASOrg to create 'nexo', an organisation whose aim is to design, develop, promote and maintain card payment and cash withdrawal standards, protocols and implementation specifications under a universal ISO 20022 standardisation process.

There are currently 32 principal members of nexo, including American Express, VISA, Mastercard, BNP Paribas, Crédit Agricole, SNCF, TOTAL and Auchan. Furthermore, there are 44 associate members, such as AccorHotels, Ayden, FIS, Lidl, LVMH and Subway.

Major international card schemes involved in acquirer-to-issuer card payment such as Visa, Mastercard, AMEX and Discover have ultimately come to the conclusion that ISO 20022 would progressively lead to the replacement of the legacy ISO 8583 industry standard which is still extensively used worldwide. A dedicated initiative in the acquirer-to-card issuer domain, ISO 20022 ATICA, involving the above actors aims at bridging the standard gap by completing the existing series of ISO 20022 card payment standards. The outcome of this work will enable a terminal using the EPAS standard to further reach a card issuer through the ATICA norm and so provide a full-fledged ISO 20022 solution from one end of the chain (the terminal initiating the card payment) to the other end (the issuer of the card giving the authorisation for the payment).

# EPAS

05008

**PROJECT LEADER**

William Vanobberghen, Groupement CB

**PROJECT START**

June 2006

**PROJECT END**

July 2008

**PROJECT WEBSITE**

http://www.nexo-standards.org

**PARTNERS**

*Austria*
Europay Austria ⊙

*Belgium*
Banksys ●
Integri ⊙

*France*
Galitt ⊙
Groupement des Cartes Bancaires ●
Ingenico ⊙
Ingenico (MoneyLine) ⊙
Lyra Network ⊙
Thales E-transactions France ●
TOTAL France ●

*Germany*
Atos Worldline GmbH ●
Retail Services Company ●
Security Research & Consulting GmbH ⊙

University of Applied Sciences Cologne ◉

*Luxembourg*
Cetrel ⊙

*The Netherlands*
Equens ⊙

*Portugal*
SIBS ⊙

*Spain*
Sermepa ⊙
Thales E-transactions España ●
Wincor Nixdorf ●

*Sweden*
PAN Nordic Card Association ⊙

*United Kingdom*
BP ●



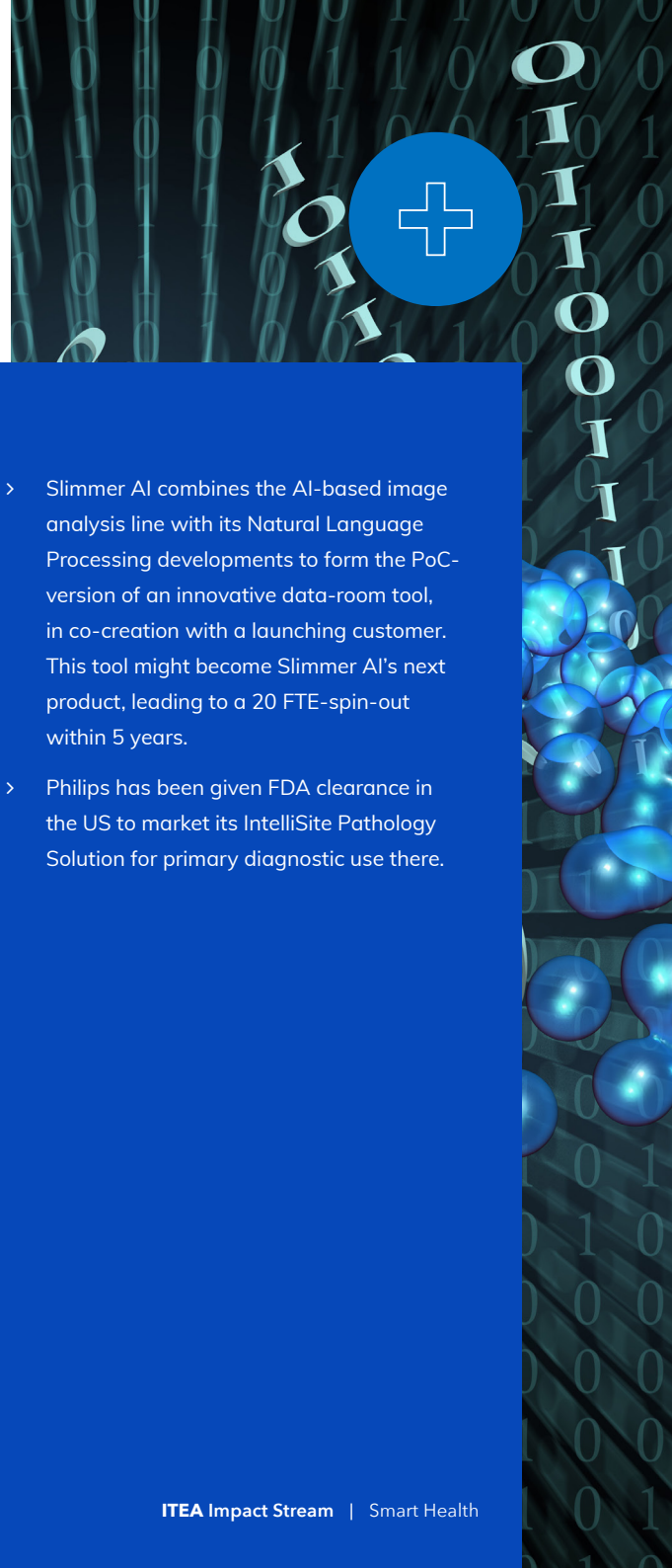
● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# 3DPathology

## Developing 3D Digital Pathology with Spectroscopy

*Published December 2020*

**We all know pathology, thinking of the healthcare professional examining a tissue section under a microscope, looking for evidence of cancerous cells. Many years ago, the pathology process was digitalised by capturing the glass slides with a scanning device to provide a high-resolution digital image that can be viewed on a computer screen or mobile device, facilitating the acquisition, management, sharing and interpretation of pathology information. More recently, these digital images were becoming increasingly more accurate to render 3D shapes of objects. Organs structures and contents were already revealed in 3D distribution, but this was not yet the case for tissues, which require microscopic spatial resolution to develop 3D analysis. The main bottleneck to achieving efficient 3D imaging of tissues was to provide a quantitative and global analysis at microscopic resolution. The project 3DPathology, headed by Barco and Philips along with knowledge partners and university hospitals from six countries, was set out to create a 3D digital pathology solution, based on a combination of multiple existing pathology modalities, for same-day diagnosis and much more personalised treatment of cancer.**



## Impact highlights

- A 3D multi-modal pathology demonstrator, the first of its kind in the world, enables unique features such as access to the microscopic organisation of tissue sub-structures in 3D, providing complete chemical information and access to unexplored dimensions of histology.
- Academic Medical Center of the University of Amsterdam reported a 10% reduction of re-occurrences/readmissions, considering the cost for a typical re-occurrence/readmission for bladder cancer diagnostics is 2 to 3k euros for every 6 months.
- Barco has already sold several hundred optimised display systems that address a variety of pathology lab needs, worldwide, and in the next few years Barco is expecting a large increase in sales of display systems for Digital Pathology.
- Slimmer AI combines the AI-based image analysis line with its Natural Language Processing developments to form the PoC-version of an innovative data-room tool, in co-creation with a launching customer. This tool might become Slimmer AI's next product, leading to a 20 FTE-spin-out within 5 years.
- Philips has been given FDA clearance in the US to market its IntelliSite Pathology Solution for primary diagnostic use there.

## Project results

To achieve this, 5 major technical challenges had to be tackled:

- The 3D acquisition of data using multiple imaging modalities
- The acquired data of some modalities had to be reconstructed and aligned from actual 2D images of pathologic slices into 3D images
- The aligned 3D data from different modalities had to be analysed to improve the quality of diagnosis
- The project developed new 3D visualisation and interaction technologies (equipment and algorithms) optimised for multi-modal 3D pathology
- An IT backbone was created to deal with data of tremendous size

The resulting 3D multi-modal pathology demonstrator provides complete chemical information and access to unexplored dimensions of histology. The 3D visualisation of, and interaction with, the relevant data from multiple imaging modalities optimises the presentationof the relevant views and parameters and allows the huge amounts of data to be handled.

## Exploitation

First of all, the 3DPathology project has had a significant impact on JPEG XS standardisation, which focuses on near loss-free, low-latency coding of high-resolution data. Intensive collaboration between imec, ETRO and VUB resulted in the launch of a new extension of JPEG 2000.
Furthermore, **Philips** expects the results to help bring new pathology scanners to market and an innovative multi-layer bright field imaging solution to increase its market share of the bright field pathology. Increased usability range and robustness will address the needs for both small labs and large medical centres.
As a result of the project, **Prodrive Technologies** finalised the scan engine design and the production tools, which are now available. This emerging technology project will result in better patient care and significantly higher revenue.
**Slimmer AI**, formerly Target Holding, applied the experience in image handling and analysis from 3D molecular image alignment in different customer cases and proofs of concept (PoC). Currently, the AI-based image analysis line is combined with Slimmer AI's Natural Language Processing developments to form the PoC-version of an innovative data-room tool, in co-creation with a launching customer.

**Barco** has developed optimised display systems that address a variety of pathology lab needs for review, positioning of samples but also for diagnostic purposes. In addition, Barco prepared a White Paper for the Medical Imaging Working Group of ICC which is a first step towards the standardisation of medical colour imaging.
In addition, **PS-Tech** has developed masking technology for extractions within volumetric datasets. This technology, which has now been commercialised in Vesalius3D, is used for preoperative planning in various cardiovascular procedures.
For the Korean partner **Xavis**, the project will result in bringing to market new 3D X-ray Microscopy Instrumentation capable of high-resolution, non-destructive imaging and analysis for the quantification of internal structural parameters at submicron to nanometre scale.
And last but not least, increasing the accuracy in pathological examination practice and interpretation has a significant impact on improving quality of life due to personalised treatment, limiting re-occurrence as a result of better treatment outcomes and a reduction in the cost of healthcare from fewer readmissions.

# 3DPathology

14001

**PROJECT LEADER**

Dominique Segers, Barco

**PROJECT START**

July 2015

**PROJECT END**

July 2018

**PROJECT WEBSITE**

https://itea4.org/project/3dpathology.html

**PARTNERS**

*Belgium*
- Barco ◉
- imec ○

*Finland*
- Sec-control Innovation ⊙

*Republic of Korea*
- POSTECH ◉
- Xavis ⊙

*The Netherlands*
- Academic Medical Center of the University of Amsterdam (AMC) ◉
- Eindhoven University of Technology ◉
- Maastrict University ◉
- Philips ◉
- Prodrive Technologies ⊙
- PS-Tech ⊙
- Slimmer.AI ⊙

*Romania*
- VAltfactor ⊙
- Siveco Roman ◉

*Taiwan*
- Academia Sinica ◉
- Bio Material Analysis Technology ⊙



◉ (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# BENEFIT

## Advancing evidence-based medicine for better patient outcome

*Published December 2019*

**The BENEFIT project tackled three main challenges: the societal aspect of coping with the increasing number of minimally invasive image-guided interventions; the economic dimension of delivering care with quantified targets in terms of quantity, price and quality of care; demonstrating the technical feasibility of an integrated infrastructure that includes all relevant imaging and data sources, the modelling, analysis and presentation of these data and the integration into a Clinical Decision Support System. Current diagnostic and therapeutic solutions do not offer the flexibility, quality and integration to automatically extract all the relevant quantified data and process flows. The ITEA project BENEFIT aimed to support clinicians in selecting the optimal diagnostic and treatment pathway for patients.**

## Impact highlights

- The Dutch SME Medis gained CE and FDA approval for its analysis that calculates pressure drop from X-ray images leading to a reduction of the excessive use of stents and the need for a disposable pressure wire of €500-1000, and thus saving costs.
- The Belgian SME FEops gained CE approval for its TAVIguide product and secured an investment injection of €6m for the FEops HEARTguideTM. FEops has grown from 4 to 15 employees.
- At the end of 2019, Philips sold over 250 copies of its new commercial tool AneurysmFlow for treating cranial aneurysms. Philips also created an automatic 3D detection of liver tumour feeding vessels, boosting detection accuracy by 26% and resulting in at least 20% less recurrence than with 2D feeder detection.
- Elekta gained CE and FDA approval for its Leksell Gamma Knife ICON system with Cone beam CT (CBCT). By September 2019, 107 systems have been installed and are clinically in use while 200 existing systems can be upgraded worldwide. The planning time for test cases is reduced significantly by around half.
- Linköping University (LiU) in Sweden has published a paper for functional MRI in PNAS (Proceedings of the National Academy of Sciences) in 2016, which has been covered by Science, The Economist, The New York Times, has been downloaded over 200,000 times and received over 1800 citations.
- The Dutch SME Quantib gained CE and FDA approval for its brain analysis software and secured €4.5m in fresh funding to support the company in its international expansion ambitions. Between July 2014 and end of 2019, Quantib grew from 6 to nearly 30 employees, developed 4 products including certification, has installations in over 20 countries and initiated partnerships with 3 top medical university centres in the Netherlands.
- In total, the project partners applied for 7 patents.

## Project results

BENEFIT focussed on tools and protocols for imaging and treatment and quantified data before/during/after treatment, supported by common IT tools for structured collection and analysis of these data. This generic approach was applied to five different clinical use cases: diagnosis and treatment of cardiac blood vessels, cardiac valves, brain vessels, brain tumours and liver tumours. The consortium of 3 large industries, 5 SMEs and 4 university hospitals covered scientific input, input from clinical end users, technical innovation and market access. This has resulted in new products and dissemination in 70 publications, 3 master theses, 2 PhD theses, 2 book chapters, 60 presentations at scientific and commercial conferences and 7 patent applications. Finally, integrated demonstrators of the collaborative and complementary work of the partners in all five use cases showed that BENEFIT has advanced evidence-based medicine by providing imaging tools, devices and a database for heterogeneous medical data. It has also prepared for a next step in healthcare, which is the adoption of AI based on such quantified clinical data. This has been incorporated in a new ITEA project called IMPACT.

## Exploitation

Through the collaboration in BENEFIT, many achievements were realised by the different partners for the 5 use cases.

E.g. for **blood vessels**, a procedure called QFR® (Quantitative Flow Ratio) analysis developed by Medis calculates pressure drop from the X-ray images which are acquired anyway saving the costs of a separate disposable catheter for pressure and promoting widespread adoption of pressure analysis to further reduce excessive use of stents. For **cardiac valves**, BENEFIT also had a significant impact on FEops in terms of technology, funding and staffing; it secured an investment injection to help drive commercial adoption of the FEops HEARTguideTM and almost quadrupled its number of staff. For **brain vessels**, Philips has introduced a new commercial tool based on the research efforts performed within the scope of BENEFIT for the treatment of cranial aneurysms. It is the first interventional tool to visualise and quantify flow patterns in a vessel and an aneurysm. It predicts the chance of long-term treatment success while the patient is still on the operating table and the catheter is in place. This enables the surgeon to take immediate additional action where the chance of success is too low, reducing the risk for the patient and the need for repeated treatment. For **brain tumour radiotherapy**, BENEFIT helped Elekta develop its Leksell Gamma Knife ICON system with Cone beam CT (CBCT) for optimal patient positioning. The CBCT positioning system allows frame and frameless workflow in radiotherapy such that patients do not need to wear a stereotactic frame for imaging before treatment planning, thus allowing more flexibility and efficiency in treatment planning for both clinicians and patients. Finally, for **liver tumours**, partners collaborated on different treatment alternatives. For reliable differentiation of healthy tissue and tumours Barco developed a colour calibration procedure for the whole chain of endoscopes and medical displays which can now be performed in less than 5 seconds. DEMCON has developed a CT guided needle positioning system (NPS), allowing more accurate needle placement; freehand placement required on average one additional placement. And during the BENEFIT project, UMC Utrecht set up a collaboration on method development with ErasmusMC, and useful contacts with companies as DEMCON and Quantib were established.

# BENEFIT

13031

**PROJECT LEADER**

Herman Stegehuis, Philips

**PROJECT START**

July 2014

**PROJECT END**

December 2017

**PROJECT WEBSITE**

https://itea4.org/project/benefit.html

**PARTNERS**

*Belgium*

- Barco ◉
- FEops ⊙

*The Netherlands*

- ADemcon ⊙
- Erasmus MC ◉
- Leiden University Medical Center ◉
- Medis medical imaging systems ⊙
- Philips Medical Systems Nederland ◉
- Quantib ⊙
- Utrecht University Medical Center ◉

*Spain*

- Other side mirror ⊙

*Sweden*

- Elekta ◉
- Linköping University ◉

# MEDIATE

## Boosting healthcare on three fronts: patients, the healthcare system and the economy

*Published December 2017*

**The costs of sustaining healthcare for the world's ageing population are rising constantly and have become a significant component of global GDP. Healthcare is a major and growing market, with diagnostic and interventional medical imaging alone is worth almost €20 billion globally and growing. The significance of the market is reflected in the significance of the challenge that the MEDIATE project took up: to reduce costs and to improve the predictability of patient outcomes. The key lies in integrating medical imaging systems fully into surgical procedures and hospital workflow systems. MEDIATE focused on three medical fields: cardiology, oncology and orthopaedics, where planned minimally invasive procedures follow a pre-programmed workflow procedure, namely medical imaging to aid diagnosis, intervention planning, image-guided navigation during the intervention, execution of the therapy and therapy response assessment.**

## Impact highlights

- For Philips, the strategy and improvements based on the MEDIATE results in both its MRI and Image Guided Therapy businesses have significantly boosted annual sales volume.
  - Philips' metal artefact correction techniques have been brought to market with sales of over 1000 licenses in 2 years.
  - The unique capabilities of the Philips platform ScanWise Implant have set them above their competitors.
  - One of the leading hospitals in the Netherlands using Philips' new Azurion system reported significant time efficiency gains before (12%), during (17%) and after (28%) interventional procedures, which gives the ability to treat 1 more patient a day in the same room (on an average of 6-8 patients a day).
- By the end of 2016, over 1000 operating rooms within Europe had installed Barco's Nexxis platform – a networked digital Operating Room - which is based on MEDIATE results. At the end of 2017 this has increased to over 1600 installations and accelerated adoption is expected over the next few years.
- Following the MEDIATE project, Digisens is now selling 300 licences per year of Cone beam computed tomography (CBCT) reconstruction for clinical systems. Moreover MEDIATE opened new investigation fields for Digisens in the domain of noncircular reconstruction trajectories with a direct impact on industrial inline 3D inspection and homeland security.

## Project results

MEDIATE geared its efforts to developing system architectures that enable the integration of multi-modal systems, support multi-vendor interoperability, allow integration of third-party solutions and facilitate user interaction. The resulting set of technologies improves not only healthcare practitioners' knowledge of the condition of individual patients but also the predictability of procedures, reducing complications and obtaining better clinical outcomes from treatment. The platform-independent, interoperable solutions were based on open, stable standards such as XML Web Services while new software and electronics concepts for user interaction, communication and ergonomics were optimised for the specific tasks and environment of the clinical user. These solutions had to be intuitive and easy to use, support communication between clinical staff, address logging and reporting as well as facilitate optimal workflow. The software and electronics for navigation and autonomous steering of diagnostic and therapeutic devices were smoothly and seamlessly integrated with imaging systems to enable the real-time acquisition, processing, integration and visualisation of high-resolution medical images from different sources. Finally, there was a focus on the analysis, pattern recognition and decision support for diagnosis, planning and treatment during medical interventions.

## Exploitation

In recent years, Philips has released motion compensation enhancements for MRI developed in MEDIATE as well as metal artefact correction techniques based on MEDIATE results. Moreover, in 2015, after updating the relevant IEC standards and actively collaborating with big implant vendors like Medtronic, Abbot (St Jude) and Biotronik, Philips was the first to introduce an easy-to-use user interface, called ScanWise Implant, for scanning patients with MR Conditional implants, serving a rapidly growing population of patients around the globe. The MEDIATE architecture is also the basis for Azurion, Philips' next generation image-guided therapy platform and the new core of its integrated image-guided therapy solutions portfolio. The MEDIATE results on a new architecture for its interventional X-ray systems fit in with Philips' strategy to enter the Image Guided Interventions and Therapy solutions market, which is about 10 times larger than the interventional imaging market alone.

Barco used the results of the MEDIATE project to create its Nexxis platform, an IP-centric solution for video and image management and distribution in the next-generation digital operating rooms. This unique video distribution-over-IP approach allows 'plug & play', enabling medical equipment to be rolled into the operating room and be instantly connected. Furthermore, the Nexxis system has been selected as the integration and visualisation backbone by leading suppliers of operating room equipment, like Karl Storz, Merivaara and Brainlab.

SurgiQual Institute designed and developed an innovative clinical application that uses radio frequencies to suppress tumours as well as leveraged this work into a more general software environment adapted for planning patient-specific medical interventions. Digisens developed a new reconstruction algorithm based on an iterative approach for dose reduction and metal artefact reduction.

