ARTEMIS JU
Annual Work Programme 2013 –

Part ASP

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Change history

N.B. Only substantive changes are recorded here: not typographical, grammatical or formatting corrections, re-ordering of text, or stylistic clarification.

Changes from AWP2012 to AWP2013:

- Page 5: Anticipating an additional call in 2013
- Page 8: Reference to Vision 2030 (ARTEMIS & ITEA common High level Vision)
- Page 10: list of ASP's open for call2013
- Page 12: weblink added to tool platform definition (labelling criteria)
- Page 13: weblink added to repository (requires login)
- Page 16: Foundational research topics are toned down.
- Page 18/19: text of ASP1 substantially modified
- Page 21/22: text of ASP2 slightly modified
- Page 25/26: some modifications to text of ASP 4
- Page 27/28: text of ASP5 substantially modified
- Page 29/30: some modifications to the text of ASP6
- Page 31: ASP7 is closed
- Page 32/33: some modifications to text of ASP8
- Page 35: explicit reference to patent activity added
- Page 36: Cooperation with other projects (ARTEMIS, FP, ITEA)
- Page 36: explicit reference to the CoIE added
- Page 37: Limitation of the Project's duration

1 Introduction

Networked Embedded Systems are THE NEURAL SYSTEM OF SOCIETY. Embedded Systems pervade all artefacts of life, from children's toys and mobile phones to space probes and from transportation vehicles to healthcare systems. In fact, Embedded Systems will be part of all future products and services, providing intelligence on the spot and capabilities to clever connect to the abundance of systems in their environment, either physical or at cyber-space level, in real time.

These connections can be direct or via a network, such as the Internet. In this sense, Embedded Systems form the edges of the 'Internet of Things' bridging the gap between cyber space and the physical world of real 'things', and are crucial in enabling the 'Internet of Things' to deliver on its promises. In fact, Embedded Systems are the technologies that make the future Internet work,
By nature, internet communication cannot be expected to provide the same quality as dedicated Embedded Systems networks. Therefore Embedded Systems must be made more autonomous and robust to compensate for the reduced real-time and reliability guarantees, operating dependably even in the presence of network degradation or temporary failure. The safe and secure operation of such increasing complexity will impose huge challenges on design, operation and interoperability of Embedded Systems, be it in software, electronics, sensors, actuators or a combination of those.

Embedded Systems, also referred to as Cyber-Physical Systems, become part of bigger systems in a world of 'systems of systems'. This imposes even larger challenges on the functionally of Embedded Systems.

Internet connected intelligent embedded systems will provide the core of solutions for the big societal challenges like affordable healthcare and wellbeing, green and safe transportation, reduced consumption of power and materials, reduction of food waste, smart buildings and communities of the future, and an imminent lack of natural resources. Such solutions to our pressing societal challenges will spur on European competitiveness. In a global world EMBEDDED SYSTEMS are a crucial KEY ENABLING TECHNOLOGY for Europe's industrial and societal future, and one that must not be underestimated or overlooked.

This present document - the ARTEMIS[1] Annual Work Programme (AWP) for 2013 - sets out the research priorities for projects to be supported through the Call2013 for Proposals of the ARTEMIS Joint Undertaking (JU). Although this Call 2013 is the sixth and last call of ARTEMIS JU in its present setting, the content of the call is anticipating a follow-up JTI that is expected to take over the ARTEMIS JU mission to pursue the European stakeholder's ambitions in the fulfilling ARTEMIS objectives in Embedded Systems research.

In addition, a third call by the very end of 2013 is not excluded, if following conditions are met:

1) availability of funding and
2) H2020 based funding tools are judged to have too low maturity to launch calls early 2014.

[1] ARTEMIS -*"**A**dvanced **R**esearch and **T**echnology for **Em**bedded **I**ntelligence and **S**ystems"*- is the European Technology Platform for Embedded Computing Systems.

2 Context

2.1 Societal and Economic Context

As highlighted in the AWP 2012, Embedded Systems continue to be a major enabler for further responding to the two wake-up calls that society has had in recent times - climate change and the economic crisis. Both these developments indicate the urgent need for better use of natural, industrial and human resources.

