# ARTEMIS BOOK OF SUCCESSES

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# Contents

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*Eric Schutz*

INTRODUCTION

# ARTEMIS Book of Successes

The ARTEMIS Programme: a long road to successes, a long road paved with success stories! Yes, it was a long road. It took four years, from 2004 until the end of 2007 to prepare the ARTEMIS Joint Undertaking, and now, at the beginning of 2013, we have six years of fantastic collaboration behind us: a unique collaboration between all stakeholders of the Embedded Systems world, from the main European Large Enterprises, the most dynamic and promising SMEs, the most famous European Universities and Research Institutes, to most of the countries in the European Union, and the European Commission.

After five annual calls, and more than 50 projects, some of them already finished, some others just going to start, we can be proud about the results already achieved. In this book, you will read and understand more about some remarkable success stories. Those projects are the foundations of the global ARTEMIS construction. They will give you an idea about what this global construction will look like in five years from now.

I am absolutely convinced that, when observers and analysts look at the ARTEMIS programme at the end of this decade, they will conclude that ARTEMIS has been a unique programme.

- ARTEMIS is the largest R&D effort ever for Embedded Systems for Safety-Critical Systems.
- ARTEMIS has focused its R&D activities on projects addressing the main societal challenges of the beginning of this 21st century, from the health issues of our ageing society to electro-mobility in our evolving cities, energy management in our homes and offices, and so many other challenges impacting our daily life, and the future life of our children.
- ARTEMIS has created new Centres of Innovation Excellence, changing the way European stakeholders collaborate.

So, I wish that you enjoy reading about these Success Stories. They have contributed to the success of ARTEMIS.

Eric Schutz
*Executive Director ARTEMIS Joint Undertaking*

"ARTEMIS is a proven concept for R&D actors in Embedded Systems. The Industry Association represents an influential network of more than 200 members from all over Europe ... "

*Heinrich Daembkes*

PREFACE

# ARTEMIS in the driving seat

I have been a member of the ARTEMIS Steering Board since 2007 and in that time have had the privilege to experience at close quarters many of the successes that have been achieved by what has become a real European community for Embedded Systems. Now, in my role as President of ARTEMIS Industry Association, it is with pride and pleasure that I introduce this Book of Success Stories.

ARTEMIS is a proven concept for R&D actors in Embedded Systems. The Industry Association represents an influential network of more than 200 members from all over Europe, and is gearing up for the next phase as we discuss with the European Commission, key members of the European Parliament and Member States about the best way forward. This is a very interesting phase because it gives us the opportunity to benefit from the experience of the processes of the last six years and improve them where required.

This Book of Success Stories bears testament to what we have achieved during this period. Achievements that are the result of the combined effort defined by all the stakeholders. In ARTEMIS, we have have – for the first time on common European level – a common strategic research agenda, developed using both a top-down and a bottom-up approach, integrating all important stakeholders in a combined effort. This enables ARTEMIS to bring together the best available resources specifically on embedded systems to achieve the focus that makes a difference. It really puts ARTEMIS in the driving seat for the European Embedded Systems community.

While I realise that we still have some way to go, and that the future and speed of change may have surprises in store, I am proud of all these achievements made within the ARTEMIS programme. We have already come a very long way and through the community that has been created are focused on the role of embedded systems in rising to the grand societal challenges. What you will read in this book will, I hope, make you feel as proud as I do of the successes the ARTEMIS programme has brought to industry and society.

Heinrich Daembkes
*President ARTEMIS Industry Association*

chapter I

# Introduction
# Programme Successes
## summary & purpose

In terms of projects launched from Calls to date, ARTEMIS has reached its mid-point. With the publication of a revision of the ARTEMIS SRA in 2011 and new initiatives in the Call 2012 (AIPPs), this Portfolio Analysis gives a description and state of play of the programme's "ASP" projects up to Call 2011 (i.e. all projects whose technical content and evaluation/selection criteria fell under the concepts, vision and strategy described in the original ARTEMIS SRA).

The ARTEMIS Joint Undertaking's annual calls each release an Annual Work Plan (AWP), which serves to describe the technical content of proposals submitted for each Call. This AWP is, in turn, derived from a Multi-Annual Strategic Plan (MASP) and Research Agenda (RA), which lays out the general strategies for a series of subsequent calls. The MASP itself is derived from the over-arching vision described in the ARTEMIS SRA, and both MASP/RA and the AWPs are proposed by the members of the ARTEMIS Industry Association – the private partner in the public-private partnership that is the ARTEMIS-JU.

Each AWP splits the programme into a set of eight "ARTEMIS Sub Programmes" (see further for details). While the fine detail of the description or the title of each sub-programme has evolved over the four Calls, the basic thematic content of each has remained the same.

Due to the trans-national component of the funding mechanism (with currently 23 participating ARTEMIS Member States) it was deemed not to be useful to modulate the budget allocated to each sub-programme as a means of steering the programme. Instead, all sub-programmes have been open in each Call, with no 'earmarking' of parts of the budget for any specific one.

The ARTEMIS programme, with its four calls from 2008 to 2011, to date has amassed a total of 44 projects:

- Call 2008 – 12 projects
- Call 2009 – 13 projects
- Call 2010 – 10 projects
- Call 2011 – 9 projects

A key aspect of the ARTEMIS-JU MASP is that it promotes "Self-Sustaining Innovation Ecosystems" to maximise R&D impact. It is already evident from this that some powerful project clusters have emerged, which will be discussed in more detail later on. It is the strong belief of those involved in the ARTEMIS programme that such clustering is a vital aspect in facilitating the concrete valorisation of R&D project results, and therefore converting the R&D efforts into true innovations in products, services and relevant approaches.

# 1.1

## HISTORICAL BACKGROUND – THE ARTEMIS SRA (SRA / MASP / AWP guidance approach)

In response to an initiative of European Commissioner Liikannen in 2004, a European Technology Platform for Embedded Systems was established. In the document "Building ARTEMIS", a high-level group of industry leaders identified the path towards establishing a Joint Technology Initiative, resulting in the "ARTEMIS ETP". With a clear governance structure the ARTEMIS ETP became more than an informal discussion group and brought a large cross-section of the European ICT/systems industry together to define a VISION and detailed STRATEGIC RESEARCH AGENDA (SRA) for Europe. Published in 2006, this served as the basis on which the ARTEMIS-JU programme was developed.

The VISION centres on the ubiquity of Embedded Systems and the economic and societal importance of innovation in this branch of ICT.

The AGENDA recognises a number of research challenges and addresses new ways of stimulating INNOVATION (as the driver of economic well-being). It also proposes ideas for new ways of funding RD&I, intended to empower European companies to achieve better valorisation of R&D results and using the Public-Private Partnership model as a means of implementing the "Joint Technology Initiative" concept. This, in turn, led to the European Council decision to ratify the establishment of the ARTEMIS Joint Undertaking (JU) in 2008.



# 1.2

## THINK BIG

*The ARTEMIS-JU was set up to implement relevant parts of the ARTEMIS SRA*

From its outset, the ARTEMIS-JU has adopted the vision and main goals (mission) described in the ARTEMIS SRA:

***Mission statement:*** *to define and implement the Research Agenda for the development of key technologies in the field of Embedded Computing Systems, by creating a sustainable public-private partnership and leveraging increasing private and public investment in the sector of embedded systems in Europe.*

***Vision and Objectives:*** *The ARTEMIS-JU aims to achieve effective coordination and synergy of resources and funding from the industry, the Framework Programme, national R&D programmes and intergovernmental R&D schemes, thus contributing to strengthening Europe's future growth, competitiveness and sustainable development.*

***Values:*** *ARTEMIS seeks to foster collaboration between all stakeholders such as industry, including small and medium-sized enterprises (SMEs), national or regional authorities, academic and research centres, pulling together and focusing the research effort. The ARTEMIS-JU adopts a commonly agreed research agenda closely following the recommendations of the Strategic Research Agenda developed by the ARTEMIS Technology Platform. This Research Agenda identifies and regularly reviews research priorities for the development and adoption of key technologies for embedded computing systems across different application areas in order to strengthen European competitiveness and allow the emergence of new markets and applications important to society.*

***Strategy:*** *The ARTEMIS-JU will support R&D activities through open and competitive calls for proposals published annually to attract the best European research ideas and capacities in the field of Embedded Computing systems. Proposals submitted to ARTEMIS-JU calls undergo a technical evaluation and selections process carried out with the assistance of independent experts. This process ensures that allocation of the ARTEMIS Joint Undertaking's public funding follows the principles of equal treatment, excellence and competition.*

The Council Regulation that established ARTEMIS clearly demarcates the responsibility for defining the technical work programme to the private partner in the JU (the ARTEMIS Industry Association, ARTEMIS-IA) and for decisions on financial matters to the public sector partner (representatives of the participating Member States and the European Commission). The ARTEMIS-JU Office, under the guidance of its Executive Director, fulfils the necessary management of all the operational aspects of the programme's execution.

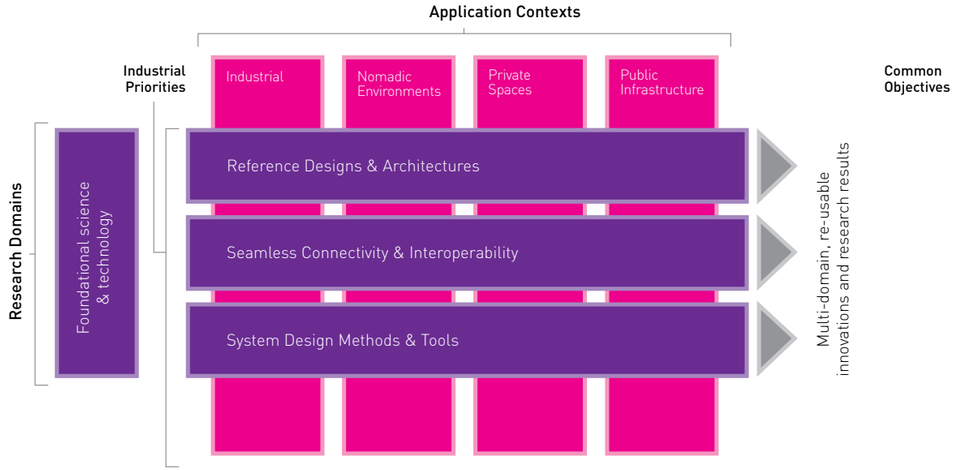
In order to reinforce the larger perspective of ARTEMIS' goals, being primarily to boost valorisation of R&D results and to stimulate true Innovation (with a capital 'I') as opposed to scientific novelty, four guiding principles were adopted:

**"Think BIG"** i.e. consider that ARTEMIS projects should have appropriate critical mass and societal insight to assure significant impact of the public funds used ("taxpayer value-for-money"). This is moderated by observing that "Big" refers to the IMPACT of a project, not necessarily its size in term of partners or total budget, the idea being the ARTEMIS adage that the programme should comprise some "large projects supported by smaller, targeted initiatives".

**"Act Socio-Economic":** the main goals being improved industrial efficiency "... to strengthen European competitiveness and allow the emergence of new markets and societal applications," i.e. a focus on key technical issues, solving high-visibility problems with results that can be commercially valorised.

**"Act Multi-national"** (= "Act Pan-European"), consider national and/or regional strategic priorities and specific specialisations available within the diversity of the European Union.

**"Think Different":** strive for significant and complementary added-value to existing programmes and projects.






# 1.3

## SRA / MASP / AWP TARGET SETTING

*The ARTEMIS SRA classifies the work to be done into "Application Contexts".*

As described above, the ARTEMIS-JU was set up to implement relevant parts of the ARTEMIS SRA, using a new financing model combining National and EU funds, following the 2006 ARTEMIS SRA Vision and with a work programme derived from that SRA.

In order to describe its own work programme, the ARTEMIS-JU publishes a Multi-Annual Strategic Plan ("MASP") and a Research Agenda ("RA", being the work programme for each Call). An important component of this is that ARTEMIS has an industry-led, DESCRIPTIVE work programme, i.e. using "top-down" strategic guidance to define and structure the work, specific details of the programme being provided by the industrial participants in a "bottom-up" mode with "Market Innovation" as its central theme. In this way, the ARTEMIS-JU programme seeks the complementary middle-ground between the prescriptive Framework Programme (EC) and the very open Eureka (trans-national) programmes.

The ARTEMIS SRA classifies the work to be done into "Application Contexts". Each application, of course, has its own specificities, but the underlying technologies can and should, wherever practical, be re-used. To distinguish them from the far-from-market foundational science and technology work, these underlying technologies are called the "Industrial Priorities" and to encourage re-use across the different context, they are diagrammatically arranged in horizontal actions that support the (vertical) application contexts.

This basic concept has been adopted in the ARTEMIS-JU technical work programme, implemented as a set of eight "ARTEMIS Sub-Programmes" (ASPs). The ASPs (listed below) have evolved during the execution of the programme, in terms of their names and detailed content, though the generic outline has remained constant. As the ARTEMIS-JU programme is an industry led initiative with a strong, market-facing character, the foundational science and technology aspects are de-emphasised though not eliminated completely.

### The 8 ARTEMIS Sub Programmes (ASPs)

**ASP1:** Methods and Processes for Safety-relevant ES
**ASP2:** Embedded Systems for Healthcare Systems
**ASP3:** Embedded Systems in Smart Environments
**ASP4:** Manufacturing and Production Automation
**ASP5:** Computing Platforms for Embedded Systems
**ASP6:** ES for Security and Critical Infrastructures Protection
**ASP7:** Embedded Technology for Sustainable Urban Life
**ASP8:** Human-centred Design of Embedded Systems

"An important aspect of the ARTEMIS SRA, and consequently of the ARTEMIS-JU work programme, is the will to strengthen Europe's ability to convert its excellent scientific, research and development capability into commercially viable products and services, or improved production methods for existing products ..."

# 1.4

## PROJECT QUALITY

*In the Multi-Annual Strategic Plan of the ARTEMIS-JU, this is approached through the vision of establishing "Self-sustaining Innovation Eco-Systems"*

An important aspect of the ARTEMIS SRA, and consequently of the ARTEMIS-JU work programme, is the will and strength of Europe's ability to convert its excellent scientific, research and development capability into commercially viable products and services or improved production methods for existing products.

In the Multi-Annual Strategic Plan of the ARTEMIS-JU, this is approached through the vision of establishing "Self-sustaining Innovation Eco-Systems", which past experience shows can be brought about by the attainment of sufficient "critical mass" with enough industrial "buy-in" of (non-differentiating) technological solutions (see the ARTEMIS SRA document on Innovation Environment). While respecting the pan-European vision of the programme, it is the expectation that such Innovation Eco-Systems can condense to form structured "Centres of Innovation Excellence" ("CoIE", modelled on the existing "Competitiveness Centres" or simply "Centres of Excellence" for scientific work). The ARTEMIS Industry Association has initiated a labelling scheme to enable these CoIEs to be recognised as such.

On this point, the ARTEMIS-JU faces a limitation in that the funding it provides can be used only for R&D activities – supporting activities that can financially support such non-R&D activity are not fundable under the present scheme.

To address this, and encouraged by the ARTEMIS-JU Office, the ARTEMIS community has adopted the idea that project clustering is a valuable first step towards establishing CoIEs and has implemented this through a series of annual inter-project workshops called ARTEMIS Technology Conferences.

### 1.4.1 Intangibles and longer-term impacts

The ARTEMIS Industry Association maintains a number of working groups in support of the programme. In addition to defining the technical work programme, these groups, voluntarily supported "in kind" by the industrial and academic employers of the people involved, address topics that are peripheral to the ARTEMIS programme today yet have an important role for the future. These include Standardisation (which has resulted in the adoption of the PROSE* strategic document on standardisation), Open Source, Education and SME involvement as well as the WG Success Criteria and Metrics in particular, the work and output of which are described below.

*(*PROSE is a project funded under the FP7, set up by members of the ARTEMIS community specifically for the benefit of the ARTEMIS programme).*

### 1.4.2 The WG Success Criteria and Metrics

In order to monitor the progress of the ARTEMIS-JU programme, a specific working group, "Success Criteria and Metrics", was set up. Its goal is to address the difficulty of converting the generic targets described in the ARTEMIS SRA, which had been taken up in the Council Regulation establishing ARTEMIS-JU, into measurable quantities and baselines. This it approached by means of a bottom-up study using a targeted questionnaire to the participants in ARTEMIS projects, and the results of the first such questionnaire were published in 2011. The detailed results of a second questionnaire show that ARTEMIS is gaining momentum on several important "intangibles" for the programme:

- Networks have been established and are fully operational. New partnerships and SME involvement have grown
- The Industry-driven approach and the combination of scientific & industrial views are considered to be key strengths and motivators within the ARTEMIS community
- There is growth of awareness of and interaction with "CoIEs"
- Business impact has been mostly observed in reduced development costs, reduced time to market and higher re-usability
- The ARTEMIS AWP targets, revised for each call, are a living instrument
- The societal challenges, led by "security and safety", are addressed properly
- The building of prototypes and demonstrators has seen growing attention, including public trials and/or field tests
- There has been increasing attention to press releases and press coverage, bringing ARTEMIS more into the public domain.

# 1.5

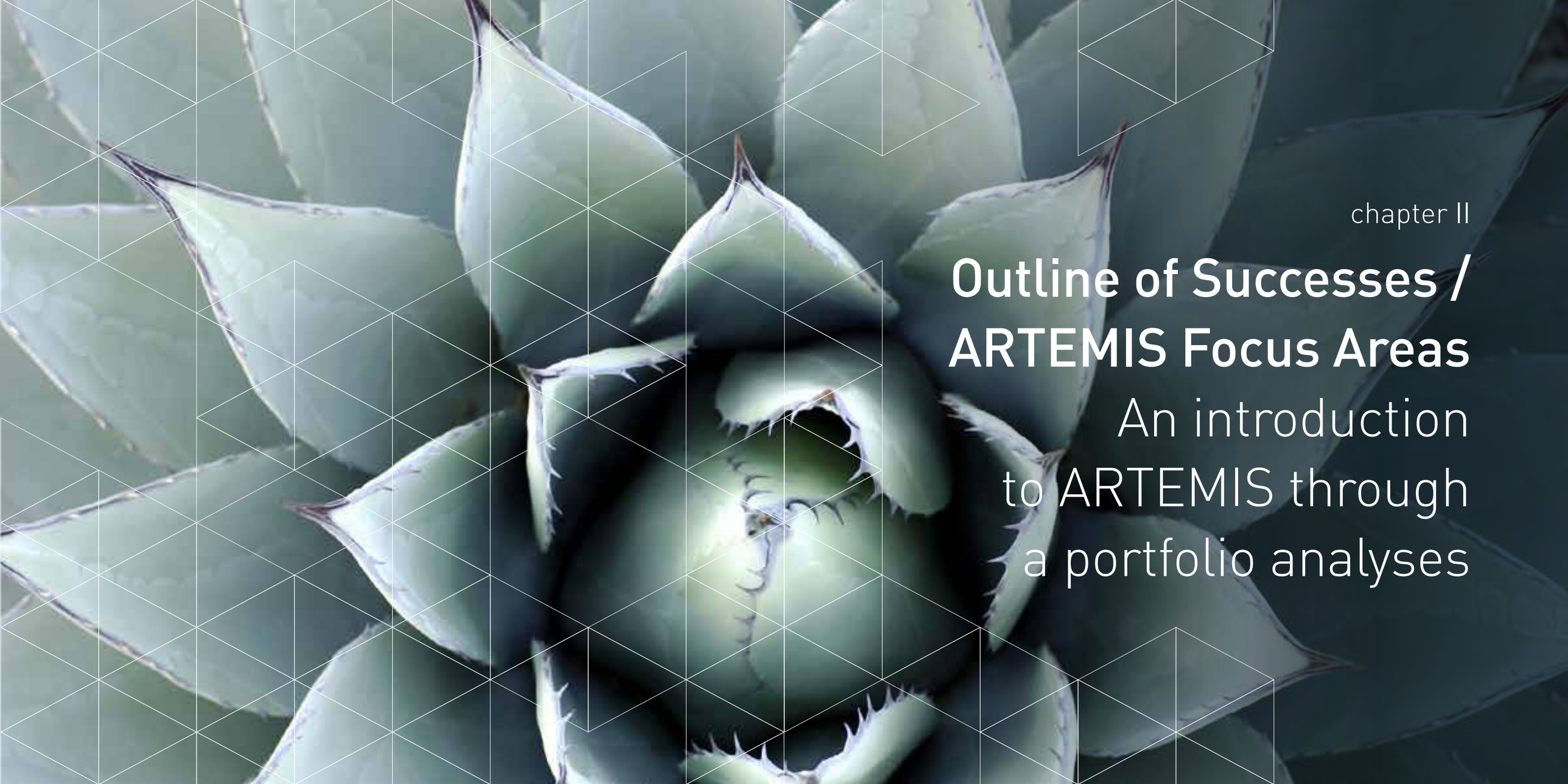
## JU APPROACH
(tripartite: basics for success)

*The success of the JU approach is evident in how private and public sectors have been brought together in such a large-scale way*

The Seventh Framework Programme provides for a European Community contribution for the establishment of long term public-private partnerships in the form of Joint Technology Initiatives (JTIs) to be implemented through **Joint Undertakings** within the meaning of Article 171 of the EC Treaty (Article 187 TFEU). Several Joint Undertakings were set up for a period up to 31 December 2017, as public-private partnerships aimed at mobilising and pooling European, national and private efforts. The "ARTEMIS Joint Undertaking", which promotes the development of key technologies for embedded computing systems, was recognised by the governing regulation as an extremely important ingredient in boosting innovation and, thereby, tackle societal challenges.

Since its establishment, the ARTEMIS-JU has evolved in line with the strategy as laid down in the strategic research agenda, which is not merely a technical roadmap but a guide to stimulating innovation. In fact, the multi-annual strategic plan that is derived from the SRA goes even further in describing an innovation eco-system. The evolution has therefore seen projects not simply doing their work in isolation and after completion disappearing into the distance but over the years becoming increasingly actively in collaborating and cooperating as links and networks broadened out and a community developed. This ongoing evolution sees new projects picking up the baton of predecessors, which, incidentally, may not even be related. But because the technology is reusable, it is reused and allows for greater efficiency. So the evolutionary process is one whereby projects conceived as separate entities collaborate and forge connections that result in innovation eco-systems. In turn, the ARTEMIS Industry Association has also evolved by creating centres of innovation excellence and the relevant criteria that enable such eco-systems to be justifiably labelled as such. With the focus on Innovation (capital 'I'), these CoIEs bridge the gap between scientific excellence and the impact on the market in the products and services that permeate, and improve, our lives. This evolution took another step in 2012 with the creation of market-shaping innovation pilot projects that really test the innovations in real-life industrial cases to test the practicability of processes, production, development, etc.