# MEDIATE

12026

**PROJECT LEADER**

Herman Stegehuis, Philips

**PROJECT START**

September 2010

**PROJECT END**

December 2013

**PROJECT WEBSITE**

https://itea4.org/project/mediate.html

**PARTNERS**

*Belgium*
- Barco ●
- imec ○

*France*
- CEA LIST ○
- Cedrat Technologies ⊙
- Digisens ⊙
- EndoControl ⊙
- HAPTION ⊙
- Institut Mines-Télécom Bretagne ◉
- Philips Medisys ●
- SurgiQual Institute ⊙
- Therenva ⊙
- Université de Rennes 1 - LTSI ◉

*The Netherlands*
- Demcon
- Erasmus MC ◉
- Leiden University Medical Center ◉
- Nucletron Operations BV ⊙
- Philips ●
- Philips Research ●
- Prodrive ⊙
- Technolution ⊙
- University of Amsterdam - Academic Medical Center ◉
- Utrecht University Medical Center ◉

*Spain*
- Alma IT Systems ⊙
- Atos S.A.E Origin ●
- Institute of Applied Computing with Community Code (IAC3) ○
- University of Girona ◉
- Vicomtech Foundation ○



● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# MoSHCA

## Mobile and Smart Healthcare Assistant

*Published December 2019*

**There is a dramatic increase in the number of persons worldwide experiencing chronic disease like diabetes, which affects approximately 350 million people and is projected to become one of the world's main disablers and killers within the next 25 years. The impact of chronic diseases is evident: it has been estimated that over the next 20 years the cost of five of the major chronic illnesses could reach $47 trillion and in 10 years claim almost 400 million lives. The ITEA 2 MoSHCA project was geared to improving patient-doctor interaction and controlling chronic diseases, developing technological set-ups that significantly improve the self-management of chronic illnesses, promote communication between the patient and the health provider, and support health staff in providing better clinical follow-up.**

## Impact highlights

- After the MoSHCA project, Evalan has experienced a growth rate of 100% each year, in 2016, 2017 and 2018. This growth is reflected in all metrics – employees, turn-over, profitability etc. During that period Evalan has added 40 FTEs to its payroll. Evalan expects that growth will continue in 2019. The technology Evalan developed within the context of the MoSHCA project greatly contributes to this growth as the same technologies are now used in other products.
- The Epilepsy App, developed by CLB Research and Sound Intelligence on the basis of MoSHCA technology, is now being used to monitor 2000 patients at the Dutch 's Heeren Loo care group (ten-year contract). Three big care groups – 's Heeren Loo, ASVZ and Baalderborg Groep - are currently using the Sound Intelligence algorithm to detect snoring. In addition, around 30 healthcare institutions – including the mentioned care groups and hospitals like Prinses Maxima, Zuyderland, Elkerliek and Zaans Medical Centre - are using the CLB Messenger's "critical messaging core" to distribute alarms from medical devices to nursing staff.
- The project resulted in two patents in the areas of hypertension and COPD (Chronic obstructive pulmonary disease) care

## Project results

The MoSHCA solution typically involves a number of body and other sensors that communicate wirelessly with a smartphone, transmitting relevant physiological and activity data such as different cardiac and vascular information, glucose levels, etc. The intelligent MoSHCA software installed on the mobile terminal receives this information, along with subjective patient generated data such as pain and mood levels, stiffness, medication taken, etc. With context-awareness and interoperaility as key features, the technology was tested in medical environments with real patients and valuable feedback was gained from these patients and their care providers. The reliability and energy consumption of medical sensors were improved and a better understanding gained of the balance of the privacy and security needed for healthcare data-mining and data communications, along with the systematic means to privacy and security assurance. In addition, collaboration between the SME and academic participants enabled the facilitation of access to medical data and the appropriate adaptation of algorithms, leading to a high degree of user orientation. 7 use cases in the areas of mobility, general health, hypertension, COPD, baby monitoring and epilepsy, were performed resulting in tangible products.

## Exploitation

Key software technology developed by **Evalan** within the project is incorporated in SensiStep, a rehabilitation support application being used in the Netherlands, Belgium and Sweden, whereby people recovering from certain types of leg or hip fractures have to perform partial weight-bearing exercises. SensiStep provides dynamic support and shows the actual weight that is exerted on a leg continuously and in real-time. This means that both the patient and the physiotherapist can monitor whether the rehabilitation is progressing on track, or if the exercise programme needs to be adjusted accordingly.

**CLB Research** and **Sound Intelligence** developed an individually tuneable sound recognition system and exploited the MoSHCA technology in an Epilepsy App. This is the first (mobile) product that can detect sounds affiliated with epileptic seizures and is able to alert care providers to on¬going seizures without using physical sensors attached to the patient's body with the added benefit of comfort, as no sensors are attached to the patient.

**Actimage** developed a unique know-how that allows predictive algorithms to function autonomously on smartphones. This technology enables the deployment of personalised algorithms on patients' smartphones and is a relevant advance towards personalised medicine. Actimage exploits MoSHCA results in three applications: Actelin, a mobile application for diabetics, ActiHomePro, a smartphone application for day-to-day management for healthcare professionals working in patients' homes, and Hol'Autisme that offers a first catalogue of mixed-reality applications to improve the social skills of children with autism.

At the **Radboud University Nijmegen**, a new system for predicting exacerbations for COPD patients at home was developed. This app enables self-monitoring of COPD patients, by providing automatic recommendations to patients and will be marketed by MonitAir.

The **University of Girona** developed the intelligent algorithms of Care Me At Home, a mobile app that enables premature babies to be monitored at home via wireless sensors. Currently, there are 30-35 new-borns under a discharging programme at home per year and it is expected to increase up to 40-45 in 2019. The reasoning module for premature babies has been developed in collaboration with the clinical staff of the Institut d'Investigació Biomèdica de Girona Dr. Josep Trueta and is protected by the Catalan Intellectual Property Office.

# MoSHCA

11027

**PROJECT LEADER**

Hendrik R Schwietert, Evalan

**PROJECT START**

October 2012

**PROJECT END**

March 2016

**PROJECT WEBSITE**

https://itea4.org/project/moshca.html

**PARTNERS**

*Republic of Korea*
- BAcroem Co. Ltd ⊙

*Luxembourg*
- BAcroem Co. Ltd ⊙

*The Netherlands*
- CLB Research BV ●
- Evalan ⊙
- Radboud University Nijmegen ◉
- Sound Intelligence BV ⊙

*Portugal*
- Instituto de Telecomunicações ○

*Spain*
- Answare Tech ⊙
- Institut d'Investigació Biomèdica de Girona Dr. Josep Trueta ○
- University of Girona ◉

# PARTNER

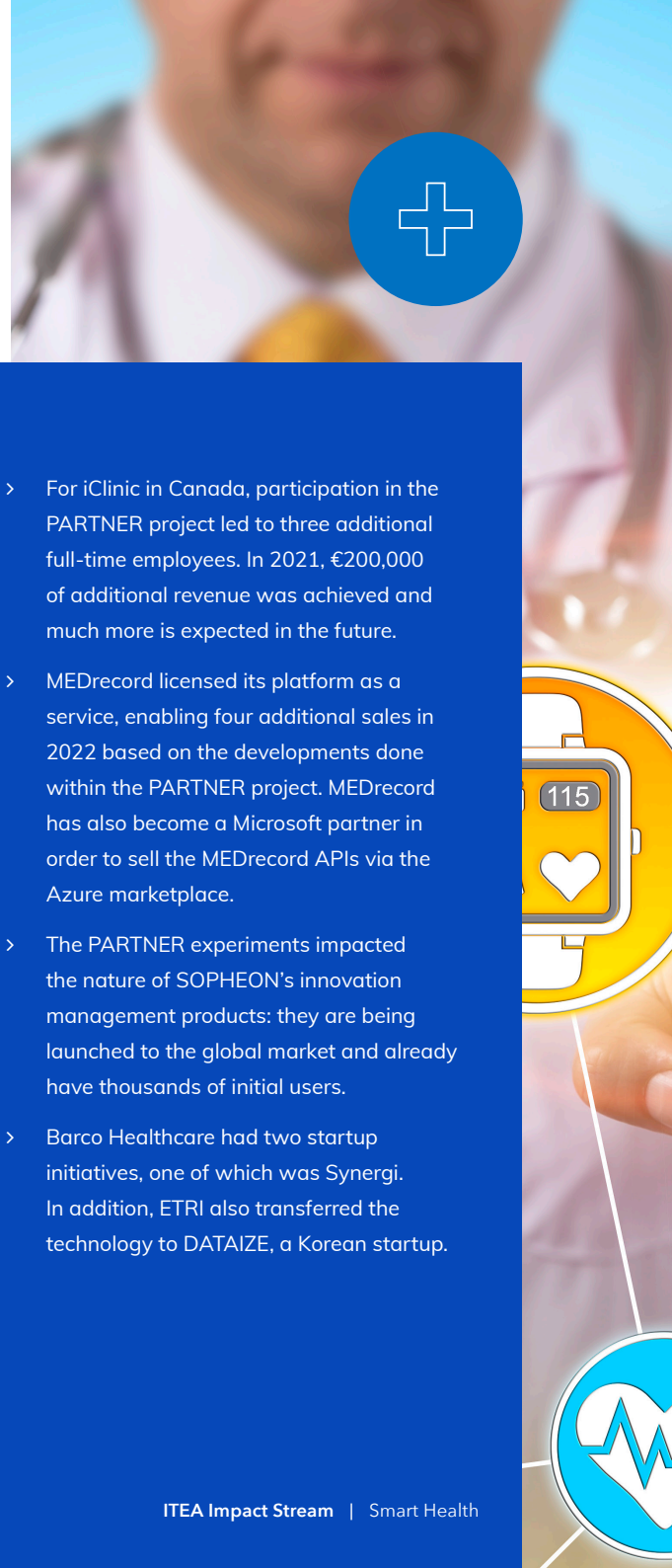
## ‘One patient, one team’ approach for hospitals

*Published December 2023*

**During a patient’s journey through the health system, his or her medical information is often stored in multiple databases focusing on specific elements of the needed care and the patient’s condition – even within one hospital. These databases generally cannot interact, which makes it impossible to draw up all information belonging to one patient at the click of a button.**

**Wearables and other compact devices that work with physiological sensors are creating a lot of possibilities to monitor patients when they are not in the hospital. Integrating this information with the hospital’s data could open up an information treasure chest that can stimulate better treatment and lower costs for both patients and hospitals.**

**The PARTNER project, gathering 20 partners from Belgium, Canada, the Netherlands and South Korea, has developed an architecture that makes it possible to let different systems, offered by multiple vendors, communicate with each other. The solution also includes these self-monitoring solutions for patients.**




## Impact highlights

- PARTNER demonstrates that a patient-centric approach with an optimised collaborative care team leads to greater efficiency – up to a 10% improvement compared to traditional workflows – and a knock-on effect of lower healthcare costs.
- For patients, the PARTNER approach should result in better health outcomes and, above all, a higher quality of life even when ill.
- The successful collaboration in PARTNER has resulted in clear commercial opportunities for the consortium; every contributor involved has released new products and services, ready to be installed in several hospitals for further trials.
- Barco’s Synergi represents a new business case and has allowed Barco to push further into the health domain. Synergi can lead to a significant improvement in the efficiency of the multi-disciplinary team meetings, as well as a significant reduction in the time between the referral of the patient and the commencement of treatment.
- For iClinic in Canada, participation in the PARTNER project led to three additional full-time employees. In 2021, €200,000 of additional revenue was achieved and much more is expected in the future.
- MEDrecord licensed its platform as a service, enabling four additional sales in 2022 based on the developments done within the PARTNER project. MEDrecord has also become a Microsoft partner in order to sell the MEDrecord APIs via the Azure marketplace.
- The PARTNER experiments impacted the nature of SOPHEON’s innovation management products: they are being launched to the global market and already have thousands of initial users.
- Barco Healthcare had two startup initiatives, one of which was Synergi. In addition, ETRI also transferred the technology to DATAIZE, a Korean startup.

## Project results

Worldwide, over 40 million people suffer from heart failure. As a global challenge requires a global solution, one of PARTNER's primary achievements has been bringing together partners from three continents.

The system created by the PARTNER project partners has been demonstrated using a fictitious patient's journey through cardiac care. The demonstration clearly showed the system's comprehensiveness: thanks to its architecture based on interoperability standards, it enabled the different partners' systems to exchange information.

## Exploitation

In addition to providing a wider reach, the international collaboration has clear commercial opportunities for the consortium. The successful participation of SME partners highlights PARTNER's role in circumventing dominance by larger companies and the resulting lock-in.

iClinic, for instance, developed the iClinic Heart Failure system during the PARTNER project and has successfully implemented the system at the Heart Failure Clinic at Vancouver General Hospital, with further deployment of the system at Kelowna General Hospital expected in Q4 2023.

MEDrecord succeeded in showcasing the (semantic) interoperability with several international partners and licensed its platform as a service, enabling four additional sales in 2022 based on the developments done within the PARTNER project.

Sopheon has brought the MS Teams integration designed in the PARTNER project to the market under the name Microsoft Connect. This application was launched as part of its Accolade 13 release and has already been sold and implemented many times at new and existing customers as a feature component of the standard offering. In addition, Sopheon has launched a series of new 'InnovationOps' products in 2022.

Next to these SME successes, the project has opened doors for large players too.

Barco's Synergi - a solution for more efficient meetings between multi-disciplinary healthcare professionals - has been used in a pilot in two hospitals in the UK and Australia, which represents a new business case and has allowed Barco to push further into the health domain. As a result of PARTNER, some Synergi components are now being used in existing products and Barco is currently working on new, innovative collaborative features for their radiology displays based on the work performed in the project.

Finally, thanks to the PARTNER Hub prototype developed by Korean partner ETRI, patients have ownership of and access to their medical data that is scattered across several hospitals. In addition, ETRI and the Korean consortium demonstrated collaboration between doctors through a medical workflow for a chronic disease patient. In addition, ETRI has developed a separate governance management system to be used for automating a wide variety of medical data processing by linking it with the PARTNER Hub.

PARTNER's maxim is 'one patient, one team'; its central philosophy is driven by dedicated, personalised patient care. This should result in better health outcomes and, above all, a higher quality of life even when ill.

# PARTNER

16017

**PROJECT LEADER**

Danny Deroo, Barco

**PROJECT START**

October 2017

**PROJECT END**

December 2020

**PROJECT WEBSITE**

https://itea4.org/project/partner.html

**PARTNERS**

*Belgium*

- Barco ●
- Hasselt University ◉
- NXP SemiConductors Belgium ●

*Canada*

- Calgary Scientific ⊙
- dapasoft ⊙
- iClinic Systems ⊙
- XCO Tech ⊙

*Republic of Korea*

- Chungbuk National University ◉
- ETRI (Electronics and Telecommunications Research Institute) ○
- eZEX corporation ⊙
- Gangnam Severance Hospital ◉
- Neighbor System ⊙

*The Netherlands*

- Academic Medical Centre Amsterdam (AMC) ◉
- Eindhoven University of Technology ◉
- Koninklijke KPN ●
- MEDrecord ⊙
- Siemens Healthcare Nederland ●
- Sopheon ⊙
- Stichting IMEC Nederland ○
- ZorgGemak ⊙



● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# STARLIT

## Aiming for ‘first-time-right’ treatment for cancer patients

*Published December 2023*

**The global incidence rate of cancer is expected to grow by 70% over the next two decades, with Radiation Therapy (RT) treatment currently recommended for 52% of new patients. Although radiation oncology has led to a drop in mortality for several cancers, the need remains to reduce side effects such as incontinence or dysphagia. The solution lies in ‘first-time-right’ treatment in which the right dose is given to the tumour while keeping the dose to healthy tissue as low as possible to prevent side effects.**

**The ITEA project STARLIT - a follow-up to the award-winning ITEA project SoRTS - gathered 14 partners from Austria, Canada, the Netherlands and Sweden and developed technology to improve treatment accuracy and minimise the unintended dose in image-guided radiation therapy. A focus area for both projects was to improve the real-time connections within a system of systems called Elekta Unity, comprising a Philips MRI scanner for imaging and an Elekta linear accelerator for radiotherapy.**

## Impact highlights

- As a result of the STARLIT project, the number of radiotherapy treatments needed for cancer patients will be reduced and so too will the related burden.
- A cancer patient can also benefit from a risk reduction of side effects as less tissue is damaged. This improves overall safety of the treatment and reduces recovery time.
- The projected annual top-line revenues for the consortium are over USD 650 million after 2020.
- Before the project, low-latency motion detection for tracking was clinically impracticable or suffered delays of over 500 ms, whereas STARLIT has created a prototype with delays of just 200 ms.
- High-resolution imaging has also seen an enormous boost thanks to STARLIT: an echo time reduction from over 100 ms to 70 ms, a 20-30% increase in signal-to-noise ratio (this ratio compares the level of a desired signal to the level of background noise) and a decrease in distortion from more than 10 mm to less than 1 mm.
- Elekta has already received over 80 orders in more than 25 countries.
- Philips had sold roughly 10,000 Compressed SENSE software licences by Q4 2022, which have been used in nearly 25 million examinations.
- Thanks to participation in STARLIT, Tesla Dynamic Coils (TDC) was able to address a new market for flexible and wearable coils which increase the comfort for the patient, especially children. They are maturing the technology to TRL 8.
- In addition to generating 19 full-time positions within the consortium, STARLIT has led to eight Master theses, one PhD thesis and four new courses at Utrecht University.

## Project results

STARLIT has improved Elekta Unity's software to speed up imaging, thereby allowing a number of intervention and monitoring processes to be carried out in real time. The STARLIT system is integrated with low-latency connections, causing minimal delay in the processing of computer data, and a feedback loop, allowing for real-time adaption of treatment based on separate monitoring processes. These verify that the delivered dose and the position of the tumour are correct.

The project's main focus was technical feasibility, which resulted in several very successful outcomes. Thanks to these strong technical improvements, physicians can benefit from higher confidence and control of treatment delivery and potentially reduce margins while the patient, as a result of margin reductions, can potentially benefit from a risk reduction of side effects.

As reported in a press release by Elekta, in December 2022, a milestone was reached in radiation therapy as the first patients completed their full course of radiation therapy treatment with Elekta Unity using Comprehensive Motion Management (CMM) with True Tracking and automatic gating functionalities. Based on initial results, there is great potential in using Unity's CMM functionality to treat abdominal cancers, lung tumours, prostate tumours – wherever there is motion, regardless of the cause.

## Exploitation

The STARLIT partners show a real complementarity in their collaboration, in which the SMEs involved have a unique role as the creators of additional products that improve STARLIT's efficiency. For example, IT-V Medizintechnik from Austria created the Head & NeckSTEP M and the HeadSTEP MRL PushPIN, respectively the only head and neck positioning devices for iCAST and PushPIN masks officially certified for use with Elekta Unity.
Tesla Dynamic Coils (TDC) from the Netherlands developed a head-and-neck coil for the Elekta Unity system. The outcome was a radiolucent flexible coil that demonstrated a threefold increase in signal-to-noise ratio (the quality indicator of MR images) compared to the traditional coil in the Elekta Unity.
Modus QA from Canada contributed to quality assurance during project testing with the Quasar MRI⁴D Motion Phantom, which is the world's first MR-safe programmable motion phantom. The 4D motion phantom has a patented deformable tumour target, reduces measurement latency from over 50 ms to roughly 500 µs and improves target position precision from 1 mm to 0.25 mm.
Quantib from the Netherlands developed and improved upon its Visual Scoring Tool, which has played an important role in image quality assessment for Quantib's current line of products, including those for brain and prostate MRI.
In addition, Philips had sold roughly 10,000 Compressed SENSE software licences by Q4 2022, which have been used in nearly 25 million examinations and Elekta has already received over 80 orders from more than 25 countries.

Promising uptake paves the way for STARLIT's most important result: improved quality of life for patients, who currently go through the radiation procedure up to 20 times. Higher doses with greater accuracy could reduce this to two or three times – perhaps even just once. This means less travel to hospital and potentially fewer side effects.

# STARLIT

16016

**PROJECT LEADER**

Frank van der Linden, Philips

**PROJECT START**

October 2017

**PROJECT END**

September 2020

**PROJECT WEBSITE**

https://itea4.org/project/starlit.html

**PARTNERS**

*Austria*
- IT-V Medizintechnik ⊙

*Canada*
- Elekta ⊙
- Modus Medical Devices ⊙

*The Netherlands*
- MR CODE ⊙
- MR Coils ⊙
- Nucletron Operations ⊙
- Philips Electronics Nederland ●
- Quantib ⊙
- Tesla Dynamic Coils ⊙
- the Netherlands Cancer Institute ○
- UMC Utrecht ○

*Sweden*
- Akademiska university hospital ◉
- C-RAD ⊙
- Elekta Instrument ●



● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# SoRTS

## A system of real-time systems for more effective healthcare

*Published September 2018*

**While there have been considerable advances in recent years in the oncological and radiotherapy treatment of cancer, a major challenge still faced by image-guided intervention and treatment is the availability of coupled real-time feedback of the imaging and therapy systems during interventions. The goal of the SoRTS project was to develop a System of Real-Time Systems to support healthcare professionals in the transition from invasive, open surgery to minimally invasive, image-guided intervention and treatment (IGIT). The outcome not only significantly lowers healthcare costs through shorter hospital stays and higher throughput, but it also boosts the productivity and effectiveness of cancer treatment and reduces patient risk.**

## Impact highlights

- With the key innovations from the SoRTS project, Philips MRI will sell 50-100 systems in Europe in a new market, meaning an addition of more than 5% to the present MRI market of €4.5 billion.
- For Elekta, the results from the SoRTS project represent an order opportunity of over USD 700 million until 2019. As of April 2018, Elekta began installing 18 high-field MR-adaptive linear accelerator systems - Elekta Unity - worldwide. The target is to generate orders for 75 systems before the end of 2019.
- On 19 May 2017, less than six months after the end of the SoRTS project, the University Medical Centre (UMC) Utrecht treated the first patient as part of a clinical study with Elekta Unity.
- Based on the SoRTS results, Technolution released its SigmaXG product platform for video switching over standard IP infrastructure successfully to the market through its partners/resellers. An exploitation example: the Erasmus MC university hospital in Rotterdam has selected Technolution partner Inter Visual Systems' Sensumed platform for 26 new operating theatres in its building. The operating theatres will be equipped with Advantech displays, with integrated SigmaXG NDcoders.

## Project results

Essentially, the problem is that the movement of a tumour under the effect of respiration, for instance, risks damaging surrounding tissue during treatment. The only imaging modality that can visualise the tumour well, MRI, traditionally has image creation times of minutes. SoRTS came up with a solution to this problem in the shape of the MR-linac system (Magnetic Resonance Imaging - Linear Accelerator), which is designed to improve the targeting of tumour tissue while reducing the exposure of healthy tissue to radiation, allowing physicians to precisely target a tumour, even when tumour tissue changes shape, location, size or composition during treatment. The successful technological solution, real-time coupling of imaging and treatment systems, was built on the collaborative power of consortium partners in the value chain for state-of-the-art IGIT and was demonstrated in 3 use cases. The Magnetic Resonance Imaging (MRI) imaging systems of Philips, for example, are made suitable for low latency real-time feedback during image-guided interventions while therapy systems, like brachytherapy, linear accelerator (Linac) and high-intensity focused ultrasound (HIFU), as provided by Nucletron, Elekta, Philips Finland and UMCU, can destroy malignant tissue via a minimally invasive or non-invasive method. UMC Utrecht developed and optimised clinical procedures to determine the most effective and efficient way of using automated image guided interventional systems, validating such procedures in several radiotherapy applications. Finally, a Real-time Therapeutic Procedure Supervisor was developed. This integrated image-controlled therapy by independent systems allows the deployment of algorithms specific to needs of any partner in the chain, without the need to upgrade or replace individual systems.

## Exploitation

The SoRTS project has provided state-of-the-art technology to Philips MR diagnostic systems and allows the exploitation of real-time motion correction. The innovations provide Philips with a competitive edge creating a higher market share. Based on SoRTS results, **Philips** released a new MR clinical application in 2017: Compressed SENSE, an acceleration technique that can accelerate all routine 2D and 3D clinical MR applications by up to 50% with virtually equivalent image quality. Compressed SENSE is also featured in Philips' new 3.0T MR solution, Ingenia Elition, announced in March 2018. The Ingenia Elition helps clinicians perform MRI exams up to 50% faster, with no compromise in image quality. In 2017, Royal Philips has made an agreement to transfer its MR-guided, high-intensity focused ultrasound (MR-HIFU) business to Profound Medical, in which it has obtained a minority interest.