This is recognised in the 2009 “Recovery Package” of the European Commission[2],that established three major partnerships for critical area’s between the public and private sectors:

- In the automobile sector, a ‘European green cars initiative’
- In the construction sector, a ‘European energy-efficient buildings’ initiative
- To increase the use of technology in manufacturing, ‘a factories of the future’ initiative,

and in the “Final report[3] of the Key Enabling Technologies (KET)”, the High-Level Expert Group identified the enabling technologies, crucial to many of the existing and future value chains of the European economy:

- Nanotechnologies
- Micro and Nano electronics
- Photonics
- Biotechnology
- Advanced materials
- Advanced Manufacturing Systems.

As such, Embedded Systems are key to enable intelligent applications that will be based on the supporting KET’s identified, as Embedded Systems pervade in all artefacts of life and enable providing intelligence on the spot and capabilities to clever connect to the abundance of systems in their environment, either physical or at cyber-space level, and in real time.

This enabling key role of Embedded Systems is getting deeper and deeper involved in the European society as indicated by the 2011 ISTAG Report[4], This defining key role envisioned for ICT underlines the importance of Embedded Systems as enabling key technology in the move from localised, sector-specific improvements - in homes, offices, vehicles, factories, traffic management, healthcare, and so on .., to smart cities, smart regions and even smart societies. And, apart from their contribution to energy management and especially to reduced consumption in other domains, new techniques to reduce the energy consumption of Embedded Systems themselves become increasingly important.

The 2011 ISTAG report also advises in its Recommendation 9;

> “*Future funding of cross-border, co-funded initiatives and partnerships should focus on areas and activities where EU-wide action, services and systems-of-systems are needed. This notably includes development and support to common platforms and reference architectures as binding sets of structures, processes, interfaces, and data exchange standards and documentation standards*”.

[2] COM(2008) 800, action 8: ‘Increase investment in R&D, Innovation and Education’
[3] “Key Enabling Technologies”, Final Report of the HLG-KET, June 2011
[4] “*Orientations for EU ICT R&D & Innovation beyond 2013*”, July 2011. ()

2.2 Strategic context

The ARTEMIS strategy as defined in the Strategic Research Agenda (SRA) 2011 is to overcome fragmentation in the Embedded Systems markets so as to increase the efficiency of technological development and, at the same time, facilitate the establishment of a competitive market in the supply of Embedded Systems technologies.

The original ARTEMIS industrial priorities aim to achieve multi-domain compatibility, interoperability, and even commonality was already moving in this direction. In the 2011 update to the ARTEMIS Strategic Research Agenda, this strategy is taken further: the societal challenges are used to structure the inherent technological issues into a concrete research and innovation strategy spanning multiple application contexts, with results that will benefit both society and the economy.

Scenarios have been developed to break down the complexity of these challenges to manageable and comprehensible pieces and map them to application contexts and technological domains.

The 2011 ISTAG report also advises this direction:

> *"As ICTs will provide the vital e-Infrastructure for the future knowledge society, a value shift in policy is needed. ICT cannot be understood only as a means to achieve growth or competitiveness; it has to be understood primarily in terms of what fundamental societal needs we want to address. Technical advancement cannot be evaluated only using criteria and values that are internal to technology expert communities. The social dimension of technical innovation becomes increasingly visible and important."*

The ARTEMIS matrix approach presented in the SRA 2006 has been extended to a three-dimensional representation, which puts applications contexts, research priorities and societal challenges into perspective.

Closer investigation of the societal challenges has highlighted the importance of interoperability, system autonomy, networking - including use of the Internet - and consideration of mixed criticality for more dependable systems. This 'bigger picture' for embedded systems implies change from local networks to open networks of embedded systems. This leads in turn to a change from single-system ownership to multiple-design processes and responsibilities involving many parties, multi-views, with conflicting objectives.

There is a change from static networked embedded systems to systems-of-systems which are highly dynamic and evolving and are never down. The convergence of applications on open networks introduces requirements for component and network safety, availability and real-time behaviour in areas where such requirements have not been an issue so far, such as in home networks and car-to-infrastructure communication. Get access to information systems and in turn the information systems get access to the embedded systems which now enable the internet of things. *Networked embedded systems will, in effect, become the neural system of society*.

Specific barriers to progress have been identified that have common characteristics across the different application contexts. These fall into three main Research Domains that comprise the 'ARTEMIS Priorities' (see section 3.1):

- Reference designs and architectures, to support product development in a diversity of application domains such as automotive, aerospace and nomadic environments.
- Seamless connectivity and semantic interoperability across application domains to support novel functionality, new services, and the formation of systems of systems to promote the emergence of services to enable the ambient, intelligent environment.
- Systems design methodologies and associated tools for rapid design and development.