The success of the JU approach is evident in how private and public sectors have been brought together in such a large-scale way. With the presence of an industry association and the community around it, the effect is much broader. In addition, the ARTEMIS model has member state participation on the funding side. This has a key impact on two areas: the project footprint is significant, with an average country participation rate of seven for a single project, and SME participation is huge – half of the participants in ARTEMIS projects are SMEs, which are benefiting considerably from their participation, with a positive knock-on effect in terms of employment and business prospects in and for Europe. This is attributable to the tripartite approach of the joint undertaking and the presence of an industry association. The legacy which comes from this can be found in the community that has been created and the CoIEs that will continue into the future.



chapter II

# Outline of Successes / ARTEMIS Focus Areas

## An introduction to ARTEMIS through a portfolio analyses

# 2.1

## LIST OF PROJECTS INCLUDED IN THIS ANALYSIS

*This analysis includes data from all 44 projects resulting from the first four ARTEMIS calls.*

This analysis includes data from all 44 projects resulting from the first four ARTEMIS calls. Most of the Call 2008 projects and one Call 2009 project were completed at the time of writing, while others are still in full swing. This analysis is therefore a snapshot of the programme. The projects are:

| CALL | Project |
|---|---|
| 2008 | SOFIA |
| 2008 | EMMON |
| 2008 | CESAR |
| 2008 | iLAND |
| 2008 | INDEXYS |
| 2008 | SCALOPES |
| 2008 | CHARTER |
| 2008 | eDIANA |
| 2008 | SYSMODEL |
| 2008 | CAMMI |
| 2008 | SMART |
| 2008 | CHESS |
| 2009 | iFEST |
| 2009 | RECOMP |
| 2009 | SIMPLE |
| 2009 | SMARCOS |
| 2009 | ACROSS |
| 2009 | POLLUX |
| 2009 | R3-COP |
| 2009 | ME3GAS |
| 2009 | CHIRON |
| 2009 | ASAM |
| 2009 | eSONIA |
| 2009 | SMECY |
| 2009 | pSHIELD |
| 2010 | D3CoS |
| 2010 | WSN DPCM |
| 2010 | IoE |
| 2010 | MBAT |
| 2010 | nSHIELD |
| 2010 | PRESTO |
| 2010 | ASTUTE |
| 2010 | HIGH PROFILE |
| 2010 | pSAFECER |
| 2010 | ENCOURAGE |
| 2011 | e-GOTHAM |
| 2011 | VeTeSS |
| 2011 | CRAFTERS |
| 2011 | DEMANES |
| 2011 | nSafeCer |
| 2011 | DESERVE |
| 2011 | SESAMO |
| 2011 | VARIES |
| 2011 | PaPP |

# 2.2

## PROGRAMME EXECUTION – THE INVESTMENT SO FAR

*... the ARTEMIS programme has achieved one of its high-level goals of reducing fragmentation ...*

Using statistical data from the awarded projects, the following table summarises the key investments made in ARTEMIS projects for the first four calls.

| Call | Total Costs (investment) €m | Total National funding €m | Total EU funding €m | Total Public funding €m | Own means €m | RATIO National vs EU funding |
|---|---|---|---|---|---|---|
| 2008 | 193.53 | 60.68 | 31.77 | 92.45 | 101.08 | 1.91 |
| 2009 | 206.00 | 67.64 | 33.64 | 101.29 | 104.71 | 2.01 |
| 2010 | 166.39 | 54.64 | 27.09 | 81.73 | 84.66 | 2.02 |
| 2011 | 142.14 | 45.21 | 23.67 | 68.88 | 73.26 | 1.91 |
| **Total** | **708.06** | **228.17** | **116.17** | **344.35** | **363.71** | **1.96** |

In addition to this, the following key figures are of interest:

The average countries per project is nearly 7 (6.68). This indicates that the ARTEMIS programme has achieved one of its high-level goals of reducing fragmentation, by enlarging the typical 'footprint' at a European level. In other programmes, averages of 3 to 5 countries per project are more typical.

The average national funding rate (for ARTEMIS Member States only) is 33.22% whereas the average EU funding rate over all participants is 16.41% (this slight adjustment to the theoretically fixed value of 16.7% is due to specific ad-hoc arrangements required in Greece). The average total funding rate over all projects is 48.63 %, with the remaining 51.37% being the participants' own financial input.

The total R&D&I investment made in the programme to date is €708 m, with €228 m from national contributions and €116 m in EU contributions, the remaining €363 m being provided by the 'private' partners (industries, large and small, as well as Public Research Organisations, or PROs).

A key reference figure, stipulated in the Council regulation that establishes the ARTEMIS-JU, is the ratio between national and EU contributions, which must be not less than a factor of 1.8. The programme to date has established this ratio at 1.96, which is largely within requirements and allows a margin for any reduction in EU funds leverage in the last calls of the programme.



### 2.2.1. Programme participation: the attractiveness to industrial and research organisations

To date, a total of 941 organisations of various types have participated in the ARTEMIS programme.

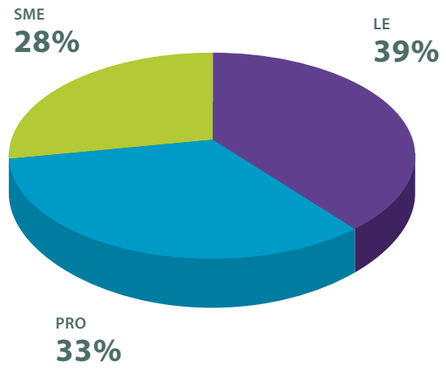
| Call | Participations |
|---|---|
| 2008 | 223 |
| 2009 | 286 |
| 2010 | 224 |
| 2011 | 208 |
| **Total** | **941** |

ARTEMIS classifies participants into PROs, which embrace universities and other publicly funded institutions, LEs ("Large Enterprises") and SMEs ("Small and Medium-sized Enterprises"). The last two together represent the industrial participation in the programme.

The split of participations by partner type is shown here.

| Call | LEs | PROs | SMEs | Total |
|---|---|---|---|---|
| 2008 | 88 | 79 | 56 | 223 |
| 2009 | 106 | 99 | 81 | 286 |
| 2010 | 101 | 58 | 65 | 224 |
| 2011 | 75 | 72 | 61 | 208 |
| **Total** | **370** | **308** | **263** | **941** |

Calculating the relative participations of each partner type reveals the following pie chart:




From this, two interesting observations may be drawn. Firstly, the programme has succeeded in attaining a strongly industrial focus, with 67% of the total participations being industrial players, large or small.

Secondly, although ARTEMIS wants to increase the enrolment of SMEs, the only mechanism available for this at programme level is the selection criteria by which project proposals are ranked. SME enrolment is mentioned only in one sub-criterion, where the evaluators are asked to rank the balance of the consortium regarding the useful participation of SMEs. There is no quota or other method applied, though the participation rules in certain member states do require or encourage SME participation (for example, with favourable funding rates). Still, SMEs do make up 28% of the total number of participations, indicating that the vision, goals and work programme of ARTEMIS are indeed attractive to them, possibly, and in addition, because of the participation of Member States who understand more fully the needs of their SME communities.

A side-effect of the ARTEMIS funding model and proposal selection mechanism is that, when budgets are allocated,

national funding in certain countries may "run out", leaving some participants without national funding support. In many cases, the technical aspects of the project can be fulfilled by identifying equivalent partners in different countries, where funding is still available. Alternatively, a partner with no national funding may still participate with EU funding support only.
It is interesting to note that, out of the 941 participations, 38 cases (4%) have chosen to participate without national funding support, receiving only the 16.7% EU funding. Of these, 12 are SMEs, 12 are large enterprises and (surprisingly) 14 are PROs. That these partners are willing to participate with only minimal public support indicates compelling nature of the technical programme for them.

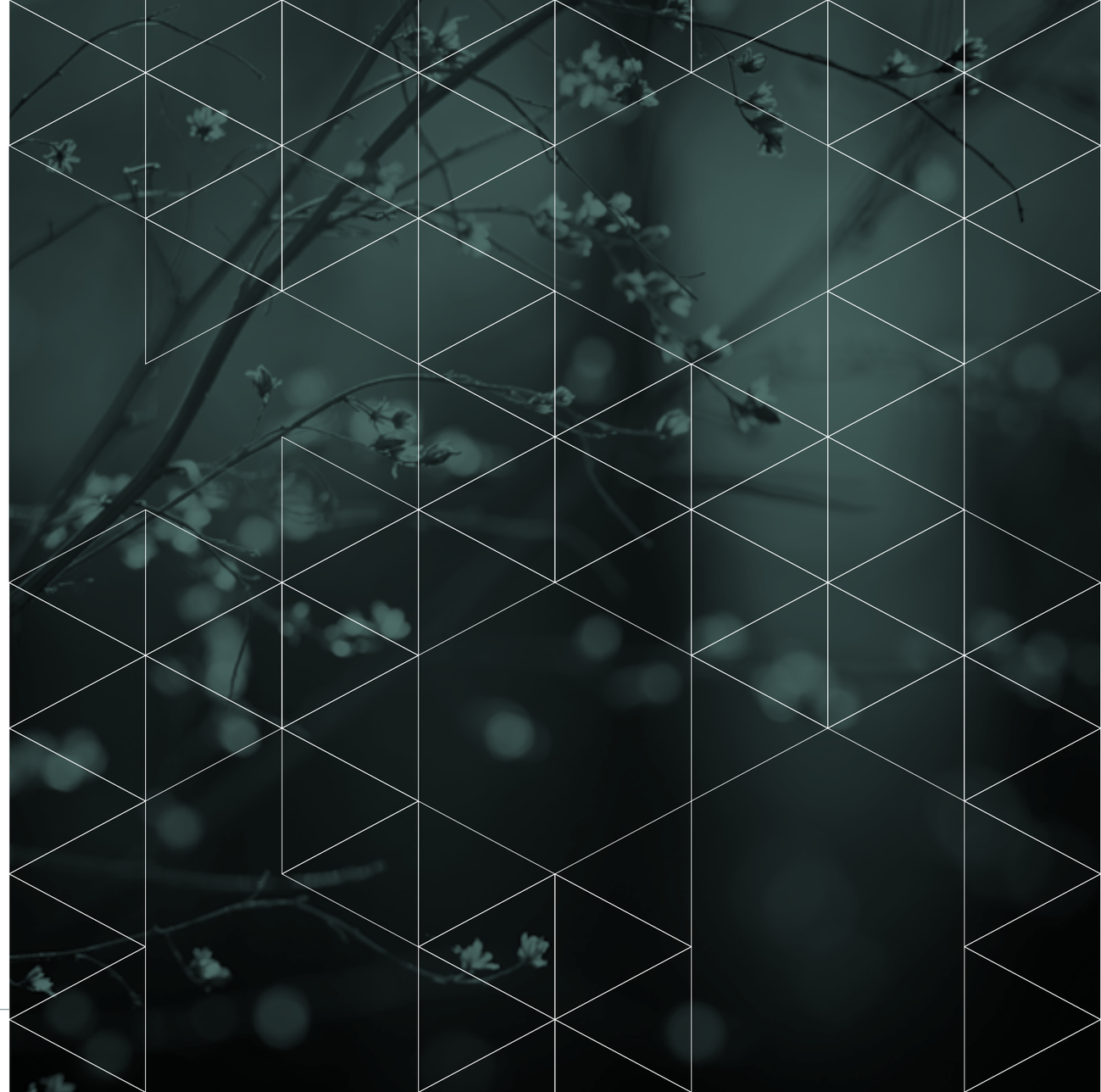
### Unique Participations

The total number of participations includes the possible multiple projects a single organisation may be participating in. In terms of unique participations (i.e. counting a participating organisation only once), the following charts applies:

| Total Unique Participations | LEs | SMEs | PROs |
|---|---|---|---|
| 586 | 207 | 210 | 169 |
| | 35% | 36% | 29% |

Counting this way removes the advantage that large enterprises and public research groups have in participating in multiple projects, and thus gives a better picture of the global ARTEMIS community participating in projects. In this way, we can see that roughly 70% of all participants are from industry, with a balanced mix of 35% each for large industrial companies and SMEs. (Note that, for the purposes of this analysis, the different divisions of the several multinational companies in different countries are counted as separate entities).

Of the 586 unique participations, 415 are single participations by an organisation. 109 organisations participate in 2 or 3 projects, while 50 participate in 5 or more. Among these "top scorers" we naturally find the large industrial groups (ST, Infineon, NXP, AVL, Fiat Research, Barco, Siemens, Acciona, Philips, Thales, etc…) and the large research organisations (VTT, CEA, Fraunhofer, Tecnalia, …) along with a few SMEs (Integrasys, TTTech, …). That SMEs, with their traditionally limited resources, wish to participate to such an extent indicates that, for them, the ARTEMIS programme and the eco-system of companies involved in the projects is indeed very attractive.



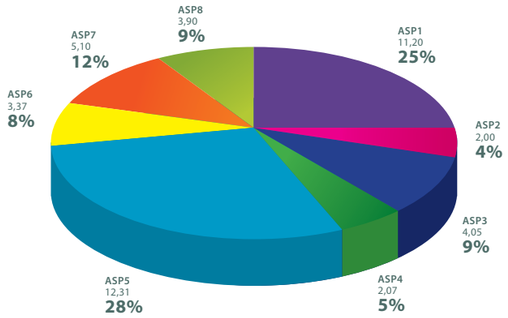
# 2.3

## TECHNICAL COVERAGE

*... many ARTEMIS project proposals address key technological issues relevant to more than one of the ASPs*

### 2.3.1 Coverage of the ASPs

The allocation of projects to the APSs of the ARTEMIS Research Agenda gives the following distribution

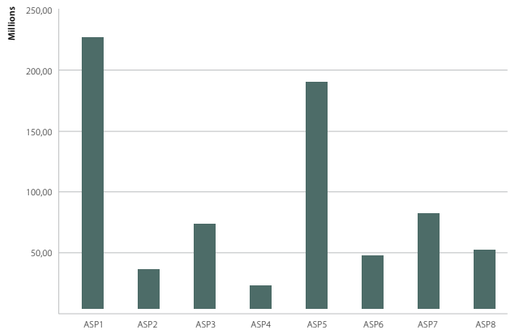



Note that fractional projects are possible here, as many ARTEMIS project proposals address key technological issues relevant to more than one of the ASPs. The independent experts who assist the ARTEMIS-JU in the evaluation and selection process are asked to estimate the allocation of project content to ASPs. The numbers above are the sum of all (partial) projects allocated to the ASPs – the total is thus 44.

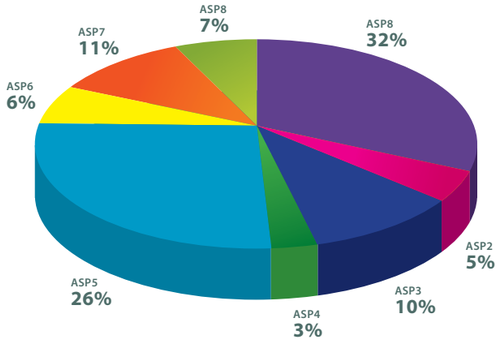
The preponderance of projects in ASPs 1 and 5 is immediately aparent. This is explained for ASP5 (architectures for embedded) by observing that this ASP, which is more upstream, technology focused, presents a much lower threshold to the more academic participants and will generally seed smaller projects due to the need for technology focus. ASP1, which focuses on safety-critical issues for embedded systems, on the one hand has a high impact on many application domains (automotive, aerospace, health, …) and one the other has a high focus on design processes and tools which are required across the whole of the electronics industry, due to the high impact they have on design efficiency and product certification (hence cost). The other ASPs typically have more specific application orientations.

However, simply counting projects, even with the additional refinement of partial project allocation to ASPs, is not really a fair comparison, as the size of projects in terms of partners, budgets, etc. varies greatly. A better measure is to combine the ASP allocation matrix with the total cost of the projects, as a direct measure of the amount of effort being expended on these topics. Note that the ARTEMIS projects each contain a sufficiently diverse mix of countries, such that local variations in cost-per-manhour may be ignored for the purpose of this analysis.

The chart below shows the investment, as measured by total cost, made in all projects, and how this is distributed over the ASPs, using the same allocation data provided by the independent experts when the proposals were evaluated prior to selection (note that this was done ***a posteriori*** for the Call 2008 proposals, as this analysis was not foreseen at that time).




Proportionally, this is:



### 2.3.2 Analysis of project contributions to the Industrial Priorities

The contribution in projects towards the Industrial Priorities has been extracted by noting manpower expended, using the classification of the three Industrial Priorities identified in the ARTEMIS SRA of 2006 – Reference Designs and Architectures (RD&A), Seamless Connectivity and Middleware (SC&M) and Design Methods and Tools (DM&T), augmented by a category for Management, for Dissemination and for Application (which captures the contribution toward demonstrators).

Due to the large volume of disparate data, information has been extracted from a representative set of projects with significant levels of manpower. While not completely rigorous, it is felt that this approach gives a statistically meaningful outcome. The results of this analysis are shown in the table below.

| Management | Dissemination | Application / Demonstration | RD&A | SC&M | DM&T |
|---|---|---|---|---|---|
| 5% | 4% | 47% | 9% | 9% | 26% |

In this analysis, the percentage of manpower expended on project management is low compared to other programmes (typically, up to 10%), though this may be due to the economies of scale seen with the larger ARTEMIS projects included in this analysis. The percentage explicitly spent on dissemination may be felt to be disappointingly low, though this does not do justice to the enthusiastic participation to the various ARTEMIS events (especially the ARTEMIS Technology Conferences), which are generally not fully foreseen when the Technical Annex (the basis for claimable costs) for each project is constructed.

That roughly half of the effort is expended on "Application" is healthy for a programme that is market-facing and driving innovation. However, the heavy imbalance seen between the Industrial Priorities in favour of DM&T may require attention in such programmes in the future. While the presence of the very large CESAR project explains this distortion partially, the contributions to this figure from projects involved in multi core architectures and from middleware also necessarily contain much work on tools dedicated to the architectural structures they define.

chapter III

# ARTEMIS Focus Areas

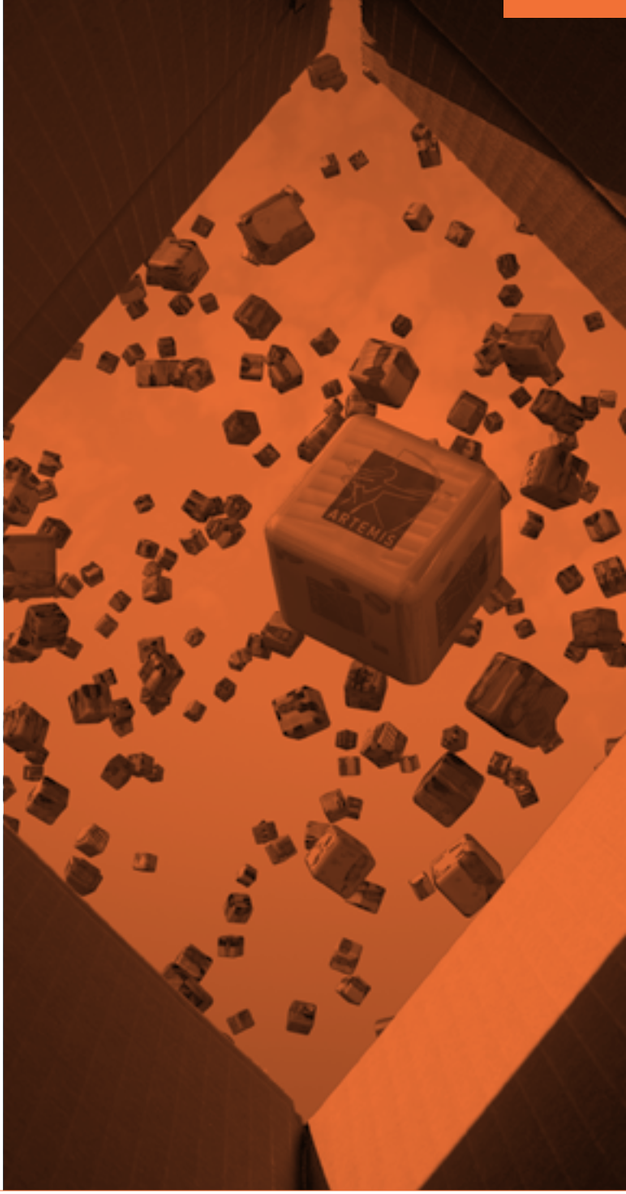
# ARTEMIS Project Clusters – an analysis of success

After the first two calls – 2008 and 2009 – it was already becoming apparent that the community was putting forward excellent project proposals that did not align perfectly with the segregations described by the ARTEMIS sub-programmes. This is to some extent to be expected: by design, the ASPs have some technological overlaps and are not completely orthogonal – some are indeed more application specific while others are more technology oriented.

For that reason, already in Call 2009, the experts evaluating the proposals were asked to express their opinion about the contribution of each proposal, proportionally, to the various ASPs so that the effort expended in each could later be estimated and analysed: this fractional allocation is the basis of the figures reported above.

Therefore, to better analyse the impact of the ARTEMIS programme on the innovation community, an alternative classification based on project clusters has been adopted for the purposes of this analysis. Projects are put into clusters based on their general application field, and the inter-project exchanges noted, either within the cluster or between projects in different clusters (consistent with the "re-use" aspect of the ARTEMIS programme).

This chapter examines the interactions between projects that have already been achieved at the time of writing. It is interesting to note that interactions and transfer of know-how happens not only within each cluster, but also between projects that ostensibly belong to different clusters. For example, the results of the SOFIA project, on Smart Spaces, are taken up by other projects in the domains of manufacturing and healthcare, demonstrating the cross-domain re-usability of the results as called for in the original ARTEMIS SRA.



# 3.1

## SAFETY AND RELIABILITY (HI-REL)

(Projects: CESAR, CHARTER, CHESS, SYSMODEL, iFEST, RECOMP, MBAT, pSAFECER, nSafeCer, DESERVE, VARIES, VeTeSS)

Secure, industrial-strength software design tools and environments in which to operate them are of paramount importance to many sectors of European industry, and in particular to the automotive, aerospace, industrial processes and medical/healthcare sectors. These industries form the backbone of virtually all European industrial output and the future welfare of these industries depends upon being able to deliver very high quality, hyper-reliable products that earn the respect of markets worldwide. As such, the domain we have classified as the ARTEMIS Hi-Rel (high reliability) cluster is of particular importance and interest to industry. We can see this by the very large participation in ASP1 projects and, in particular, the enthusiasm with which a large and representative cross-section of European industry is cooperating in these projects. The list is long (see above) but most, if not all, orbit around CESAR.

CESAR is a very large project – the largest in the ARTEMIS portfolio. Its importance, in terms of both size and topic, has generated such gravitational pull that many projects, after starting out as essentially free-standing entities, have quickly "moved into orbit" and provide inputs to CESAR or make use of its output.

What CESAR has created is a "Reference Technology Platform" (the CESAR RTP, or CRTP). In essence, this is a sophisticated toolkit to manage the plethora of tools needed when developing software-intensive products for markets that demand the absolutely highest standards of reliability, which must pass through complex certification processes, often by legislation. The CRTP allows relevant and interoperable tools to be selected for particular market/product requirements and generate a customised working environment in which these tools can be used to their best advantage. It is in essence a "Tool Platform", as described in the ARTEMIS AWPs. For this, it feeds on its own technological developments, and a large and expanding database of tools and process descriptions (methods of working) from within itself or provided from outside sources (often, other projects' output). In 2012 the CESAR RTP successfully applied for the ARTEMIS Tool Platform label.