One of the key outcomes for **Elekta** was the MR-linac system, commercially introduced as the Elekta Unity. It is the only MR/RT system that integrates a premium quality (1.5 Tesla) MR scanner, from MR technology partner Philips, with an advanced linear accelerator and intelligently designed software. As of April 2018, Elekta began installing 18 high-field MR-adaptive linear accelerator (MR-linac) systems worldwide and the system received the CE label in June 2018. Furthermore, in 2018, Elekta won the iF Design Award, a world-renowned design prize, for Elekta Unity.

In May 2017, the **University Medical Centre Utrecht** treated the first patient as part of a clinical study with Elekta Unity. Following this first clinical study, more patients, e.g. with lumbar spinal bone metastases, were treated.

Technology integrator **Technolution** benefited from its participation in SoRTS by improving its core business in providing solutions for real-time multi-core hardware for medical and for non-medical applications.

# SoRTS

12026

**PROJECT LEADER**

Frank van der Linden, Philips

**PROJECT START**

July 2014

**PROJECT END**

December 2016

**PROJECT WEBSITE**

https://itea4.org/project/sorts.html

**PARTNERS**

*Finland*

Philips Healthcare ◉

*The Netherlands*

Nucletron Operations BV ⊙
Philips Medical Systems Nederland B.V. ◉
Technolution ⊙
Utrecht University Medical Center (UMC) ◉

*Sweden*

Elekta ◉



◉ (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# APPSTACLE

## Vehicle connectivity for novel applications

*Published October 2022*

**In the automotive domain, there is an increasing demand for software related to services like location, media and driving assistance. Although high-end cars now contain hundreds of millions of lines of code, development takes place in silos belonging to each manufacturer or OEM. To meet consumer needs at this high level of complexity while avoiding 'walled' proprietary solutions from a few monopoly players, a secure, open car-to-cloud and cloud-to-car platform is needed.**

**The ITEA project APPSTACLE, hosted at the Eclipse Foundation and gathering 21 partners from Finland, Germany, the Netherlands and Turkey, has created such a platform, connecting cars and transportation vehicles to the cloud using hybrid communication technologies for V2X (vehicle-to-everything) communication. Eclipse facilities have been used to build an open ecosystem in which security, privacy and identity requirements can be met, allowing the platform to be used in a wide range of vehicles.**

## Impact highlights

- In November 2019, APPSTACLE has launched the first release of the Eclipse KUKSA platform that unifies the technologies across the vehicle, IoT, cloud and security domains to provide an open-source ecosystem to developers which addresses the challenges of the electrified and connected vehicle era.
- KUKSA shows large companies that there is more to be gained from sharing data than from protecting it within proprietary solutions. As more vehicles become connected, more applications and services will emerge. Companies can therefore enhance the business domain while increasing the size of their own share.
- In the research and education domain, KUKSA is currently shaping itself towards a de facto mobility research platform for managing data around transport, smart mobility and vehicle, driver & passenger data-intensive use-cases.
- APPSTACLE has so far played a role in 10 Masters of Science and 14 PhDs across Europe. KUKSA also has an important role as a platform for live demonstrations and university student exercises around software-defined vehicle concepts and technologies around cloud & edge computing and continuous/secure software deployments in the automotive domain.
- Ericsson has been using the knowledge and relations resulting from APPSTACLE for their software R&D transformation to open-source software. A separate Ericsson-owned open-source software development company has been established in Finland, which is one of their first subsidiaries.

## Project results

As a vehicle-to-cloud ecosystem, the APPSTACLE project has enabled the vehicle connectivity infrastructure and added functionalities to connect to an open-source environment for developing, deploying, maintaining and monitoring in-vehicle applications.

For vehicles without in-built connectivity, an open-source dongle (hardware) can be used to access the vehicle data. Data on aspects such as speed, temperature and driver behaviour can be fed to the outside world, where it can be applied in new and existing market sectors.

Additionally, the consortium has adopted an ontology standard, Vehicle Signal Specification (https://covesa.github.io/vehicle_signal_specification/), which enables the interoperability of the implementations between vehicle manufacturers and unified data models for in-vehicle signals and data-intensive application development.

The APPSTACLE project provided 15 demonstrators involving various vehicle-centric use-cases.

## Exploitation

On 30 November 2019, the project announced the first release of the Eclipse KUKSA platform that unified the technologies across the vehicle, IoT, cloud and security domains to provide an open-source ecosystem to developers which addresses the challenges of the electrified and connected vehicle era. The platform is supported by an integrated development environment as well as an app store where device owners can select and install applications.

Eclipse KUKSA is an open-source platform and is available for download from the website https://www.eclipse.org/kuksa/. KUKSA is continuously being updated to support changes to the Vehicle Signal Specification (VSS), an industry-wide effort between OEMs, TIER 1 and other suppliers to standardise vehicle data. By continuously providing VSS-compliant software components, KUKSA continues the vision of APPSTACLE to provide open standards and implementations for connected car ecosystems.

Besides software, APPSTACLE also created open-source hardware that can be connected directly to the diagnostics port of a vehicle. It allows even better access to vehicles and enables low-cost entry to the development of in-vehicle applications and work with in-vehicle data.

Additionally, Eclipse KUKSA is offering non-manufacturing companies in the automotive domain the opportunity to access new markets and business models, such as allowing rental companies to track the status of their vehicles.

Academic dissemination is another key result of the project. Next to playing a strong role in 10 Masters of Science and 14 PhDs across Europe, the consortium has also organised three Eclipse KUKSA-related courses and summer schools which were attended by around 150 students in total. KUKSA should therefore become an asset in teaching and research for automotive IoT end-to-end frameworks.

Since 2022, Eclipse KUKSA is put into a bigger context by integrating its results into the newly formed Eclipse Software Defined Vehicle Working Group, a joint effort by 27 partners from the automotive industry who join forces to build an open technology platform for the software-defined vehicle of the future. KUKSA's role here and its impact on driving the COVESA VSS standard was highlighted at events such as the EclipseCon 2022 and the Bosch Connected World 2022, the leading industry conference on AIoT and digital transformation.

In the long run, Eclipse KUKSA will make disruptive changes to the automotive value chain. One aspect is the emergence of new forms of connectivity: street infrastructure hold the potential to become information base stations to enable data processing near to the car rather than in the cloud.

# APPSTACLE

15017

**PROJECT LEADER**

Matti Frisk, Ericsson

**PROJECT START**

October 2016

**PROJECT END**

December 2019

**PROJECT WEBSITE**

https://itea4.org/project/appstacle.html

**PARTNERS**

| *Germany* | | *Finland* | | *The Netherlands* | | *Turkey* | |
|---|---|---|---|---|---|---|---|
| BHTC | ● | Ericsson | ● | Eindhoven University of Technology | ◉ | KoçSistem | ● |
| Bosch.IO | ● | Haltian | ⊙ | Forescout Technologies | ● | Netas Telekomunikasyon | ● |
| Dortmund University of Applied Sciences and Arts | ◉ | Link Motion | ⊙ | NXP Semiconductors | ● | Otokar Otomotiv ve Savunma Sanayi | ● |
| Eclipse Foundation Europe | ⊙ | Tieto Finland | ● | Technolution | ⊙ | | |
| Expleo Germany | ● | University of Oulu | ◉ | | | | |
| Fraunhofer IEM | ○ | | | | | | |
| Robert Bosch | ● | | | | | | |
| taskit | ⊙ | | | | | | |
| University of Paderborn | ◉ | | | | | | |

● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

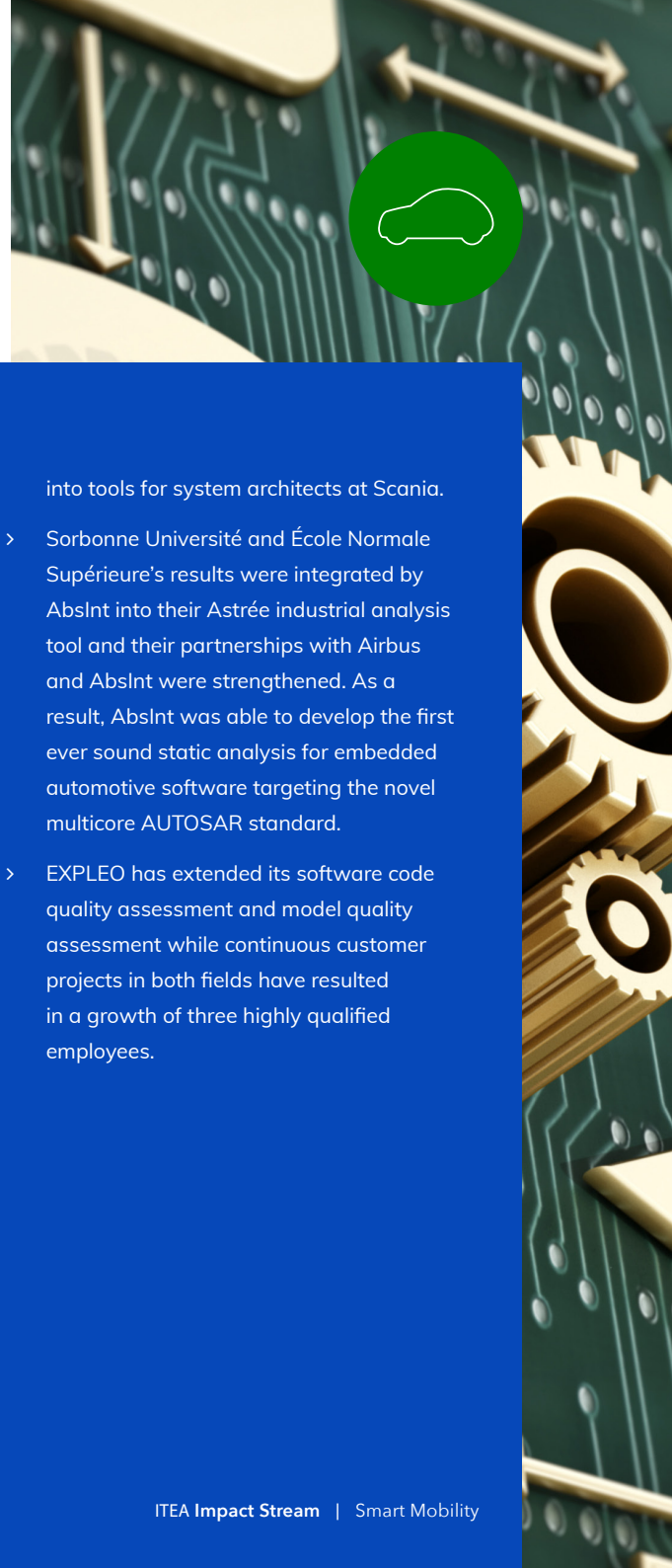
# ASSUME

## Reducing bugs and false errors to boost efficiency

*Published October 2021*

**Mobility is one of today's key societal challenges and is impacted by a huge array of factors, including global warming, restrictions in the energy supply, an ageing population and security concerns. Fortunately, autonomous systems can play an important role in tackling all of these issues due to the possibilities for increased safety, reduced fuel consumption and emissions and social inclusion for the elderly or disabled.**

**An inherent problem, however, is the excessive amount of time taken by tools to find bugs and false errors in autonomous systems. For instance, tools using abstract interpretation to prove the absence of runtime defects typically cease to be useful above 200-300,000 lines of code (depending on the programming features and complexity), while model checking techniques are currently limited to much smaller code sizes. This is the challenge that the ASSUME consortium of 38 partners from 5 countries set out to meet from September 2015 to December 2018.**



## Impact highlights

- ASSUME has enabled the use of results between different tools including:
  - a 50% increase in the (run-time) performance of analysis tools
  - a 60% reduction of spurious warnings in analysis tools for single cores
  - an almost 100% reduction of error classes in single core analysis
  - an 80% or more success rate of traceability of run-time errors back to the model level
  - a 40% cut in efforts to inspect runtime errors in a typical industrial setting
- In Bosch, the methods developed in ASSUME are now routinely used for large software products with more than two million lines of code. Furthermore, the methods and tools are being applied in several other business units of Bosch, which can now use formal methods efficiently in real projects.
- FindOut was able to hire two consultants for three years to develop a suite of visualisations for electrical systems, message passing structures and software structures which has now been integrated into tools for system architects at Scania.
- Sorbonne Université and École Normale Supérieure's results were integrated by AbsInt into their Astrée industrial analysis tool and their partnerships with Airbus and AbsInt were strengthened. As a result, AbsInt was able to develop the first ever sound static analysis for embedded automotive software targeting the novel multicore AUTOSAR standard.
- EXPLEO has extended its software code quality assessment and model quality assessment while continuous customer projects in both fields have resulted in a growth of three highly qualified employees.

## Project results

In a nutshell, ASSUME's main goal was to enable the affordable, standard-compliant development and verification of highly automated, safety-relevant and performance-critical mobility systems. A strong focus on development methods for concurrent systems and static verification techniques allows for the cost-effective proof of the absence of problems, even in a multi-core environment. The major field of innovation for the project's industrial partners (end-users) was model-based parallel software engineering for multi- and many-core processors. By improving their existing tools and developing new ones, ASSUME ultimately enabled the effective use of formal verification and synthesis technology along the design flow.

## Exploitation

The ASSUME partners have seen successes in terms of technical output, commercial results and ongoing collaboration. Bosch, for example, worked with several ASSUME partners to develop new methods and tools for the sequential verification of very large embedded software. Through several Bosch use-cases, these lead to a threefold decrease in the time taken for verification, a reduction of the memory footprint by a factor of three and a reduction of the number of false warnings by a factor of up to ten.
BTC ES, MES, Daimler and OFFIS set up a collaborative toolchain for model-based, requirement-driven development which integrates the industrial tools of BTC ES and MES with an OFFIS research prototype. In an industrial use-case provided by Daimler, it has been shown that this can reduce the effort for safety verification while improving requirement traceability.

The main activities of the Swedish consortium were focused on allowing seamless traceability and impact analysis of functional and safety properties for Scania's development environments alongside SME FindOut. The collaborations initiated in the project are still running at several levels. A KTH senior researcher for instance, has been working part-time as an external consultant for Scania's R&D team on technologies initially developed within ASSUME – a great example of knowledge transfers from academia to industry. Cross-academic links also had a crucial role to play in ASSUME. For example, Sorbonne Université and École Normale Supérieure developed new models and abstractions that account for the weak consistency memories of multicore systems, the detection of deadlocks and the real-time scheduling policies used in multicore embedded software systems. This produced both theoretical results and proof-of-concept implementations.

ASSUME made TU/e aware of both the importance and the costs of fault-resistance, especially in the automotive domain and for space-critical operations. The developed advanced analysis techniques have been consolidated into the publicly-available SDF3 (SDF For Free) toolset and the open-source tool LSAT and have been used in collaboration with ASSUME and other partners.
Thanks to newly developed or improved tools, ASSUME enabled KoçSistem to open up a commercial revenue stream with Ford Otosan, and start a new, local R&D project based on automotive manufacturing processes and two additional ITEA projects, XIVT and PANORAMA.

Around 700 developers currently use one or more tools developed in ASSUME and this number is set to grow, helping society as a whole to make a smooth transition to mobility which is sustainable, affordable and inclusive for all.

# ASSUME

14014

**PROJECT LEADER**

Dumitru Potop Butucaru, INRIA

**PROJECT START**

September 2015

**PROJECT END**

December 2018

**PROJECT WEBSITE**

https://itea4.org/project/assume.html

**PARTNERS**

*France*
- Airbus Operations ●
- École Normale Supérieure (ENS) ◉
- Esterel Technologies ⊙
- INRIA ○
- Kalray ⊙
- Safran Aircraft Engines SAS SNECMA ●
- Safran Electronics & Defense Sagem ⊙
- Sorbonne Université ◉
- Thales ●

*Germany*
- AbsInt Angewandte Informatik ⊙
- BTC Embedded Systems ⊙
- Daimler ●
- Expleo Germany ●
- FZI Forschungszentrum Informatik ○
- Karlsruhe Institute of Technology ⊙
- Kiel University ◉
- Model Engineering Solutions ⊙
- OFFIS ○
- Robert Bosch ●
- Technische Universität München ◉

*The Netherlands*
- Eindhoven University of Technology ◉
- NXP Semiconductors Netherlands ●
- Recore Systems ⊙
- TNO ○
- University of Twente ◉
- VDL Enabling Transport Solutions ●
- Verum Software Tools ⊙

*Sweden*
- Arcticus Systems ⊙
- FindOut Technologies ⊙
- KTH (Royal Institute of Technology) ◉
- Mälardalen University ◉
- Scania ●

*Turkey*
- Arcelik ●
- Ericsson ●
- Ford Otosan ●
- Havelsan ●
- KoçSistem ●
- UNIT Information Technologies R&D ⊙

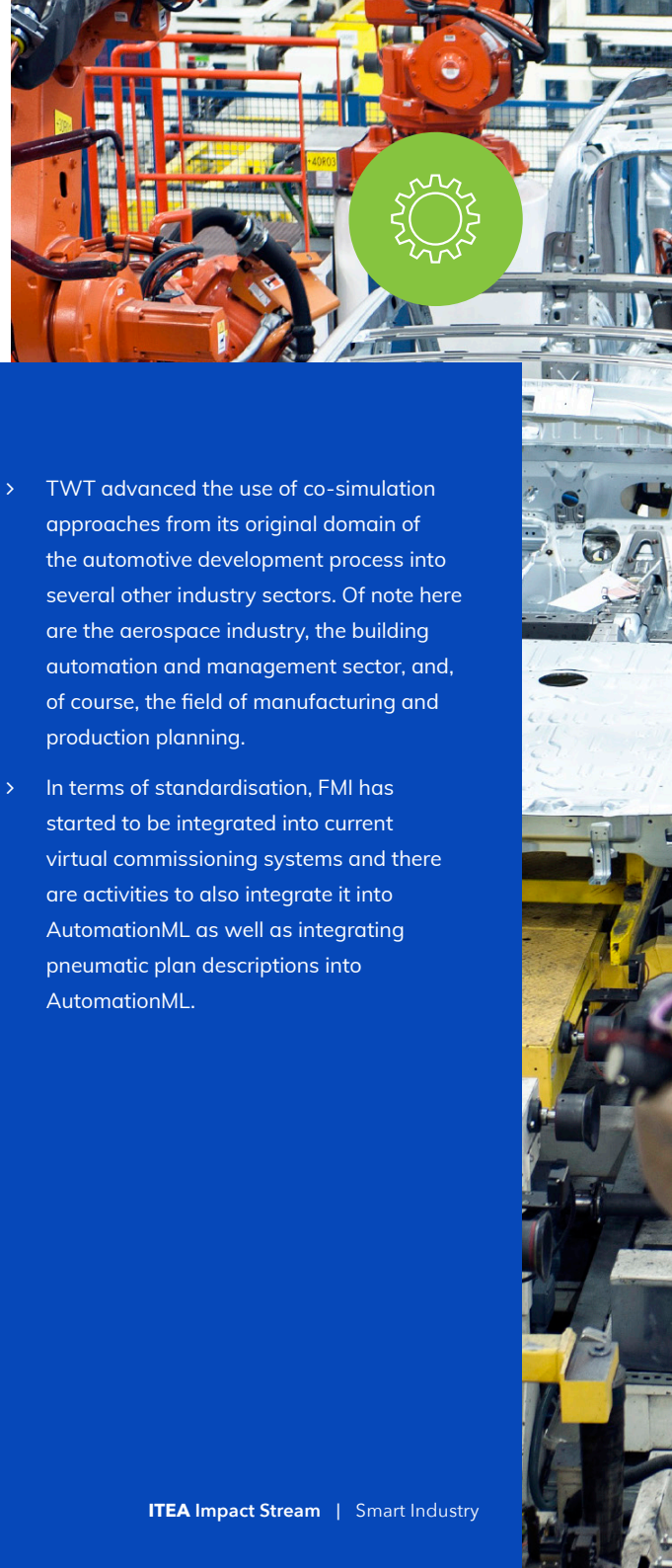
● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# AVANTI

## Virtual commissioning test methodology gets a competitive edge

*Published September 2017*

**European industry's need for flexible production system design, optimised time to market and extremely high product quality provided the background for the ITEA 2 project AVANTI. The goal was to develop a virtual commissioning test methodology based on behaviour simulation of production systems to enable leading European OEMs, component and tool providers to gain a competitive edge. The project's two key innovations were: (1) virtualisation of the testing process for industrial production lines and (2) the combination of different models and tools for simulating production to create and perform tests for virtual commissioning and industrial application.**



## Impact highlights

- In all application domains, the project resulted in an efficiency improvement of 25-30 % in production preparation:
  - Moventas – windmill gearboxes: significant reduction of the months-long gearbox testing process
  - Arcelik – transportation systems for white goods: decreasing the number of stops of trolleys during line commissioning through preceding simulations
  - Daimler – Production equipment for automotive final assembly: Reducing time for virtual commissioning of automated assembly stations through automated testing and more efficient simulation models
- Already at the final review of the project, Daimler had several persons working with the tools from the project, together with even more people at their European suppliers.
- The growth of EKS InTec in the field of digital innovation, from 15 employees (September 2013) to 45 employees (June 2017) was partly based on their participation in AVANTI.
- TWT advanced the use of co-simulation approaches from its original domain of the automotive development process into several other industry sectors. Of note here are the aerospace industry, the building automation and management sector, and, of course, the field of manufacturing and production planning.
- In terms of standardisation, FMI has started to be integrated into current virtual commissioning systems and there are activities to also integrate it into AutomationML as well as integrating pneumatic plan descriptions into AutomationML.

## Project results

AVANTI has been at the heart of novel developments in co-simulation or distributed simulation in which the Functional Mock-up Interface (FMI) standard is a common approach. Standardising automation and using functional mock-up interfaces enables better product distribution channels and easy use of standard software, thereby reducing the effort needed to create complex simulation models.

A project result highlight was the collaboration of TWT and EKS InTec to design, specify, implement, and test a co-simulation framework. This framework facilitates co-simulation of mechatronic components of production systems. At its core lies a fast and lightweight FMI-based co-simulation alleviating the integration of co-simulation approaches into existing processes. This performance-based, versatile and scalable simulation approach allows multi-domain simulation based on functional mock-up units, the integration of open or black-box component models, protection of Intellectual Property and easy integration into existing Virtual Commissioning tool chains.

Three OEM use cases from different industrial sectors demonstrated the results: Daimler (Germany) in automotive assembly, Arcelik (Turkey) in the production of white goods and Moventas (Finland) for windmill gearbox production and testing.

## Exploitation

The AVANTI project generated a set of impressive exploitable results. Daimler, Moventas and Arcelik are using the developed tools in their virtual testing and commissioning process chain. TWT, EKS InTec and KaTron are in the process of marketing the developed exploitable results.

Moventas introduced a process simulation tool for gearboxes. They target a virtual prototyping tool to optimise efficiency of the gearbox of wind turbines thereby reducing testing time and optimising energy production.