While the ARTEMIS JU programme seeks maximum commonality across application sectors, it is recognised that different application domains impose differing demands on the technology to be developed. The ARTEMIS SRA therefore identifies a number of representative 'Application Contexts' in which sets of applications can share common domain expertise, design characteristics and requirements so that they can, in turn, share methods, tools, technologies and skills[5]. These are:

- Industrial systems - large, complex and safety critical systems that embrace Automotive, Aerospace, Healthcare, Smart Manufacturing and specific growth areas such as Biomedical;
- Nomadic environments - enabling devices such as smart phones and on-body systems to communicate in changing and mobile environments that offer users access to information and services while on the move;
- Private spaces - such as homes, cars and offices, that offer systems and solutions for improved enjoyment, comfort, wellbeing and safety, and lighting;
- Public infrastructures - major infrastructure such as airports, cities and highways that embrace large-scale deployment of systems and services that benefit the citizen at large (communications networks, improved mobility, energy distribution, intelligent buildings, …).

Embedded Systems technology should no longer be considered in isolated application contexts but should be seen in relation to their contribution to the evolution of society and, in particular, to their contribution in addressing today's and tomorrow's societal challenges.

The SRA2011 therefore identifies societal challenges as an overarching concept, where several application and research domains contribute to each of the three key societal challenges selected as examples: Healthcare and wellbeing, Green, safe and supportive transportation and Smart Buildings and Cities of the Future.

More recently, in 2012, ARTEMIS and ITEA have developed a common High-level Vision, a document prepared by the ARTEMIS ITEA Sherpa Group and published on September 19th, 2012. In this Vision 2030 both ITEA and ARTEMIS describe the areas of major changes and disruptions as well as the role of ICT, in general, and embedded systems in particular, in the global economy and society in 2030. This common vision reflects the partnership now instituted between the two initiatives and that will be continued through the ARTEMIS ITEA Cooperation Committee AICC.

[5] To name some examples, the transportation industrial domains such as aerospace, automotive, e-vehicle and off highway applications will require significant improvements during the next decade in order to reply to the needs of the society such as connections to the internet (i.e. vehicle2vehicle, vehicle2infrastructure) also with respect to service and maintenance tasks. Since these applications have an inherent need to protect data from unauthorised use, the topic of security combined with safety needs to be taken into account and requires novel approaches. In addition, the industrial domain of alternative energy sources such as wind power plants or solar energy and their connection to smart grids is another application area that shall be included and smart grids will play a major role in close future and will require a high amount of research and development to cover all challenges.