All of the projects within this "Hi-Rel" cluster address some specific aspect of relevant software design: SafeCer focuses on certification requirements; SYSMODEL on accessible model-based engineering tools, CHARTER offers Java-based tools capable of meeting stringent Hi-Rel requirements, and so on. A key issue in this is the interoperability of the tools and data-formats they use, and CESAR and other projects organised the ARTEMIS Technology Conference 2012 specifically on this topic. An extract from the CESAR report on this event: *"In order to foster the exchange beyond project borders and research programmes on interoperability, CESAR has initiated the Interoperability Day 2012 under the umbrella of the ARTEMIS Technology Conference 2012. The event was hosted by CESAR and co-hosted by iFEST, MBAT and pSAFECER in conjunction with the Embedded World 2012 and the ARTEMIS Spring Event 2012. To increase the variety of interoperability approaches presented, a call for contributions had been launched within ARTEMIS, ITEA and national research communities. It resulted in an interesting group of contributing projects and initiatives, each highlighting a specific aspect of interoperability: CESAR (ARTEMIS), MBAT (ARTEMIS), iFEST (ARTEMIS), OSLC (Open Community), POLARSYS (Eclipse Industry Working Group), SAFECER (p- and n-, ARTEMIS), SAFE (ITEA), SMECY (ARTEMIS), SOFIA (ARTEMIS), R3COP (ARTEMIS), SPES XT & SPES 2020 (National German)."*

Although the approaches presented during this day are different with regard to scope and granularity, they are homogeneous in the big picture. A need for a generic basis with specific applications has been recognised. An example is the large scope CESAR Interoperability Specification (IOS), where compatibilities with the iFEST approach have already been recognised. Events like this ARTEMIS Technology Conference are a first step in the right direction. It is now up to all stakeholders involved to push the harmonisation of approaches forward and to foster and continuously improve an interoperability concept. By opening up the AIPPs in Call 2012, ARTEMIS-JU is now offering the community of stakeholders the opportunity to take this initiative forward. To discover more about ARTEMIS Innovation Pilot Projects, please refer to the documentation for Call 2012.

The high-reliability domain has benefited from many of the successes generated in this ARTEMIS cluster. The CESAR Reference Technology Platform (CRTP) has already been mentioned and many young researchers have been given the valuable possibility to develop their skills in a mixed academic/industrial ecosystem and publish academic results, many of which represent fundamental progress on the state of the art. Furthermore, the CRTP is not the only beneficiary of the results of a complete, real-time Java-based IDE (Integrated Development Environment) toolkit for high-reliability software development defined in the CHARTER project. The tool vendors involved also profit from the valorisation of the project's results, which have been made widely accessible. Solutions were also created in the CHESS project to property-preserving (software) component assembly in real-time and dependable embedded systems, and to support the description, verification, and preservation of extra-functional properties of software components, at both component design level and execution level. Finally, the useful and accessible toolkit for system-level modelling developed in the SYSMODEL project promises major savings in product development time by supporting design decisions early in the process and thereby boosts reliability as well as lowers the threshold to improving productivity, especially for SMEs.

# 3.2

## ENERGY EFFICIENT COMMUNITIES AND ELECTRIC CAR

(Projects in this cluster: eDIANA, ME3GAS, e-GOTHAM, ENCOURAGE, IoE, POLLUX)

eDIANA established a middleware platform designed to overcome the concerns of interoperability and longevity of the various sensors and actuators used to monitor and control heating in buildings. The architecture distinguishes "Cells" (living units, be they individual homes or apartments in a larger building) and "Macro-Cells" (being apartment blocks or industrial/office blocks). The middleware was shown to greatly improve the interoperability of devices from various manufacturers using diverse connection methods (different types of wireless or wired connections). From an embedded-systems viewpoint this proved to be ahead of the field, though the integration of mechanisms to actually improve the efficient use of energy still has to be improved. In a similar vein, ME3GAS is developing a new generation of smart gas meters with integrated communication devices and an electronic shut-off valve (which is non-trivial due to the safety risks implied by mixing electronics with potentially explosive gas). In the gas supply market, different communication methods presently prevail, so the meters are modular, allowing migration from GPRS connection to the utility supplier, to integration into the Home Area Network, initially using M-Bus and later Zigbee or other commodity protocols. In parallel, a demonstration residence using these commodity wireless protocols has been set up and is working, showing how the integration of such sensors into the home environment can indeed influence and aid more efficient use of energy, indeed exposing new business models based around equipment monitoring and maintenance. ME3GAS has studied the use of the eDIANA Middleware platform, but the work today is at too different a level: a future project could conceivably integrate the results from these two projects, however.

The projects ENCOURAGE and eGOTHAM address the energy efficiency topic mostly from outside the residence or user premises, with eGOTHAM studying the management of the external supply network (for both domestic and industrial use, with demonstrators in both) and ENCOURAGE looking specifically at the integration of locally generated energy and storage into the "Micro Grid" architecture. Both projects expect to develop quite large demonstrators, though these are indeed still quite small compared to the larger picture. This does not, however, limit the applicability of the output of these projects to future, larger-scale field trials. ENCOURAGE specifically shares partners in the IoE and Green eMotion projects (see IoE below), and the project is being actively encouraged to follow up on these contacts.

The POLLUX project integrates closely with the IoE project: a part of the project deals with the provision of electrical energy for electric vehicles. Another major part of POLLUX is developing the new, distributed (embedded-systems) architectures for vehicle electronic controls that future generations will demand, and for this the project collaborates with ENIAC, CATRENE, ARTEMIS, EPoSS, EUCAR and other relevant EU platforms and as such is *"thought of as complementing, from the Embedded Systems point of view, the current efforts of Europe's major stakeholders for enabling the forthcoming architecture of electric vehicles"*.

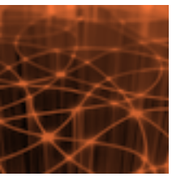
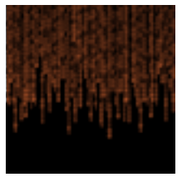
The IoE ("Internet of Energy") is of a much larger scale, addressing the issues of energy supply management and associated business models at a higher level, modelled on the principles of the Internet (which it also uses as a communication backbone for the principles being developed). It provides for an integration platform for the types of energy management architectures developed in the other ARTEMIS projects listed above as well as tackling the (non-trivial) integration of electrical mobility, and includes renewable generation and storage methods. The architecture design, of course, extensively considers the security and privacy issues connected with this domain. While cooperation with other ARTEMIS projects on energy efficiency has not been highlighted (except possibly ENCOURAGE), cooperation has been undertaken with CASTOR (FP7 STREP, focusing on the distributed power train and on battery management), ENIAC "E3Car" on component level (SiC, SOI, high and medium power modules) and ARTEMIS POLLUX (on architecture and module level). In addition, cooperation has been started between IoE and the FP7 "Green eMotion" and "Finseny" (also part of the Future Internet initiative).

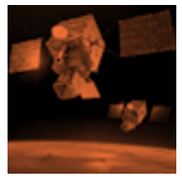
Cluster benefits brought about by the successes of the projects can be seen, for instance, in the middleware platform created by eDIANA that enables devices from different manufacturers to operate together and allows various sensors and controls to communicate with each other to facilitate energy management in commercial or residential buildings. Looking to future, the open reference architecture and middleware with seamless connectivity developed in a project like e-GOTHAM provide the communications and decision support tools needed to optimise and manage local microgrids on the basis of demand-supply matching. Going a step further, the architecture designed in the Internet of Energy project will enable the Internet to connect with energy grids to create an electric mobility infrastructure, with the car the visible model and the focus of the POLLUX project that has helped to realise an energy-efficient and cost-effective electric vehicle with enhanced safety and comfort.

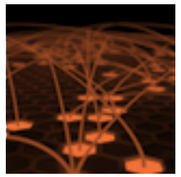
# 3.3

## LOW-POWER MULTICORE

(Projects: INDEXYS, SCALOPES, ACROSS, ASAM, SMECY, PRESTO, CRAFTERS, PaPP)

The projects running or finished in ARTEMIS on this broad topic show a similar dispersion of the topics they cover. It is therefore difficult to provide a complete picture of how they interact with each other, though many are referred to by projects in the other clusters, for the obvious reason that this is basic technology work.

The INDEXYS project decided to extend its duration in order to include some results of the ARTEMIS ACROSS project as both projects are based on the GENESYS architectural blueprint approach. (GENESYS is a project financed under the FP7, specifically aimed to provide such an architectural blueprint for the ARTEMIS programme to refer to). In this way INDEXYS could refer not only to the INDEXYS demonstrators but also to the much bigger ACROSS demonstrators thereby providing more insight into the advantages of using the GENESYS services in embedded design. Both INDEXYS and ACROSS target applications in the automotive/aerospace domain and thus also contribute, as does SMECY, to the large "Hi-Rel" cluster.
ASAM (Automatic Architecture Synthesis and Application Mapping) addresses a uniform process of automatic architecture synthesis and application mapping for heterogeneous multiprocessor embedded systems based on Application Specific Instruction Set Processors (ASIPs) that can be customised to a particular application through instantiation and extension. From its input, being a high-level behavioural, structural and parametric specification of the embedded system required for a given application, this process will produce a corresponding optimised and application-specific ASIP-based multi-processor system realising the required application's behaviour, satisfying the structural and parametric constraints, and optimising the objectives and trade-offs related to the physical and economic system characteristics.

In contrast, the objective of CRAFTERS is to guarantee secure, reliable, and timely system operation while conserving energy and introducing a very minimal run-time overhead. These are technological challenges of rapidly growing importance and vast market opportunities. The CRAFTERS project realises a predictable and flexible many-core platform with a run-time scalable execution environment. Some versions of the platform as well as the execution environment will be based on open technologies and standards and made publicly available.

The key R&D challenges include scalable parallel programming, application and middleware portability, system-wide performance predictability and power and technology awareness. Although low-power is really a major concern, it is not the only one addressed by the ARTEMIS projects (as it is evident from the descriptions of the above two). Some of the other projects address the equally severe concerns of programmability (e.g. SMECY), composability and predictability of multicore systems, where problems are getting even more severe with a shift from homogeneous to heterogeneous multicores and many-cores. On the top of that, design tools for multicore/many-core systems are generally missing, which is another hot topic relevant to all efforts for practically sound multicore developments (in and beyond low-power). Safety and security for multicore systems are yet largely unexplored domains and certification of such systems is still a challenge. All in all, multicores could be (and actually are) put in a much wider scope than low-power (see examples later in this chapter).

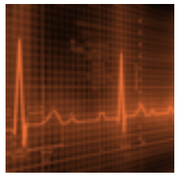
Cluster gains are evident in the successes achieved in the cross-domain (horizontal) technologies and tools that have been developed (in SCALOPES) for next generation multicore architectures. These technologies and tools are related to application & programming models, composability, predictability, and dependability as well as resource management and power aware architecture reference platforms. Furthermore, significant benefits from basing embedded design on the principles and services defined by the GENESYS architectural blueprint have been proven (by INDEXYS) through the development and evaluation of three demonstrators in the automotive, aerospace and railway industrial domains, with potentially significant savings in cost and development time.

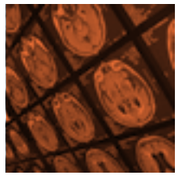
"The influence of projects on each other, across the theoretical boundaries of a "cluster": is fully in line with the ARTEMIS goal of assuring broad uptake and re-use of R&D results."

# 3.4

## E-HEALTH

(Projects CHIRON, HIGH PROFILE)





Projects in this cluster, centred on ASP2, are few but welcome: this is an important area addressing a high-profile societal concern – the cost of healthcare for all and assuring a longer, active life of an ageing population. The low subscription level can be attributed to the difficulties that emerge when technologies from previously unrelated domains come together, in this case from the medical and the embedded-systems environments: there is a necessary learning curve during which mindsets must converge to assert the maturity of the programme and the proposals put to it.

The two projects presently show little interaction with each other: they address very different areas. While HIGH PROFILE develops advanced sensors and new techniques for enhanced medical imaging and merging of sensor data for improved diagnosis in the hospital environment, CHIRON looks at using Smart Spaces technologies for patient monitoring outside of the hospital.

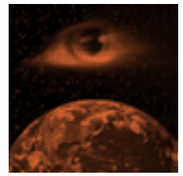
CHIRON has already successfully collaborated with another ARTEMIS project. As mentioned above, and also shown at the 2011 ARTEMIS Technology Conference, the CHIRON reference architecture uses a middleware developed by the SOFIA project to support the Healthcare domain with Smart Spaces.



# 3.5

## "THINGS OF INTERNET"

(Projects clustered around this topic: EMMON, iLAND, SMART, SOFIA, SIMPLE, WSN-DPCM, DEMANES)



The Internet of Things has become a daily catch-phrase to describe the massively pervasive growth of our interconnected electronic devices. At present, the growth focus is driven by mobile communication devices and services – the "smartphone generation" – though the trend to include autonomous devices that can ever more closely impact our daily lives is also very apparent, where the prospect of failure of these devices would have an increasingly dramatic impact on our individual and collective wellbeing. These systems – the autonomous "Things of the Internet" – are nothing more than Embedded Systems, with the same stringent requirements for absolute conformance to our expectations of absolute reliability.

Four ARTEMIS projects (SMARCOS/SOFIA/CHIRON/iLAND) presented their intermediate results at the 2011 ARTEMIS Technology Conference in Bologna (Italy) on September 12-13. The aim of the event was to provide public visibility over technical aspects raised and solved by ARTEMIS partners in the field of Smart Environments. Exchange of ideas resulted in an increase of R&D results' effectiveness empowering the impact on industry and on society at large.

As a direct result, the CHIRON project, on patient-centric healthcare, decided to adopt the platform developed within the SOFIA project as its communication backbone. In addition, the projects iLAND, SOFIA and eSONIA together have materialised the creation of a special issue on a FIRST QUARTER JCR indexed journal (IEEE Transactions on Industrial Informatics) with the goal of producing a special issue with very high-impact publications, presenting a European view of the distributed systems middleware based on Service Oriented Architecture for industrial applications.

Note here the influence of projects on each other, across the theoretical boundaries of a "cluster": this is fully in line with

# 3.6

## SUSTAINABLE MANUFACTURING
(Projects eSONIA, R3-COP)

the ARTEMIS goal of assuring broad uptake and re-use of R&D results. Moreover, iLAND and eSONIA co-organised a special session in the IEEE INDIN (International Conference on Industrial Informatics) conference in Caparica, Portugal, in 2012 thereby boosting the visibility of their results.

The other projects listed above have not participated explicitly in such clustering activities, though the project SIMPLE (not completed at the time of writing, being from Call 2009) has already developed a (potentially patentable) highly re-usable technique for embedding security and trust information exchange within the ZIGBEE protocol. In addition, the eSONIA project released a low-power IPv6 stack implementation (6lowPAN), aimed at applications in industrial controls but applicable across many applications that require extreme autonomy.

eSONIA, which stands for "Embedded Service-Oriented Monitoring, Diagnostics and Control: Towards the Asset-Aware and Self-Recovery Factory", is an ARTEMIS project aiming truly at optimising factory automation. Its work centres around the intercommunication of devices and actuators in an aggressive, industrial factory environment making particular use of wireless technologies for easy deployment. Its key output to date is the release of an IPv6 "6lowPAN" protocol stack into the public domain, specifically designed to support autonomous (low-power) sensing devices. The project has not only been active technically, but has also been given an award for its clear public communication and dissemination activities. Though ostensibly an "industrial controls" project, eSONIA has networked well with others in the ARTEMIS "Things of the Internet" domain (see above).

R3-COP is classified as "industrial", though its focus is more on autonomous machines and the safety/reliability aspects that are critical to them. It is, in fact, a "robotics" project, though this special and important application of embedded systems is

not clearly described as such in the ARTEMIS SRA or the AWPs derived from it (though the important characteristics required of it are). R3-COP studies both technology and methodology.

Technology:
- Fault-tolerant, high-performance processing platform based on a multicore architecture
- Robust perception of the environment
- Reasoning, learning and reliable action control

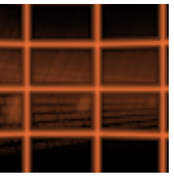
Methodology:
- Development framework with an underlying knowledge base
- Tool platform for guarded development and standardised test
- Model-driven process for the compositional development of safety
- and security critical systems
- New validation and test methods for autonomous systems

Demonstrators from the ground-based (domestic), airborne (unmanned) and underwater domains will be shown. A preliminary demonstration of the (ground-based) service robot developed in R3COP won the project the "best exhibit" award for its clear communication about its work at the ARTEMIS-ITEA Co-Summit 2012 held in Paris.

# 3.7

## HUMAN MACHINE INTERFACE (HMI)

(Projects in this cluster: CAMMI, SMARCOS, ASTUTE, D3CoS)




Surprisingly, the ASP8 of the ARTEMIS work programmes, to which this cluster is mapped, on human-machine interfaces was initially undersubscribed and has to date attracted only these four projects. Other projects do refer to operator interfaces (for example eDIANA, where such a display/control panel is developed to work in the middleware platform for demonstration).

The ARTEMIS project SMARCOS has successfully collaborated with the ARTEMIS project SOFIA, implementing the resulting project technologies in some of their use cases, adding the possibility of the multi-platform connection of events by broadcasting semantic information. This collaboration was shown at the 2011 ARTEMIS Technology Conference: SOFIA provides principles, platform and design kit to enable interoperability among cross-domain environment-dependent applications and SMARCOS applies SOFIA technology on Attentive Personal Systems and Complex Systems Control (Collaborative Synergy-Navigation System). Furthermore, ASTUTE has collaborated with the Belgian national project "Tiii", with whom it shares some partners.

In the CAMMI project, the adaptive human-machine interfaces that respond to the workload of the operator (human-in-the-loop) have been developed in four industrial application domains: avionics, civil emergencies, automotive and agriculture. By introducing a joint cognitive approach into operator console control, any workload that exceeds the operator's capability should be reflected in offloading, or automating, non-critical, time-consuming tasks. This will enable control to be shared between operator and system, allowing the operator to focus specifically on critical tasks. The potential benefits of this to industry and society are tremendous and the gains can be expressed at both macro (industrial, economic and societal) and micro (individual well-being) level.



## PROJECT HIGHLIGHTS – FINISHED PROJECTS CALL 2008, CALL 2009

At the time of writing, all projects from the first ARTEMIS Call (in 2008) and one two-year project from Call 2009 have been completed or are near completion. Here follows a brief summary of the achievements of these projects, with notes on what could not be accomplished during their execution.

### CESAR

The CESAR project has delivered a great number of very valuable and innovative results in various areas. All of the results are documented to a very high standard and many of the results have been made public for the benefit of the embedded systems community (many of them are currently being accepted outside of the consortium). With an impressive number of real breakthroughs having been made, the project's main achievement is the CESAR Reference Technology Platform (CRTP) which has attracted interest from well beyond the boundaries of the project.

Another project achievement that cannot be rated highly enough is the large number of PhD and Master Theses written within CESAR whereby many young researchers had the valuable possibility to develop their skills in a mixed academic/industrial ecosystem. Also the academic results – many of them representing fundamental progress on the state of the art – have been extensively published.

CESAR has shown the value of very large projects* – many previous projects also tried to produce consistent tool chains but the results were only partial successes because the consortia lacked critical mass. For the first time CESAR managed to provide industrially acceptable solutions in (almost) all areas relevant to safety-critical embedded systems.

CESAR has also managed to provide a credible avenue for "life after the project", i.e. for the maintenance and continuation of the results achieved.

* Note: A very important prerequisite for the success of such large projects is a strong, consistent and knowledgeable management team, both technically and organisationally. This was true to a very high degree in CESAR.

### CHARTER

*Successes:*

CHARTER defined a complete, Realtime Java*-based IDE (Integrated Development Environment) toolkit for high-reliability software development.

The toolkit includes: modelling, annotation-code generation, a certifiable Real-time Java compiler, a Real-time optimised Java Virtual Machine with deterministic Garbage Collection, resource analysis, formal verification, validation and test-generation tools. Demonstrators in Aeronautics, Automotive and Medical domains, referencing ISO 26262, DO-332/ED-217 standards, were used to prove its performance.
The results are made available for the ARTEMIS-CESAR "RTP" platform.
Contributions were made to a number of standards, including RTCA SC-205 / EUROCAE WG-71, JCP, JSR (282 and 302), OMG and TOGAF as well as certification guidance for dynamic memory management that went into Avionics standard DO-332.

The valorisation of the project's results will be through a hybrid COTS/OSS model, which benefits tool vendors involved in the project while making the key results also widely accessible.

(*Java is a popular language for object-oriented programming, particularly in consumer electronics and web applications, and many engineering schools produce designers working with it.

Until CHARTER, it had largely not been possible to make use of this language in any real-time critical application. The CHARTER tool-chain enables deterministic, real-time software to be developed using Java, opening up a vast resource of application code and engineering capability for high-reliability product development. It may also be seen as opening a pathway to rigorous, science-based engineering solutions for cost-effective implementations in mixed-criticality systems).

*Work to be continued:*

- Floating point equations are supported but still have the well-known caveats in handling "Not a Number" cases. The strong link with the CESAR project's Reference Technology Platform (RTP) hopes to alleviate this in the near future.
- Full compliance with ISO 26262 (automotive safety standard) could not yet be demonstrated within the timeframe, even though the tools support this capability. Also, AUTOSAR (the automotive SW framework standard) is very "C"-centric in its description which complicated proof of compliance of efficient Java code. This can be addressed in the future.

## CHESS

*Successes:*

CHESS created solutions to property-preserving (software) component assembly in real-time and dependable embedded systems, and to support the description, verification, and preservation of extra-functional properties of software components, at the abstract level of component design as well as at the execution level. Demonstrators cover a wide range of domains following a 'separation of concerns' concept. More specifically, the main project achievements could be summarised as follows:

- A multi-concern component model embodying the 'separation of concerns' concept was proposed. A multi-concern component methodology and toolset for model-driven component-based architecture definition and transformations were developed
- The CHESS modelling language meta-model was defined. Transformations among models down to code as well as back-propagation capabilities were developed and tested. Extensions to the CHESS modelling language enhance the precision of extra-functional decorations and enable virtual multiprocessing.
- Dependable and secure component concerns were investigated in depth**.** A transformation engine for state-based analysis was defined and implemented, considering the whole transformation chain from CHESS to dependability analysis model and back-annotation
- Predictability, isolation and transparency component concerns were addressed by the CHESS methodology.
- Different execution platforms have been adapted to the CHESS concept: an Ada code generation engine makes it possible for functional source code generated in Ada, C and C++ for components with third-party utilities to be automatically and seamlessly integrated; an integration of Java in SystemC (see also the CHARTER project) provides the ability to exchange communication protocols/media between applications, and adds non-functional properties to communication latencies; C++ and Java/RTSJ code generators along with an extension of ObjectAda Raven allow execution time monitoring and deadline monitoring; an extension of JamaicaVM with an API for static thread creation was implemented along with a secure application manager.

*Work to be continued:*

- Security concerns using the CHESS methodology need to be investigated further.

## eDIANA

*Successes:*

eDIANA has created a "Middleware Platform" specification that allows various sensors and controls to communicate with each other, specifically aimed at energy management in houses and larger commercial or residential buildings. The middleware ensures that devices from different manufacturers can operate together*, using wireless or wired technologies. It also foresees connection to larger, district-level networks such as "smart grids". The platform's functionality and usefulness in the retrofit scenario were tested on three medium-scale application demonstrators.

(* The ability of equipment to interoperate is a major consideration when building new installations, or when retrofitting for existing buildings. Worries about equipment compatibility, security of supply and "future-safe" issues effectively slows down the roll-out of technologies beneficial to saving energy and reducing our carbon footprint: a building has a very long lifetime, throughout which its monitoring and control equipment is expected to operate without requiring major re-investment should upgrades be required. A uniform "middleware" platform removes many of these concerns).

The eDIANA consortium is at the heart of the recently certified ARTEMIS-IA Centre of Innovation Excellence "ES4IB" (Embedded Systems for Intelligent Buildings), and one partner has set up a spin-off company (WSENSE, Rome) on wireless sensor networks based systems.