EKS InTec introduced a virtual commissioning test generation and execution tool for users in the manufacturing sector. This tool automatically generates detailed test cases, performs test cases and provides a detailed overview of the results of test cases performed. TWT introduced the fast and lightweight co-simulation framework mentioned above to its industrial customers and partners. It supports FMI-based co-simulation, it facilitates integration of simulation approaches into existing process chains, and connects to virtually every modelling and simulation software.

In the white goods manufacturing domain the Turkish partners Arcelik and Katron wanted to reduce the number of stops of trolleys due to collision during line commission. KaTron introduced the AVANTI virtual commissioning simulator (AVICS), a tool to provide a generic framework for physics-based 3d simulation.

# AVANTI

12035

**PROJECT LEADER**

Thomas Bär, Daimler AG

**PROJECT START**

November 2013

**PROJECT END**

June 2016

**PROJECT WEBSITE**

www.avanti-project.de

**PARTNERS**

*Finland*

- Moventas Gears Oy ◉
- Lappeenranta University of Technology ◉

*Germany*

- Daimler AG ◉
- EKS InTec GmbH ⊙
- Festo AG & Co. AG ◉
- ifak ○
- tarakos GmbH ⊙
- TWT GmbH Science & Innovation ◉

*Turkey*

- Arcelik A.S. ◉
- KaTron Defence AeroSpace and Simulation Technologies Inc ◉



◉ (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

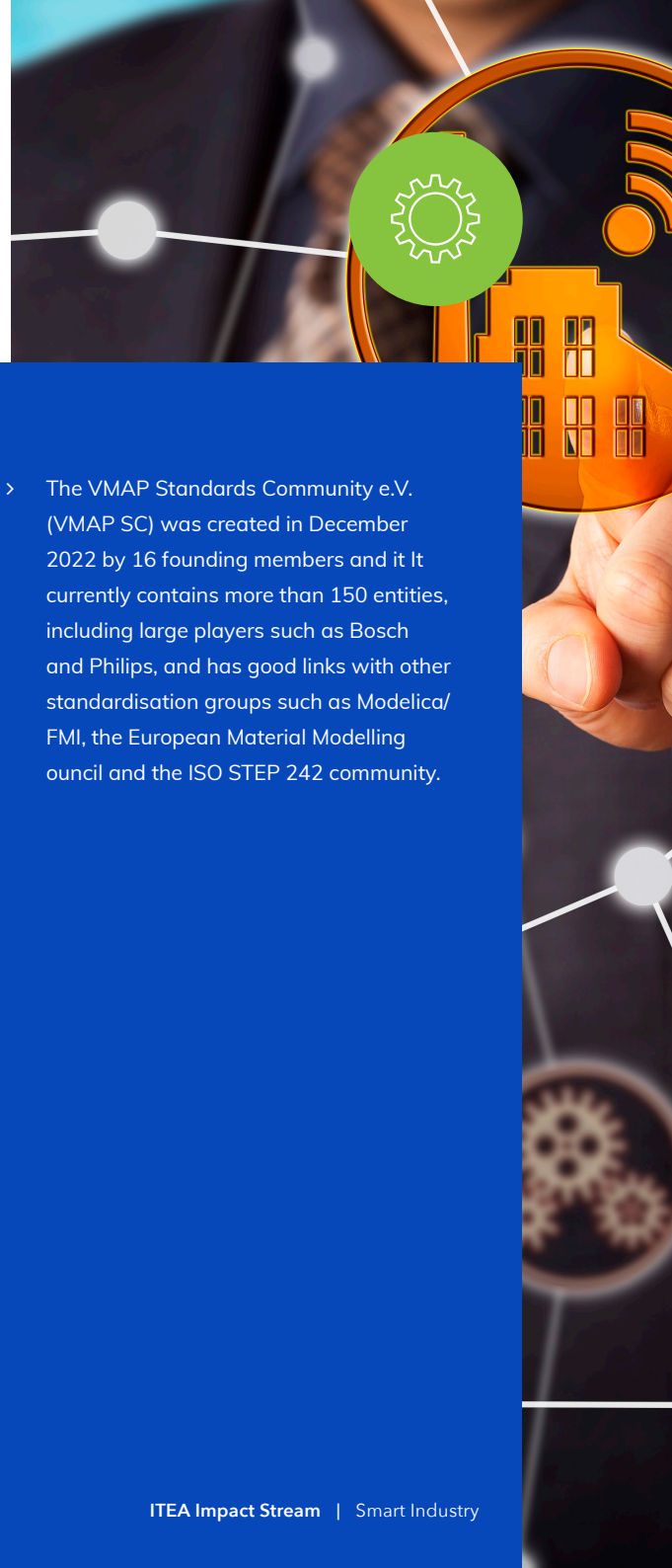
# VMAP

## Enhancing interoperability in virtual engineering workflows

*Published December 2023*

**A wide range of computer-aided engineering (CAE) software tools already enables virtual material and product design, virtual manufacturing and machining process parameterisation, and virtual product testing of high-tech materials. However, these tools are rarely interoperable and contain multiple native formats for storing the CAE data to be transferred between simulation codes, such as geometrical discretisation, simulation results and metadata. The ability to carry forward result data from one simulation step to another in a CAE software workflow has therefore always been dependent on customised data transfer solutions, which require a huge effort in terms of time and money.**

**The goal of the ITEA project VMAP, which ran from September 2017 until October 2021 with 29 industrial and academic partners from Austria, Belgium, Canada, Germany, the Netherlands and Switzerland, was to gain common understanding and interoperable definitions for the modelling of materials and manufacturing processes and to generate universal concepts and open software interface specifications for the exchange of simulation results information in CAE workflows.**



## Impact highlights

- The VMAP project has created the world's first CAE workflow interface standard for integrating multi-disciplinary and multi-software simulation processes in the manufacturing industry. This standard is vendor-neutral, cost-free and completely open. The first public version of the standard was announced by the VMAP project in January 2020, before the end of the project.
- As a result of VMAP, Philips boosted the innovation speed of highly complex parts by almost 50%.
- The time spent on strength assessments in the moulding of plastic parts by RIKUTEC Richter Kunststofftechnik in Germany has been reduced by 42%.
- The set-up time for virtual process chains for lightweight automotive components with composites within a prominent German car manufacturer fell by 40%.
- The VMAP Standards Community e.V. (VMAP SC) was created in December 2022 by 16 founding members and it It currently contains more than 150 entities, including large players such as Bosch and Philips, and has good links with other standardisation groups such as Modelica/ FMI, the European Material Modelling ouncil and the ISO STEP 242 community.

## Project results

The VMAP project has created the world's first CAE workflow interface standard for integrating multi-disciplinary and multi-software simulation processes in the manufacturing industry and its major result is simple: setting up and adapting workflows in computer-aided engineering is now quicker, easier and more cost-effective than ever before. Thanks to the VMAP results, innovation speed can be increased up to 50%, the time spent on quality assessments can be reduced by more than 40% and the time needed for setting up vitual process chains can be reduced by 40%. In addition, VMAP significantly contributes to automation in highly interdisciplinary design processes as it seamlessly integrates into the respective tool chains. By eliminating the need for customised solutions, delays caused by human errors are also greatly reduced.

These examples clearly show that the introduction and use of format and interface standards increases software interoperability. Consequently, VMAP leads to significant savings in the creation and adaptation of process flows in virtual engineering. These reduced time expenditures and the increased flexibility in virtual design can therefore help to increase the innovative strength of a company even in the short term.

The VMAP IO Library, which is provided free of charge, also enables software owners to adapt their own codes to this new standard with little effort and thus make them compatible with a growing number of other simulation tools.

## Exploitation

As a standard is only as strong as its users, the VMAP Standards Community e.V. (VMAP SC) was created in December 2022 by 16 founding members, including several partners that were attracted from outside of the consortium, with the purpose of disseminating the VMAP standard, further developing it and ensuring and maintaining a uniform interface development library. It currently contains more than 150 entities.

The current standardisation activities of the VMAP SC focus on the extension to support complete calculation models in the standard so that input parameters and load cases for simulation models will soon be able to be stored neutrally and uniformly for as many simulation tools as possible.

Another focus is the consideration of real data from sensors and measurements, which are needed for the evaluation and validation of the virtual calculation models. More information about this can be found in the follow-up ITEA project VMAP analytics.

VMAP is the first-ever CAE workflow interface standard. One of its biggest strengths is therefore its rich potential, which the community seeks to exploit by extending the standard into technical domains beyond simulation for manufacturing parts. VMAP thus represents the tip of the iceberg: as the number of organisations involved in the community increases, so too will the number of engineering domains which can benefit from the faster processes and lower costs of CAE interoperability. ITEA is supporting the further development of this standard (through follow-up ITEA projects) to create a new 'string of pearls' – successes that have laid the foundations for ITEA to be just as, if not more, successful in the future in a number of key domains.

# VMAP

16010

**PROJECT LEADER**

Klaus Wolf, Fraunhofer SCAI

**PROJECT START**

September 2017

**PROJECT END**

October 2020

**PROJECT WEBSITE**

https://itea4.org/project/vmap.html

**PARTNERS**

*Austria*
- 4a engineering ⊙
- Wittmann Battenfeld ●

*Belgium*
- MSC Software Belgium ●

*Canada*
- Convergent Manufacuring Technologies ⊙

*Germany*
- Audi ●
- Dr. Reinold Hagen Stiftung ⊙
- DYNAmore ⊙
- EDAG Engineering ●
- ESI Software Germany ●
- Fraunhofer SCAI ○
- Hagen Engineering ⊙
- inuTech ⊙
- Karlsruhe Institute of Technology ◉
- Kautex Maschinenbau ⊙
- NAFEMS Deutschland, Österreich, Schweiz ⊙
- RIKUTEC Richter Kunststofftechnik ⊙
- Robert Bosch ●
- Simcon kunststofftechnische Software ⊙

*The Netherlands*
- Delft University of Technology ◉
- DevControl ⊙
- In Summa Innovation ⊙
- KE-works ⊙
- Materials innovation institute M2i ⊙
- MSC Software Benelux ●
- Philips Electronics Nederland ●
- Reden ⊙
- University of Groningen ◉

*Switzerland*
- BETA CAE Systems International ●
- Sintratec ⊙

● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# ACOSAR

## An innovative simulation that saves time and money

*Published December 2020*

**The development of vehicles has become increasingly complex, involving over 50 different suppliers who need to ensure that all components, parts and devices work together. Modelling and simulation represent key methods for a successful development. To facilitate this, the introduction of co-simulation methodologies and the interoperability of simulation tools and infrastructure had already taken root. But there was no standardised way of integrating distributed simulation and test environments back in 2015. So there was still room to enhance the process.**

**In the ACOSAR project, 16 partners came together under the lead of Virtual Vehicle Research GmbH in order to accelerate development steps with new simulation technologies. With a strong focus on the automotive domain, the consortium's members operated on all levels of the automotive supply chain and included original equipment manufacturers (OEMs), suppliers, software tool and real-time system vendors, as well as research and academic partners.**

## Impact highlights

- Since July 2018, the main and sustainable project outcome, the Distributed Co-simulation Protocol (DCP), is developed as a Modelica Association Project (MAP) and is available as an open-access international standard.
- Competitors and non-funded partners collaborated in this project because of its importance.
- International technology leaders such as AVL, Volkswagen and Boeing are already applying this solution.
- A prominent German sports car manufacturer reports over 13,000 developer days which could be saved in the next five years thanks to this developed protocol – which corresponds to a value of around five to seven million euros.

  This prominent German sports car manufacturer represents less than 1% of the market share of car manufacturers, thus this clearly shows the huge impact the ACOSAR project results can have in the automotive domain.
- The international partner network of Virtual Vehicle Research GmbH now consists of 30 national and 50 international industrial partners (OEMs, Tier 1 and Tier 2 suppliers as well as software providers) as well as 18 national and 30 international scientific institutions.

## Project results

Early predictions and correspondingly early design decisions are key success factors in modern development processes. With the aid of co-simulation, diverse simulation models can be linked together to enable overall system analysis at a very early stage of development (‘front loading’). Within the virtual system development, front loading is getting more and more important in a plenitude of industrial domains to reduce development times, stranded costs and time-to-market. Co-simulation is a particularly promising approach for interoperable modular development. However, the coupling and integration of real-time systems into simulation environments (especially of systems of distributed Hardwarein- the-Loop (HiL) systems and simulations) still require enormous effort. ACOSAR developed both a non-proprietary ‘Distributed Co-simulation Protocol’ (DCP) for Real-Time (RT) System integration and a corresponding integration methodology, which is a substantial contribution to the international standardisation (Modelica Association Project DCP - MAP DCP).

## Exploitation

Transfer of results into standardisation was one of the key goals of ACOSAR. In the final year of the project, the consortium members therefore decided to pursue standardisation of the DCP with the Modelica Association. Since July 2018, the DCP has been developed as a Modelica Association Project (MAP). The DCP specification document 1.0 was released in March 2019, as an open-access Modelica Association standard. The DCP complements an existing set of standards for system simulation, including the Modelica Language, the Functional Mock-Up Interface (FMI), and the System Structure and Parameterisation (SSP) standard.

For project coordinator Virtual Vehicle Research GmbH, the success of the project was another milestone in its 15 years of experience in the field of simulation technologies. This focus on industry-related research makes Virtual Vehicle Research GmbH the innovation catalyst for future vehicle technologies.

In addition, ESI Group implements DCP for its system simulation solutions. ESI expects to significantly increase the interoperability of its tools and a reduction of development and maintenance costs due to the replacement of several tool specific co-simulation modules by the standardised and tool-independent DCP.

The range of applications is wide and can, for example, reduce the set-up and configuration time. Further applications gaining benefit from the DCP are typically found in the fields of distributed simulation, co-simulation, hardware-, software-, or model-in-the- loop testing, and process automation. The results of ACOSAR will lead to a modular, considerably more flexible and shorter system development process for numerous industrial domains as well as enable the establishment of new business models.

# ACOSAR

14004

**PROJECT LEADER**

Martin Benedikt, Virtual Vehicle Research

**PROJECT START**

September 2015

**PROJECT END**

August 2018

**PROJECT WEBSITE**

https://itea4.org/project/acosar.html

**PARTNERS**

*Austria*

- AVL List GmbH ●
- Spath Micro Electronic Design GmbH ⊙
- Virtual Vehicle Research GmbH ○

*France*

- Renault ●
- Siemens Industry Software SAS ●

*Germany*

- dSPACE GmbH ●
- ESI ITI GmbH ●
- ETAS GmbH ●
- Ilmenau University of Technology ◉
- ks.MicroNova GmbH ⊙
- Leibniz University of Hannover ◉
- Porsche AG ●
- Robert Bosch GmbH ●
- RWTH Aachen Insitute for Combustion Engines ◉
- TWT GmbH Science & Innovation ⊙
- Volkswagen AG ●

# AMALTHEA & AMALTHEA4public

## From individual approaches to a widely accepted open platform

*Published December 2018*

**The ITEA 2 projects AMALTHEA and AMALTHEA4public are part of a 'string of pearls' in the automotive domain; successes that have pushed this domain into the next phase of its development. AUTOSAR, a result from the former ITEA project EAST-EEA, defined a methodology for component-based development of automotive software and a standardised software architecture for automotive electronic control units. However, AUTOSAR offered only limited support for detailed behaviour descriptions, which are indispensable for developing much more complex multi-core systems of high quality. Those require an increased exchange between tools. Multi-core optimisation especially relies on additional information like detailed timing behaviour. AMALTHEA set about adapting existing development methods and tools and creating a common model that offers the required description capabilities on different abstraction levels. The follow-up project AMALTHEA4public was set up to foster the transfer into application and to create a sustainable open ("public") platform and a vibrant community of users and contributors.**

## Impact highlights

- Robert Bosch's internal tooling for embedded multi-core is based on the AMALTHEA model as a central component.
- Some of the well-known automotive OEM and TIER1 customers of Timing-Architects Embedded Systems GmbH (now part of Vector Informatik) have set AMALTHEA as the internal Group standard for modelling the dynamic software architecture of ECUs.
- BMW, Daimler, Volkswagen and PSA use the format and the APP4MC platform in cooperation with their tool vendors and tier suppliers.
- Volkswagen/Audi and Continental published the article "Shared SW development in multi-core automotive context" (ERTS2016, http://web1.see.asso.fr/erts2016/uploads/pdf/erts_2016_Proceedings.pdf) in which AMALTHEA was promoted as a collaboration model between OEM and TIER-1.
- Community building is ongoing via the Eclipse Open Source network. This has led to a healthy community and a three-month release cycle to keep the software and data model up to date. Users worldwide downloaded each release several hundred times.
- Due to its open nature, universities are able to use APP4MC successfully in teaching. E.g. FH Dortmund organised several APP4MC-focused summer schools. Several Master and PhD theses were conducted in the context of APP4MC at FH Dortmund, Fraunhofer IEM, University of Gothenburg and Paderborn University. The project also enabled about 60 students to use their expertise in the industry. Some 8 students involved in the project were directly hired by industry companies to ramp up and enhance their know-how in multi- and many-core performance and work in close cooperation with the Eclipse APP4MC developer team.

## Project results

One of the major achievements of the AMALTHEA consortium was a common meta-model for multi-core software and hardware modelling that enables integration of heterogeneous tools in a custom tool chain to gain easy and efficient access to the overall characteristic of a multi-core system. The AMALTHEA platform is distributed under the Eclipse open source license (EPL) and allows efficient data exchange between different cooperating companies but also between different (new and/or existing) tools used by a single organisation. The AMALTHEA model was taken to a next level by the AMALTHEA4public consortium by adding additional features like verification and test generation as well as traceability of requirements.

In 2015 the AMALTHEA4public framework was moved to the newly created open source project Eclipse APP4MC, an open tool platform for modelling, analysis and optimisation of embedded multi- and many-core software (www.eclipse.org/app4mc/). APP4MC was created by AMALTHEA4public project participants Robert Bosch GmbH, itemis AG, Timing Architects Embedded Systems GmbH, Dortmund University of Applied Sciences and Arts and Eclipse Foundation Europe GmbH. In 2016 a second Eclipse project Capra (www.eclipse.org/capra/) was created. It contains the traceability management tools mainly contributed by the Swedish AMALTHEA4public partners.

## Exploitation

AMALTHEA4pubic partners AVL, BHTC and Bosch demonstrated the applicability of the project's results in industry in several projects incorporating different companies. The AMALTHEA data model or platform is currently in use with some major automotive vendors from several countries around the world.

Robert Bosch uses the consolidated model as input for tools (commercial and in-house) and to exchange timing information with customers. Bosch intends to publish some tools as open source to further support the APP4MC platform. The source code analysis tool "SCA2AMALTHEA" was the first contribution of that kind in August 2017.

For Timing-Architects Embedded Systems GmbH (now part of Vector Informatik), AMALTHEA is the ideal format solution for many of its customers working with software modelling for real-time analysis. The Eclipse Framework APP4MC offers AMALTHEA users an easy start and supports the first steps on the path of introducing model-based timing analysis with well-developed and maintained basic functions, such as Import/Export APIs.

With the help of the AMALTHEA format, real-world benchmarks are available and the exchange between research and industry is alive and ongoing. A fundamental cooperation between academic and industry has been built to master the upcoming performance challenges within the new EE architectures. Thereby, the AMALTHEA and AMALTHEA4public projects contribute to the training of future specialists and managers.

AMALTHEA and its successor projects have shown how an idea for a narrow application (timing analysis of multi-core automotive and telecom systems at some companies) has become an extensive application in many core systems for the most diverse applications in a big number of companies.