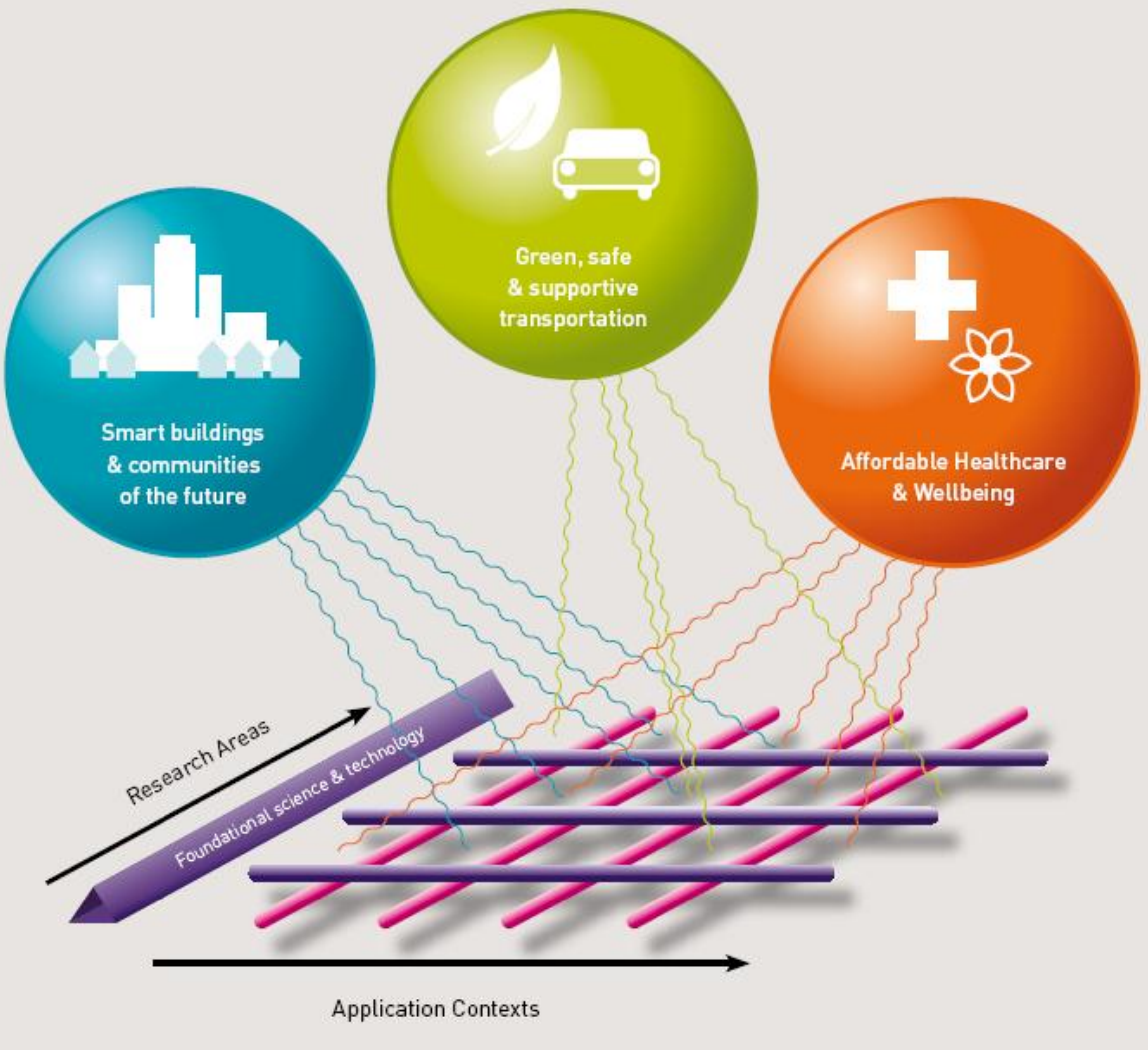


Figure: *SRA applications contexts, research priorities and societal challenges into perspective*

The industrial partners within ARTEMIS stress that the downstream research supported by the JU should be application-oriented, providing proofs of concepts for novel embedded systems in specific domains, so as to empirically validate design requirements and evaluate real-time performance of novel designs and architectures.

In addition, the ARTEMIS-JU strategy as defined in the Multi-Annual Strategic Plan (MASP) 2013 is to: ***"Build self-sustaining innovation ecosystems for European leadership in Embedded Systems"***, by stimulating the emergence of innovation ecosystems within the field of embedded systems in a number of business sectors, facilitating their integration into larger ecosystems, mainly through support of R&D projects and relevant supportive actions.

To achieve this, an essential element of the ARTEMIS-JU strategy is to establish a suite of sub-programmes that embrace both technological and application-oriented development in a way that integrates the participants so as to facilitate the emergence of innovation ecosystems of pan-European scale. These ecosystems are expected to grow around existing or new Centres of Innovation Excellence, feeding on the innovations created within the sub-programmes' R&D activities.

Therefore, in order to focus the research towards concrete instantiations of these Application Contexts, the ARTEMIS-JU MASP and Research Agenda (RA) defines eight 'sub-programmes' of research into both technologies and applications. However in the present call only the following ASPs are open:

ASP1: Methods and processes for safety-relevant embedded systems
ASP2: Embedded Systems for Healthcare and Wellbeing
ASP3: Embedded Systems in Smart environments
ASP4: Embedded Systems for manufacturing and process automation
ASP5: Computing platforms for embedded systems
ASP6: Embedded Systems for Security and Critical Infrastructures Protection
ASP8: Human-centred design of embedded systems

In addition to making a contribution to the cross-domain aims of the strategy explained above, the outcome of the research within the Work Programme is expected to fulfil concrete targets for the ARTEMIS JU that are set out in the MASP (*see References, section 7*) and in section 4.2 of this AWP2013.

2.3 Innovation environment context

2.3.1 ARTEMIS Innovation

ARTEMIS is an Innovation Program around Embedded Systems. As the term "innovation" is broadly used, in the ARTEMIS program "innovation" will be mainly connected to innovative technologies, will range from fundamental and industrial research to experimental development of new products, processes and services. Process and organization innovation of services are within the scope of the ARTEMIS program.