*Work to be continued:*

- eDIANA made some major advances in the Embedded Systems technologies used in monitoring and controlling the use of energy in buildings and how these can be easily interconnected and made interoperable. However, the studies on how this information and control capability should be used in practice to improve the energy efficiency of the building need further work. This is work for specialists in a different discipline than Embedded Systems design.

## EMMON

*Successes:*

- Medium-scale deployment of a fully functional system prototype in a real-world scenario (composed by hundreds of nodes);
- New WSN embedded middleware with better overall energy efficiency, security and fault tolerance;
- New efficient and low-power consumption WSN multilevel communication protocols and reliable middleware for large-scale monitoring;
- Simulation models for WSN behaviour analysis;
- Centralised C&C Centre for easy and centralised monitoring;
- Mobile C&C station or device for local access, diagnosing, viewing and troubleshooting of the network;
- Comprehensive toolset for assisting network planning and deployment of large-scale WSN systems.
- The project had the chance to setup the EMMON system in a real live environment. This deployment allowed the team to validate the EMMON architecture and system implementation. A number of lessons were also learnt from dealing with a large-scale deployment in a live site.

DEMMON1 is the first wireless network prototype developed by the EMMON project. It was first demonstrated at the project review meeting at ISEP in Porto on 7 December 2010. DEMMON1 is, as far as we know, the largest implementation of a wireless sensor network in Europe. Consisting of 303 nodes, it measures temperature, humidity and light levels. The sensor nodes, placed on glass supports, were aligned with an axis that was 5° from the north-south axis and were given GPS co-ordinates. Tests, which involved changes of environmental parameters and progressive introduction of active nodes, were carried out in order to investigate the wireless network response. When a node selected at random was either covered by dark opaque material reducing the amount of available light or exposed to heat gradient from an electric heater, DEMMON1 responded promptly, giving the reading in the corresponding node. Scaling up tests was carried out by staged activation of nodes in groups of 100. Changes in the number of active nodes did not cause DEMMON1 to show any noticeable change of performance. From this basis, EMMON then developed "DEMMON2", a real-life implementation of DEMMON1.

"CESAR has shown the value of very large projects – many previous projects also tried to produce consistent tool chains but the results were only partial successes because the consortia lacked critical mass. For the first time CESAR managed to provide industrially acceptable solutions in (almost) all areas relevant to safety-critical embedded systems."

At the "EMMON Open Day 2012" event in the SANJOTEC Business and Technology Park (São João da Madeira, Portugal) the "DEMMON2" demonstrator was presented, using more than 400 Wireless Sensor Nodes (WSN) for an environmental monitoring application.

DEMMON2 includes new integrated features, such as:

- instant queries
- temperature mapping
- OTAP ("Over-the-Air Provisioning")
- remote restart
- portable device for maintenance and configuration
- automatic positioning

*Work to be continued:*

- The deployment is an error-prone and time-consuming process; this should be made more agile in future improvements to the system.
- Investigations should be made in direction of having a layout which is less rigid but that could maintain some of the structure imposed by the layout. In deployment it was noticed that the defined layout was sometimes hard to deploy due to minor mistakes like programming the incorrect node or placing the node incorrectly. These we occasionally hard to identify.
- Larger-scale deployments in real-world scenarios composed of tens and hundreds of thousands of nodes need to be investigated. It was not done within the project mainly due to cost-limiting factors.

## iLAND

*Successes:*

iLAND set out to define a middleware architecture that could offer deterministic services with QoS-based resource management for networked systems with a high degree of dynamic composition. For this it would develop the necessary enabling technologies and demonstrate the concept on three applications. Aimed at devices that often operate in ad-hoc configurations, the middleware solution itself must be 'lightweight'.

iLAND architecture has been finalised, and the iLAND Reference Implementation (RI) has been implemented, including all the defined architectural elements. It is an open-source component-based modular design (for function isolation and easy algorithm replacement) and platform-independent (complete abstraction of specific resources, OS policies, and networking infrastructures).

The iLAND RI provides for:

- Deterministic middleware services. Bounded-time composition algorithms and dynamic reconfiguration algorithms have been developed for service-based networked applications. The iLAND approach is based on creating solutions that impose a number of limitations to the target systems that are realistic for the selected iLAND application domains.
- QoS-based resource management and support for adaptation. Combined resource management enables adaptation support to changing needs due to environmental or programmed changes. This allows for real-time execution support based on resource reservation.
- Built-in basic security hooks and policies. iLAND is not a security project but it has identified the precise slots that should be filled in to target security.
- Modelling tools to support the iLAND RI have been developed. Demonstrators have been designed and implemented as a concept of proof for the iLAND middleware.
- In total, 5 demonstrators have been implemented showing the advantages of the iLAND middleware:
- Laboratory prototype: experimental iLAND system for testing different reconfiguration scenarios.
- Remote Monitoring for Early Warning Using Public Transportation: iLAND technology is tested in a remote energy-constrained ad-hoc network.
- Distributed video surveillance with dynamic reconfiguration: the whole iLAND process is validated through a service-oriented remote surveillance application.
- Daily activity monitoring application in home care domain: concept of proof for dynamic reconfiguration with soft real-time constrains.
- Healthcare monitoring application: validation of full iLAND process (from model to implementation) in the healthcare domain, using reconfiguration with hard real-time constraints.

*Work to be continued:*

- Publication of the open-source code (Sourceforge) including a short description on the open-source implementation is still pending.
- Although iLAND's main focus is not security, it would still be beneficial to launch a systematic debate among developers and future users on how security features such as encryption could be included in the framework and associate potential trade-offs (security vs performance) with targeted applications.

## SOFIA

The objective of SOFIA is to create a semantic interoperability platform and a selected set of vertical applications to form an embedded system "Smart Environment". The project addresses three vertical application areas – personal spaces, smart indoor spaces and smart cities. The main idea is to use semantic technologies to provide information-level interoperability between many different multi-vendor devices.

The project has been successful in demonstrating many different prototype applications of their technology, but more effort is required to achieve a robust and coherent development platform. Significant progress in disseminating the project results has been achieved. In particular, SOFIA organised an ARTEMIS Technology Conference, a key result of which was the adoption of its platform by the CHIRON project, on out-patient person-centric health monitoring. Fruitful collaboration with the ARTEMIS project SMARCOS was also undertaken.

In general the project has been successful, but has not fully succeeded in producing a generic, reusable middleware solution (horizontal integration) that satisfies the requirements of all three vertical application areas. Instead, it has produced a set of middleware components that either function well at lower-level than is really required, or have limited functionality and interoperability. That is, the middleware components produced do not cover fully the requirements of the vertical application area to which they are targeted.

## INDEXYS

*Successes:*

INDEXYS has proven (with the development and evaluation of three demonstrators in the automotive[1], aerospace[2] and railway[3] industrial domains) that significant benefit can be derived from basing embedded design on the principles and services defined by the GENESYS[4] architectural blueprint that provides a lot of support to embedded design activities and also offers, independent of the technology used, potential significant savings in cost and development time:

- Shorter time to market
- Lower development cost
- Cross-domain benefit
- Improved reliability (long term)
- Benefits in re-use of design

The INDEXYS project has enabled patenting of the approach for the CAN Router, a star architecture device for the CAN network.

The CAN bus was initially designed as a bus architecture but INDEXYS has expanded the opportunities of the popular network technology towards a star architecture.

INDEXYS has significantly influenced and contributed to the release of the SAE Standard for the Time-Triggered Protocol TTP. TTP was filed for standardisation at SAE shortly prior to the beginning of the INDEXYS project and was finally released during the INDEXYS project. The standard number assigned is AS6003. In addition, TTEthernet, which was also filed for standardisation prior to INDEXYS project, was strongly influenced by the project results. The standard for TTEthernet was released during the last work period of INDEXYS and obtained the SAE number SAE 6802.

*Notes:*

1 *The automotive demonstrator consisted of a CAN based star network and a FlexRay based star network. Since CAN and FlexRay were initially designed as a "bus architecture", the implementation as a star network is a novel design. The advantage in a star architecture is found in the significantly better safety features compared to the bus architecture. The star devices developed within the INDEXYS project were based on FPGA designs. The final application was integrated into a real world Audi A7 to make the environment as real as possible.*
2 *The aerospace demonstrator developed several small components based on the Time-Triggered Protocol (TTP) and optical Ethernet based links. The applications ranged from developing a Remote Data Concentrator (RDU) based on TTP communication to a Network Access Controller (NAC) using gateways and optical links by Ethernet connections.*
3 *The railway demonstrator implemented a safe communication protocol implementation into real-world railway signalling equipment investigating in-depth diversity error mitigation concepts for the railway domain and evaluating the use of TTEthernet for the railway domain.*
4 *GENESYS is an architectural template defined and documented in a project supported by the EU's FP7 programme.*

*The participants were largely organisations involved in the definition of the ARTEMIS SRA and subsequent work programme, which had already indicated that such a template was a useful tool for secure embedded system design.*

*Work to be continued:*

> It may well be worthwhile trying to file the GENESYS architectural blueprint as a standard. Since there is a very good cooperation with the ARTEMIS ACROSS project, INDEXYS has recommended the ACROSS project to further investigate this opportunity.

## SCALOPES

*Successes:*

> SCALOPES has developed cross-domain (horizontal) technologies and tools for next generation multicore architectures. These technologies and tools are related to:
  1 application & programming models,
  2 composability, predictability, and dependability
  3 resource management
  4 power aware architecture
  5 reference platforms.
> These developments were driven by and proven for four different application domains:
  1 Communication infrastructure: the main result is the NAD tool, a networking application development tool designed to provide easy and fast application development for FPGA based networking devices. It consists of a graphical user interface, and provides modular system development (available as open source).
  2 Surveillance systems: the basis is the SPEar platform. The addition of HW coprocessors (massive computing structures) resulted in huge performance boosts for specific applications (like H.264 video encoding and motion estimation) with a power consumption of approximately 5W (compared to >80W for classical CPUs).
  3 Smart mobile terminals: the auto-parallelisation of application on multicore systems resulted in drastically reduced development time (compared to manual development). The performance acceleration and gain in power consumption were considerable (although lower than the manual version).
  4 Stationary video systems
> A key result is a simulation-based performance analysis methodology (at chip level), based on a new solution for system level performance analysis called Application Task Mapping (ATM), which Synopsys has added to its Platform Architect product line. In essence, ATM enables the rapid creation of an executable system model to collect information about performance metrics like throughput, latency, and resource utilisation.
> An LCD television set with advanced 2D dimming backlight algorithms, resulting in around 50% power savings.
> At system level, threefold power savings and fivefold cost improvement have been achieved by using the technical results on resource management. These results were achievable by a combination of the latest SoC technology, optimisation of resource assignment and the improved system architecture that was required to enable the creation of an embeddable display controller

*Work to be continued:*

Further improve the methods and tools for automatic parallelisation, to bring the results closer to what is achievable with manual methods while keeping the improvements in development time and reduced power consumption.

## SYSMODEL

*Successes:*

> The project has created a useful and accessible toolkit for System Level Modelling*, which can lower the threshold to improving productivity, especially for SMEs.
> Based on the academic "ForSyDe" framework, the project has added key functionalities ("models of computation", wrappers, domain-specific models, …) integrating ForSyDe into popular "System C" language-based development chains.
> Extensive training materials are now available to facilitate further uptake of the ForSyDe framework and tools.
> Results are also made available to the ARTEMIS-CESAR "RTP" platform, as well as for the projects CRAFTERS, iFEST, ASAM, SMECY, other non-ARTEMIS projects and the ARTIST-DESIGN NoE.
> Six application demonstrators were executed by SMEs, using the toolkit and its extensions developed in the project, as proof of concept and evaluation of performance/risks.

(*System-level modelling is a technique that promises major savings in product development time, by supporting design decisions early in the process thereby reducing errors and the re-works coming from them. However, it is a complex and sophisticated technique generally requiring access to expensive design tool chains. "ForSyDe" is an academic modelling framework, available basically free of charge, though it is not yet at the "industrial strength" required by industrial developers (SYSMODEL has, however, considerably enhanced its uptake readiness).

*Work to be continued:*

> SYSMODEL showed that system-level modelling can potentially reduce total design time (including re-works) in five of the six applications studied, all of which had a strong real-time element. No advantages were evident In the VoIP router case, being essentially governed by pre-existing server architectures.

> Further publication and dissemination: a book is planned, as is formal introduction of the training material into graduate courses.

## CAMMI

*Successes:*

CAMMI has developed adaptive human-machine interfaces that respond to the workload of the operator (human-in-the-loop). The project focused on four industrial application domains: avionics (both EFIS, Electronic Flight Instrument Systems, and GCS, Ground Control Systems), civil emergencies and automotive/agriculture.

> In the EFIS domain, three workload mitigation concepts have been developed: the crew workload manager, integrated data link and dual operations. These concepts are designed as adaptive systems and aim to balance workload. Each of these mitigations were integrated into the EFIS demonstrator and evaluated in experiments by external experts on the subject.
> The GCS has involved the prototyping of human-machine interfaces in avionic and civil applications, characterised by a truly open architecture that can be easily integrated on any platform and thus offering inherent growth opportunities. The prototypes have been designed to improve MMI effectiveness, including the CAMMI methods and procedures and increasing the use of COTS solutions to ensure affordable capability and technology enhancement.
> In the Civil Emergencies Team (CEnT) demonstrator, the tactical handling of the emergency is done from a mobile Command and Control (C2) post. Here, the commander manages the team and the operation analyst controls the sensors. The emergency team is equipped with PDAs and sensors. Depending on the workload, as measured by the cognitive monitor, the application then switches to the right 'mitigation mode'. The mitigation strategies implemented are: "highlighting of important information", "changing modality of the interaction", "task offloading" and "task sharing".

The CAMMI architecture has also been instantiated in the two sub-domains of road driving and agricultural machine operation, according to the following basic aspects:

> Workload estimation based on a metric related to context, being primary task behaviour and secondary task load
> Mitigation strategies consisting of:
    1 adapting and prioritising information based on workload estimation and information relevance
    2 automated intervention on driver / operator assistance systems if the informative approach is not effective.

*Work to be continued:*

> While the CAMMI concept is mainly reactive (mitigation measures to reduce the operator's workload), it would also be worthwhile investigating pro-active concepts (so avoiding that the operator's workload becomes too high in the first place).

## SMART

SMART, though not completed at the time of writing due to a project extension, has developed a suite of tools and techniques for the design, deployment and commissioning of wireless sensor networks. Its main achievements are:

> a sophisticated WSN node, based on a low-power miniaturised reconfigurable device with a new, real-time reconfigurable processing unit and a very low-power CPU for power-efficient processing in WSN environments. It includes a mechanism for sensing the environment and re-configuring the reconfigurable devices in real-time
> secure WSN nodes providing high resistance to side-channel attacks, using innovative encryption and authentication schemes, data compression algorithms and video compression schemes to meet the very low power requirements of WSN nodes
> A middleware for the seamless programming, configuration and management of the SMART infrastructure
> a large real-world trial consisting of sensors and cameras, including face detection.

*Work to be continued:*

> SMART is on track to deliver the above (making use of a nine-month extension), though does need to more widely publicise its work.

## pSHIELD

pSHIELD is a pilot project focusing on the full demonstration of only a subset of the technical objectives stated in the original proposal SHIELD that unfortunately, despite a positive evaluation, could not be fully financed because of lack of funding in some of the ARTEMIS Member States.

SHIELD sets out to define a consistent architectural framework for Security, Privacy and Dependability (SPD), specifically for resource-limited embedded systems, designed to allow the SPD aspects to be considered very early in the design process (rather than being added as an afterthought, with consequent design inefficiencies and weaknesses, which is often the case today). In its final configuration, pSHIELD started off in a very difficult management situation. However, the innovative ideas expressed and revealed by the core technical contributors convinced us that the project consortium could rescue its difficult position. A short deadline was given to show recovery, and subsequent work was of excellent quality and justified proceeding with the project. Those changes paid dividends and, by the second year, the consortium had showed tremendous progress, further demonstrated at the final review meeting where again impressive results were shown.

Globally, the major goal of proving the feasibility and the innovation potential of the proposed approach to SPD integration has been fully achieved. The selected demonstrators are very effective and clearly show the added value of the pSHIELD technology.

The project has delivered some important breakthroughs and has documented them very well. Its main objective – to demonstrate the feasibility of the foundation concepts in SPD – has been achieved and a good foundation laid for nSHIELD (a follow-up project already funded by ARTEMIS).

Special mention is warranted for the fact that many deliverables are public and freely available on the project's website – which is a valuable service to the Embedded Systems research community.

chapter IV

# The ARTEMIS Community

# 4.1

## STRATEGIC RESEARCH AGENDA (SRA)

*The scale of the ambition put forward in "Building ARTEMIS"*

### 4.1.1. Introduction: role and relevance

After a few internal revisions, the "ARTEMIS Strategic Research Agenda" was first released to a larger public in March 2006. This document was the result of much hard work, not only by a dedicated editing team lead by Eric Schutz (ST) and Laila Gide (Thales) supported by Alun Foster (ST) and Robert Malcolm (Ideo), but also by very many contributors from some of Europe's best enterprises – large and small – from leading universities and other research institutes. Indeed, many national authorities and representatives of existing research funding organisations in Europe also participated. The work was carried out under the umbrella of the "European Technology Platform ARTEMIS".

The European Technology Platform was a voluntary but organised group of participants concerned with Innovation in the Embedded Systems field. It was to pave the way towards realising the ambitions of the "Building ARTEMIS" document, published a little over a year earlier. The document "Building ARTEMIS" was a statement and was underwritten by 25 CEOs of leading European technology organisations. It describes in a top-down way precisely why Embedded Systems is such an important, if intangible, domain for Europe. Put briefly, social well-being means competitiveness, which comes from Innovation (capital "I"), which increasingly comes from the use of "invisible" computing devices which we call "Embedded Systems".

The scale of the ambition put forward in "Building ARTEMIS", coupled with the complexity and potential impact that embedded systems represent, meant that the ARTEMIS SRA had to be much more than a technological roadmap to help researchers forward. It had to propose ways and means of being sure that the enormous potential benefits, to society and to industry, actually do become realised, and within reasonably short timescales. After all, Europe may have a leading position in several types of embedded systems applications and know-how, but the world at large is developing rapidly. Europe could soon be overtaken, having then to rely solely on external sources for products and technologies that will become essential for the well-being of its citizens.

For this reason, and to keep the problems at all tractable, the ARTEMIS ETP established specialist working groups to handle different parts of the complete document. These are on the one hand the technical agenda itself and on the other "how to make it happen". The latter has a section on Innovation (capital "I" again) and another on the coordination and financing of the whole ambitious project. If we look more closely at these

aspects of the SRA, it should be remembered that none of them can usefully exist in isolation from the others.

### Technical research programme

The technical research programme starts off by identifying applications which are felt to be particularly important for Europe, grouping them into four large clusters labelled "Application Contexts". The main criterion for grouping is bringing together applications or industry sectors that would seem to share a common set of requirements and problems related to embedded systems. The next step was to take the issues and requirements from each of the application contexts and group them horizontally. This way, a set of "Research Domains" was identified that would best benefit them. Put into a few sentences like this, it sounds so simple. In reality, a huge number of man-hours was spent in many discussions before a list could be put together that covered pretty well all the bases. The diversity of existing, preferred and envisioned solutions, coupled with an equally diverse set of standard approaches made this a rather delicate operation. So why not take an easier route?

Well, the leading idea behind what became called "the ARTEMIS approach" is to research new solutions which can be of re-used as much as possible, both within industry sectors and across the different ones. This will go a long way to allowing different industries to compete on their differentiating characteristics while making use of a set of ready-made technological solutions. In turn, this will lead to a dramatic improvement in product design cycles and competitiveness. In addition to "foundational science", which is necessary to fuel more serendipitous innovations, the set of three research domains directly feed more downstream innovation. These three research domains were defined as Reference Designs and Architectures, Seamless Connectivity and Middleware and System Design Methods and Tools. These are detailed in their own documents, including prioritisation of the topics to be handled. Since then, the resulting "matrix" diagram has served as inspiration for many pan-European research initiatives, as well as worldwide. It does, however, represent the partitioning and prioritisation seen at that time, by the subset of industrial and academic partners involved in its creation. It is certainly now time to recalibrate the model and refine it, based on today's knowledge.

### Innovation Environment

A number of times above, "Innovation" has been written with a capital "I". This was done not only to emphasise its importance to industries and companies, but also to stress that it means more than technical novelty alone. Without viable markets in which to sell the results, and the means to manufacture and deliver them to end customers, innovation as such will not contribute much to our general well-being. Embedded systems do not really exist in isolation – the products and services they enable are very diverse and often complex (despite the relative simplicity in use). In increasingly de-verticalised industries, they are the result of several integration steps along the supply chain. Left to its own devices, natural entropy would lead to many uncoordinated and inefficiently developed products – a recipe for unsuccessful business. The ARTEMIS SRA addresses this by promoting the concept of the "Innovation Environment". This includes large-scale collaboration through Centres of (Innovation) Excellence, standardisation (itself a major market enabler), education and training along with the often difficult position of high-tech SMEs. The ARTEMIS-JU has taken up much of this in its strategy for creating "Self Sustaining Innovation Ecosystems", though much work is still needed to make it happen. The funding of research provided through the JU goes a long way in promoting collaboration among the various R&D actors, which is a *sine-qua-non* for seeding such eco-systems. However, the rules of the ARTEMIS-JU do not allow for funding non-R&D actions, so the funding streams needed to support these eco-systems long-term must come from elsewhere and, while they are generally known about, they still need to be pressed into action.

### Coordination and Making it Happen

The ARTEMIS SRA has, as a key goal, the ambition to fight the fragmentation and resulting lack of efficiency that is often seen in complex technological developments, and technologies involving embedded systems are a case in point. The technical part of the SRA tries to group the technologies in a way that should help mitigate this tendency at the implementation level, and the document goes further. It proposes an additional and novel model for public financing of collaborative R&D that should greatly increase cohesion between actions undertaken across Europe. While public funding schemes already exist at national and transnational levels (the Framework Programme of the EC and EUREKA are most relevant for embedded systems), the ARTEMIS SRA puts forward an approach that aims to put their best features together. This makes for a very compelling scheme that will attract the participation of all the actors in the field. After extensive study of the complexities of European law, a fine-tuned version agreed by the European Council and accepted by the European Parliament now lies at the heart of the ARTEMIS-JU. The experience of executing this operation can be an inspiration for future versions of the SRA that look beyond the life-span of the existing ARTEMIS-JU, remembering that the Research Agenda of the JU has a smaller scope and sub-goals with respect to the ARTEMIS SRA.

The ARTEMIS ETP SRA has provided inspiration and guidance to a broad spectrum of people directly or indirectly involved in innovation. The world of today is already a different place than it was in 2006, when the SRA was first published. The experience of setting up the ARTEMIS-JU as an additional programme and new knowledge about the world, specifically on embedded systems, can serve well in keeping this important document fresh and up-to-date.

# 4.2

## NATIONAL MIRROR ORGANISATIONS

*"... the actors from various industry sectors beginning to speak with one voice in response to specific challenges"*

In addition to the funded projects that are carried out under the umbrella of the ARTEMIS Joint Undertaking and that are R&D oriented, the ARTEMIS Industry Association has built a unique innovation eco-system through a number of very active working groups formed by voluntary members from industry and research institutions. Among the vehicles for this are national mirror organisations, one of which is the ARTEMIS-Austria platform created in 2009. Each year it organises and hosts an international conference in Austria, contributing to the innovation eco-system activities of ARTEMIS. The ARTEMIS Austria conference that took place in Vienna on 20 and 21 September 2012 and was attended by some 80 people provides a fascinating insight into the way in which such national events contribute to the ARTEMIS goals. This particular event considered "Future Embedded Systems – Solving Societal Challenges" and the twenty presentations at the conference covered an interesting spectrum of ARTEMIS topics, such as Safety and Security, Energy Efficiency, Systems-of-Systems as well as revealed the results of ARTEMIS projects.