# AMALTHEA & AMALTHEA4public

09013 – 13017

**PROJECT LEADER**

Harald Mackamul & Jörg Teßmer
Robert Bosch GmbH

| AMALTHEA | AMALTHEA4PUBLIC |
|---|---|
| July 2011 | September 2014 |
| April 2014 | August 2017 |

**PROJECT WEBSITE**

https://www.eclipse.org/app4mc

**PARTNERS**

* only in AMALTHEA ** only in AMALTHEA4public

*Germany*

- BHTC ●
- Dortmund University of Applied Sciences and Arts ◉
- ETAS GmbH* ●
- Eclipse Foundation Europe Gmbh* ●
- Fraunhofer IEM ** ○
- ifak ○
- Itemis ⊙
- OFFIS** ○
- Regensburg University of Applied Science ◉
- Robert Bosch GmbH ●
- Timing Architects Embedded Systems GmbH ⊙
- TWT GmbH Science & Innovation** ●
- University of Gothenburg** ◉
- University of Paderborn C-LAB ◉
- University of Paderborn Software Engineering Group ◉

*Finland*

- Metso Automation* ●
- Nokia Solutions and Networks* ●
- University of Oulu* ◉

*Spain*

- Asociación de empresas tecnológicas Innovalia** ○
- Carsa** ⊙
- CBT** ⊙
- Engine Power Components** ●
- Software Quality Systems S.A.** ⊙

*Sweden*

- rt-labs AB** ⊙

*Turkey*

- AVL Turkey ** ●
- Mobilera** ⊙
- TOFAS ** ●



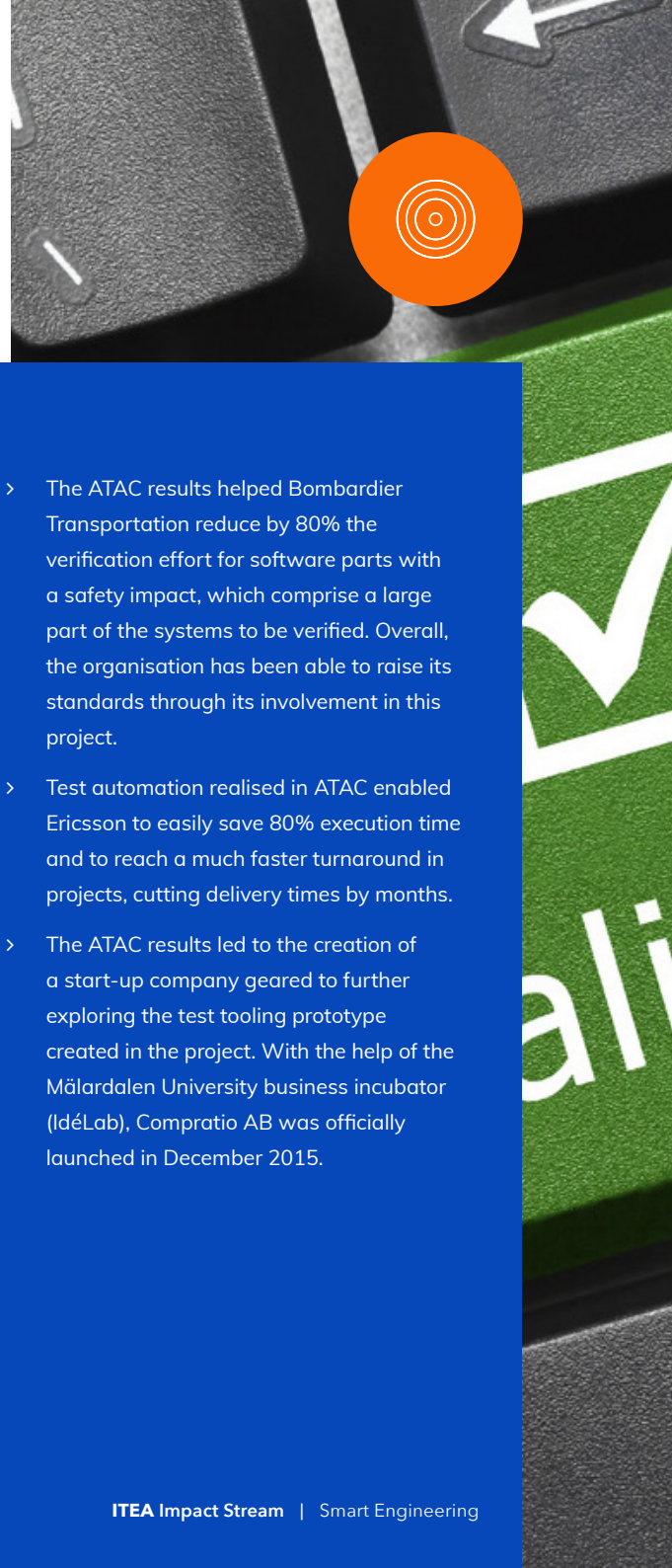
● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# ATAC

## Developing automated testing for complex real-time systems

*Published December 2018*

**Ever more functionality is demanded by end-customers from the software-intensive systems they use. At the same time their expectations with respect to the correct operation, safety and security of these systems have become higher than ever. Severe system failures can lead to significant damage or even loss of life, while successful cyber intrusions can destroy their reputation. As such, breaches in both safety and security can have a significant adverse impact on business and reputation. Due to the dramatic increase in the complexity of the software itself, the intricate interaction modes between the software and the external world, and the sheer magnitude of the customisability of the software, these systems have become increasingly difficult to develop and verify by traditional development processes and testing methods. The ATAC project took on the gauntlet to resolve such challenges by researching, evaluating and rolling out a number of methodologies, associated processes and tools to efficiently and automatically verify complex and highly configurable software-intensive systems.**



## Impact highlights

- The ATAC results enabled Barco to test more product variants in a shorter time as the in product-line regression testing has now been largely automated. This has given amongst others a boost to the ClickShare product portfolio, the main contributor to the Corporate segment, which is a growing part of the Enterprise division representing approximately 30% of Barco sales in 2017.
- The production testing platform introduced as a result of the ATAC project has been deployed across Bittium's complete product portfolio cutting the required test development effort by 70% for new products. This results in hundreds of k€ in cost savings for every new product compared to the situation prior to ATAC.
- ATAC has given Maximatecc the opportunity to boost and develop their simulation platform SimTec. They now have more customers using it and many more developers in total directly affecting the number of licences sold. The number of active licences increased by more than 300%, from 30 to over 100.
- The ATAC results helped Bombardier Transportation reduce by 80% the verification effort for software parts with a safety impact, which comprise a large part of the systems to be verified. Overall, the organisation has been able to raise its standards through its involvement in this project.
- Test automation realised in ATAC enabled Ericsson to easily save 80% execution time and to reach a much faster turnaround in projects, cutting delivery times by months.
- The ATAC results led to the creation of a start-up company geared to further exploring the test tooling prototype created in the project. With the help of the Mälardalen University business incubator (IdéLab), Compratio AB was officially launched in December 2015.

## Project results

ATAC's overarching goal was always to push the functional, safety and security requirements coverage envelope while minimising the number of test cases required to achieve the necessary degree of coverage and confidence in the software, hence greatly reducing the required testing effort for both the fully automated and remaining manual test cases. To ensure that the researched solutions and tools solve real industry needs and to maximise their potential application in other settings, all R&I activities were anchored around a jointly defined set of industrial case studies in different application domains. During the project, a flexible and heterogeneous portfolio of different tools and methodologies was developed to cover the needs of these different application domains as it was soon recognised that one-size-fits all approach would be less than optimal.

## Exploitation

During ATAC, Barco's Collaborative Media Team developed a framework that provided better support for tracing system requirements down to detailed requirements, linking them with corresponding test-cases on all levels of the V-model. This framework reduced the software verification and validation effort by 20% and has since been rolled out company-wide thanks to this success. Bittium Wireless developed an automated VoIP network test tool in ATAC and introduced a production testing platform for a Bittium product family, both of which Bittium has continued to develop after the project's end in 2014. Today, the automated VoIP network test tool is used in Bittium as a standard testing framework in all VoIP based products and the company automated more than 90% of its functional testing for VoIP based products resulting in significant verification cost savings.

Bombardier's prototype tool developed in ATAC minimised the number of test vectors required to demonstrate sufficient code coverage, massively decreasing the time needed by testers to demonstrate these coverage objectives. In addition, the tool gave a figure on the achieved code coverage by testing when the automatically tool-generated test vectors were used. Maximatecc collaborated closely with Bombardier and ATAC has made it possible to develop their products and services for the simulation of embedded systems and applications, especially their SimTecc simulation platform. The flexibility of SimTecc is that it can be applied both at component level for module testing and at application level for testing complete machines and vehicles, e.g. a complete train.

The ATAC results have enabled Valmet Automation to run over 1500 automated tests in less than one hour, where manual testing would take days and be much more error-prone. In ATAC, Ericsson automated millions of test cases that are executed daily in different test systems, and test code is now delivered together with software code and executed with every change to the system.

ATAC has been a key ingredient in the formation and establishment of the Software Testing Laboratory (STL) research group at Mälardalen University, one of the largest of its kind in Sweden. Kaunas University of Technology founded one of the largest mobile application testing laboratories in the Baltic States.

# ATAC

10037

**PROJECT LEADER**

Stijn Rammeloo, Barco

**PROJECT START**

October 2011

**PROJECT END**

September 2014

**PROJECT WEBSITE**

https://itea4.org/project/atac.html

**PARTNERS**

*Belgium*
- Barco ◉

*Finland*
- Adensy ⊙
- Bittium (Elektrobit Wireless Communications Oy) ◉
- F-Secure ◉
- Valmet Automation (Metso Automation) ◉
- Tampere University of Technology ◉
- Tekia ◉
- VTT Technical Research Centre of Finland Ltd. ○

*Lithuania*
- Kaunas University of Technology ◉
- Singleton Labs UAB ⊙

*Sweden*
- Bombardier Transportation ◉
- CrossControl ⊙
- Ericcson ◉
- Mälardalen University ◉
- SICS ○



◉ (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# DIAMONDS

## Strengthening software security for a connected world

*Published December 2017*

**Nowadays open networks are taken for granted yet this continuous interconnection and data-sharing are vulnerable to a growing number of security threats from both internal and external sources. In sectors such as transport with train control systems, healthcare with medical patient care, automotive with car-to-infrastructure communications and mobile telecommunications, there are safety-critical implications. The ITEA project DIAMONDS set out to examine how to secure these safety and security-critical systems. The project, which brought together 22 industrial and scientific players from six countries to develop a new security testing paradigm and methodology, known as model-based security testing, successfully demonstrated and evaluated it in eight industrial settings from four different industrial domains.**

## Impact highlights

- As a result of the DIAMONDS project, Fraunhofer FOKUS gained recognition as an expert in the field of security testing in industry as well as in the academic realm. RACOMAT, the outcome of DIAMONDS, is currently the main tool for risk-based security testing within Fraunhofer FOKUS.
- Thanks to the business impact coming from the results of the project, Montimage's workforce was increased from five to twelve people.
- Using the results from DIAMONDS, Codenomicon was able to identify the OpenSSL Heartbleed vulnerability, which had gone unidentified for over two years and impacted over 500,000 websites.
- Multiple standardisation documents reflecting the project's case studies have been adopted by the European Telecommunications Standards Institute (ETSI) and have been forwarded to international standardisation bodies.
- Techniques like fuzz-testing and risk-based testing have been recognised by international and national certification bodies like the German BSI. They will become part of supplemental guidelines to support guidelines such as e.g. the Common Criteria Certification.

## Project results

DIAMONDS developed a series of systematic, model-based risk analysis, test and monitoring approaches for security testing of software systems. This included advanced model-based security testing methods that enable the early identification of design vulnerabilities, underpinning a focus on efficient testing of security aspects.

The consortium focused on the particular issue of testing networked systems for susceptibility to malice, error or mischance, helping to build trust in such systems by enabling them to demonstrate their robustness and fault-tolerance in the face of such attacks. Security issues with industrial-scale networked systems, as in banking, smart cards, information technology, software-defined radio and defence electronics were a high priority. The DIAMONDS security-test methodology is adaptable to different domain security standards through the derivation of common principles and methods. Furthermore, it integrates security risk assessment and security testing over the whole software life cycle, encompassing early testing, risk assessment, and automatic testing and monitoring.

## Exploitation

Montimage has improved and integrated the security analysis functionality of their Monitoring Tool, and it is now being used and evaluated by the Thales TCS business division, the French DGA, and academic research (Institute Mines Télécom, Université de ParisSud). Two public tenders have been won and six licenses have been sold. It will also be evaluated by setting up a Proof-of-Concept with Orange beginning of 2018.
Smartesting developed, prototyped and validated a new approach to security testing based on security test patterns. This has been implemented in the Smartesting CertifyIt MBT tool and is under deployment in the context of security components and ePayment systems.

In DIAMONDS, Codenomicon extended its main product Defensics. Defensics and Codenomicon have both gained a widely acknowledged reputation. Codenomicon has been acquired by Synopsys, one of the leaders in Application Security Testing according to Gartner in 2017.

The System Quality Centre at Fraunhofer FOKUS provides methods, processes and tools for the development and quality assurance of software-intense systems that often perform business-critical or security- and safety-relevant functions in urban infrastructures, cars, trains, planes or factories. In order for such systems to work in a fault-tolerant, fail-safe and IT-secure way, even in unexpected situations, the system quality has to be ensured throughout the entire development process, from the requirements analysis to the certification. DIAMONDS results such as FUZZINO and RACOMAT have become essential products that complement and support Fraunhofer FOKUS' security testing services and research.

Testing Technologies extended the capabilities of its TTCN-3 test development and execution platform TTworkbench towards security testing and successfully initiated standardisation work on security testing at ETSI MTS. Testing Technologies has been acquired by Spirent and the TTworkbench has become a central building block of Spirent's Automotive Testing Products, an emerging part of Spirent's business and therefore with significant growth potential.

# DIAMONDS

09018

**PROJECT LEADER**

Ina Schieferdecker, Fraunhofer FOKUS

**PROJECT START**

October 2010

**PROJECT END**

May 2013

**PROJECT WEBSITE**

https://www.itea2-diamonds.org

**PARTNERS**

*Austria*
- Graz University of Technology ◉
- Secure Business Austria ○

*Finland*
- Codenomicon ⊙
- Conformiq Software Ltd ⊙
- Ericsson ●
- Metso Automation Inc ●
- University of Oulu ◉
- VTT Technical Research Centre of Finland ○

*France*
- FSCOM ⊙
- Gemalto SA ●
- Institut Polytechnique de Grenoble ◉
- Institut Télécom SudParis ◉
- Montimage EURL ⊙
- Smartesting ⊙
- Thales Communications and Security ●
- Trusted Labs ⊙

*Germany*
- Dornier Consulting GmbH ⊙
- Giesecke & Devrient GmbH ●
- Fraunhofer FOKUS ○
- Testing Technologies IST GmbH ⊙

*Luxembourg*
- ITRUST ⊙

*Norway*
- Norse Solutions AS ⊙
- SINTEF Stilftelsen ○



● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# EAST-EEA

## Paving the way towards revolutionary automotive software development

*Published December 2017*

**The challenge posed at the beginning of the new millennium in the evolution of vehicles was the implementation of integral electronic control of in-vehicle and extra-vehicle functions in order to improve safety and comfort in all areas of the vehicle – from engine, steering and braking systems to communications, entertainment and human-machine interfaces. The problem was that, when a new component is introduced, not only must it be tested thoroughly but so must all existing components to ensure none has been adversely affected. As a result, introducing new electronics puts development costs and cycle times under enormous pressure. The ITEA project EAST-EEA successfully addressed the need for software and hardware interoperability by developing an integrated platform based on open-systems architecture.**

## Impact highlights

- EAST-EEA paved the way to the automotive industry's standardised platform for automotive applications: the Automotive Open Systems Architecture (AUTOSAR). AUTOSAR is now a global industrial initiative that is bringing together about 250 original equipment manufacturers (OEMs), Tier 1 automotive suppliers, software suppliers, semiconductor manufacturers, tool suppliers and others worldwide. The initial ITEA partners still form the majority of the current core group.
- The AUTOSAR software and therefore the EAST-EEA results are today part of each single embedded ECU throughout the automotive sector worldwide and the component-oriented software development method is now state-of-the-art in the embedded environment.
  - To give an impression of the order of magnitude of this widespread success: when production for AUTOSAR ECUs started in around 2008, this concerned an average of more than 50 million passenger cars per year. Nowadays smaller cars have today maybe 50 ECUs and premium vehicles more than 200. As an estimate we multiply 10 years times 50 million cars times 100 ECUs = 50 billion ECUs are based on the EAST-EEA project.
- Based on EAST-EEA, the EAST-ADL language is an established, AUTOSAR-aligned representation for Systems Engineering information of automotive embedded systems. The language acts as a lingua franca between tools and organisations and is currently maintained by the EAST-ADL Association. Its members are, employees from among others: Carmeq/VW, FIAT, Hyundai, McLaren, Volvo, Volvo Cars, Bosch, Continental, CEA LIST, Fraunhofer ESK, INRIA and KTH.
- The EAST-EEA project acted as an important reference platform for further development in several ITEA projects over the course of many years.

## Project results

In the EAST-EEA project, twenty-three consortium partners represented all the major players in the automotive sector, including manufacturers, their suppliers, SMEs with essential control software expertise, and academic and research institutions. Key project results included:

1. Creation of standard middleware that integrated all the different electronic systems and components from different suppliers into the complete network of a vehicle system;
2. Definition of a publicly-available dedicated ADL, Architecture Description Language to make all this accessible; and
3. Development of the specialist tools necessary, including test tools and demonstrators.

The middleware, as well as the communication layer concepts, were implemented and validated in demonstrators in the different automotive areas of body electronics, powertrain, chassis, telematics and human-machine interfaces. The new software architecture allowed easier integration of new electronics in vehicles through plug-and-play technology, dramatically reducing development time and costs to market. Furthermore, the project also guaranteed a level of quality that is essential to the competitiveness of European vehicles.

## Exploitation

Thanks to the EAST-EEA approach, vehicle manufacturers acquired an integrated framework for software and communication interfaces, tool environments and rules while suppliers benefited from standard solutions and re-use became possible, with new vehicle models able to be developed faster and product quality improved.

The outcome of EAST-EEA formed the basis for the automotive industry's standardised platform for automotive applications: the Automotive Open System Architecture (AUTOSAR) initiative. The AUTOSAR partnership was formed in July 2003 as a spin-off from EAST-EEA, taking the ADL initially defined in the EAST-EEA project and subsequently refining this to describe automotive electronic systems through an information model that captures engineering information in a standardised form.
While AUTOSAR industrialised the software architecture aspects of EAST-EEA, systems engineering aspects like requirements, variability, safety and timing were addressed in related initiatives. The EAST-ADL language is fully integrated with AUTOSAR and covers a wide range of automotive development concerns. The language is maintained by the EAST-ADL Association, and the EATOP Eclipse project provides a reference implementation that is aligned with Artop, the corresponding platform for AUTOSAR.

There are also several European and national projects building on EAST-EEA. For example, based on AUTOSAR+EAST-ADL+FMU models, Volvo is currently providing simulation support for continuous integration.

The successes of other ITEA projects like AMALTHEA, SAFE and TIMMO-2-USE, in terms of revolutionising software development in the automotive industry and the impact they have had and will have on subsequent related projects, can be traced back over the past two decades to EAST-EEA. They are projects that have added something new, something extra in response to the state-of-the-industry and market demands.

# EAST-EEA

00009

**PROJECT LEADER**

Joachim K. Irion, Irion & Junker Management Consulting

**PROJECT START**

July 2001

**PROJECT END**

June 2004

**PROJECT WEBSITE**

https://itea4.org/project/east-eea.html

**PARTNERS**

*Framce*

- CEA LIST ○
- Continental Automotive France SAS ●
- INRIA LORIA Sophia Antipolis ○
- INRIA Rocquencourt Sophia Antipolis ○
- IRCCyN ○
- Peugeot Citroën Automobiles SA ●
- Renault Research Center ●
- Robert Bosch ●
- Valeo ●

*Germany*

- Audi AG ●
- BMW Group AG ●
- Continental Automotive ●
- Daimler AG ●
- ETAS GmbH ●
- Opel ●
- Siemens AG IT Solutions and Services GmbH ●
- Technische Universität Darmstadt ◉
- University of Paderborn ◉
- Vector Informatik GmbH ●
- ZF Friedrichshafen AG ●

*Italy*

- CRF ●
- Magneti Marelli ●

*Sweden*

- Volvo ●

● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# FLEX4APPS

## Deep customer understanding, backed by data

*Published December 2021*

**Anybody in the industry knows that monitoring applications is important: you want to know how your apps are performing, both from a technical perspective, such as CPU usage, memory, errors, as well as from a user perspective. The problem today is that for many teams, monitoring and analytics is just one of the many things they need to do, with little technical nor methodological guidance. And collecting, storing, analysing and acting upon data from larger, distributed systems is not that easy.**

**The forming of the Flex4Apps project, gathering 11 partnes from Belgium and Germany, at the end of 2016 was paralleled with an increase in containers and serverless paradigms, making the monitoring challenge both harder and easier: harder in the sense that there is even more to monitor because there is more that can go wrong, and easier because the same building blocks allow for a team to build performance monitoring and analytics systems for themselves, at a reasonable cost.**

### Impact highlights

- Nokia brought down the monthly costs of fixing bugs detected in both early and late development from over 16,000 euros to 1,900 euros – a yearly saving of 180,000 euros.
- For Unifiedpost, the success of this project has led in 2021 to the creation of a dedicated data warehouse and machine learning project team of 15 persons, expanding on the original ideas and assisting in the rapid growth of the company.
- Flex4Apps enabled the SME DataStories to grow from 6 to 18 employees.
- evermind, which has connected Flex4Apps to the home automation platform Eigenheim Manager, has increased sales by 50-100,000 euros per white-label customer.
- Genode predicts a 200% growth in licence revenue within two years, with the smart home market expected to be worth 19 billion euros in Germany alone by 2025.
- The SaaS tool Survey Anyplace has increased their conversion rate by 33% and their activation by 54%.

## Project results

The Flex4Apps partners built reference architectures, providing template solutions for dealing with monitoring and analytics, and they developed the methodological support to help teams leverage these. For the reference architecture, they opted to make this available via one-click installs and they have published some of their work in a publicly available GitHub. The methodological insights were bundled in the book “Hyperscale and Microcare, the digital business cookbook”, written by Nick Boucart and Peter Verhasselt from project partner SIRRIS. The book is now in its third print already, with over 1000 books sold to date.

The main innovation generated by IMPONET laid in the advanced real-time architecture that contained a dual model of publish/subscribe and request/response data exchange mechanisms in which data access allowed interoperability between the different data models, while making extensive use of big data technologies for the processing of huge volumes of information gathered from the electricity grid.

## Exploitation

Thanks to improved monitoring and analytics, project partners were able to serve their customers better, yielding improved retention and customer satisfaction as well as, in some cases, even better, sharper pricing of their offerings.

Project partner Unifiedpost (formerly Inventive Designers) has been operating a Flex4Apps inspired platform in production for several years now. While it was initially used as an internal tool to support product management and customer support for one particular product line with both premise-based and cloud services, today the company is using the platform to provide daily business value and insights across several important product lines. This data helped the technical team to find the cause of a very rare race condition occurring in production, while giving sales a detailed view on actual product usage, resulting in better tailored contact with customers. Since its inception, it has required very little upkeep and has kept on churning through the masses of received data with ease.

In terms of improved services, the Belgian SME DataStories is now using Flex4Apps’ automated algorithms in 25-30% of their projects, allowing them to move into data-driven product management and take on more complex assignments.

Genode’s home automation use-case has reduced their trusted computing base by a factor of 20%, making an exhaustive examination of its code base feasible, and has grown their customer base on ARM by 70%.

The project partners didn’t limit themselves to impacting only the partners in the project. By publishing their reference architectures, others can benefit from their insights too. This is testified by the Fintech start-up STOKR, a crowd investment platform powered by Ethereum Blockchain. Flex4Apps greatly helped the team to untangle initial complexities related to the technical architecture of the platform. Flex4Apps perfectly understood the need of complex financial platforms like STOKR and provided the right advice.

The open approach of Flex4Apps, combined with the innovative nature of the framework, will play a crucial role in the digital transition. In the future, a company’s most valuable intellectual property will be its deep customer understanding, backed by data, rather than its technology. Companies that take up Flex4Apps stand to gain the most from this insight.

# FLEX4APPS

15025

**PROJECT LEADER**

Till Witt, NXP Semiconductors Germany

**PROJECT START**

November 2016

**PROJECT END**

October 2019

**PROJECT WEBSITE**

https://itea4.org/project/flex4apps.html

**PARTNERS**

| *Belgium* | | *Germany* | |
|---|---|---|---|
| Datastories International | ⊙ | evermind | ⊙ |
| Unifiedpost | ⊙ | Fraunhofer | ○ |
| SIRRIS | ○ | Genode Labs | ⊙ |
| Survey Anyplace | ⊙ | HiConnect | ⊙ |
| | | Nokia | ◉ |
| | | NXP | ◉ |
| | | Provedo | ⊙ |



◉ (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# H4H

## Hybrid programming to optimise HPC applications on Heterogeneous Architectures

*Published September 2018*

**High-performance computing (HPC) is essential in meeting the demand for increased processing power for future research and development in many domains, such as aircraft and automotive design or multimedia. The goal of the ITEA project H4H (Hybrid for HPC) was to provide a highly efficient, hybrid programming environment for heterogeneous computing clusters to enable easier development of HPC applications and optimise application performance. The project also aimed at providing a new infrastructure for HPC cloud computing and a new cooling technology to reduce energy needed to operate the HPC system. The H4H project assembled a consortium of Supercomputing Centres and HPC Research Labs, the European HPC manufacturer, HPC software tools editors and a range of HPC users to validate the proposed technology in real applications from various domains.**

## Impact highlights

- The H4H project made important contributions to the Bull Exascale Program as many project outputs were integrated during or after the project end within Bull's commercial offers, such as Bull Sequana X and the Bull SuperComputer Suite. The research and development emanating from such projects have attracted customers along the years and gained new entrants. CEA, CINES, SurfSARA, STFC, ZIH-TUD are among the major customers, accounting for several million euros.
- For Efield, participation in H4H contributed a highly competitive software package for electromagnetic analysis in the wireless communication and defence industry. In the last year of the project, a record contract was closed with a major Asian service provider for defence industry resulting in a 50% increase in revenue.
- The performance improvements achieved for RECOM's 3D combustion simulation software developed in the H4H project have enabled RECOM to make the necessary transition from traditional contracts in the coal-based power generation sector towards other industrial sectors within less than two years, allowing the company to recover more than 50% of lost turnover and stay in business.
- Several H4H improvements were integrated in open source code releases (SLURM, MAQAO, FoREST, UtoPEAK, SCILAB). The MAQAO performance evaluation framework developed by the University of Versailles Saint-Quentin-en-Yvelines, was enhanced with Xeon Phi support and is exploited by Bull, CEA, Dassault Aviation, Intel. Improvements made in FoREST and UtoPeak resulted in an average 20% gain in energy efficiency at less than 5% loss in performance.