Within the ARTEMIS SRA and MASP/RA the ARTEMIS priorities are defined in technological terms.

In the evaluation criteria in chapter 6, market innovation and market impact are addressed. Market innovation and market impact can be divided in different directions, addressing new markets and new concepts in cooperation e.g. open innovation concepts.

2.3.2 Real-Life experiments in Living Labs

ARTEMIS supports the creation of Living Labs as part of or besides the typical R&D projects. The concept of Living Labs is based on a systematic user co-creation approach integrating research and innovation processes. These are integrated through the exploration, experimentation and evaluation of innovative ideas, scenarios concepts and related technological artifacts in real-life use cases. Living Labs enable concurrent consideration of both the global performance of a product or service and its potential adoption by end users.

The Living Labs concurrently involves the following multidisciplinary activities: co-creation, exploration, experimentation and evaluation.

ARTEMIS recognizes that large experimentation platforms exist at national or European levels, which could provide for some applications domains targeted by ARTEMIS a suitable "real-life" experimentation environment, and which could benefit from the innovative ideas, concepts and artefacts developed by ARTEMIS. Supporting the participation to such established Living Labs is part of the real-life experiments priority.

As example: Digital lighting is far more suited for manipulation of the lighting conditions in terms of intensity, spatial, temporal and spectral distribution. Information is available on the effect of incumbent lighting technologies on the health and well-being of people. How dynamical effects of lighting affect people however is unexplored territory. In order to surface the beneficial effect of dynamic lighting there is a need for living lab involving thousands of people.

2.3.3 SME Integration

Support integration of the SME environment in ecosystems
This involves facilitating such services as identification of high-potential SMEs, promoting business development beyond the projects, enabling that the point of view of SMEs is brought to the different events such as summer camps, conferences, working groups, etc.

Facilitate the participation of SMEs in projects.
A basic requirement in assuring heightened SME enrolment is the creation of an environment that will allow high-potential SMEs to be identified and communicated with, that encourages their participation in technically relevant collaborative R&D projects, and carries this through with support in valorising these developments as market-viable innovations.

2.3.4 Collaborative Innovation

The key actions to push open innovation within ARTEMIS-JU projects will be to:

- use Centres of Innovation Excellence to collect, attract and retain skills and resources, which will form critical mass for sustainable innovation;
- support actions towards SMEs and for SME networking;
- develop open- or community-source organizations for embedded software technologies, where appropriate;
- facilitate access to funding instruments to support development and commercialization of new innovations (Interface with European Investment Bank and with other financial institutions providing guarantees to SMEs, EC instruments, Venture Capital firms);
- support standardization activities, combating today's fragmentation;
- encourage sharing of research infrastructures;
- encourage sharing of and contributing to tool platforms;

2.3.5 Standards

All projects to be supported by the ARTEMIS-JU will be required to agree a strategy for standardisation, if applicable. This will include a rationale for that strategy that takes into account the ARTEMIS Strategic Standardisation Agenda (available from the ARTEMIS-IA web-site, see section 7). Projects will be expected to communicate with relevant ARTEMIS standardisation initiatives[6] concerning their standardisation needs and opportunities, including those that may emerge during project execution.

2.3.6 Education

Effective education and training is crucial to maintaining competitive leadership. ARTEMIS-JU projects will make recommendations to instigate improvements to the following:

- creation of a highly skilled, multi-disciplinary work force, and maintenance and upgrading of existing skills of a professional workforce (life-long continuous learning);
- joining of forces and inclusion of interests of both industry and academia, in initiatives, support actions etc., designed to overcome the gap between theory and practice of (industrial) application;
- establishment of new types of people mobility programmes with an industrial focus, additional to those with a rather academic focus;
- support of high-tech spin-off and start-up companies by facilitating non-technical training in entrepreneurship, finance and business practice, etc…;
- pan-European Policies for long-term effort in Embedded Systems Education and Training,
    - providing adequate university and applied university curricula in embedded and smart systems domains, and