### Speaking with one voice

During his welcoming address, Michael Wiesmüller, Head of ICT, Industrial and Nano-Technologies and Space at the Austrian Federal Ministry of Transport, Innovation & Technology, suggested that Austria was "currently in a very important and thrilling phase concerning the implementation of Artemis with respect to the large demo and pilot projects. These are generating more innovations that are really quite close to the market and are helping to create a platform on which we are starting to see the actors from various industry sectors beginning to speak with one voice in response to specific challenges."

The conference began with keynote presentations. Sabine Herlitchka of Infineon spoke about the perspectives on global challenges from the point of view of a leading technology company. Infineon is a well-known chip producer, but is also an active partner in the field of embedded systems. Rolf Ernst from the TU Braunschweig, well-known in the European embedded systems community, presented his insights on deriving research problems from complex societal challenges while Heinrich Daembkes of EADS spoke about cyber-physical systems, followed by Rainer Zimmermann from the European Commission, who focused on the strategies for embedded computing research in Horizon 2020. A further keynote address by Laila Gide of Thales entitled "Vision and Facts for the Future of the ARTEMIS Strategy" provided a short introduction about the next steps in ARTEMIS activities as well as calls.

The ARTEMIS Austria conference very successfully communicated an overview of the activities and results in the field of embedded systems research in Europe. Aimed at a mainly Austrian audience, the conference highlighted national activities as well as transnational activities with Austrian participation. In summing up the value of the 2012 conference Michael Wiesmüller suggested that it was "a good example of how, after five years of ARTEMIS, certain topics have reached a maturity and we now have an awareness of what the state of the art is in Europe. For instance, in the area of in-car electronics, with collaboration between the OEMs, supply chains, companies developing electronics … we have a very clear pathway to where we should be heading in Europe."

But ARTEMIS Austria is not alone. Similar groups have sprung up in Hungary, Denmark and particularly in Spain where the PROMTEO platform has been instrumental in assuring such active participation in the ARTEMIS Programme, especially supporting SMEs.



# 4.3

## SUCCESS OF CoIEs AND THEIR ROLE IN ARTEMIS COMMUNITY

*CoIEs exist mainly to create new, self-sustaining businesses that, in turn, drive employment and social responsiveness*

Centres of Innovation Excellence (CoIEs) are groups of multi-country, multi-organisation, interconnected R&D actors and businesses able to achieve a significant advantage in innovation success in a specific market through efficient planning, acting and cooperation. CoIEs exist mainly to create new, self-sustaining businesses that, in turn, drive employment and social responsiveness, among other things. However, in order for CoIEs to be successful, they must comprise a range of actors in a suitable environment and nurture a culture of cooperation in which various forms of partnerships work across boundaries.

### Holistic approach

By establishing a new, holistic approach to research, technology development, innovation and skill creation through innovation ecosystems, ARTEMIS aims to enable benefits to be created from both cooperation and market competition. This will both increase the efficiency of technological development and, at the same time, enhance the competitiveness of the market in the supply of embedded systems technologies. These collaborative innovation ecosystems will strengthen the European position in Embedded Intelligence and Systems and so achieve world-class leadership in this area.

### Partners

An ARTEMIS ecosystem must include partners active in the market. They could be institutions or initiatives based on a group of individuals or teams, or a local CoiE, working closely together, with proven highly recognised experience and capabilities in their domain. Partners may be both public and private bodies, large companies, SMEs, intermediaries and cover all levels in the supply chain, such as knowledge providers, generic technology providers, systems developers, systems integrators, service providers and product companies, and even end-users. Academic institutions at all levels as well as bridging institutions that help close gaps between actors and other public and private organisations (venture capital firms, shared resources, training companies) are also relevant partners. CoIEs will be subject to a re-assessment of the CoIE-ARTEMIS label by ARTEMIS Industry Association once every three years. If the CoIE fails to fulfil the criteria, the label could be withdrawn.

### Minimum of three

The minimum number of partners to begin with must be three, with representation from at least two different countries. Although a higher number of partners is preferred, this is not mandatory for the start. The minimum number of participants from industry must be two. The application should provide info on where partners are positioned in the supply chain, which end-users are involved and the geographical scope of the CoIE. Membership of ARTEMIS Industry Association of one of the members of a candidate ARTEMIS CoIE is required at the time of application. As soon as the label is granted, at least 50% of the members of the CoIE have to become a member of ARTEMIS Industry Association within one year. If a candidate ARTEMIS CoIE is a cluster of associations, at least one member per association should be member at the time of application and at

least 50% of all members of each association have to become members of ARTEMIS Industry Association within one year to benefit from the support of the Industry Association.

### Innovation and R&D

The actors in a CoIE will share common interests - potentially from key technology research through to a market – that provide a focus for both the participants and the outside world to recognise the ecosystem. It is important that a culture of openness, trust, fairness and willingness to cooperate must pervade and a base of world-class knowledge and experience is created. In such a stimulating environment interaction is facilitated and encouraged rather than inhibited, and situations arise in which solution ideas meet problem situations. The scope and desire is to support the development of academic excellence regarding both technology and cooperation. The main R&D domain of the ecosystem should fit the ARTEMIS Strategic Research Agenda. Through relations with other networks and public authorities, this should provide enough mass to sustain the visibility and viability of this interaction, and to attract interest from and retain considerable impact on the market.

### Label certification criteria

A CoIE must have a mission document and some basic rules of interaction. A Chairperson or Speaker will be nominated to act as the point of contact for the CoIE to the outside world. The CoIE mission must then be translated into a plan of action that describes the main activities driving the innovation system forward: common meetings, workshops, pre-studies/pre-projects, R&D projects, different interest groups (technology, sector, etc), events involving representatives from all stakeholders (researchers, developers, producers, users, financers, marketing, etc). This plan of action must be updated at least once a year. More on CoIE labelling below (see 4.3.5).

### Networking

A CoIE will build and maintain relationships with other networks (it has an inter-cluster cooperation strategy) and the public authorities, and contribute to enhance EU competitiveness. It will have to demonstrate its activities on a regular basis, for example, publishing an annual activity and progress report that describes, amongst other things, the progress made on ARTEMIS label criteria. The CoIE should also provide networking and matchmaking facilities to encourage frequent interaction and the initiation of cooperative R&D projects. The ARTEMIS CoIE should also be open to questions from the members of the ARTEMIS Industry Association on ways of working and best practices.

### Optional extras

CoIEs might also contribute to ecological principles, recognising real concerns about safety, energy usage and sustainability as well as actively stimulate SME participation in the ARTEMIS innovation ecosystem(s), thereby enhancing their growth and success. CoIEs could also explore new business models for trading in the envisaged dynamic innovation environment, including the incorporation of open source concepts and encouraging the establishment of open European Tool Platforms that could evolve and interoperate with other tool solutions. They might also consider extending standardisation to related domains and recommending adaptations to European educational systems, assisting them to supply, sustainably, suitably skilled engineers and researchers. Finally, by encouraging the opening of supply chains, where beneficial, a more open innovation environment might be created through the ARTEMIS Innovation Ecosystems.

## CoIEs IN ACTION

### 4.3.1 EICOSE

#### Strategic R&D alignment in the domain of safety critical systems engineering for transportation

Embedded systems are an essential part of today's transportation, be it cars, trains or airplanes, as well as in the supporting infrastructure (traffic management systems, road and rail-side sensors, signals, etc.). Although the exact details vary between automotive, aerospace and rail applications, there are a lot of common, cross-domain problems and challenges caused by ever increasing systems complexity and traffic density. EICOSE, the European Institute for Complex Safety-Critical Systems Engineering, collaborates with European experts to identify and help overcome these problems.

EICOSE was founded in January 2007, building on strong cooperation between the two French clusters (Pôles de Compétitivité) Aerospace Valley and Systematic, and the German competence cluster SafeTRANS. Five years later, EICOSE has become a dynamic institution with two associated partners – ARTEMIS Austria and the Spanish organisation Tecnalia – and a multitude of associated experts organised in E²GEST, the EICOSE Experts Group on Embedded Systems in Transportation. Within the frame of EICOSE, a true innovation eco-system has been established to foster cross-domain R&D through harmonised roadmapping and project incubation.

### EICOSE activities and impact

Two correlated activities of EICOSE are roadmapping and project incubation, performed by experts from E²GEST within three Working Groups (WGs), aligned to the respective ARTEMIS sub-programmes (ASPs):

- WG 1: Methods and Processes for Safety-Relevant Embedded Systems (ASP 1)
- WG 2: Computing Environments for Embedded Systems (ASP 5)
- WG 3: Human-Centred Design of Embedded Systems (ASP 8)
- The EICOSE activities are structured in three phases:
- Working Groups identify and agree on R&D topics and their prioritisation, which are harmonised between the automotive, aerospace and rail domains, and updated annually.
- The harmonised R&D topics then feed the roadmaps of European funding programmes, such as the ARTEMIS Strategic Research Agenda 2006 and 2011, and other European (ITEA 2, FP7) and national funding programmes.
- Building on these strategic roadmaps, aligned projects are incubated, again taking into account the results from the WGs. ARTEMIS projects incubated by EICOSE include CESAR, MBAT and D3CoS.

Each of the clusters harbours an ecosystem covering the whole range from research to industrial applications, within a stimulating environment that facilitates and encourages interaction, and with knowledge exchange between the clusters especially regarding SME contacts and matchmaking. These ecosystems feed and are fed by the roadmapping and project incubation activities done on a European level.

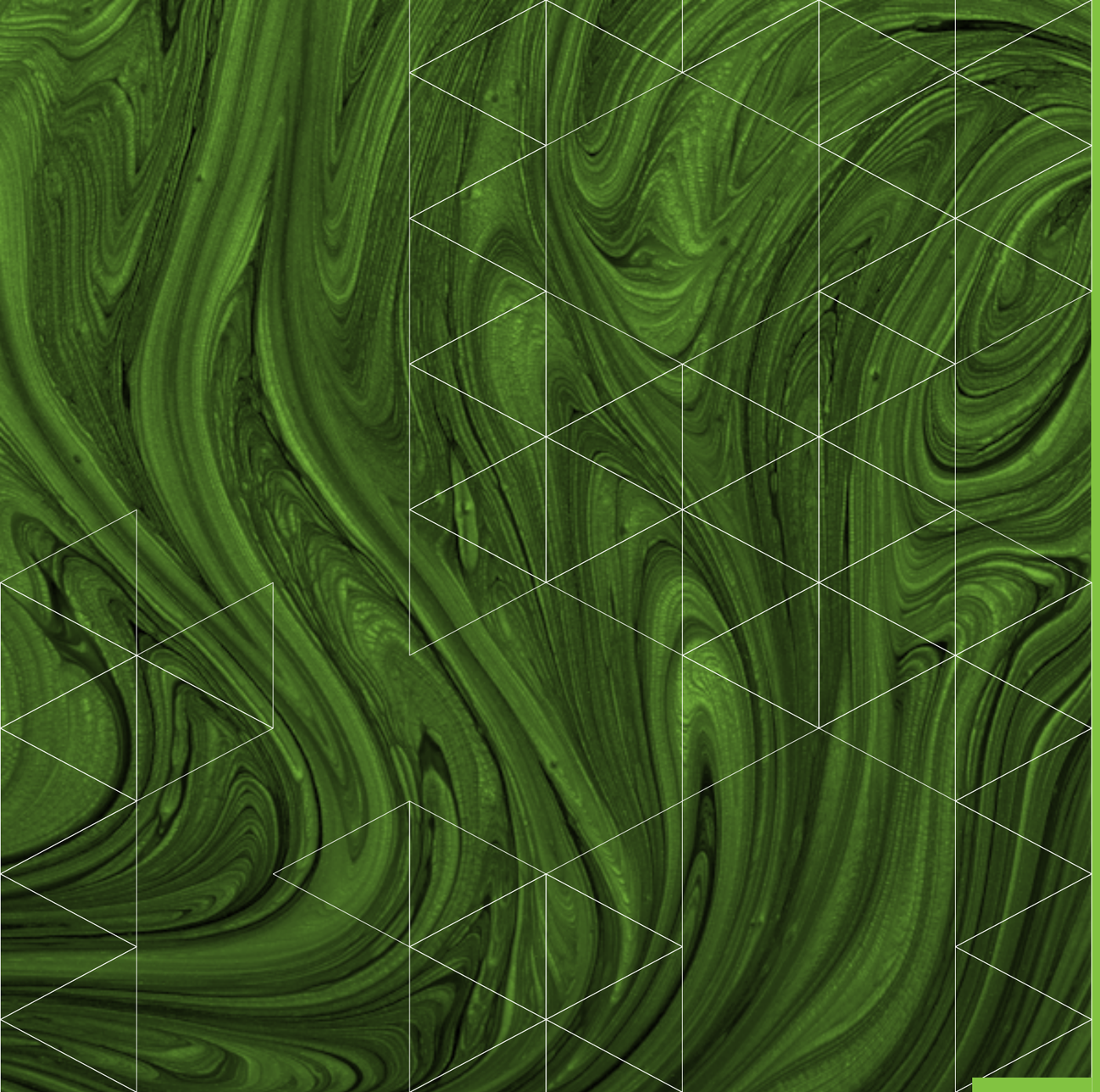
EICOSE also fosters a strong commitment to ARTEMIS and contributes to numerous ARTEMIS-IA Working Groups, such as Tool Platforms, Centres of Innovation Excellence, and Standardisation.

In the domain of European Tool Platforms, EICOSE promotes and advances plans for a Reference Technology Platform for the development of embedded systems in the transportation domain, with collected input from CESAR, MBAT and many other projects and initiatives.

Recognising the very substantial contribution to building up ARTEMIS and installing a European innovation ecosystem, the ARTEMIS-IA Steering Board awarded EICOSE the Centre of Innovation Excellence label in 2007. Following a successful evaluation in 2011, the CoIE label has been renewed.

### Inside EICOSE

The cooperation of all partners in EICOSE can be characterised as friendly and motivated. In the pre-competitive domain of the development of methods, processes and tools for embedded systems, all stakeholders (OEMs, suppliers, tool vendors, research organisations and universities) pull together to pro-actively



"The main criterion for grouping is bringing together applications or industry sectors that would seem to share a common set of requirements and problems related to embedded systems."

stimulate the development of new components, tools and design methodologies supporting embedded systems.

The benefits for partners active in EICOSE are first and foremost to be part of a community that enables cross-domain cooperation and harmonisation of research topics, exchanges best practices and solutions across domains and national borders, fosters the exchange of tools, technology and knowhow and supports, and shapes European as well as national R&D projects.

Europe is thus benefiting from a productive R&D community generating aligned projects with efficient use of resources and accelerated innovation processes. EICOSE partners are all aware that strategically aligned R&D activities enable the effective use of resources, avoid fragmentation and facilitate deployment. EICOSE is an example of how an innovation-friendly ecosystem can be built at European level.

### 4.3.2. ProcessIT.EU
### Mobilising for automation in the European process industry

Efforts to create a research and innovation centre of excellence for automation in the European process industry have taken a big step forward following the recent meeting in Stockholm of industry, research and clusters along with public authorities. The intention is to create **ProcessIT Europe**, a Centre of Innovation Excellence (CoIE) targeting manufacturing automation within the framework of the European Joint Undertaking ARTEMIS.

#### Win-win across the board

ProcessIT Europe targets manufacturing automation for process industries like mining & minerals, pulp & paper, metals, oil & gas, energy, chemicals, pharmaceuticals and wastewater. Many of these industries share similar automation problems so there is a basis for making cross-industry solutions feasible. By targeting manufacturing automation for different industry sectors, ProcessIT Europe will have the potential to integrate automation activities now present in different technology platforms throughout Europe.

Industries, suppliers and end users will all benefit from ProcessIT Europe through increased competitiveness, enhanced product development and new business opportunities. The CoIE will focus on automation innovations enabled by embedded and information systems technology. In a growing global market where competition is increasing, such an initiative is both welcome and necessary.

The value proposition of ProcessIT Europe has a few key elements. Firstly, it will be a meeting point for manufacturing automation suppliers, their end users, active scientists and public authorities. Here, end user needs will merge with research and supplier competencies from which ideas for new products will emerge. These ideas will subsequently be incubated as R&D projects, with ProcessIT Europe serving specifically as an R&D project incubator. In parallel, the development of a road map for manufacturing automation within the targeted industries will support and influence other technology road maps by ARTEMIS and others.

#### Breeding ground

Luleå University of Technology, together with the regional initiative ProcessIT Innovations, initiated the formation of ProcessIT Europe and hosted the recent meeting in Stockholm. Some 30 people, including representatives from automation suppliers, end users and regional clusters from Sweden, Finland, Poland, Germany and Austria attended. Representatives from the UK, Czech Republic and France have also announced their interest in participating in ProcessIT Europe.

It is quite natural and logical that the initiative to create a European ARTEMIS CoIE for IT in the process industry comes from the Bothnia Bay region, including northern Sweden and Finland, with its variety of heavy process industries and corresponding world-leading research. "Our research skills related to the process industry go back a long way and we now have the ProcessIT Innovations research centre linked to the Luleå University of Technology and Umeå University. With some of Sweden's and Finland's key process industries, such as LKAB, Boliden, SCA, Stora Enso and Outokumpu Stainless, located in the Bothnia region, this is a breeding ground for top research," says Jerker Delsing.

Thanks to collaboration between research and industry stakeholders, ProcessIT Europe will be able to drive innovation processes whose social value will boost industrial development and elevate the quality of research.

### 4.3.3 ES4IB
### ES4IB Centre of Innovation excellences

At the Co-Summit 2011 in Helsinki, eDIANA was granted the status of Centre of Innovation Excellence and is known as ES4IB, the acronym for Embedded Systems for Intelligent Buildings. This ES4IB CoIE can be seen as the final stage in structuring excellent partners working together in different international projects related to the innovation chain in ICT for intelligent buildings. Since buildings are the heaviest consumer of energy in Europe (40%) and are also responsible for about a third of Europe's greenhouse gas emissions, this is a vital focal area. The centre will contribute to Europe's leadership in ICT-enabled energy efficiency through intelligent solutions and support Europe's objective to reduce energy consumption by 20% by 2020 and facilitate broad use of ICT systems to enable future buildings to become at least energy neutral.

#### Living Lab

High performance in efficient buildings (using ES) has been an important research and business focus for the partners in general and specifically in Spain. Moreover, the eDIANA project was led by the Spanish company ACCIONA under the ARTEMISIA JTI first call. The ES4IB is working with other centres and will increase collaboration between centres, universities and companies in Spain in the area of intelligent buildings. It therefore stands to reason that Spain provides a very suitable environment in which to use a European living lab strategy. Indeed, some partners are already in the process of applying for membership of ENOLL, the European network of living labs. The real-life test and experimentation environment of a living lab enables users and producers to co-create innovations through exploration, experimentation and evaluation.

#### Benefits across the board

Benefits can be envisaged in terms of standardisation, with cross-area standardisation analysis within and beyond the embedded system, ecological principles whereby real concerns about safety, energy usage and sustainability are recognised along with environmental impact with a significant reduction in emissions. Furthermore, SMEs and institute spin-offs stand to benefit if they can bring the technology to market. Finally, ES4IB continuously supports education, promoting research and making use of the research potential of the universities involved, supplemented by the work of the technology centres and industry needs. Medium and small companies from industrial sectors working with similar technologies may be interested in supporting a research group, focusing on new R&D action about emerging technologies, where risks are high but at the same time considerable economic and technological profits may be achieved. Cooperation with universities and/or technological centres will increase the value and size of the new projects and create a win-win situation.

### 4.3.5 Labelling for CoIEs


For ARTEMIS, a **Centre of Innovation Excellence** is a group of multi-country, multi-organisation, interconnected R&D actors and businesses that by efficient planning, acting and cooperation, achieve a significant advantage in innovation success in a specific market. CoIEs exist mainly to create new, self-sustaining businesses, which in turn drive employment, social responsiveness, etc. To be successful, CoIE's must comprise a range of actors in a suitable environment and nurture a cooperation culture to work across boundaries by various forms of partnerships. The label is granted for a period of 3 years

#### Basic premise for ARTEMIS CoIE labelling

An ARTEMIS ecosystem must include partners that are active in the market. A partner could be an institution or an initiative based on a group of individuals or teams, or a local CoE, working closely together, with highly recognised experience and capabilities in their domain. The minimum number of partners in the beginning must be three, coming from two different countries. A higher number of partners is desirable, but not mandatory. Information must be provided on how the partners are positioned in the supply chain, which end-users are involved in the CoIE and the geographical scope of the CoIE. One of the members of a candidate ARTEMIS CoIE must be a member of ARTEMIS-IA at the time of application. As soon as the label is granted at least 50% of the members of the CoIE must become ARTEMIS-IA members within one year. If a candidate ARTEMIS CoIE is a cluster of associations, at least one member per association should be an ARTEMISIA member at the time of application and at least 50% of all members of each association must become ARTEMIS-IA member within one year.

The actors must share common interests – potentially from key technology research to a market – so as to provide a focus both for the participants and for the outside world to recognise the ecosystem. There must be a culture of openness, trust, fairness and willingness to cooperate as well as a base of world-class knowledge and experience, a stimulating environment that facilitates and encourages, rather than inhibits, and stimulating situations in which "solution ideas meet problem situations". The CoIE should support the development of academic excellence in terms of both technology and cooperation. The main R&D domain of the ecosystem should fit the ARTEMIS SRA and relationships with other networks and public authorities should have enough mass to sustain visibility and viability as well as attract interest and retain major market impact.

#### Label certification criteria

A CoIE must nominate a Chairperson or Speaker, acting as point of contact for the CoIE to the outside world. It must have a mission document along with an action plan that implements its mission. This action plan describes the main activities driving the Innovation system forward and must be updated at least once a year. The CoIE must contain some basic rules of interaction. It is expected to build and maintain relationships with other networks and the public authorities as well as enhance EU competitiveness. A CoIE has to demonstrate its activities on a regular basis, e.g. publish an annual activity and progress report that describes, among other things, the progress made on ARTEMIS label criteria. A CoIE should also provide networking and matchmaking facilities to encourage frequent interaction and the initiation of cooperative R&D projects. The label might be withdrawn if the criteria are no longer fulfilled.

CoIEs may apply for the label by sending a document to the ARTEMIS-IA Office describing the CoIE and its activities as well as how the CoIE will fulfil the criteria listed in the CoIE label criteria document.



# 4.4

## SUMMER CAMPS: CREATING A STRATEGY

*Shaping the future of embedded intelligence in Europe is an exciting venture*

Each year, the Office of ARTEMIS Industry Association organises a two-day "ARTEMIS Summer Camp" at a hot spot in Europe, bringing together members of the ARTEMIS Industry Association, public authorities and other guests to give their views on strategic issues and feedback on research priorities. This event is a kind of rendezvous occasion during which the research agenda and strategy for embedded intelligence in Europe can be openly discussed. Shaped by a series of working sessions, there is opportunity for brainstorming and, as output, drawing up a list of tangible ideas that can be seen as bottom-down input to feed into the various annual working plans and agendas. Such an approach ensures that the ARTEMIS Innovation Programme is and remains industry driven. The Multi Annual Strategic Plan (MASP) and its associated Research Agenda (RA) are submitted annually to the ARTEMIS Joint Undertaking by the International Research Committee (IRC) to the Governing Board. The Annual Working Plans (AWP) are derived from the RA and form the basis for the ARTEMIS-JU calls. The AWP is submitted each year to the ARTEMIS-JU for acceptance by the Public Authorities Board.