## Project results

Key to the technological progress achieved were the extensive collaboration and workshops in which the partners engaged to develop and test the various technologies, customisation and optimisation options, and ultimately produce significant innovations to all the H4H technology components. Key results included:

- A new HPC architecture including new accelerators based on GPU and MIC technologies.
- A tailored development environment including optimisation tools and libraries supporting the new hardware architecture, allowing performance improvements (by an acceleration factor of 2 to several tens in application execution time).
- An advanced cooling design enabling a large reduction of the energy needed to operate the future Exascale HPC systems.

## Exploitation

The H4H project made important contributions to the **Bull** Exascale Program, which aims to design and develop the next generation of supercomputers. H4H contributions were packaged within the Bull Super Computer Suites 4 & 5. In 2015, Bull launched Sequana - an open range of supercomputers that is ready to support future Exascale technologies. Bull benefited from these H4H developments as the new cooling technologies lead to new cooling improvements in the Sequana commercial offering, currently being sold as the Bull Sequana X, in which the X1210 blades integrate the latest Intel's Xeon Phi technologies.

During H4H. RECOM achieved major performance improvements of its 3D combustion simulation software. Shortly after H4H, 50% of RECOM's turnover from traditional contracts in the coal-based power generation sector disappeared due to an increasing share of renewable power generation in the European grid. This had to be compensated by expanding the applicability of the RECOM AIOLOS software to other industrial sectors, which required a huge effort in combustion model development and validation of its predictive quality in these new fields within a very short period. The performance improvements achieved in H4H have enabled RECOM to make this transition happen within less than two years.

H4H allowed **Efield** to drastically improve the performance of their electromagnetic solvers to successfully address the industry's evolution towards higher operating frequencies, complex materials and increased density of ICT equipment. Efield and Scilab enterprises (open source software for numerical computation with HPC optimisations), both H4H SME partners, were acquired by a larger company ESI group.

Optimisation strategies developed in H4H were implemented by **Dassault Aviation** on proto-applications referring to highly computational parts from its industrial code. Thanks to the ITEA COLOC project, which was a follow-up of H4H, Dassault Aviation was able to improve the parallel efficiency of its in-house software to maintain its competitive edge in the aeronautics industry.

Based on H4H, **CEA** improved its CEA Computing Complex infrastructures in terms of computational power and energy efficiency. CEA-LIST, also signed a commercial contract with the "Gendarmerie Nationale" for its image-based stolen object retrieval. The contract is still ongoing in 2018 evolving to other types of recognition features.

Thanks to H4H, **Jülich Supercomputing Centre** got the opportunity to work in a Siemens-funded collaboration (2014-2015) together with the Corporate Technology Multicore Expert Center of Siemens AG on runtime analysis of parallel applications for industrial software development.

# H4H

09011

**PROJECT LEADER**

François Verbeck, Bull

**PROJECT START**

October 2010

**PROJECT END**

February 2015

**PROJECT WEBSITE**

https://itea4.org/project/h4h.html

**PARTNERS**

*France*
- ATEME ⊙
- Bull S.A.S. ●
- Caps Entreprise ⊙
- CEA DAM ○
- CEA LIST ○
- Dassault Aviation ●
- EADS Astrium BU SATELLITES ●
- Institut Mines-Télécom SudParis ◉
- NUMTECH ⊙
- scilab enterprises Enterprises ⊙
- University of Versailles Saint Quentin ◉
- XediX ⊙

*Germany*
- Forschungszentrum Jülich GmbH ○
- Fraunhofer SCAI ○
- GNS ⊙
- GWT Online -TUD GmbH ⊙
- INTES ⊙
- Magma Gießereitechnologie ⊙
- RECOM Services GmbH ⊙
- Technische Universität Dresden ZIH ◉
- University of Stuttgart HLRS ◉

*Spain*
- BMAT Licensing, S.L. ⊙
- Datalab ⊙
- Repsol YPF ●
- Universitat Autònoma de Barcelona (UAB) ◉

*Sweden*
- Efield AB ●
- Rogue Wave Software ●

# MODELISAR

## An international standard for systems- and embedded software design in vehicles

*Published September 2017*

**Modelling is not new in automotive systems development but enabling interoperability between different subsystem components from various disciplines has presented engineers with a big challenge. The objectives of the MODELISAR project were to boost collaboration and innovation across system and software disciplines and to test the vehicle behaviour earlier, faster and more affordably in the virtual world. During the project, an international and open Functional Mock-up Interface (FMI) standard was developed to conveniently exchange and interoperate models from different modelling and simulation environments.**

## Impact highlights

- The FMI standard is currently supported by some 100 modelling, simulation, code generation and testing tools offered by more than 50 tool - free or commercial - suppliers.
- Dassault Systemes delivers six FMI compatible tools to dozens of customers who are leading manufacturers of complex systems like aircraft, cars and energy systems. These 'open' tools are key enablers in these companies' product development processes and are now being integrated in the Dassault 3DEXPERIENCE platform to support interoperability in their business processes. The 3DS development platform is in the core strategy of Dassault Systemes.
- FMI helped TWT to boost its innovation offer through many new collaborative projects (ITEA, H2020, ECSEL and national) and business contracts with leading German automotive OEMs.
- Together with major automotive OEMs inside the VDA PLM & ProStep iViP Consortium, AVL has become one of the leading players in interfacing tools for design, validation and optimisation based on FMI.
- Based on the results of MODELISAR and FMI, Siemens Industry Software NV (Belgium) has created two new product categories in its business: Virtual Sensing, and Hardware-in-the-loop & Human-in-the-loop simulations.These categories have contributed significantly to entry into new, rapidly growing markets. After MODELISAR, Siemens continued the R&D in FMI 2.0 with Flemish regional funding from VLAIO and two PhD student projects.
- The FMI standard is now managed and developed as a Modelica Association Project (MAP) through active participation of 16 companies.

## Project results

MODELISAR set out to improve the design of automotive systems models and embedded software in Electronic Control Units (ECUs) and delivered the FMI standard. This standard supports the automotive open system architecture (AUTOSAR). Generated Functional Mock-Up is the next generation of the Digital Mock-up to enable co-simulation between heterogeneous tools to support large-scale, cross-domain functional mock-ups.

MODELISAR has developed a set of 25 use cases to demonstrate FMI in different areas such as engine combustion, mechatronic control of the gearbox, climate control and virtual reality support, embedded software code generation, test and calibration, and finally management of the simulation components and related data to help design applications in industrial projects.

The first version, FMI 1.0, was published in 2010, followed by FMI 2.0 in July 2014. To continue the cooperation beyond MODELISAR, the core FMI development partners founded a new Modelica Association Project "Functional Mock-up Interface" (FMI MAP) (www.fmi-standard.org). As of today, development of the standard continues through the participation of 16 industry adopters, tool editors and technical working groups.

## Exploitation

FMI is exploited in many system design tools in automotive applications by OEMs and their suppliers, with a large variety of areas: engines, engine controls, powertrain and cabin applications like air-conditioning. After MODELISAR, FMI has gained worldwide acceptance in the automotive domain and is spreading widely in non-automotive areas like aerospace, trains, automation, energy, etc.

In automotive, FMI is being used by Daimler in software-inthe-loop simulations in all gearbox projects for Mercedes passenger cars and for all powertrain projects for trucks. FMI is the preferred model exchange and co-simulation format of Robert Bosch GmbH for models at system level enabling the exchange models with internal and external partners (e.g. OEMs) using different modelling tools. FMI is increasingly used for real-life, complex simulation tasks, since ETAS GmbH and Bosch Rexroth AG subsidiaries support FMI in their software tools. FMI reduces the Volvo Cars tool compatibility matrix considerably to increase the ROI of simulation models. Together with Volvo Group, they developed a tool for ECU software development called ADAPT.

In 2012, Daimler and Ford started an initiative to establish FMI as the standard for simulation model exchange between OEMs and suppliers. They were joined by several OEMs to sign a supporting commitment in 2012, and later by 9 OEMs to form a group of about 20 Automotive adopters.

EDF chose FMI to design and study large energetic systems (mixing physics and ICT), and develops an open source distributed co-simulation master (Daccosim). Dassault Aviation and Liebherr Aerospace consider new process and associated tools based on powerful capabilities of Modelica and FMI to manage heterogeneous models for Aircraft systems assessment.

# MODELISAR

07006

**PROJECT LEADER**

Patrick Chombart, Dassault Systemes

**PROJECT START**

July 2008

**PROJECT END**

December 2011

**PROJECT WEBSITE**

www.fmi-standard.org

**PARTNERS**

*Austria*
- AIT ○
- AVL List ●

*Belgium*
- LMS International (currently Siemens Industry Software) ●
- Triphase ⊙
- Verhaert ⊙

*France*
- ARMINES ○
- Dassault Systemes ●
- Geensoft ⊙
- IFP Energies Nouvelles ○
- LMS Imagine ●
- Trialog ⊙

*Germany*
- Altran GmbH ⊙
- Atego Systems GmbH ⊙
- ATB ○
- Daimler AG ●
- DAVID GmbH ⊙
- DLR ○
- ESI-ITI GmbH ⊙
- Fraunhofer FIRST / IIS / SCAI ○
- Halle University ◉
- INSPIRE AG ⊙
- QTronic ⊙
- Simpack GmbH ●
- TWT GmbH Science & Innovation ⊙
- Volkswagen AG ●

*Sweden*
- Volvo ●
- Dassault Systemes AB ●



● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# MODRIO

## Digital twins for the safe and efficient design and operation of cyber-physical systems

Published December 2019

**Cyber-physical systems (CPS) are very large systems that not only involve a large number of stakeholders but are safety critical and have significant impact on the economy and the environment as well. This makes tools for the safe and efficient design and operation of such systems imperative. The ITEA project MODRIO, which ran from 2012 to 2016, was set up to extend modelling and simulation tools based on open standards (Modelica and FMI) from system design to system operation. The main technological ambition of the project was to provide an integrated modelling and simulation framework able to efficiently specify, design and operate CPS. To that end, new ideas were developed to address the complete engineering lifecycle, from preliminary design to operation and maintenance.**

## Impact highlights

- OpenModelica has been used in ABB's Optimax Powerfit product to generate optimising control code that controls and coordinates about 5000 MW (approx. 7.5%) of German electricity production within seconds. This has subsequently been expanded to about 6000 MW.
- Vattenfall used the results to optimise the start-up of conventional power plants, with an estimated yearly gain of €850k per plant.
- Knorr-Bremse developed a new braking system that allows to reduce by 30% the hardware tests, which are generally very resource consuming. In addition, this braking system can reduce the safety margins between trains and thus enable more efficient use of the track. In turn, the flow of trains and passengers can be improved – by between 5 and 14%, depending on the type of traffic.
- For EDF, which uses results regarding the modelling of requirements to automate the FMEA (Failure Modes, Effects and Criticality Analysis) of safety critical systems, the expected gains are estimated to be around 30% of the cost of large projects.
- For Dassault-Aviation, MODRIO has enabled many very useful breakthroughs for the design of next-generation aircraft, in particular the results regarding the modelling of requirements and system architecture, associated with fast multi-core simulations, multi-mode modelling of system failures and safety analysis. Output from ITEA projects like MODRIO has brought Dassault-Aviation capabilities that allow different working methods to handle complex systems, thereby contributing to the global (digital) transformation of the company.

## Project results

New features include the formal modelling of requirements involving objects, sub-systems, systems and human interactions in space and time in order to automate system design verifications. With optimisation of the operation of large transients such as start-ups or shutdowns or the evaluation of the consequences of faults and failures in mind, a new modelling approach was developed. The aim was to provide the ability to simulate the system behaviour away from its nominal operating point when transitions between modes, represented by completely different sets of equations, take place. One key success factor was the involvement of large industrials whose businesses are to design and operate large CPS in four major industrial domains: energy (electricity production, transmission and distribution), aerospace (civil aircraft), transportation (trains) and buildings. Other key factors were to base tool development on two existing standards, Modelica and the FMI together with the participation of all prominent players in those two standards, in terms of standard and tool development. Finally, the project benefited from the cooperation between SMEs and research organisations.

## Exploitation

One of the main early achievements was the ability to generate software code for optimising the control of 6000W, representing almost one tenth of German electrical power production. Up to 1500 MW comes from more than 2500 small solar and wind power generators that are coordinated to operate as a single big power plant.

Vattenfall used the results to optimise the start-up of conventional power plants, necessitated by the rising share of renewable energy production that forces conventional power plants to manoeuvre more frequently to balance the grid, while complying with all operational constraints in order to satisfy safety and environmental regulations and minimise system wear.

In the rail domain, the industrial cooperation partners – Knorr-Bremse and Bombardier Transportation – focused the results on crosswind stability and friction brakes. To boost the potential of brake distance management, Knorr-Bremse uses FMIs extensively to share simulation models between stakeholders. This makes it possible to simulate the behaviour of the entire system of a passenger train at a very early stage of development.

EDF uses results regarding state estimation to detect and diagnose the causes of power losses in power plants. A new power loss monitoring system, which combines physical modelling with Modelica and Bayesian networks and modelling based on neural patterns, is now deployed in the nuclear power plant EDF fleet, and has prompted the launch of a new start-up to provide model-based smart diagnosis and prognosis services for CPS.

The roots of EMBrACE, a follow-up ITEA project in which 45 organisations across 8 countries have declared interest to develop a new standard and associated tools for the formal modelling and simulation of requirements, can be found in MODRIO that produced the draft specifications for a new requirement modelling language. Finally, ideas developed in MODRIO about multi-mode modelling were among the incentives behind the development of a new modelling language, named MODIA by Modelica founders, that could be the successor to the Modelica language in the long term.

# MODRIO

11004

**PROJECT LEADER**

Daniel Bouskela, Electricité de France

**PROJECT START**

September 2012

**PROJECT END**

May 2016

**PROJECT WEBSITE**

https://itea4.org/project/modrio.html

**PARTNERS**

*Belgium*
- Katholieke Universiteit Leuven ◉
- Siemens Industry Software NV ●
- Triphase ⊙

*Finland*
- Pöyry Finland Oy ⊙
- Semantum Oy ⊙
- VTT Technical Research Centre of Finland ○
- Wapice Ltd. ●

*France*
- Airbus Group SAS ●
- Ampère Laboratory - CNRS - University of Lyon ◉
- Dassault Aviation ●
- Digital Product Simulation (DPS) ●
- Electricité De France (EDF) ●
- IFP Energies Nouvelles ○
- INRIA ○
- Sherpa Engineering ●
- Siemens Industry Software SAS ●
- Supmeca

*Germany*
- ABB AG ●
- Bielefeld University of Applied Sciences ◉
- Deutsches Zentrum für Luft- und Raumfahrt (DLR) ○
- ESI ITI GmbH ⊙
- Ilmenau University of Technology ◉
- Knorr-Bremse ●
- Qtronic ⊙
- Siemens AG ●
- Simpack GmbH ●

*Italy*
- University of Calabria ◉

*Sweden*
- AB SKF ●
- ABB AB ●
- Dassault Systèmes AB ●
- Equa Simulation AB ⊙
- Linköping University ◉
- Modelon AB ⊙
- RISE - Research institutes of Sweden ○
- SCANIA ●
- Siemens Industrial Turbomachinery AB ●
- Vattenfall R&D AB ●
- Wolfram MathCore AB ⊙

● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# OPEES

## Open Platform for the engineering of Embedded Systems

*Published December 2018*

**The ITEA 2 OPEES project was created to develop an open source platform for software tools to support engineering technologies for embedded systems and to secure the competitiveness and development of the European software industry. One key requirement, brought in by Airbus, was to be able to use tools for more than 50 years, during the complete lifetime and duration of support of an aircraft programme. During the project that ended in 2012, the 28 partners not only developed and significantly improved existing open source projects such as Frama-C, Eclipse Papyrus and others, but also defined the governance and the structure for a sustainable organisation to gather an ecosystem of both developers and users.**

## Impact highlights

- OPEES stood at the inception of two important trends: open collaboration with open source in industry and open source tools for model-based systems engineering (MBSE). Neither of these trends was well developed in 2009, but almost 10 years later, and with acceleration through the OPEES project, we benefit from both good open source MBSE tools and many open collaboration initiatives in industry. OPEES was both a pioneer and a catalyst in this evolution.
- Currently, there are not only thousands of users of the MBSE tool Capella on hundreds of projects inside Thales, but also more than a hundred companies worldwide using it, including European organisations such as the European Space Agency, Ariane Group, Rolls Royce and Siemens, which rely on Capella in their System Modelling Workbench product. It also supports an ecosystem of European SMEs, like Obeo and Artal, that sell packaged products, support and expertise on top of Capella not only in Europe, but also in North America and in China.
- Two initiatives inspired by OPEES are: OpenMDM, a platform for the management of diagnostic data in automotive, and OpenPASS, a platform for virtual testing of Advanced Driver Assistant Systems. These two Working Groups gather all the German automotive OEMs and several Tier 1s to collaborate on industry open source platforms.
- At Eclipse, OPEES pioneered the approach that leverages open source for the dissemination and exploitation of research results and encourages the development and sustainability of these technology communities. This approach was then taken up by, among others, the AMASS project with the open source OpenCert, Amalthea4public and Eclipse APP4MC, APPSTACLE and Eclipse Kuksa.

## Introduction to OPEES

In 2012, the first Working Group was created at the Eclipse Foundation. The Eclipse Foundation provides the global community of individuals and organisations with a mature, scalable and commercially-friendly environment for open source software collaboration and innovation. With actors from industrial sectors such as aerospace, transport and energy, this PolarSys Working Group quickly reached a larger community by recruiting both new members and new technologies until it gathered 25 members, including some OPEES partners such as Airbus, CEA and Thales, as Steering Committee members.

When Airbus reached out to the Eclipse Foundation in 2007, it explained the need to setup an organisation similar to the Eclipse Foundation, but for industry collaboration instead of collaboration between software vendors. Companies like Airbus, Thales, Ericsson and others need tools that have properties that fit well with the freedoms offered by open source: to use, study, improve and share software. In industry terms this means the capability to adapt the software to a specific industry context, to support the software for the long term (>10 years) or even the very long term (>50 years), to ease deployment across the supply chain and to ease interoperability through open standards.

## Exploitation

Three noteworthy projects that evolved inside PolarSys are Papyrus, Capella and OpenCert:

- **Papyrus** had been established as an Eclipse project in 2008, prior to the launch of the OPEES project. Aspects of project development were brought under the umbrella of OPEES, and after the project, Papyrus development continued via the collaboration of several industrials led by Ericsson.
- **Capella**, an MBSE tool based on the Arcadia methodology, was launched in the late 2006 as an internal tool at Thales. By 2013, however, and thanks to participation in OPEES, Thales realised that the closed nature of the tooling was an obstacle to larger deployment, especially with an extended supply chain, because subcontractors did not have access to the tool due to its proprietary nature. In 2014 the Capella open source project was created in PolarSys with the goals of lowering the barriers to use and of fostering collaboration. In subsequent years, Capella has been applied in industries such as Aerospace, Automotive, Defence, Energy and Railways.
- **OpenCert** was created in late 2015 by Tecnalia, another partner of the OPEES project, and other partners from the OpenCOSS (FP7) and AMASS (ECSEL) projects. The goal of OpenCert is to create an open source platform for safety and security assurance project management, assurance case management and evidence management while integrating other projects like Papyrus and CHESS for System Design and Analysis.

The principles for industry collaboration through open source, as developed in OPEES, continue to be used in a range of successful Working Groups hosted by the Eclipse Foundation. The structures and initiatives originating with OPEES continue to be successful in other European industries. Industries such as Automotive are benefiting from collaboration on technological innovations to meet specific challenges common to the entire industry and from continuous, sustainable innovation through open source. This model allows industrials to continue to compete in other areas while leveraging common open source assets.