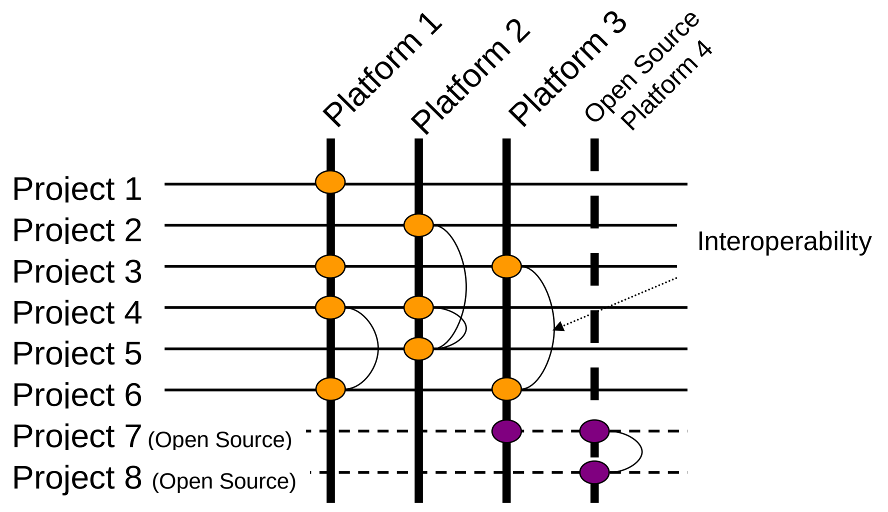
[6] Such as the FP7 Supporting Action 'PROSE' (*"Promoting Standardisation for Embedded Systems"*)

- providing a platform of excellence with special curricula and educational and training institutions (separately or on top of existing organizations).

For the realisation of the above targets, cooperation with EIT-ICT-Labs might be pursued by the projects.

2.3.7 Tool platforms

The need for integrated, trustable, interoperable tools and tool-chains from reliable sources with assured long-term support is identified in the ARTEMIS-ETP SRA on Design Methods and Tools. The innovative element is the concept of the "ARTEMIS Tool Platform"[7], of which there may be several – each adapted to particular sector or part of the complete design flow.
Unlike a complete design flow tool-chain, an ARTEMIS Tool Platform will not have a fixed or even physical existence. An ARTEMIS Tool Platform is not 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 a particular element or phase 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. The demands on design tools can be very different between industrial sectors (indeed, even between companies within the same sector, due to product diversity), making a single ARTEMIS solution unrealistic. Therefore a number of ARTEMIS Tool Platforms are foreseen, as shown schematically below.



Here it can be seen how tools developed in various research projects can be linked via the platforms into viable solutions as part of a complete chain. This also includes the possible inclusion of existing (commercial or open-source) tools. Note that a development project can yield a tool or tools which is/are compatible with more than one Platform. Also, the Platform concept does not impose a specific business model: these can be aimed towards a specific commercial implementation (a future ambition), can expressly address the Open Source paradigm, or even a mixture of these. A Tool Platform can also form the core of an ARTEMIS ecosystem. ARTEMIS-JU ask future project proposers to voluntarily indicate, for information, what target platforms they intend to address in the course of the project or in the future.
In general this AWP is business-model agnostic, although in several ASP's it encourages projects to propose new business models for relevant application areas.

[7] Tool platforms description on ARTEMIS-IA website: http://www.artemis-ia.eu/tool_platforms

2.3.8 ARTEMIS Repository

In March 2011 a new working group was established with the goal to define an ARTEMIS Repository. The ARTEMIS Repository[8] collects various public technical results into place of single access and description form to be shared for the developing community. The level of openness and availability is defined by the provider of the results.
The ARTEMIS Repository is complementing the ARTEMIS Tool Platforms.
In short, the purpose of the ARTEMIS Repository is to:

- Make public project's results available to the Embedded Systems R&D community in Europe.
- Enable new ARTEMIS-JU projects to build on results of previous ARTEMIS-JU projects.
- Provide information to proposers of new projects on results achieved and the state-of-the art.
- Promote ARTEMIS-JU project results. The Repository is a window showing the impact of results accompanied with information on the actual use and proliferation of results.
- Provide a snap-shot of the coverage of the ARTEMIS industrial priorities.
- Support the building of networks, especially the Center of Innovation Excellence networks.

ARTEMIS-JU asks future project proposers to voluntarily indicate, for information, what potential project results they foresee to contribute to this repository.

2.4 Research & Development Context

The structure of the ARTEMIS Joint Undertaking (JU) is laid down in the Council Regulation no 74/2008 which states that the Joint Undertaking will develop its own ARTEMIS Research Agenda (RA). The Research Agenda closely follows the recommendations of the ARTEMIS Strategic Research Agenda (SRA) of the ARTEMIS Technology Platform and addresses the design, development and deployment of ubiquitous, interoperable and cost-effective, powerful, safe and secure electronic and software systems.