#### Special mission

The first Summer Camp took place over two days in June 2009 and had a special mission: to be the kick-off of the new edition of the Strategic Research Agenda for 2010. The first ARTEMIS Strategic Research Agenda was published in 2006 by the European Technology Platform (ETP), and it was now time to recalibrate it for the next ten years. Shaping the future of embedded intelligence in Europe is an exciting venture which attracted a balanced mix of 95 representatives of SMEs, large enterprises, knowledge centres and public authorities, all enthusiastic participants.

When the European Technology Platform decided, in 2007, to establish ARTEMIS-IA Association as legal body, the association of actors in the field of ARTEMIS ensured the identity of the European Platform and took over the responsibility for the Strategic Research Agenda. The Steering Board of the ARTEMIS Industry Association decided that the next version of the Strategic Research Agenda (SRA) should be published in 2010. This is an important task, since this new SRA will provide the future direction for the European research in Embedded Systems for all R&D actors, not just for the ARTEMIS Joint Undertaking. The SRA has to take account of the recent evolutions in the embedded intelligence systems domain and aims to make Europe stronger in the face of increasing global competition. The ARTEMIS Industry Association therefore gave the Summer Camp 2009 a special mission to pave the way for the ARTEMIS-ETP SRA 2010, and the shaking of hands with the European Commission and the Public Authorities.

"The SRA has to take account of the recent evolutions in the embedded intelligence systems domain and aims to make Europe stronger in the face of increasing global competition."

## SWOT

The first day of this 2009 Summer Camp started with a SWOT analysis of the SRA as it was then; looking at the strengths, weaknesses, opportunities and threats. This analysis is designed to help reveal the challenges that Europe will encounter in future research and innovation in Embedded Systems. The SWOT was set up along the three major themes of the SRA: Strategy, Research and Innovation. The second day, the consolidated SWOT outcome was mapped onto the existing Working Groups of the ARTEMIS Industry Association and the SRA Experts Groups. In the morning of the second day, the research update of the Research Agenda of ARTEMIS-JU 2010 was presented, followed by a discussion in several of the Working Groups of the ARTEMIS Industry Association on the impact of the SWOT results on their plans and ideas. The results of these very fruitful discussions were presented in the plenary meeting at the last and closing session of the Summer Camp.

Below three Summer Camp participants present their experiences of and views on the ARTEMIS Summer Camp.

Dr Helen Finch of Infineon UK, which designs microcontroller and multicore technology for real-time embedded systems, principally for automotive applications, sees close alignment between the aims of ARTEMIS and her company's R&D activities. "The Summer Camp is a great opportunity to inform and shape both the future of ARTEMIS and our own strategic thinking. Since collaborative R&D is quite new for Infineon UK, we are keen to learn and to get more involved. This collaborative approach also helps to raise our profile. I see ARTEMIS as a community of projects, all contributing to common goals. I found a strong sense of community and cooperative spirit at the Summer Camp which reinforced this view. I valued the opportunity to participate in discussions on the 2011 AWP and feel that I now have greater insight into its structure and content. The Working Groups were new to me; I found the 'Centres of Innovation Excellence' particularly interesting given the level of innovation in microelectronics concentrated in Bristol and the South West of England. This was Infineon UK's first involvement in ARTEMIS Industry Association – I don't think it will be the last."

Antonio Pérez Berdud, Electronic Area Manager and Embedded Systems Research Line Coordinator at IKERLAN-IK4, a research centre for the Mondragon Group, one of the leading industrial and economic groups in Spain, sees ARTEMIS as a key platform in terms of developing the centre's strategy. "On the basis of our experience in embedded systems, we feel that it is important to participate in the review of the new strategic agenda, and to maintain contacts and establish new ones with other centres, companies and universities affiliated to ARTEMIS. The companies we collaborate with also require us to operate as a connecting hub with a global network, and events like the ARTEMIS Summer Camp enable us to keep up and improve contacts in the European ecosystem of embedded systems. The reason why I attended was mainly to check out the alignment with the new Strategic Agenda and endeavour, as far as possible, to contribute towards it with our vision on some subjects. Apart from that, the Summer Camp is, of course, a good place for meeting up with the embedded systems 'family' and making contact with collaborators in the preparation of projects for ARTEMIS, FP7 and others. It's an excellent opportunity to obtain first-hand information on the calls and actions carried out by ARTEMIS, and this enables you to orientate yourself and appraise your own technology strategy. It is extremely difficult to influence the ARTEMIS strategic agenda, but the comments are well received by the different working groups. At the end of the day, it's a wonderful chance to get together with potential partners and collaborators and find out about new proposals and ongoing projects."

Luca D'Onofrio, automotive software engineer at Intecs S.p.a. in Italy, a company that has been involved in managing all the phases of the lifecycle of software for embedded systems in many application domains for more than 30 years. "We made a strong commitment to ride the wave of evolving technologies and new systems in each of them. For this reason we joined the ARTEMIS Industry Association and we are strongly interested in building partnerships with European industry and research leaders, by means of the ARTEMIS-JU projects, and, hence, being an active player in the market ecosystem of embedded systems. Summer Camp 2010 was rich in interesting and constructive discussions, concerning both the Strategic Agenda and the emerging roles of embedded systems in everyday life. I believe the latter is of paramount importance and it has been addressed in detail, including the fusion between emerging technologies, methodologies and the needs of today's society (healthcare, ageing society,  etc.). I was delighted to find that, thanks to the synergy among industrial and academic stakeholders, ARTEMIS is actually promoting the cohesion between academic research, industrial and marketing know-how."

# 4.5

## ARTEMIS TOOL PLATFORMS

*The ARTEMIS MASP recognised the need for trustworthy, interoperable tools from reliable sources with assured long-term support*

European dependency on too few companies for strategically important tools can be considered a major weakness and open-source alternatives, due to small user bases, are often not workable. The ARTEMIS MASP recognised the need for trustworthy, interoperable tools from reliable sources with assured long-term support. The introduction of the "ARTEMIS Tool Platform" concept is a response to this need.

Unlike a complete design flow tool chain, an ARTEMIS Tool Platform has no fixed or even physical existence, neither is it intended as a commercial entity. These virtual platforms are sets of commonly agreed interfaces and working methods, which may evolve and become more refined over time, that allow specific tools addressing particular elements or phases of a design flow to interoperate with other tools addressing the same design goal, so forming a complete working environment. In its simplest expression, it is a specification for interfaces and operating methods. One such tool platform is the CESAR reference technology platform.

### 4.5.1 CESAR

With strong commitment from a wide community of major end-users, tool vendors and technical experts from academia and industry, CESAR is ideally positioned to build the fundaments for next generation system engineering by defining tool interoperability for an ecosystem that may as much as halve the costs of integration, configuration, deployment and maintenance of tool chains.

CESAR's specific focus is to improve the development processes in embedded system engineering in terms of new methods, processes and tools to meet new challenges imposed by, for example, the many new standards and requirements in the transportation and automation domains, especially in respect to safer and more environmentally-friendly mobility. However, since the solutions bring an ever increasing complexity that is inherent in working with new technologies and functionalities like car-to-car or car-to infrastructure communication, development processes must be able to handle the requirements imposed by these new requirements in a competitive way and yet can adequately respond to the demands of the future.

A key factor of an ecosystem is standardisation linked to a business model. CESAR deals with different domains and many different stakeholders so top priority is to arrive at a level of interoperability that enhances all kinds of tool connections by reaching an industrial level of interoperability specification that in the long run may lead to the creation of a standard. CESAR provides the environment in which solutions coming from one domain may transfer to other domains that neither the problem owner nor the solution provider may previously have considered. It broadens the range of possibilities and opportunities. On the tool platform front, there is great potential to integrate tools from different stakeholders. The CESAR RTP is cooperating with other ARTEMIS projects that are going in similar directions, providing the information generated in the CESAR project.

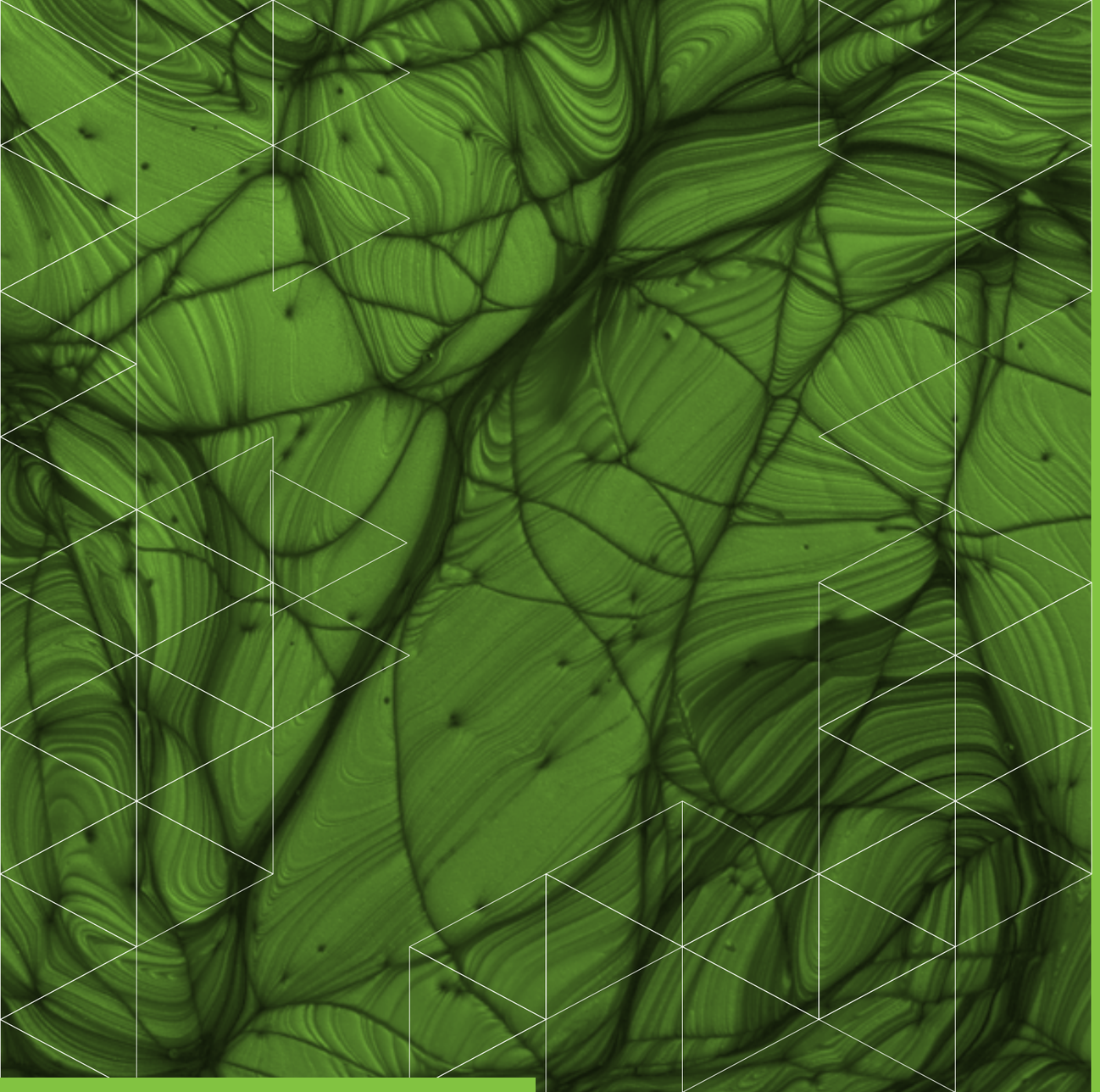
CESAR also has a real impact on education and training since academic partners in the project get immediate feedback from their industrial partner and the research being done in the project is already influencing their academic programmes. Without CESAR, this process would normally take much longer. Also, since the project is multi-domain, the knowledge of an academic partner can be taken on board in one domain and used in another. This creates new connections and real win-win situations. The multi-domain approach is essential as is the involvement of academia and SMEs.

### 4.5.2 Labelling for Tool Platforms

Tool Platforms are set of services to a community enabling it to pool intellectual property, methodology, components or services, in accordance with a specific architecture, in order to avoid duplicate efforts when developing, maintaining, or using them. ARTEMIS defines Tool Platform to designate the collaborative development environment of a tool chain that allows the design of Embedded Systems (design/build time) as distinct from Embedded Software Target Hardware, a set of embedded soft or hard constructs to enable various components to communicate and operate together (at run time). Therefore, the ARTEMIS R&D Tool Platforms for Embedded Systems focus on pooling intellectual property, system, software and hardware development services to help the ongoing ARTEMIS projects to deliver their innovative embedded systems development applications across multiple disciplines and partner companies. A further focus is software components for the customer working with the applications that result from ARTEMIS projects to help develop embedded systems. In establishing the criteria for labelling platforms as ARTEMIS Tool Platforms, emphasis is put on three points, namely to facilitate early instalment of initial tool platforms, the integrating role of the Tool Platform in establishing ecosystems around tool development and to safeguard platform sustainability.

The organisation providing the tool platform will be uniquely identified. The Tool Platform is developed under the responsibility of a single organisation, such as a software vendor, a joint-venture, a not-for-profit organisation, an open-source organisation or a consortium of such organisations under a common governance structure, known as the 'tool platform provider'. The tool platform provider may be self-funded, apply for public funding, be open-source or sell its software and services. The tool platform provider will distribute all the information needed, such as APIs, documentation and support, to the partners wishing to integrate with his tool platform.

Tool Platforms might contribute to interoperability (by discussing and agreeing with various other Tool Platforms on common interfaces or components in order to facilitate interoperability between separate Tool Platforms), an Innovation Ecosystem (to support the ARTEMIS objective to develop an ecosystem of various communities around the ARTEMIS *platforms*) and standards by leveraging as much as possible on current, or de-facto, standards.



"The role of ARTEMIS is to promote platform definition, implementation and interoperability, with exploitation strategies generally regarded as outside the scope."

The ARTEMIS Industry Association will label a number of focal tool platforms, which meet the appropriate criteria of quality, scalability, value to support specific markets, etc. It is not the intention to label an excessive number of platforms as this would lead to a proliferation of solutions, which would negate the aim of effective interoperability. The role of ARTEMIS is to promote platform definition, implementation and interoperability, with exploitation strategies generally regarded as outside the scope.

Applications for Tool Platform labelling are directed to the Office of the ARTEMIS Industry Association and must contain all the information necessary for the Tool Platform assessment committee to evaluate this information and make a recommendation to the Steering Board, which ultimately decides on granting the label. The ARTEMIS Industry Association will reassess the platform label every three years in order to ensure that progress has been achieved according to the labelling criteria.



# 4.6

## ARTEMIS TECHNOLOGY CONFERENCES

*... provide public visibility about the technical aspects raised and solved by ARTEMIS partners in the field of Embedded Systems*

The aim of the ARTEMIS Technology Conference is to provide public visibility about the technical aspects raised and solved by ARTEMIS partners in the field of Embedded Systems. The exchange of ideas increase the effectiveness of R&D results and so empower their impact on industry and on society at large.

### 4.6.1 First ARTEMIS Technology Conference – organised by SCALOPES

Budapest, Hungary, was the venue for the first ARTEMIS Technology Conference from 29 to 30 June 2010. This public, open event, organised by the ARTEMIS-JU Call 2008 SCALOPES project, was hosted by the Budapest University of Technology and Economics (BME) and AITIA International Inc. The conference gave four 2008 call projects – SCALOPES, INDEXYS, SYSMoDEL and CESAR – the opportunity to present their work to an international audience of colleagues working in the same field, to get critical feedback on the ideas and to network with people who share similar interests. The event was attended by 96 people from 16 European countries. The organisers hope that this kind of interaction will give rise to further discussion outside the symposium and will initiate future collaboration.

The two-day conference included 28 presentations on embedded systems. This know-how lies at the heart of European industry competitiveness - and is a vital element in ensuring future economic growth and stability to the benefit of European citizens. Participant interaction was encouraged by the presentation of 9 demos and 24 posters during the informal lunch. As always, poster sessions combined with demos maximise the opportunities for those who have something important to say, to stimulate debate and to make contacts.

Embedded computing systems are all around us - over 98 per cent of all computing chips today are actually hidden, or "embedded", in everyday devices that do not resemble computers. It will come as no surprise there are multiple embedded computing systems in your mobile phone, and in consumer electronic devices such as your television, your digital camera and your portable media player. But embedded computing systems are also in your coffee maker, your washing machine, your refrigerator and your child's speaking toy. They operate hundreds of functions in cars, buses, trains and planes as well as perform critical tasks in industrial machinery, medical equipment, satellites and nuclear power plants.

The focus of the four reporting ARTEMIS projects was on cross-domain technology and tool development for next generation architectures. These developments are driven by and proven for various application domains relating to ARTEMIS-JU industrial priorities such as communication infrastructure, surveillance systems, smart mobile terminals, stationary video systems & entertainment, automotive, aerospace and railway sectors. The technology developments for these application domains, centred in key institutes in specific countries, are being built around key competencies in European top research centres. On the first day the SCALOPES project presented 14 lectures

covering topics like power efficiency, next generation networking and mobile/wireless technology. on the second day the focus shifted to low-power design of MPSoC, performance analysis, power savings in LCD panels and resource management.

The seven presentations by INDEXYS covered topics like introducing the INDEXYS embedded platform approach based on the GENESYS reference architecture and services, implementation in the automotive and railway domains, the semantic models applied, the error propagation approach as well as developments conducted in the area of deterministic network technologies using the TTethernet.

SYSMoDEL covered the progress made on the development of open-source based modelling tools. The system level modelling tools target the design and implementation of time and power critical, heterogeneous systems. This is geared to the development of modelling concepts, methods and tools that master system complexity by allowing cost-efficient mapping of applications and product variants onto an embedded platform while respecting constraints in terms of resources (time, energy, memory, etc.), safety, security and quality of service. The initial focus is on applications, i.e. RFID, wireless systems, telecom, VoIP and audiology applications, mastered by the SMEs directly involved in the project.

CESAR was strongly represented at the technology conference with four presentations about the CESAR approach and corresponding technical selections, including a top-level presentation that revealed the progress that had been made in terms of the project's objectives. Furthermore, one of first results of the CESAR project, a real demonstrator of an automotive scenario, was shown. The technical selections of the CESAR project are the engineering requirements, a multiple approach for component based architecture design and the development of a Reference Technology Platform (RTP).

The first ARTEMIS Technology 2010 was a very successful event with attendees from Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Hungary, Italy, Latvia, the Netherlands, Portugal, Spain and the UK. The organisers would like to thank all the participants that attended and hope they enjoyed the conference.

### 4.6.2 Second ARTEMIS Technology Conference – organised by SOFIA

The second ARTEMIS Technology Conference was located in Bologna (Italy) from 12 to 13 September 2011. This public and open event, organised by the ARTEMIS-JU Call 2008 SOFIA project, was hosted and co-organised by the University of Bologna and Indra Sistemas S.A. The fulfilled objective of the event was to provide public visibility over technical aspects raised and solved by ARTEMIS partners and increase R&D results' effectiveness.

The conference gave three running 2008 & 2009 call projects - SOFIA, SMARCOS & CHIRON, the valuable chance of presenting their results to an international audience of colleagues working in the same field, to get critical feedback on the presented ideas and to network with people who share similar interests. The three projects focused on cross-domain technology and tool development. These developments address to various application domains relating to ARTEMIS industrial priorities such as Smart Environments, Healthcare Systems, Human-centred Design of Embedded Systems. During the two days event, SOFIA (Smart Objects for Intelligent Applications) project, organised the conference and gave a total of 11 presentations on its main results: SOFIA architecture, platform, tools and applications. In addition, the project presented 10 demos on the successful application of SOFIA technologies around Smart Home, Smart City and Smart Indoor Spaces that were of great interest to event participants.

It is relevant to mention that the Smart Space vision and middleware provided by SOFIA is shared and already applied by the 50 partners within the 3 participant projects. In the next article you can read what this Smart Space Vision 'is all about'.

SMARCOS (Smart Composite Human-Computer Interfaces) project was very active too with presentations on Obtaining and Using Context Information in Personal Attentive Systems, Challenges in Designing Inter-usable Systems and demos on Exploring the Usage of Context-based Awareness Cues in Informal Information Sharing and Integrating Distributed Context Information. It is important to highlight that SMARCOS received the demo award of the event for its attentive coaching system targeting to adopt a healthier lifestyle.

CHIRON (Cyclic and person-centric Health Management) project took part of this event and actively contributed by given 5 presentations and 2 demos on Using a Smart Space-based Infrastructure for Remote Monitoring of Health Parameters and Exploiting FPGAs for Fast DSE of ASIP-based MPSoCs.

In conclusion, the second ARTEMIS Technology 2011 was a fruitful event with attendees from Austria, Belgium, Finland, Italy, Spain and The Netherlands, ensuring further discussion outside the conference and new and further multi-project collaboration.

### 4.6.3 Third ARTEMIS Technology Conference – organised by CESAR

**Towards a vision of an interoperability standard for critical embedded systems**

1 March, 2012, Nuremberg: eleven projects and initiatives from ARTEMIS, ITEA, national funding schemes and open collaboration communities came together to discuss the future of an interoperability standard. This was the ARTEMIS Technology Conference 2012 on Interoperability. The event was hosted by CESAR and co-hosted by iFEST, MBAT and pSAFECER in conjunction with Embedded World 2012 and the ARTEMIS Spring Event 2012. To increase the variety of interoperability approaches presented, a call for contributions had been launched within ARTEMIS, ITEA and national research communities. It resulted in an interesting group of contributing projects and initiatives, each highlighting a specific aspect of interoperability:

- CESAR (ARTEMIS)
- MBAT (ARTEMIS)
- iFEST (ARTEMIS)
- OSLC (Open Community)
- POLARSYS (Eclipse Industry Working Group)
- pSAFECER (ARTEMIS)
- SAFE (ITEA)
- SMECY (ARTEMIS)
- SOFIA (ARTEMS)
- R3COP (ARTEMIS)
- SPES XT & SPES 2020 (National German)

With most of the engineering environments built years ago, connecting home-grown tools and tools designed by different vendors from different disciplines, the resulting landscape is very heterogeneous and lacks a common concept of interoperability. Current demands are increasing the need for interoperability: faster time to market, reduction of costs, even more distributed teams and an increasing number of external partners to collaborate in a product life cycle. An interoperability concept that is able to support all these demands needs to be based on a technology that has proven its ability to drive such environments and is adequately scalable for future challenges, e.g. web-based services, with a loosely arranged linked data approach.

Such an interoperability concept involving many groups of stakeholders (tools vendors, industrial end users, integrators, software and hardware engineers, project leads, managers,

"Electric vehicle technologies are currently facing several challenges including limited driving range, high cost and generally limited efficiency."

etc.) cannot be driven by a single group. At the ARTEMIS Technology Conference, project presentations, poster sessions and a keynote speech by Bola Rotibi CEng., Research Director at Creative Intellect Consulting Ltd, led to discussions which increased understanding of the challenges, commonalities and differences in the approaches taken by projects and initiatives to interoperability.

An essential question addressed during the ARTEMIS Technology Conference was: "Is it enough to have one interoperability standard – or will we need more than one?" The participants agreed that it might not be sufficient to have one common standard but rather a number of standards leading to a layered approach from general to specific applications.