# OPEES

08019

**PROJECT LEADER**

Gaël Blondelle, Eclipse Foundation

**PROJECT START**

January 2009

**PROJECT END**

December 2012

**PROJECT WEBSITE**

https://itea4.org/project/opees.html

**PARTNERS**

*Belgium*
- Barco N.V. ●
- Katholieke Universiteit Leuven ◉
- Space Applications Services NV ⊙

*France*
- Adacore ⊙
- Airbus Operations ●
- Alyotech ●
- Atos Origin Integration ●
- CEA LIST ○
- CNES - Centre National ○
- CS Systemes d'Information ●
- Dassault Aviation ●
- EADS Astrium Sattelites ●
- EADS Astrium Space Transportation ●
- INRIA Rennes Sophia Antipolisd ○
- Institut National Polytechnique de Toulouse (INPT) ◉
- LINAGORA ⊙
- MBDA France ⊙
- OBEO ⊙
- Onera ⊙
- Thales Corporate Services ●
- Xipp ⊙

*Norway*
- ICT-Norway ●

*Spain*
- INDRA ●
- Innovalia Association ○
- Software Quality Systems S.A. ⊙
- TCP Sistemas e Ingenieria ⊙
- Universidad Politécnica de Valencia (UPV) ◉

Sweden
- Combitech ●
- Ericsson ●
- University of Skövde ◉



● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

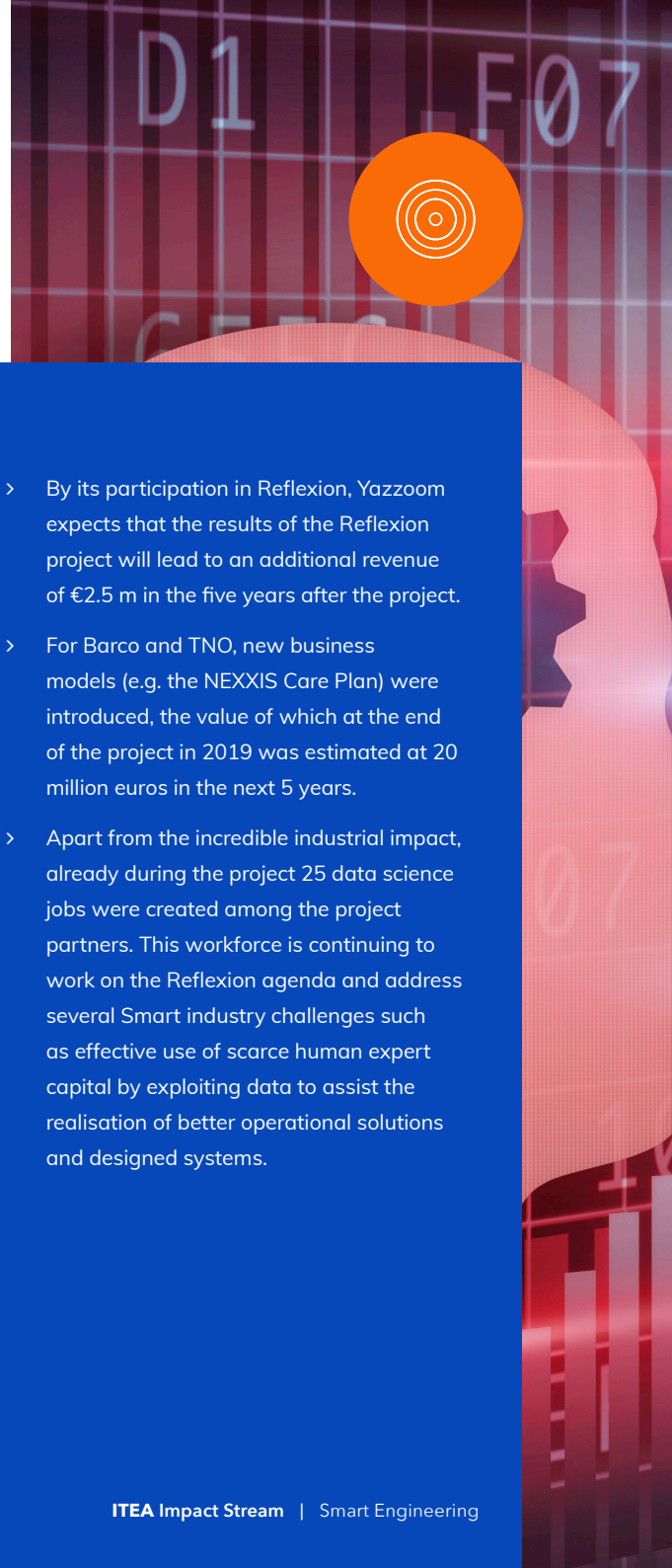
# REFLEXION

## Nourishing high-tech manufacturing with valuable high-quality data

Published September 2021

**The next step forward for the high-tech systems manufacturing domain is to integrate operational data into a product's development lifecycle. While there is an understanding that data can lead to improved processes, less is understood about the necessary roadmaps to get there.**

**The challenge taken up by the ITEA project Reflexion, comprising eight partners from Belgium and the Netherlands, was to support the paradigm shift emerging in high-tech industry from selling 'boxes' to supporting 'integrated solutions', by providing significant improvements in quality and stability during early product rollout. The objectives were defined as follows: to react to unforeseen problems or emerging needs in a fast, cost-effective way by augmenting products with an introspective layer of data sensing and data analytics, thereby creating value out of the high-tech system's operational data which is still characterised by legacy choices based on infrastructural and analytical approaches. Then propagate this knowledge (automatically) back into the product development lifecycle and the service and maintenance flow.**




## Impact highlights

- Thanks to the achievements resulting from the Reflexion project, Axini aims to realise an additional € 2.5m of revenue between 2020-2025 and company growth of 20%.
- Bridging the existing tabular data with log, text and image data allowed SynerScope to bring the first-time-right percentage up from 90% to 99.5%, saving an effective 40 FTE. Structured log analysis and analytics on interaction logs are now part of its user experience monitoring, reducing the time from initial problem to pinpointed bottleneck at least by half. In addition, the structured log analysis has opened up exploitation in new verticals Energy and Oil & Gas, which represents a multimillion-euro market opportunity.
- During Reflexion, Canon Production Printing developed an incredible maturity on the full digital loop and a set of products and methodologies that can be useful for many other European players. Thanks to this new approach, Canon Production Printing has improved its mean time to repair (MTTR) for all new machines by 50%.
- By its participation in Reflexion, Yazzoom expects that the results of the Reflexion project will lead to an additional revenue of €2.5 m in the five years after the project.
- For Barco and TNO, new business models (e.g. the NEXXIS Care Plan) were introduced, the value of which at the end of the project in 2019 was estimated at 20 million euros in the next 5 years.
- Apart from the incredible industrial impact, already during the project 25 data science jobs were created among the project partners. This workforce is continuing to work on the Reflexion agenda and address several Smart industry challenges such as effective use of scarce human expert capital by exploiting data to assist the realisation of better operational solutions and designed systems.

## Project results

Reflexion's success does not lie in a product – a non-existent 'silver bullet' to be applied in all circumstances – but in integrating pre-existing frameworks to improve the consortium partners' processes. There are a wide number of open-source frameworks that specialise in data science, backed by huge communities. Through Reflexion, high-tech systems companies were exposed to these frameworks, helping them to understand what exists and how it can be used to improve their own data management. The addtional introspective layer of data sensing and analytics allowed partners to valorise their operational data and to use the newfound knowledge to improve the development cycle, services and maintenance. Reflexion supported them to create a so-called 'digital loop'.

## Exploitation

The application of data science in manufacturing was new back in 2015 when data use predominantly targeted the control engineering of mechatronic systems. Reflexion introduced another perspective of data exploitation providing a new added value. As a result, the market penetration for the participating tool and service providers grew by 10% in terms of both improved product offering and extended services.

The Dutch SME Axini has further developed and improved its platform for scriptless test automation. The unique property of the Axini approach is that AI and formal method algorithms automate the entire test process. Axini has productised the project's prototypes into its platform and has proven that the new approach is 50% faster and more effective than all other alternatives in the market.
In general, the Dutch SME SynerScope saw a 30% reduction in time spent troubleshooting performance issues at the customer site by using structured log analysis and analytics on interaction logs.

The Belgian SME Yazzoom has further developed and improved the algorithms in its Yanomaly software for anomaly detection and predictive analytics on machine data. In particular, algorithms were created and validated for semi-automatic parsing and anomaly detection in log files.

Additionally, for the OEMs the impact of Reflexion on the growth in turnover and / or market penetration for selected applications was projected at 20%.

Canon Production Printing did agile development with its launching customers for its new inkjet printer. 4GB of daily data from the printer was exploited with the development of an Optimal Diagnosis Analysis System (ODAS). Beyond automatic analysis, they managed to support quick knowledge sharing between the company's different specialists to reach a common understanding of the situation and decide together on what to enhance.
By exploiting data more efficiently, Philips and Barco can now create medical equipment with a higher uptime, allowing to diagnose or operate on more patients per day.
In addition, thanks to Reflexion, Philips partnered up with Yazzoom for further research resulting in the development of a platform for both further research and new services.
Siemens Industry Software has made its first steps into machine learning. It resulted in the development of the new Simcenter Studio tool released in 2021 as a completely new solution in the Simcenter portfolio.

Reflexion turned out to be genuine successful collaboration.

# REFLEXION

07006

**PROJECT LEADER**
Bas Huijbrechts, TNO

**PROJECT START**
September 2015

**PROJECT END**
February 2019

**PROJECT WEBSITE**
https://itea4.org/project/reflexion.html

**PARTNERS**

| *Belgium* | | *The Netherlands* | |
|---|---|---|---|
| Barco | ◉ | AXINI | ⊙ |
| Siemens Industry Software | ◉ | Canon Production Printing | ◉ |
| Yazzoom | ⊙ | Philips | ◉ |
| | | SynerScope | ⊙ |
| | | TNO | ○ |



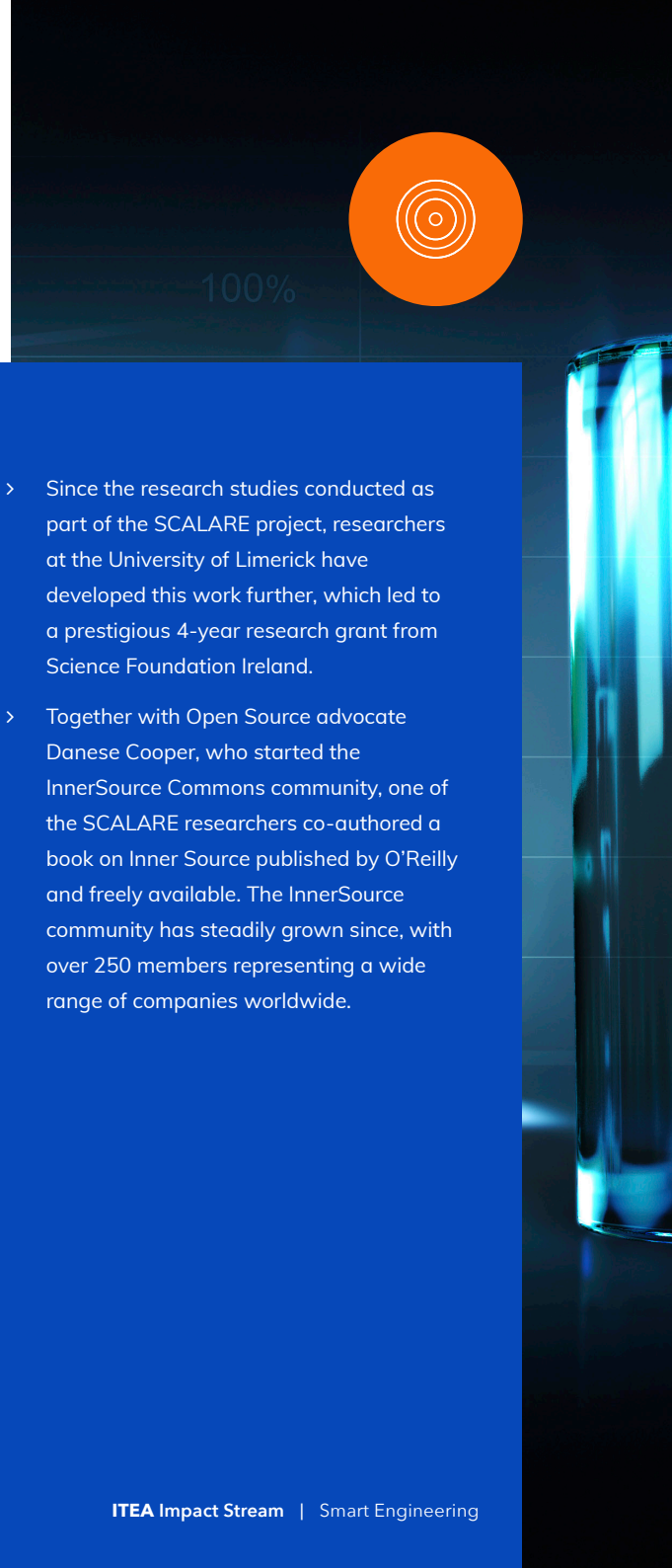
◉ (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# SCALARE

## Systematic guidance to decision makers for scaling scenarios

*Published September 2020*

**Most product innovations today are enabled through software components, so it is no surprise that software is the primary means of competitive differentiation. Software plays a key role in the digitalisation of many products that hitherto were completely driven by electronics, so scaling software in a controlled and efficient way is crucial, and represents a major challenge for organisations. The required transformations are often driven by the technological evolution of products, systems or services as well as by how the business and the company are organised. In many instances, existing processes must be reshaped, and new best practices and tools incorporated. The challenge taken up by the ITEA project SCALARE, a joint effort of industry and academia from five countries, was how to support and enable organisations in scaling their software capability in a systematic, proactive way.**




## Impact highlights

- SCALARE has enabled Husqvarna to make the digital transition, with its team of 4-5 software developers expanding to more than 160 people and enabling a 50% shorter time-to-market compared to 2016.
- For the Swedish consultancy company Addalot, the results of the SCALARE project led to the recruitment of 1 senior consultant working with new consultancy services and an increased revenue of approx. 150 k€ per year and growing.
- Thanks to SCALARE, Softhouse Consulting found a new way to enter the business area and was able to recruit 6 additional senior consultants working with new consultancy services and achieved an increased revenue of over 400k€ per year.
- The book ‘Scaling a Software Business’, published end of November 2017 and freely available as open access under a Creative Commons license, is downloaded 16,000 times by the beginning of 2020.
- Since the research studies conducted as part of the SCALARE project, researchers at the University of Limerick have developed this work further, which led to a prestigious 4-year research grant from Science Foundation Ireland.
- Together with Open Source advocate Danese Cooper, who started the InnerSource Commons community, one of the SCALARE researchers co-authored a book on Inner Source published by O’Reilly and freely available. The InnerSource community has steadily grown since, with over 250 members representing a wide range of companies worldwide.

## Project results

The SCALARE approach is unique in that it provides a holistic vision for scaling in three dimensions: software systems and services, processes and methods, and business and organisation. One of the key outcomes of SCALARE is the Scaling Management Framework (SMF), which organisations can use to assess their software development capability and plan their efforts to scale up that capability. The SMF is an analytical tool that companies can use to assess where they are and define the steps to take to improve their software process.

The SMF and a rich set of case studies are reported in a practitioner-oriented book 'Scaling a Software Business', published end of November 2017. The book is freely available as open access under a Creative Commons license. Building on the first book, which had been downloaded 16,000 times by mid-2020, the Swedish SCALARE project partners published a second book in 2018 based on the scaling management framework from SCALARE, called 'Principles for Industrial Open Source'. This book emphasises that the most innovative software is Open Source and that it is possible to simultaneously support Open Source while keeping parts of the code proprietary.

## Exploitation

In addition to these books, the SCALARE project partners have exploited the strong results in several ways.

The project has enabled Husqvarna to make the digital transition, allowing them to respond to the increasingly demanding customers needs. Husqvarna now has 32 times as many software developers, which equates to 160.

Lero, the Irish Software Research Centre at the University of Limerick developed a prototype of the open source pattern tool ASPIRE that helps managers identify key practices when faced with scaling scenarios. The Inner Source topic, which refers to the adoption of Open Source practices and processes within an organisation, has attracted considerable attention from companies worldwide including Nokia, PayPal, SAP, and Robert Bosch. The research studies conducted as part of the SCALARE project also gained a lot of interest from companies globally. And besides a great number of research studies that were published during the SCALARE project and a Special Issue of Softhouse's magazine, six Masters students completed their theses on the SCALARE topics.

Furthermore, the Continuous Delivery (CD) assessment model was developed by Softhouse Consulting. It defines different maturity levels for various disciplines within the software development lifecycle, necessary to deliver software fast with good quality. With this maturity model, Softhouse Consulting already helped over 30 organisations to understand where they stood in the software development lifecycle, and from there to define where they wanted to go. The Swedish consulting company Addalot also extended its consultancy services portfolio as Open Source and Servitisation consultancy services were introduced.

With an estimated 10,000 people having been reached via numerous organised events, tutorials and keynotes, online videos, the project partners are helping to 'arm' the European industry for the digital transformation!

# SCALARE

12018

**PROJECT LEADER**

Miguel Oltra, Schneider Electric España

**PROJECT START**

November 2013

**PROJECT END**

December 2016

**PROJECT WEBSITE**

https://itea4.org/project/scalare.html

**PARTNERS**

*Finland*
- Aalto University ◉

*Germany*
- Kugler Maag Cie ⊙

*Ireland*
- Goshido ○
- QUMAS ⊙
- University of Limerick ◉

*Spain*
- Schneider Electric España ●
- Telvent ●

*Sweden*
- Addalot Consulting ⊙
- Husqvarna ●
- Lund University ◉
- Sigrun Software Innovation and Engineering Institute ◉
- Softhouse ⊙
- Softhouse Consulting ⊙
- Sony Mobile Communications ●
- Tieto ●



● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# SPEAR

## A new approach to energy optimisation for industry

Published November 2022

**With the first global energy crisis ongoing, energy consumption and optimisation are very important concerns in today's life. This is true for households but definitely also for industrial players, as many of them are still using a lot of energy for their daily processes. However, in industrial plants, energy optimisation is impossible if there is no knowledge on how much energy is needed to perform a production process. And often, there is an unfortunate lack of energy measurement units integrated into real production systems. By precisely calculating energy consumption, industrial customers can save energy and thereby costs. Energy-intensive processes, for example, can be shifted to time windows where cheaper and sufficient energy is available. This plays a significant role in the use of renewable energies such as wind power or solar energy. To overcome this lack of energy consumption knowledge and to make energy optimisation truly accessible, a change is needed.**

**The SPEAR project, which successfully ran from 2017 to 2020 and gathered 22 partners from Germany, Portugal, Spain, Sweden and Turkey, overcomes available energy optimisation approaches by means of a unique mechanism.**

## Impact highlights

- The SPEAR project allows for a greater uptake of renewable energies (such as solar and wind) which were previously difficult to optimise on a large scale due to their weather dependency. This gives SPEAR a vital role in reducing $CO_2$ emissions and slowing the speed of climate change throughout society as a whole.
- Through the smart selection of energy sources, the smart adaptation of process-relevant parameters and the reduction of power peaks, SPEAR has been able to reduce energy costs by roughly 10%.
- The SPEAR project outcomes have provided ÅF with a unique selling point for its service over other competitors, allowing them to receive more orders, which in turn increases the value of their turnover.
- Thanks to the developments in SPEAR, Sensing & Control Systems has three new industrial customers and was able to hire one additional staff member. Sensing & Control Systems has also incorporated the Functional Mock-up Interface (FMI) industrial standard, which increased their reliability and reputation.
- For Reeb-Engineering, the knowledge gained in SPEAR has opened up a completely new field of work in virtual commissioning for a wide range in industrial applications and thus a new business area that is becoming increasingly popular. After the completion of the project, they hired one new employee.
- Thanks to its great achievements, SPEAR received the Eureka Innovation Award for 'Best Sustainability Innovation' during the 2022 Eureka Global Innovation Summit.

## Project results

Instead of using estimated or simplified models for simulation-based optimisation, the SPEAR solution makes use of real device-provided simulation models in order to produce highly accurate forecasts for the energy consumption of industrial production processes. The accuracy of these forecasts, together with the optimisation algorithms developed, enables a significant reduction of energy consumption and costs.

SPEAR created a flexible and highly generic optimisation platform and did not focus on isolated industry sectors; a broad spectrum of application domains was supported, like production processes in common plants, production lines, buildings, hybrid drives, and wind turbine drive trains. The energy-specific optimisation of new and existing production plants during virtual commissioning and running production was also supported.

## Exploitation

By helping companies to optimise their energy usage, SPEAR enables them to manage resources more effectively and increase their productivity in a sustainable manner.

Specifically, with the results of SPEAR and the experience gained in the field of virtual commissioning, Reeb-Engineering is able to already predict the energy consumption of an Automated Guided Vehicle (AGV) during the development process of the vehicle. This prediction allows the optimisation of the battery size, the driving path, the charging time and ultimately the manufacturing and operating costs.
KANCA, one the leading forging companies in Türkiye, has seen a decrease of 4 kWh/kg (8%) thanks to the KANCA Energy Management System that resulted from the project and Atkas, a pioneer in the sector of air suspension system production, has improved its energy optimisation by 5%. Swedish project partner and service provider ÅF has improved its service by being able to consider energy in the virtual commissioning of plants. And Algoryx has updated its AGX Dynamics simulation tool with a new module that can compute energy consumption. This has been used in several research projects that use AI together with the simulation software to create smart control and path planning, for which energy optimisation has been one theobjectives. The customers include users and manufacturers of different heavy machinery in areas like mining, forestry and construction - industries that have a lot of potential when it comes to reducing energy needs and lowering emissions.
Sensing & Control Systems (S&C), a Spanish SME, has integrated the SPEAR results into its proprietary commercial platform, enControl™, extending it from smart homes to the industrial sector and incorporating novel functionalities and services created during project development for the management of ovens and other intensive energy-consuming machineries in related businesses.
In addition to energy optimisation and business impact, several new employees and nine PhD students have been taken on across the consortium as a direct result of the SPEAR project.

SPEAR will allow companies of all sizes to reap such benefits by making its results available as free software prototypes. Further dissemination is taking place through the formation of two standards. This should allow for a greater uptake of renewable energies and give SPEAR a vital role in reducing $CO_2$ emissions and slowing the speed of climate change throughout society as a whole.

# SPEAR

16001

**PROJECT LEADER**

Anton Strahilov, EKS InTec, Germany

**PROJECT START**

September 2017

**PROJECT END**

September 2020

**PROJECT WEBSITE**

https://itea4.org/project/spear.html

**PARTNERS**

*Germany*

- Autoproc ⊙
- EKS InTec ⊙
- FFT Produktionssysteme ●
- let's dev ⊙
- Reeb-Engineering ⊙
- Ruhr-Universität Bochum ◉
- Technische Universität Berlin ◉
- TWT GmbH Science & Innovation ⊙
- University of Paderborn ◉

*Portugal*

- IDEPA INDÚSTRIA DE PASSAMANARIAS ⊙
- Instituto Superior de Engenharia do Porto (ISEP) ◉
- SISTRADE Software Consulting ⊙

*Spain*

- Experis ManpowerGroup ●
- Sensing & Control Systems ⊙

*Sweden*

- ÅF-Industry ●
- Algoryx Simulation ⊙
- University of Technology Chalmers ◉
- Volvo Car Corporation ●

*Turkey*

- Aktas Holding ●
- ENTES Elektronik Cihazlar Imalat ve Ticaret ●
- KANCA El Aletleri ●
- Turkcell Teknoloji Plaza ●



● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# TESTOMAT Project

## Customised test automation, saving time and improving quality

Published November 2023

**In software development, reliability and agility often seem like opposing forces. This issue is aggravated by the increasing complexity of software and the constant drive towards faster release cycles for maximum market impact. Manual testing cannot meet these challenges, yet many safety-critical and hardware-oriented companies believed that test automation was irrelevant to them back in 2017. SMEs, meanwhile, missed out due to a lack of awareness or investments in automated agile testing. To strike the perfect balance between quality and speed, a new approach to automation was needed.**

**The goal of ITEA's TESTOMAT Project, which stands for 'The Next Level of Test Automation' and gathered 34 partners from six countries, was to allow software teams to increase development speed without sacrificing quality. To achieve this goal, the project advanced the state of the art in test automation for software teams, moving towards a more agile and automated development process. The 'next level' differs per organisation and depends on factors such as sector, size and practices. Many automation-related variables are unknown to the organisation, so the project focused on providing software teams with personalised roadmaps for improving their automated testing in a cost-efficient manner.**

## Impact highlights

- The TESTOMAT Project's great strength is its customised nature, which guarantees promising results regardless of the level of automation already found within a company. For those using fully manual testing, an average improvement of 60-80% can be gained in their time to market.
- For already-automated companies, 15-30% fewer faults are predicted thanks to the TESTOMAT Project. These achievements, resulting in fewer bugs in software, are fundamentally important as nowadays people totally rely on and trust, for example, the use of software tools in healthcare, scientific experiments and many more domains.
- An advantage for the Finnish industry partner Ponsse was that the execution of tests was 25% faster with test automation and it was able to could execute tests automatically outside of office hours. Nowadays, Ponsse's simulators run test automation outside of office hours, saving about 500 hours/week of functional testing work for testers. Alongside, Ponsse has been able to reduce defects that could have ended up in the customer's product by 20%.
- Ericsson already carried out completely automatic testing but still saw a 29% improvement in product quality thanks to the TESTOMAT Project.
- Likewise, Saab increased its number of product users by 440%, leading to higher quality in earlier development phases.
- Spanish SME Prodevelop managed a 220% increase in test efficiency using to the TESTOMAT Project outcomes.
- Within the project's duration, the TESTOMAT Project had already established 23 university courses on test automation, 22 industry-academia transfers were reported, as well as 27 new employees within the consortium.
- A book on AI testing has been published by a PhD student who participated in the TESTOMAT Project – and was recruited by Ericsson afterwards – and another book will be released by Springer in the future.