Among the challenges identified were barriers to quality caused by disconnected workflows and tools. In the past, many teams focused on improving their local work environment, e.g. improving the quality of the requirement process, introducing better testing methods or raising productivity by adopting agile implementation methods. The workflows between teams as well as between disciplines (e.g. HW and SW engineering) are still disconnected. There is a big need for interoperability between the artefacts of the engineering and the product lifecycle. The main goals to achieve are: collaboration, traceability, reporting and automation.

Shedding light on this multiphysics/multidiscipline aspect of Embedded Systems Engineering, the participants recognised the need to consider the interfaces to other disciplines. However, it is seen as too early in the process to include all disciplines and to extend interoperability to the full System Engineering approach. One of the participants remarked in this context, "Let's first clean our house". By contrast, this strategy does not apply to the question of in-house interoperability versus inter-company interoperability, as these have to run in parallel so as to benefit from each other. A close connection to process and method optimisation and adaptation is also necessary.

Optimising the in-house processes might lead to a new role in the development process. In many organisations, the questions "how do I organise the architecture" and "what are the models in the background" cannot sufficiently be answered today. The participants recognised how essential the new role of the "System Engineering Environment Architect" is in answering such questions and the urgent need for education and training to meet this industrial demand.

Although the approaches presented revealed a diversity in terms of scope and level, the is considerable homogeneity in the big picture was recognised in the need for a generic basis to deal with specific applications. An example is the large scope contained in the CESAR Interoperability Specification (IOS), where compatibilities with the iFEST approach were already recognised in the past. Events like this ARTEMIS Technology Conference are a first step in the right direction. It is now up to all stakeholders involved to push the harmonisation of approaches forward and to foster and continuously improve an interoperability concept. Establishing such a concept cannot be done overnight nor can it be forced. It's more like an ongoing journey - and the journey has just begun.

### **4.6.4** Auto. E-motion Conference Day

Austriamicrosystems, a global leader in the design and manufacture of high-performance analog integrated circuits and member of the ARTEMIS Industry Association, was the host of the Auto.E-Motion Conference Day 2011, last September. This event was organised in collaboration with fellow committee members AVL and Infineon, both members of the ARTEMIS Industry Association, too. The event included the participation of well-known experts from different stages of the value chain, in addition to automotive experts in the area of market research. Furthermore, the ARTEMIS projects E3Car, Pollux, Internet of Energy and the ENIAC project Motorbrain were introduced.

Electric vehicle technologies are currently facing several challenges including limited driving range, high cost and generally limited efficiency. For the most part, solutions to these issues may be found on the subsystem level for energy storage/battery technology, power conversion, electric power train, energy management and connection to the power grid. Industry, the European Commission and market research representatives all estimate that there will be approximately five million EVs in Europe by 2020. The speakers also agreed that the future development of electric mobility will be strongly connected to new uses of semiconductors.

The situation favours semiconductor manufacturers because the new batteries are more insecure and need control, something that is only possible with semiconductors forecasted Alastair Hayfield, Research Director Automotive and Transport at IMS research. Hans Adlkofer, Vice President System Group at Infineon, pointed out that semiconductors, and no longer the engine, will be the heart of tomorrow's cars while Bernd Gessner, General Manager Automotive at austriamicrosystems suggested that the essential drivers of the automotive market are environmental protection and sustainability, safety, comfort and entertainment.

Micro- and nanoelectronics for the design and production of integrated circuits is one of the key enabling technologies (KETs) for the modern economy. This is also true for electric mobility. European F&E cooperation in the framework of projects like E3CAR or Pollux, where austriamicrosystems is involved, are vital to strengthen the competitiveness of partners in this dynamic field even more.

# 4.7

## STANDARDISATION

*... shaping the innovation role of ARTEMIS and making ARTEMIS 'more than just another funding programme'*

The Working Groups of the ARTEMIS Industry Association have the very important task of implementing - and shaping the innovation role of ARTEMIS and making ARTEMIS 'more than just another funding programme'. The ARTEMIS SRA2011 highlighted the main ARTEMIS differentiators (Chapter 'Make it Happen'). The objective of the working group ( WG) on standardisation is to provide a vision of the standardisation policy of ARTEMIS and to promote this vision to multidisciplinary and domain specific standards bodies (like the aviation, automotive, energy, telecom, consumer and medical domains). The WG wants to establish a method to identify and position standards in relation to ARTEMIS objectives and to improve consistency across different standards. Ultimately, the WG intends to deliver an update of the Standardisation Strategic Agenda prepared by ProSE to complement the Artemis Strategic Research Agenda.

The standardisation issue requires a long-term perspective and it is a high priority for the European Commission, public authorities as well as industry. It stimulates business activities, and so helps to create more jobs in Europe. Back in 2007 ARTEMIS started to draft a document, the first Standardisation SRA, describing the mission and planned activities. At the same time, a project proposal for a supporting action called 'ProSE' was prepared to promote the activities needed to support ARTEMIS. Under the coordination of Laila Gide, ProSE set about drafting the landscape for embedded systems middle are and application areas as well as identifying those existing and potential (evolving) results that could to be a good standardisation candidate. It is quite clear that standardisation can have a huge impact on the ARTEMIS objective of creating an innovation eco-system, especially in view of the multitude of domains, applications and SMEs involved within this eco-system. It is, in fact, an essential building block for the ARTEMIS strategy.

The Summer Camp provided a good opportunity to get up to date on the current planning of the European Commission and the central messages that it had received from ARTEMIS as well as discuss in breakout sessions the options for plans to realise ARTEMIS innovation targets and so help fill in the ARTEMIS 'flower'. It was agreed the colleagues at the Summer Camp that standardisation can have a significant impact on business in Europe. It was also evident that large software providers are needed to integrate standards in their software products because this will then enhance access for SMEs and smaller tool vendors. If you consider that a project lasts three years, you quickly realise that this is only enough to generate a baseline or springboard for further development so, from this point of view, we certainly need to look further into the possibilities and options created in such a baseline.

What was decided at the Summer Camp was to draw up a questionnaire for all the partners and on the basis of the completed questionnaires, around three projects for standardisation will be selected and proposed at a meeting this coming September. Selection will take place in terms of the criteria that apply in the ProSE project, so that means that potential candidates include projects like CESAR, ACROSS, GENESYS and maybe INDEXYS. Given the long-term nature of the standardisation question, the more immediate aim is to create motivation and awareness among the project leaders because it is imperative to see the benefits to be gained from standardisation in terms of the business opportunities it generates. So it is not only a matter of technical integration but also of business model integration. And this keeps the process constantly focused on application. The approach is, then, organic rather than linear. As for a roadmap, consensus is essential.

# 4.8

## METRICS

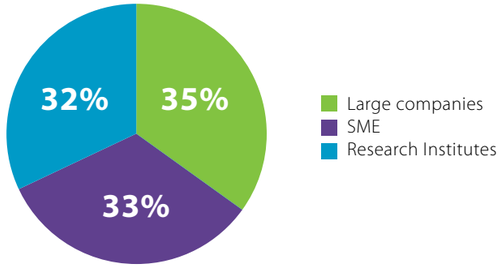
The working group (WG) 'Metrics for ARTEMIS Success Criteria' was created to define and monitor the achievements of the ARTEMIS JU Programme with the aim of generating a bottom-up report suitable to complement and support certain higher-level evaluation like the first interim evaluation of the Joint Technology Initiatives by the European Commission. The early successes of Embedded Systems Technology R&D for European Industry are revealed in the first ARTEMIS WG Metrics Report. In 2012 a second round of questions broadened the scope with the aim of measuring the success of the ARTEMIS programme and defining the steps to further improve and prioritise the programme. Significant results from this second report reveal that collaboration within ARTEMIS remains very successful and has grown drastically compared to 2010. The creation of new partnerships has almost doubled and SME involvement has expanded.

### Results

The report is the second such report. In 2010 a first questionnaire was sent around to a limited number of participants in the ARTEMIS programme. In 2012 we had a much wider number of ARTEMIS participants to tap, slightly more than 800, and received feedback from more than 150 participants.

The report is again divided into three sections, covering the following themes (as contained in the SRA):

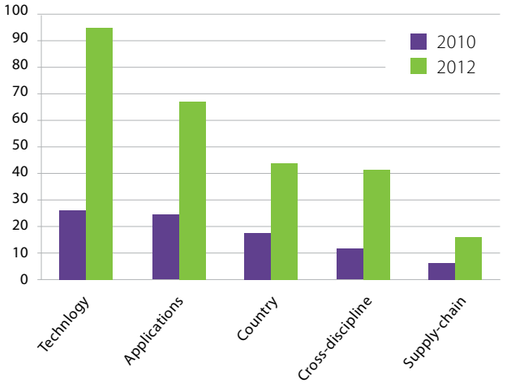
1 Focusing on common R&D agendas more effectively
2 Providing significant economic & social benefits
3 Successful results in the market.




Collaboration within ARTEMIS remains very successful and has grown drastically compared to 2010. The creation of new partnerships has almost doubled. Also SME involvement has grown. The partnerships are mainly based on technology. The concept of CoIE has become much more known within the ARTEMIS community and has become an active instrument for success. However, it will be important that CoIEs continue along that path and ensure that there is a growing impact on the future Strategic Research Agenda. Alignment with other programmes is mainly with regional/national programmes, other ARTEMIS projects and FP7. The fact that ARTEMIS Industry Association is putting a specific requirement in the proposal evaluation criteria that gives added value to cooperation with other ARTEMIS projects is probably a factor that is helping in this. In the last calls this aspect is very well covered. ARTEMIS is growing and becoming a reference in Embedded Systems research and innovation in Europe. Alignment with ITEA has increased at steering board level, but has decreased at the operational level. The main motivator to work in ARTEMIS remains the industry-driven approach, including the scale and size of investment and impact. The possibility to work together within existing networks is a new element that has emerged. The impact on the R&D agenda is mainly on having increased knowledge and experience thanks to participating in ARTEMIS projects. The combination of scientific and industrial views is considered a key strength. An item deserving of attention remains the administrative complexity and alignment. Many stakeholders request concentration ("uniformity") of all management within the JU office as this remove discrimination and efficiency gaps in administration entailed by different administrative procedures in different Member States. An important element is also the uncertainty about the availability of funding for all partners that has become a new key issue compared to 2010. Originally considered as teething troubles, this issue has not improved in recent calls and needs to be tackled.

ARTEMIS addresses a wide range of technology and application markets. From an application point of view, the automotive market is the biggest that is addressed. The impact on 20% to 40% market occurs mainly in a three to five-year period after the end of the project. This business impact largely concerns reduced development costs, reduced time-to-market and higher re-usability. All ARTEMIS AWP targets are addressed and the results are similar between 2010 and 2012, although target 4 has lost some attractiveness. Acquisition of know-how is mainly effected through in-house development, and has grown considerably from 2010 to 2012. In terms of societal challenges, the main impact is on "security and safety" which is new for 2012. Other challenges are transport and mobility, energy efficiency, and health and well-being.

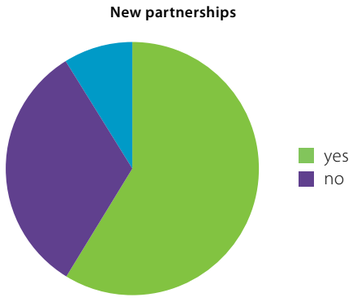
The development of prototypes and demonstrators remains a key activity in the ARTEMIS programme. Although a considerable number of respondents plan to contribute to the ARTEMIS tool platform, not all respondents do yet know what this platform is which is an item that needs attention. One of the issues to be looked into in order to make it a success is the ownership of this platform. The impact of the tools is mainly on reducing development time and improving product reliability. The contribution to standards has fallen with most emphasis on the extension of existing standards and participation in regular standardisation committees. Contributing to or creating Open-Source Communities, setting up public trials/field test and contributing to educational programmes are also important. There is an increase in the number of patents per partner. The first concrete figures have become available on dissemination. Publications of books, papers and brochures remain at the same level as 2010 while press releases have grown a lot since 2010. Participation in seminars and workshops has decreased relatively since 2010. We can imagine this has partly to do with the economic crisis and budget cuts in the industrial world.




The commitment of Member States towards the ARTEMIS programme therefore also remains an important asset to boost the Embedded Systems community impact in Europe.

### Theme 1: Focusing on common R&D agendas more effectively

The consortia were mainly formed from pre-existing partnerships. 75 % of the partners that replied already had partnerships before the project was set up. This is approximately the same figure as in 2010 where 73 % of the partners already had partnerships.



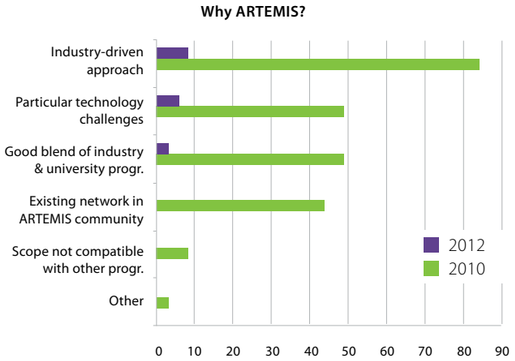

In the latest questionnaire, each respondent formed an average of 4.3 new partnerships through participation in a project consortium. This is a strong growth compared to 2010 where only 2-3 new partnerships were formed per partner and per project. In these new partnerships 2.2 involve an SME (50%), while the figure in 2010 was only 33%. So we also see a growth of SME involvement in the creation of new partnerships due to project participation.

### Project outcome

72% of respondents want to define a continuation project after the project ends. 78% wants to continue the cooperation with an SME after the project. This is almost double the figure of 2010 (40%). 10 respondents are currently thinking about creating a new company based on the project results. They are currently investigating this in more detail. In total, each of them plans 1 or 2 spin-out companies (average 1.4).

31% of the respondents plan an interaction with a Centre of Innovation Excellence (CoIE). 9% is considering establishing a new CoIE. These figures are much higher than in 2010, when the CoIE concept was new and not yet known to the ARTEMIS community. As such, CoIE is becoming a real working instrument within the ARTEMIS Programme.

The reason for having an "industry-driven approach" in the ARTEMIS programme has become much more explicit compared to 2010. The "Existing Network in the ARTEMIS Community" is the main newcomer in the answers – but here we have to take into account that this was not yet so prevalent in 2010 given the recent incorporation of ARTEMIS at that time and the network consisted mainly of the founders and some of their partners.

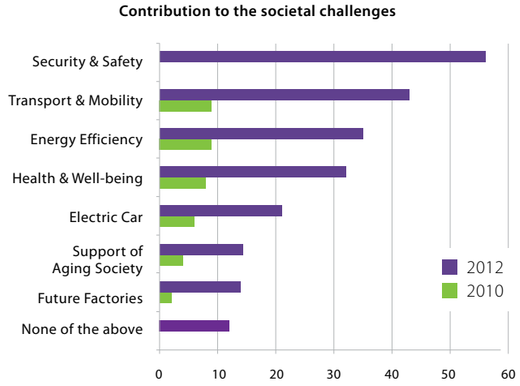



### Theme 2: Providing significant economic & social benefits

In terms of market impact, most of the respondents indicate that their project will have an impact on 20% - 40% of the application market they are addressing. The comparison with the 2010 figures is visible in the figure below. Impact was estimated to be higher in 2010, but as the number of respondents was much lower, and the projects were not yet finalised, the figure in 2010 is probably less faithful. In terms of timeframe when project results will become available, the majority is 3-5 years after the end of the project. Here the results in 2010 and 2012 are very similar. Yet a significant share is for 1-2 years, which is quite uncommon for FP7-like projects.

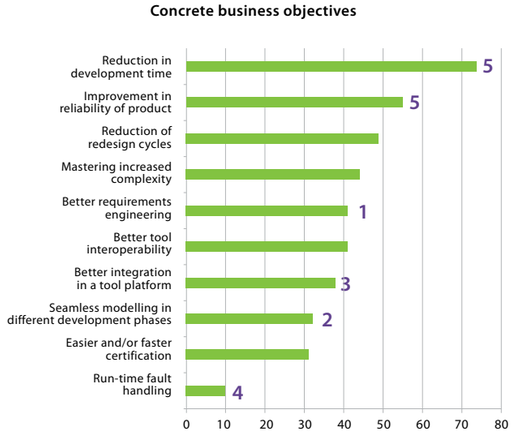
### Contribution to ARTEMIS AWP targets

In contributing to the ARTEMIS AWP and in terms of societal challenges, the main impact is on "security and safety" and is new compared to 2010. Other areas are transport and mobility, energy efficiency, and health and well-being. It should be noted that "security and safety" has a different meaning in ARTEMIS that in the overall EU policy documents. In ARTEMIS "security and safety" mainly concerns the sub-domain of the ASP1 (transport safety-critical applications, etc.) so, as such, one could state that it would more clearly contribute to the societal challenge "transport and mobility".




### Theme 3: Successful results in the market

More than 70% of the respondents indicated that they will build application prototypes. The average number of prototypes built by respondents is 1.9, higher than 2010, with around 40 respondents planning to distribute an average of 1.9 tools to an Open-Source Community and almost 30% planning to contribute to the ARTEMIS Tool Platform. However, an item requiring attention is that 43% of the respondents do not know what the ARTEMIS Tool Platform comprises, but this is probably a "maturation process" in ARTEMIS: in 2010 the main objective was to put people of different domains together and get them develop a common body language (better requirement engineering). Now that this has been achieved to some extent (e.g. the CESAR project), attention has switched to concrete business objectives. This is quite encouraging!




### Conclusion

As an overall conclusion is that ARTEMIS is alive and kicking! The original aims have been achieved to a large extent and have led to successful results, in terms of both technological developments, competitive advantages and market successes. Overall the Embedded Systems community has found its place in Europe: people are getting to know each other better, a strong link between industry and education has become visible and the quality of the technology and dissemination results is clearly visible.

"The Embedded Systems community has found its place in Europe: people are getting to know each other better, a strong link between industry and education has become visible and the quality of the technology and dissemination results is clearly visible."

The WG reports not only confirm some of the conclusions already drawn in the first interim evaluation report of the JTIs by the European Commission but it also reveals some complementary data and information.  This type of survey forms a good basis for the ongoing improvement of the ARTEMIS programme to make the technological developments in Embedded Systems the real beating heart for European industry and economy!

# 4.9

## SMEs

*SMEs are crucial to European industry and an essential ingredient in the ARTEMIS make-up.*

SMEs are crucial to European industry and an essential ingredient in the ARTEMIS make-up. They are considered to be an important link in the value chain for high-tech systems and solutions. In the ARTEMIS eco-system model, high-tech SMEs are expected to play a key role in the capitalisation and dissemination of the technologies. SMEs have a very important role to play in the landscape of innovation, research and development. They are more agile and productive in terms of generating innovation than much larger companies and, in high-tech sectors, tend to have more specialised knowhow in specific areas. SMEs that lead in their field often have very good links with the academic research community, with professors and research assistants. In this way SMEs can act as a kind of transmission agent of universities and even corporate research to the market, something that can be of benefit to larger companies too. But what does it take to be a successful SME in the ARTEMIS programme?

Dr Stefan Poledna, co-founder of TTTech Computertechnik AG answers a few questions that provide some insight into how his company has managed to be successful. Founded in 1998, TTTech Computertechnik AG has become the world's leading supplier of dependable networking solutions based on time-triggered technology and modular safety platforms. TTTech has won several prizes and awards for its highly innovative products and has been ranked among Europe's 500 most dynamic companies.

*In the ARTEMIS eco-system model, high-tech SMEs are expected to play a key role in the capitalisation and dissemination of the technologies. What is your opinion?*

I believe that SMEs have a very important role to play in the landscape of innovation, research and development. They are more agile and productive in terms of generating innovation than much larger companies, and, in high-tech sectors, tend to have more specialised knowhow in specific areas. SMEs that lead in their field often have very good links with the academic research community, with professors and research assistants. In this way SMEs can act as a kind of transmission agent of universities and even corporate research to the market, something that can be of benefit to larger companies too.

*SME participation is very important in most of the innovation programmes but how can they have the same kind of influence as large enterprises? How can SMEs become more visible for potential ARTEMIS consortia?*

Of course, it's much more difficult for an SME to have the same impact as a large enterprise simply in terms of resources. But certainly for us as an SME we find that we get a good response in the research programmes because we have a very specific know-how in the area of dependable networking and safe controls, so we are often invited by large corporate to take part in programmes because they value our expertise and want to have us on board. For us it was even possible to become a project leader with large corporate and research organisations on board. So I think it is possible for SMEs to have impact in those programmes. But if you don't engage, then nobody knows about you and if you don't have the expertise, nobody cares.

SMEs can be influential but limited resources make this more challenging. For a very small SME it's almost impossible. You need a few people who can devote their time to cooperation and liaison with ARTEMIS and other European funding programmes. On the other hand, if you take a strategic approach and have really good people, you can have a similar impact like we have. In our case, we feel respected as a first-class citizen in the research community. We don't feel discriminated because of our size. We have very good links with the Technical University of Vienna, with Professor Kopetz, a very well respected figure in the design of research programme. So I don't feel we lack anything in this respect compared to large enterprises.

As for becoming more visible, strategic commitment is essential. You then need to allocate your resources, knowledgeable people with expertise. And you have to be open to the prospects. ARTEMIS provides excellent support – all the meetings, brokerage events, information about upcoming programmes – so if you are prepared to spend some time and knock on the door, as it were, you will be welcomed with open arms. There's plenty of information – it's not hard to get. A lot of things are in place. You need to take the next step, for example, attend the brokerage event. Become involved and if you produce good work, you gain credibility and become invited to join the programmes.

After three ARTEMIS Calls a vital statistic shows nearly 30% SME participation and nearly 20% SME funding.

*How would you describe the secret of your success?*
It is about technology leadership in a very focused area. TTTech has a clear mission and vision. We are providing electronic robustness for a more electric world. We want to be leading in the very specific segment, that for embedded networks and modular safety controls in markets that benefit from reliability and robustness. And with this clear focus we aim to have a very strong technology position, so we have strategic investments in R&D and technology. A key way to do this is through European funded programmes like ARTEMIS, which for us as an embedded systems company plays a vital role. And the success that we have achieved so far is to a large extent driven by European funded research programmes. By being part of such programmes we are able to maintain our leading-edge position.

*What would your advice be to other SMEs seeking similar success?*
Of course, there's no free lunch in life and that's very true for research as well. So if you want to participate in a research programme, you have to set up your organisation in such a way to be able to do that. You need to have people who take time to collaborate with ARTEMIS and other programmes, people who have know-how and are experts in their field. In other words, you need to plan your resources to cooperate with these programmes and with other large companies. It's a three-pronged approach. You need to further R&D, you need to look for cooperation partners – this is vital if you want to identify the technological needs and where your technology can fit in this respect – and get some funding that helps you to keep on top of the R&D and technology roadmap. In our case, the fact that NASA has decided to use our backbone communications for their next generation space programmes, that we are on board the Audi A8 and Boeing 787 and Airbus A 380 is down to our position of technology leadership. Indeed, our Airbus A380 involvement was down to our participation in a European funded programme. We know that NASA would not have selected our technology if we had not been part of a research programme and had the respective funding.



# 4.10

## AIPPs

ARTEMIS Innovation Pilot Projects (AIPPs) – what they are, where they came from and where they are going.