## Project results

Through a Test Automation Maturity Survey, completed by 151 respondents in 101 organisations and 25 countries, the consortium of 34 partners from Finland, Germany, the Netherlands, Spain, Sweden and Türkiye was able to gather the status of test automation and key issues worldwide. On this basis, a Test Automation Improvement Model (TAIM) was developed to define measurable steps for improvement.

Success in the TESTOMAT Project was measured in terms of test effectiveness, test optimisation and quality and standards in testing. To demonstrate the project's versatility, its ten use cases can broadly be grouped into the following categories: trains, planes, telecoms, forestry, machines, robotics, banking, wind turbine maintenance with drones and port integration technologies.

## Exploitation

The TESTOMAT Project's great strength is its customised nature, which guarantees promising results regardless of the level of automation already found within a company. Ponsse, one of the world's largest manufacturers of cut-to-length forest machines, renewed its test automation systems during the project and improved its unit testing and requirements coverage by 64%. In addition, it reduced the time needed for testing and saved many hours of testing work for testers. Finally, the time from development to testing with actual machinery has been reduced, which has also reduced the production time as a consequence.

Likewise, Ericsson also significantly lowered development costs and increased the speed of delivery to customers. And through the TESTOMAT Project, the tooling and methodology of mutation testing has matured enough that Saab is able to use it for large-scale embedded systems consisting of hundreds of distributed components totalling millions of lines of code. The application of the technique has, at Saab, resulted in a significant overall quality improvement of not only the source code and test suite but also the requirements, test specification and developers' understanding of how their programs work. The ripple effects of the quality improvement have led to fewer issues being found when performing formal activities as required by standards, leading to a shorter time to market. Another example is Spanish SME Prodevelop. Thanks to the project, Prodevelop has increased the type and number of tests, many of which have been automated, thereby allowing the company to test more features of its application in less time, increasing the quality of its products and reducing the effort spent on testing.

Subsequent large-scale uptake of the project's innovations will have enormous knock-on effects in society. You can think of increased safety in transportation; thanks to increased use of automation in simulation testing, reliability has increased in many more scenarios. Another aspect is quality of life as society relies on quality software, from automatic maintenance to better patient treatment through healthcare optimisation. Finally, optimised manufacturing and mobility means better resource management and fewer emissions, helping to meet the grand challenge of the energy transition.

In summary, the TESTOMAT Project has changed the minds of hardcore manual testers in everyday companies and automated testing is now an accepted practice in almost all companies that produce software.

# TESTOMAT Project

16032

**PROJECT LEADER**

Sigrid Eldh, Ericsson, Sweden

**PROJECT START**

October 2017

**PROJECT END**

December 2020

**PROJECT WEBSITE**

https://itea4.org/project/testomatproject.html

**PARTNERS**

*Finland*
Comiq ⊙
EfiCode ⊙
Ponsse ●
Qentinel Quality Intelligence ⊙
Siili Solutions ●
Symbio ●
University of Oulu ◉
VTT ○

*Germany*
AKKA Germany ●
EKS InTec ⊙
Expleo Germany ●
FFT Produktionssysteme ●
Fraunhofer FOKUS ○
Institut for Automation und Kommunication (IFAK) ○
OFFIS ○
Parasoft Deutschland ⊙

*The Netherlands*
Axini ⊙
Testwerk ⊙
The Open University of The Netherlands ◉
TNO ○

*Spain*
Alerion Technologies ⊙
Prodevelop ⊙
University of Mondragón Goi Eskola Politeknikoa ◉

*Sweden*
ALSTOM Rail Sweden ●
Empear ⊙
Ericsson ●
KTH (Royal Institute of Technology) ◉
Mälardalen University ◉
RISE Research institutes of Sweden ○
Saab ●
System Verification Sweden ⊙
Verifyter ⊙

*Turkey*
Kuveyt Turk Bank ●
Saha Bilgi Teknolojileri ⊙

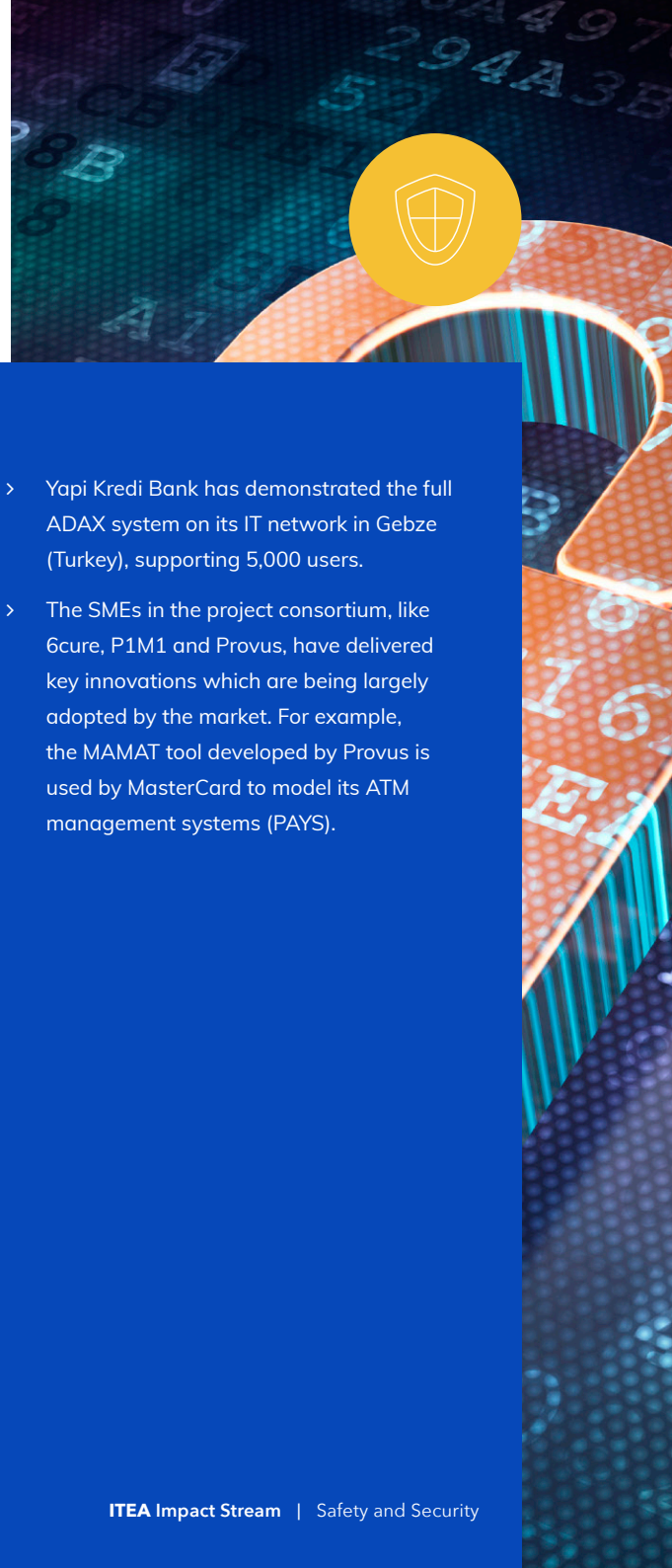
● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# ADAX

## Business excellence in cybersecurity

*Published December 2017*

**Cybersecurity is vital to any person or entity, from consumer to government, involved in conveying information. The key lies in being able to detect attacks and react quickly and efficiently by launching appropriate countermeasures. While a number of commercial off-the-shelf cyberdefence tools exist, there is a clear need in today's market for detection to be extended with reaction capabilities and support mechanisms to enable security operators to make informed decisions in a dynamic situation. The ITEA 2 project ADAX has delivered a set of key innovations improving prevention, detection, decision support, countermeasure enforcement and knowledge management to support security operation on complex and critical IT infrastructures.**



## Impact highlights

- For a random set of attack scenarios, a decision time-saving from 1 hour to 3 minutes and a reduction in average response cost from €271 k to €100 k was achieved.
- A total of 12 customer contracts have been reported directly linked with the project results, addressing diverse vertical markets like finance, military, retail, space and oil & gas.
- ADAX is known to have directly contributed to €7 m of the €33 m turnover recorded by Cassidian Cybersecurity SAS in 2014 and led to the recruitment of 6 engineers. By 2016, all developments from ADAX had been embedded in the Cymerius® commercial version.
- The mixed-signature based intrusion prevention system developed by NETASQ has been deployed by Stormshield on more than 10,000 appliances.
- Yapi Kredi Bank has demonstrated the full ADAX system on its IT network in Gebze (Turkey), supporting 5,000 users.
- The SMEs in the project consortium, like 6cure, P1M1 and Provus, have delivered key innovations which are being largely adopted by the market. For example, the MAMAT tool developed by Provus is used by MasterCard to model its ATM management systems (PAYS).

## Project results

Innovations include a hybrid detection technique in which behaviour-based and signature-based detection are combined. The former is a probabilistic approach that helps to identify new attacks (0-day attacks) while the latter is a deterministic approach that is largely applied to known attacks. Combining both techniques helps improve detection rates, lower false-alarm rates and shortens the detection time, saving both time and costs for customers and security service providers in the detection phase.
Improved detection of new complex attacks (detection rate of 98.7% and false alarm rate <1%) and acceleration of the detection-to-remediation loop resulted from the development of enhanced decision-support tools along with a network simulation tool to enable attack and countermeasure impact to be assessed before implementation on a real IT infrastructure. A new metric, 'Return-On-Response-Investment' (RORI), was set up to calculate the 'cost-benefit' of the different countermeasures that can be implemented to remediate to a particular attack.

A complete ADAX advanced simulation environment, consisting of different interacting modules supplied by different partners, was delivered and demonstrated in a real environment at the premises of Turkish project partner and on-board end user Yapi Kredi Bank.

## Exploitation

Airbus DS Cybersecurity added the countermeasure optimisation tool to Cymerius® security supervision software for exploitation by its Security Operation Centre and it is also available as a software product, with 5 key contracts awarded by key customers from the financial, defence, retail, oil&gas and space sectors. The added value of ADAX quantified cyber-risk assessment capability has been recognised by the Federation of European Risk Managers (FERMA) and will be integrated in Airbus Cybersecurity portfolio under the brand of "CyPRES-RM®".

Institut Mines-Télécom developed and patented a mechanism to assess the impact of attacks and countermeasures on multiple criteria (Attack Volume Mechanism) and to quantify the RORI to improve the quality and cost of the remediation.

The Intrusion prevention mechanism developed by NETASQ is embedded in the new Stormshield Network security appliance, providing mixed-signature detection capability with lower false alarm rate.

6cure developed the Countermeasure enforcement tool, providing automated construction, deployment, accounting and deployment of countermeasures to shorten remediation time. This made it possible to deploy countermeasures in seconds, instead of the minutes or hours it previously took for manual operations. This resulted in the company being awarded a contract with a French Internet Service Provider.

P1M1 developed the Intrusion detection system, providing hybrid detection capability with improved detection rate regarding new attacks, for which it was awarded contracts with 2 major telecom & transaction companies and a major financial institution.

Provus developed the Model acquisition and maintenance (MAMAT), providing automated large scale information network modelling capability, saving time for experts in network topology activities. MasterCard now uses the MAMAT tool to model ATM management systems (PAYS) to analyse and strengthen security.

# ADAX

10030

**PROJECT LEADER**

Adrien Bécue, Cassidian Cybersecurity

**PROJECT START**

January 2013

**PROJECT END**

April 2015

**PROJECT WEBSITE**

http://adax.boun.edu.tr

**PARTNERS**

| *France* | | *Turkey* | |
|---|---|---|---|
| 6cure | ⊙ | Bogazici University | ◉ |
| Cassidian Cybersecurity | ● | PlusOneMinusOne | ⊙ |
| Institut Mines-Télécom | ◉ | Provus A.S. | ⊙ |
| NETASQ | ⊙ | Yapi Kredi Bank | ● |

# RECONSURVE

## Reconfiguring the maritime surveillance seascape

*Published December 2017*

**The rapid ongoing rise in the global surveillance and security market is beset by a number of problems: fragmented surveillance systems, lack of information-sharing on standards, agreements, policies or processes, the difficulty of detecting small vessels used for illegal purposes or in extreme weather conditions, uncoordinated and diverse sensor data, and the unpredictable and constantly changing behaviour of suspicious vessels. The challenge faced by RECONSURVE was to develop an open interoperable maritime surveillance framework that can enable existing systems to share information and so improve maritime security.**

## Impact highlights

- The RECONSURVE project had a large user orientation; the Turkish Coast Guard Command participated in the project as an end user, and provided invaluable guidance throughout with its domain expertise. Further exploitation is planned for 2018-2020 by Aselsan with the Turkish Coastguard and Turkish Navy.
- Through the licensing of marine terminals and analysis systems developed through the RECONSURVE project, GMT generated an income of about €1410 k.
- Before GMT started participating in EUREKA around 2011, their annual revenue was USD 4 million. Now it has more than tripled, to 14 million. And it is expected to be in the region of 20 million in 2018. This would not have happened without their involvement in projects like RECONSURVE.
- For Evitech, the income which is created by participating in the RECONSURVE project is about €1000 k.
- Participation in the RECONSURVE project helped SMEs like SRDC to enter new markets and increase their product portfolio. Furthermore, the project paved the way for further future cooperation between SMEs like Evitech with large industries like Airbus.

## Project results

The project developed a complete maritime surveillance system with situational awareness, smart sensor data processing, the ability to use several platforms with a variety of sensor types and advanced algorithm-based capabilities for unmanned aerial vehicles (UAVs) and thermal cameras. Algorithms were developed for vessel recognition integrated in a ground station for small boat detection, vessel classification and behaviour analysis, including threat assessment.

Innovation is evident in the actual integration of multimodal sensors (including UAVs) for global maritime surveillance and situational awareness, and in the development of natural human-machine interfaces for managing complex command and control systems along with a complete smart system to support command & control centres.

The technical capabilities were demonstrated in two scenarios. First, at the Turkish Coast Guard Command facilities in Antalya, Turkey, vessels revealing suspicious behaviour were detected successfully by the situational awareness component of the RECONSURVE system. A second large live demonstration was performed in Brest, France, with the participation of the French Coastguard.

## Exploitation

**Aselsan** has improved its current portfolio with new features and capabilities, situational awareness capability and a new smart decision support functionality based on image processing and behavioural analysis. The main exploitation of the situational awareness and vessel classification component is planned for 2018 – 2020 with the Turkish Coastguard and Turkish Navy.

Being its first maritime surveillance project, RECONSURVE directed **SRDC** to this new market and encouraged the company to develop its Plug-and-Play Sensor Interoperability Platform, and increase its product portfolio. Currently, SRDC is starting marketing activities for this product.

The automation of the identification and classification data chain, developed in the context of the RECONSURVE project, has now been implemented in the **AIRBUS RPAS** and light mission aircraft for maritime surveillance missions. According to customer requirements, the architecture of the ground station can be customised to integrate internal or external algorithms for ship detection and classification; cooperation with Evitech and GREYC could be reinforced during future projects.

**Evitech** has sold several licences of the auto-tracking algorithm for military site surveillance. Evitech is proposing to reuse and improve the RECONSURVE algorithms in a joint project with Airbus. Evitech has also established a longer term cooperation with GREYC and will start a new project with them in 2018.

The French naval academy (**École Navale**) has exploited research in the detection of suspicious behaviour and maritime situational awareness into a large more generic approach that also considers cyber-attacks that affect maritime operational surveillance.

After RECONSURVE, **GMT** is expanding products and solutions for the ship safety and security authorities by improving vessel navigation pattern analysis and collision risk analysis capabilities based on information gathered from the operating systems. In addition, the improved artificial intelligence algorithm has been applied to the SMART-Navigation system of the Ministry of Maritime Affairs and Fisheries in Korea, to comprehensively analyse and monitor the maritime risk situation. Furthermore, GMT is supplying the RECONSURVE results to the Korea Coast Guard by providing a solution for managing automatic entry and departure of fishing vessels, responding to distress incidents, and the monitoring of illegal fishing.

# RECONSURVE

09036

**PROJECT LEADER**

Cengiz Erbas / Burcu Yilmaz, Aselsan

**PROJECT START**

January 2011

**PROJECT END**

June 2015

**PROJECT WEBSITE**

https://itea4.org/project/reconsurve.html

**PARTNERS**

| *France* | | *Republic of Korea* | | *Turkey* | |
|---|---|---|---|---|---|
| Airbus Defence & Space | ● | GMT | ● | Aselsan | ● |
| Ecole Navale - IRENav | ◉ | | | SRDC | ⊙ |
| Evitech | ⊙ | | | | |
| GREYC | ◉ | | | | |
| Institut Mines-Télécom ATOL | ◉ | | | | |
| Thales S.A. | ● | | | | |



● (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

# SAFE

## Sustaining automotive safety standards and standardisation

*Published December 2017*

**Driving on the road is a way of life. Being able to get safely from A to B is something we take for granted. And today driving is safer than it was ten years ago, and ten years before that, and in ten years time it will be even safer. In 2011, a new standard, ISO26262, was published for the functional safety-related aspects during the safety lifecycle of systems related to electrical, electronic and software elements that provide safety critical functions. The goal of the SAFE project was to enable the automotive industry to comply effectively with this ISO26262 by providing model-based development processes that integrate functional and safety development based on existing development lifecycle processes.**

## Impact highlights

- SAFE was an essential part of the jigsaw in establishing ISO26262, a worldwide standard and one of the most important in the automotive industry.
- SAFE enabled the automotive industry to comply effectively with ISO26262, which is mandatory for all OEMs and suppliers. SAFE realised the first incorporation of ISO26262 in a standardised Architecture Description Language (ADL) while the SAFE guidelines provide an interpretation of the ISO26262 standard to the market.
- SAFE has set the foundation to enable EAST-ADL, AUTOSAR, OMG and other standards to evolve as well as helped to identify limitations of the ISO26262 such that the basic standard itself can also be improved in subsequent iteration.
- Thanks to the SAFE project, Continental established the ISO26262 compliance in two major domains, namely the safety critical domains of powertrains and chassis brake systems. These domains represent 40% of Continental's product share and thanks to the SAFE project, Continental was able to keep its leading role in these domains.

## Project results

SAFE developed new concepts to model safety and architecture as well as methods for safety analysis, variant management and safety code generation based on the modelling languages EAST-ADL and AUTOSAR. In addition, an exchange format was created that is compliant with the existing standards, enriched with the SAFE meta-model formats. This represents a major step in direction of integrated, model-based design in the tool market of the automotive industry. The resulting tools provide functionality for integrated development and safety analysis on each abstraction level – requirements, architecture, hardware design, software modelling and coding. Finally, a guideline developed by SAFE, formalised in a process model and containing an assessment model, provided an interpretation to help the industry to come to a unique, commonly agreed interpretation. The evaluations during the project were made with the help of real industrial developments. These included existing products such as a powertrain e-gas concept and electronic steering column lock system as well as developments of new, innovative products like an electrical brake system and a mixed criticality HW/SW platform.

## Exploitation

As a result of the SAFE project, Dassault Systèmes developed a Smart, Safe & Connected Car solution, offering customers the 3DExperience platform© designed to give automotive developers a very specific way to manage the kind of embedded systems that have become a growing challenge in the automotive industry. This new solution also helps customers ensure they are compliant with the ISO26262 and Automotive Open System Architecture (AUTOSAR) safety standards.

Vector Informatik implemented FMEA, a model-based qualitative safety analysis method, and added malfunction modelling capabilities in its PREEvision tool, a software application that supports architects, network designers, development engineers and test engineers through the entire development process.

pure::systems has seamlessly integrated pure::variants into the SAFE platform, enabling the variant management capabilities of pure::variants for contexts with safety related assets whereby the development process becomes up to 20% more efficient, faster and more reliable.

OFFIS extended the model-based safety analyses towards security aspects in such a way that the occurrence of hazardous events can be investigated not only with respect to relevant faults (of the system) but also with respect to relevant threats. In the future all results will be embedded as part of a contract-based design theory allowing the construction of compositional safety cases.

TTTech developed a safety layer software package enabling designers to use AUTOSAR QM basic software within safety relevant applications up to automotive safety integrity level D, and developed a safety issue hardware, satisfying particular safety requirements. This enables TTTech to provide a means whereby application developers can reuse existing non-safety relevant software building blocks in highly safety relevant applications, reducing development time and cost and mitigating the risk of the reuse of proven software elements.

# SAFE

07006

**PROJECT LEADER**

Stefan Voget, Continental Automotive GmbH

**PROJECT START**

July 2011

**PROJECT END**

December 2014

**PROJECT WEBSITE**

https://itea4.org/project/safe.html

**PARTNERS**

*Austria*

- AIT ○
- TTTech Computertechnik AG ⊙

*France*

- Continental Automotive France SAS ◉
- Dassault Systèmes ◉
- itemis France ⊙
- Laboratoire Bordelais de Recherche enInformatique ○
- Valeo ◉

*Germany*

- AVL GmbH ◉
- BMW Car IT GmbH ◉
- Continental Automotive ◉
- Continental Teves AG & Co. oHG ◉
- Forschungszentrum Informatik (FZI) ○
- Fortiss ○
- Infineon Technologies AG ◉
- OFFIS ○
- pure::systems GmbH ⊙
- TÜV NORD Mobilität GmbH & Co KG ◉
- Vector Informatik GmbH ◉
- ZF Friedrichshafen AG ◉



◉ (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government

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