An important aspect of the ARTEMIS SRA, and consequently of the ARTEMIS-JU work programme, is the will to strengthen Europe's ability to convert its excellent scientific, research and development capability into commercially viable products and services, or improved production methods for existing products; i.e. to seek the holy grail of economic and societal well-being through innovation. In order to reinforce the larger perspective of ARTEMIS' goals, being primarily to boost valorisation of R&D results and to stimulate true Innovation (capital 'I') with short- to medium-term valorisation prospects, four guiding principles were adopted:

**"Think BIG"** i.e. consider that ARTEMIS projects should have appropriate critical mass, and market or societal insight to assure significant impact of the public funds used ("taxpayer value-for-money"). This is moderated by observing that "Big" refers to the IMPACT of a project, not necessarily to its size in terms of partners or total budget; the idea being the ARTEMIS adage that the programme should comprise some "large projects supported by smaller, targeted initiatives", and that all projects – large or small – must think beyond their limited lifetime to see what real effect their results can have in a European socio-economic context. Which means …,

**"Act Socio-Economic":** the main goals being improved industrial efficiency "… to strengthen European competitiveness and allow the emergence of new markets and societal applications," i.e. a focus on key technological issues, offering solutions to high-visibility concerns with commercially valorisable results.

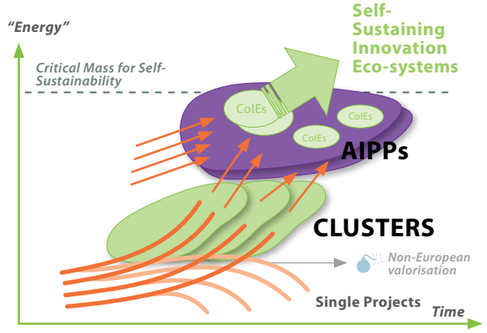
**"Act Multi-national"** (= "Act Pan-European"), consider national and/or regional strategic priorities and the specialisations in scientific and technological excellence available within the diversity of the European Union.

**"Think Different":** i.e., strive for significant and complementary added-value to existing projects and programmes. Be bold enough to change the way things are done; become game-changers in tackling the barriers to Innovation.

In the Multi-Annual Strategic Plan of the ARTEMIS-JU, all this is approached through the vision of establishing "Self-sustaining Innovation Eco-Systems", which past experience shows can be brought about by the attainment of sufficient "critical mass" with enough industrial "buy-in" of (usually non-differentiating) technological solutions. (See also the ARTEMIS SRA document on Innovation Environment, available at http://www.artemis-ia.eu/sra). Considering the pan-European vision of the programme, it is the expectation that such informally defined Innovation Eco-Systems can "condense" around the leading players (often larger enterprises or institutions) to form structured "Centres of Innovation Excellence" ("CoIE", modelled on the existing "Competitiveness Centres" or simply "Centres of Excellence"). Indeed, the converse is also true: many ARTEMIS projects already emerge from pre-existing CoIEs (for example EICOSE, on

systems with a high relevance for safety). The ARTEMIS Industry Association has initiated a labelling scheme such that CoIEs can be recognised as such and, to date, three CoIEs have already been labelled (EICOSE, ProcessIT on process automation and ES4IB on intelligent, energy-efficient buildings – more details on http://www.artemis-ia.eu/coielabel).

However, the basic charter of the ARTEMIS-JU is to fund projects, and past experience has shown that projects do not usually chose to interact in any spontaneous way: they are often too busy with their own work to look around outside. What we can observe, however, is that smaller, stand-alone projects very often tend to "fizzle out" fairly quickly after they finish. To address this, and under the stimulus of the ARTEMIS-JU Office,




the ARTEMIS Industry Association has adopted the idea that project clustering is a valuable first step towards establishing CoIEs and has helped work pro-actively towards achieving this, most visibly through a series of annual inter-project workshops, the "ARTEMIS Technology Conferences". Incidentally, these workshops are not "closed" events for the ARTEMIS community only. Though centred on some ARTEMIS projects, they have also invited projects from other schemes, as well as organisations not involved in funded R&D projects, to present and share their experience.

Already after 4 Calls, we can see that projects are "clustering", sharing ideas around (non IPR-critical) topics, delivering (public) results to each other and even forming new consortia for follow-on projects.

The fifth ARTEMIS Call, for 2012, has taken this clustering to a new level, with the introduction of a specific type of project – the ARTEMIS Innovation Pilot Projects. AIPPs are specifically designed to bring about the economies of scale and efficiency when defining, designing and building technological demonstrators or platforms of sufficiently large scale to assure strong industrial and societal take-up. As a logical extension to project clustering, AIPPs are supposed to be large initiatives: "Think Big" becomes "Think even Bigger". (Large initiatives like AIPPs indeed contain an element of risk, but without a vision for change and the courage to take a leap into the unknown, progress beyond the *status quo* is simply not possible).

The Call 2012 work programme identifies six fields where it is expected that such major clusters can bring a real impact, both commercial and societal, while the criteria for selection emphasise the market-facing nature and expected market impact even more than the "standard" ARTEMIS Sub Programmes do (Call 2012 also accepted proposals for ASP-style projects). AIPPs are intended to be the clouds within which CoIEs can form or develop further, ultimately attracting sufficient industrial attention and energy to become self-sustaining – i.e. through this route the ARTEMIS strategic goal of building "Self-Sustaining Innovation Ecosysems" becomes concretely realisable.

At the time of writing, we wait in anticipation to learn which of the proposed AIPPs received through the 2012 Call will be selected for funding and, further ahead, look forward to them producing the game-changing results they promise.

CRYSTAL and Arrowhead are two AIPPs, selected from proposals from the ARTEMIS Call of 2012, which at the time of writing are negotiating their funding contracts.



# CRYSTAL

CRYSTAL is a three-year innovation pilot project due to begin in May 2013. Its underlying goal is to accelerate quest for interoperability. As an industry-driven, application-oriented project it will establish workflows based on current and emerging technologies and enable these workflows to be used in the industrial domain of the partners' engineering environment. With key European players from different application domains, including large companies developing embedded systems-based that will mainly act as technology users and case studies (user stories) as well as large tool providers, SMEs and researchers acting as technology providers, CRYSTAL will use the considerable strength of the 71 partners from 10 different European countries to improve and implement so-called technology bricks.

Re-using results from previous European cooperative projects, the focus will be particularly on improving and industrialising the multi-domain RTP developed in previous ARTEMIS projects (e.g. CESAR, MBAT, iFEST). It will also make use of enhancements generated in related ITEA-2 projects (SAFE, AMALTHEA, TIMMO-2-USE) or FP7 projects (e.g. OPENCOSS, MAENAD) and other nationally funded projects that deal with the development of a software platform for embedded systems. The main industrial domains covered in the project are aerospace, automotive, rail and healthcare as well as .

The general objectives can be summarised as increasing the maturity, reusability and ease of integration of the technology bricks (tools in the system engineering, standards and methodologies). Given the different domains, the opportunity will be taken to exploit domain-specific insights into embedded system design and safety processes to investigate and establish cross-domain synergies. In other words, transfer experience and know-how across the domains. The whole project will work on the basis of user stories, use cases, the bricks and topics. A user story is intended to describe a typical action pattern or work flow (in the form of a step-by-step description), for which significant improvements should be developed in the CRYSTAL project. This user story is then refined by a concrete use case (real scenario for one company) in which the improvements should be directly applied. Based on this use case, a corresponding list of tools and methods (bricks), that have to be integrated, is derived. In the sense of safety-critical systems engineering for embedded systems, the brick is either a software tool or product, a software component to build such a tool or product, a systems engineering methodology or an interface or a standard or means for establishing the interoperability needed for the efficient development of safety-critical embedded systems.  The topics concern relevant items in the user stories, the refining use cases and the derived bricks, and may be derived as suggested or be collected through input in papers. Ultimately, a set of requirements for the RTP/IOS sub-project is derived.

In terms of specific results, CRYSTAL wants to reduce system design costs through the improvement and smart integration of system analysis, safety analysis and system exploration tools as well as reduce development cycles by developing reusable technological bricks in alignment with the IOS and RTP. Furthermore, there is a need to manage a growing complexity with less effort. To do this, the focus will be on multi-viewpoint and multi-criteria engineering, holistic

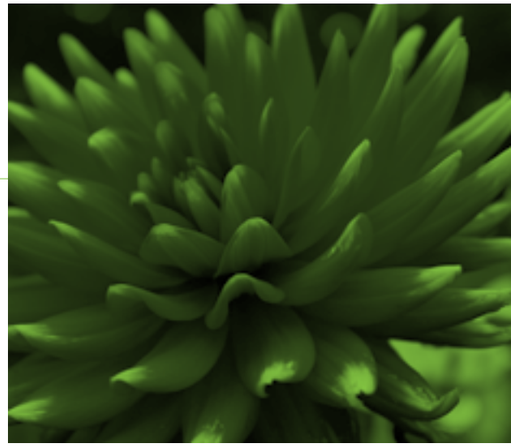
As a logical extension to
project clustering, AIPPs are supposed to be
large initiatives: “Think Big” becomes
“Think even Bigger”

modelling and simulation as well as enhanced model-based systems engineering strategies in a safety and certification context. A central part of the project is to head towards the development of a de facto standard for the future embedded systems reference technology platform and for future systems engineering methodology in general, ultimately driving forward interoperability including interoperability specification and the cooperative RTP.

The entire software product life cycle is covered and support will be provided to product line development aimed at ready-for-use industrial tool chains. Assurance of interoperability within and across domains will generate and drive forward the development of the cooperative reference technology platform (CRTP) based on related ARTEMIS projects (e.g. CESAR and MBAT) while service-oriented architecture can easily provide new services and integrate new technology and tool providers. Importantly, CRYSTAL aims to double the number of European technology providers and SMEs that can contribute to the RTP over the next five years. In turn, the technology providers will be able to increase their tool options and SMEs will get the opportunity to enter the market and provide system engineering solutions.

# ARROWHEAD

## COLLABORATIVE AUTOMATION FOR PROCESSING AND ENERGY



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

Arrowhead is an innovation pilot project, coordinated by Professor Jerker Delsing, which relates to the manufacturing, process and energy industries. Its aim is to find ways of improving communication between embedded automation systems, so-called Service-Oriented Architecture. Today, such systems require both advanced design and large staffing resources when a large number of devices are linked together to communicate. Simply, new technologies could improve and make production flows more effective, thus contributing to a more collaborative automation. While several projects have already been completed in this area, the big, overarching issue has never been resolved. This project, being launched in the first quarter of 2013, creates a step in that direction. Arrowhead will last for four years and has a budget of 69 million euros.

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

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

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

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

chapter V

# Conclusion & Way forward

"The tri-partite funding model has enabled broader Europeanisation of the programme and its projects and has also contributed to a higher enrolment of SMEs in important technology and innovation eco-systems, especially through the larger initiatives in the programme."

*Alun Foster*

# 5.1

## CONCLUSION

Some initial conclusions that can be drawn for this analysis of the ARTEMIS programme and its implementation through the ARTEMIS-JU:

- The hybrid top-down/bottom-up descriptive programme has provided the community of actors sufficient latitude for creative project proposals while visibly retaining the global strategic directions of the programme.
- The "Think Big" philosophy has indeed produced large and successful projects, particularly in the high-reliability electronics domain (which itself is of vital strategic importance to European industry). The AIPPs described for Call 2012 are a continuation of this strategy toward building self-sustaining eco-systems: analysis of their performance in achieving this should be monitored as well as, if not more closely than, the research and development work they contain.
- The present set of ASPs and Industrial Priorities does not currently fully match the partitioning seen and felt by industry at large. The dual-axis approach has, however, contributed to widespread circulation and discussion of project results. For the future, while keeping this dual-axis paradigm, the definition of the sub-programme topics could be refined, while the Industrial Priorities should better recognise the importance of development tools and processes across all technology classifications (architecture, middleware …).
- The ARTEMIS programme to date has managed to produce significant advances in the innovation capability of its participants and related enterprises, though this is not evenly distributed over all areas of the programme: a major concentration of effort and "success stories" exists around the hi-reliability topics. This is evidently of great strategic importance to Europe and to the participating organisations so must not be de-emphasised in the future. Other areas that deserve more attention, particularly related to patient-centric eHealth, are human interfaces to the systems (for ease-of-use and for safety reasons) and, to a lesser extent, to enable an energy-efficient society.
- The tri-partite funding model has enabled broader Europeanisation of the programme and its projects and has also contributed to a higher enrolment of SMEs in important technology and innovation eco-systems, especially through the larger initiatives in the programme.

The ARTEMIS programme, at present levels, is likely to finish at roughly one half of its originally anticipated volume of investment. While the programme has indeed suffered under the budget constraints coming out of the 2008 financial crisis and subsequent (quite dramatic) economic slowdown, the financial contribution of some of the participating Member States has been significantly lower that the needs expressed by their industries. While ARTEMIS prides itself on the strong industrial lead in defining the technical work programme, a future programme may do well to engage the industrial strategic considerations of the participating Member States much earlier in the technical programme definition process.

“Today we are in a very good position and lead the technology in several domains. We must strive to keep our leadership and stay ahead of the competition.“

*Heinrich Daembkes*

# 5.2

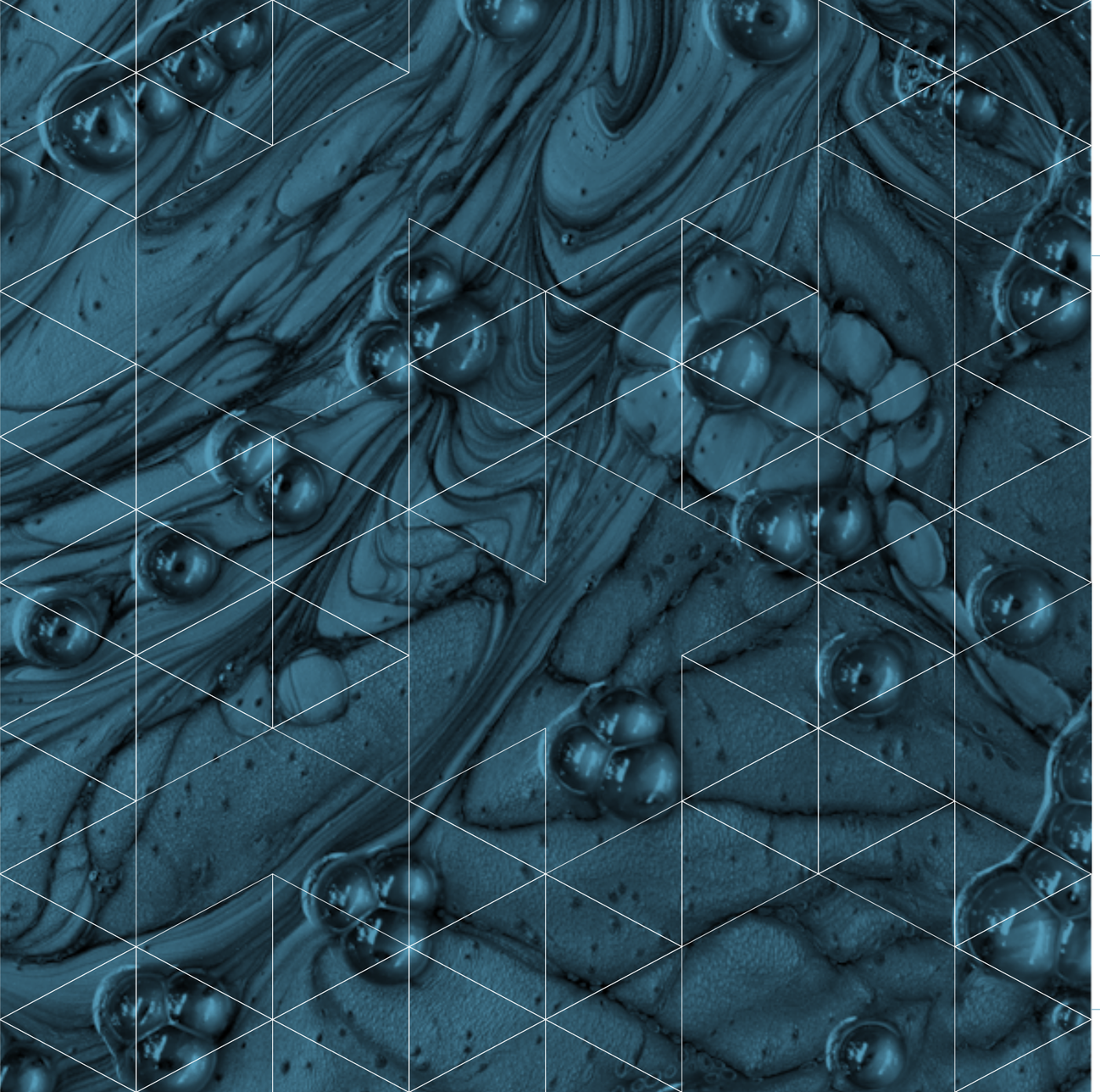
## THE WAY FORWARD

If we look at where we have arrived, considerable progress has made on the R&D side in terms of tooling, methodologies and, since recently, also in pilot innovation implementations, something that has been stimulated and enhanced by the sharing of knowledge and generation of new knowledge made possible by the European Embedded Systems community we have helped shape out of a very broad, fragmented sector. Another very important development during the first phase of ARTEMIS was the creation through the Strategic Research Agenda of a common roadmap that covers a range of industrial and societal challenges.

The world in which we live has changed radically over the past decade, and so has the attitude of consumers to their electronic environment. The industrial landscape is different, too. The days when just one or two major industrial companies, like Nokia, ruled the roost are over. Given this, we have to refine that roadmap and be more specific about what we need, what we want to achieve and how we want to achieve it. One refinement, for example, is already evident in the focal shift to industrial application embodied in the ARTEMIS Centres of Innovation Excellence and innovation pilot projects cited in this book. All in all, one could say that we have arrived today at a milestone that, at the same time, is a signpost to the way forward.

We need to step up to the next level to drive and support the growing importance of embedded systems.  A very good and catchy expression for the next phase goes by the name of Cyber Physical Systems. It takes into account the connection between hardware and software, reflecting especially the increasing role of intelligent systems extending beyond bare control functions, emphasising the ability to communicate, thus creating additional new values for the overall system.  So the roadmaps we generate must contain clear milestones to push these technologies and to make them available very quickly and in a useable format for the benefit of our industries, creating competitive advantages for our economy and society. Part of that vision will be the closer cooperation with other ETPs, such as ENIAC and EPoSS, most probably under one common roof, making the best use of the synergies and common interests.

So what kinds of trends can we expect? Embedded Systems and Cyber Physical Systems (CPS) are becoming increasingly dominant in determining the performance of new systems. They are needed in all areas that are of societal relevance and are therefore extremely influential in terms of the ability of European Industry to compete globally and directly impacting every aspect of our daily lives. For instance, when you fly you want to be sure that the safety-critical systems are fully secure and that potential threats, such as a cyber-attack on the aircraft's controllers, can be countered so that safety is guaranteed. A further development will be guaranteed quality of service. Again, from the aerospace domain, there is a need for real-time communication about flight paths and trajectories, from aircraft to aircraft and from aircraft to ground control,



requiring a guaranteed level of quality of service. Of course, this level of reliability or dependability is not so essential in the domain of entertainment. If there is a disruption then all you suffer is inconvenience; it is not life-threatening.

Today we are in a very good position and lead the technology in several domains. We must strive to keep our leadership and stay ahead of the competition. We will be able to do this through a joint effort between European and national endeavours, involving the entire chain from research in key enabling technologies through SMEs and their entrepreneurial role up to large enterprises that are able to put in the required investment and effort to tackle the new challenges. ARTEMIS has proven to be an excellent instrument to facilitate this cooperation among all these valuable partners. How the ARTEMIS Joint Undertaking and the Industry Association will continue is still being discussed at the time of writing. I favour a gradual transition to a merger with the efforts of ENIAC and EPoSS but it is clear that the strong ARTEMIS identity should remain and continue to exert its very positive influence on the promise and prospects of the Embedded Systems industry in Europe beyond its current mandate.

# ANNEX:
# Sources of data for the Analysis

The financial data used in the compilation of this report are taken from a database of the projects' financial proposals, consolidated at the end of the negotiation phase (i.e. just prior to contact signatures). Evolutions during the course of the projects are not rigorously included. However, this is estimated but can be ignored since the impact of the finances at programme level are less than one per cent.

Information about the successes and technical progress made by the projects is compiled by summarising and making information from various confidential reports, available only to the JU Staff "anonymous".

Another useful source of information are the public websites made by each project. For Call 2008 to Call 2011 projects, these are listed here for convenience.

| Call | Project | Website URL |
|---|---|---|
| 2008 | SOFIA | www.sofia-project.eu |
| 2008 | EMMON | www.artemis-emmon.eu |
| 2008 | CESAR | www.cesarproject.eu |
| 2008 | iLAND | www.iland-artemis.org |
| 2008 | INDEXYS | www.indexys.eu |
| 2008 | SCALOPES | www.scalopes.eu |
| 2008 | CHARTER | charterproject.ning.com |
| 2008 | eDIANA | www.artemis-ediana.eu |
| 2008 | SYSMODEL | www.sysmodel.eu |
| 2008 | CAMMI | www.cammi.eu |
| 2008 | SMART | www.artemis-smart.eu |
| 2008 | CHESS | chess-project.ning.com |
| 2009 | iFEST | www.artemis-ifest.eu |
| 2009 | RECOMP | www.recomp-project.eu |
| 2009 | SIMPLE | www.simple-artemis.eu |
| 2009 | SMARCOS | www.smarcos-project.eu |
| 2009 | ACROSS | www.across-project.eu |
| 2009 | POLLUX | www.artemis-pollux.eu |
| 2009 | R3-COP | www.r3-cop.eu |
| 2009 | ME3GAS | www.me3gas.eu |
| 2009 | CHIRON | www.chiron-project.eu |
| 2009 | ASAM | www.asam-project.org |
| 2009 | eSONIA | www.esonia.eu |
| 2009 | SMECY | www.smecy.eu |
| 2009 | pSHIELD | www.pshield.eu |
| 2010 | D3CoS | www.d3cos.eu |
| 2010 | WSN DPCM | www.wsn-dpcm.eu |
| 2010 | IoE | www.artemis-ioe.eu |
| 2010 | MBAT | www.mbat-artemis.eu |
| 2010 | nSHIELD | www.newshield.eu |
| 2010 | PRESTO | www.presto-embedded.eu |
| 2010 | ASTUTE | www.astute-project.eu |
| 2010 | HIGH PROFILE | www.highprofile-project.eu |
| 2010 | pSAFECER | www.safecer.eu |
| 2010 | ENCOURAGE | www.encourage-project.eu |
| 2011 | CRAFTERS | www.crafters-project.org |
| 2011 | DEMANES | www.demanes.eu |
| 2011 | DESERVE | www.deserve-project.eu |
| 2011 | E-GOTHAM | www.e-gotham.eu |
| 2011 | nSAFECER | www.safecer.eu |
| 2011 | PAPP | www.papp-project.eu |
| 2011 | SESAMO | www.sesamo-project.eu |
| 2011 | VARIES | www.varies.eu |
| 2011 | VETESS | www.vetess.eu |

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> **EICOSE**
> **ProcessIT.eu**
> **ES4IB**
> **EICOSE CRTP**
> **AIPP Arrowhead**
> **AIPP CRYSTAL**

**Disclaimer:**
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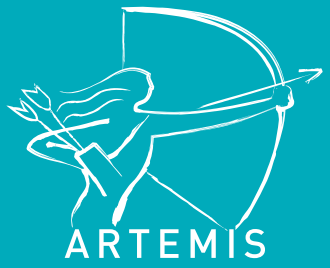


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