However, the scope of the ARTEMIS-JU RA is only part of the scope of the ARTEMIS SRA. It is intended to avoid overlap with European programmes - particularly the Framework Programme - that also contribute to the goals of the ARTEMIS SRA. ARTEMIS is also intended to help reduce the fragmentation of R&D resources available for national and regional programmes.

In particular***, the ARTEMIS-JU RA focuses on - downstream-oriented research and technological development*** *with a strong market drive.* This is intended to deliver ***prototype*** or ***demonstrator*** solutions with ***high cross-domain applicability*** to address ***specific societal needs***. It may also be enriched on topics that are not described in detail in the ARTEMIS SRA. However, the focus on downstream RTD does not preclude and indeed it specifically *includes* exploration of the potential for practical application of upstream research from various research organisations, being academic institutions, RTO's, or industry (large and small).

[8] ARTEMIS Repository description on ARTEMIS-IA website: https://community.artemis-ia.eu/roadmap/repository

The ARTEMIS-JU MASP and RA, and the consequent Annual Work Programme, are therefore designed to be complementary to other initiatives:

- The downstream nature of the research distinguishes it from the Framework Programme,
- The ARTEMIS focus on pan-European strategic objectives, as formulated in the SRA and MASP, distinguishes it from EUREKA (ITEA2,…, etc.) as well as from National and Regional programmes, that , although they are also market oriented, EUREKA programmes are typically matching combinations of national priorities and strategies by collaboration of national sub-consortia, and National and regional programmes only focus on local priorities.

Each year, the specific objectives for R&D to be achieved through Calls for Proposals are detailed in an Annual Work Programme. This present document is the Annual Work Programme for 2013. It defines the content and scope of the Call for Proposals to be launched in 2013.

The text of the subsequent Call for Proposals will further detail the available budget and the eligibility criteria, taking into account the requirements of both the European Commission and Member States.

3 Content and Objectives of 2013 Call

Each proposal should have a technological focus on at least one of the Industrial Priorities of ARTEMIS (see Section 3.1) in the context of at least one Sub-Programme (see Section 3.2). The application-driven development of new technologies and solutions can direct the project results more towards real user needs and businesses. Proposals will benefit from having a central role for applications and early feedback during the projects in order to achieve market-relevant results. Proposals should identify which of the Industrial Priorities and Sub-Programmes they address.

As indicated in section 2.4 above, ARTEMIS research is intended to focus on *“downstream-oriented research and technological development with a strong market drive”*. <u>However, the focus on downstream RTD does not preclude and indeed it specifically *includes* exploration of the potential for practical application of upstream research from academic institutions and RTOs, as detailed in 3.1.4, such as the validation of some of these foundational research, techniques and technologies in an industrial setting, for example through prototypes, demonstrators or test-beds.</u> And, as also indicated in section 2.4, it extends in the downstream direction to the prototyping of innovative embedded systems.

3.1 ARTEMIS Priorities

The ARTEMIS JTI on Embedded Computing Systems addresses the design, development and deployment of ubiquitous, interoperable and cost-effective, powerful, safe and secure electronics and software systems. To do this it must deliver on 3 industrial priorities:

3.1.1 Reference designs and architectures

Reference designs and architectures offer common architectural approaches for given ranges of applications. The objective is the creation of an energy efficient generic platform and a suite of abstract components with which new developments in different application domains can be engineered with minimal effort. It includes topics such as:

- Composability - a scalable framework that supports the smooth integration and reuse of independently developed components is needed in order to increase the level of abstraction in the design process and to reduce cognitive complexity.
- Dependability and security - the provision of a generic framework that supports mixed criticality, safe, secure, maintainable, reliable and timely system services despite the accidental failure of system components and the activity of malicious intruders is essential.
- Certification - the control of physical devices and processes, e.g., office and shop-based digital pharmacy labs or service robots that interact with humans performed by Embedded Systems makes it necessary for the design to be certified by an independent certification authority. The envisioned architecture must support modular certification.
- High-performance embedded computing - for scalable multiprocessor computing architectures and systems incorporating heterogeneous, networked and reconfigurable components. The increase by several orders of magnitude of computing power will be key for achieving embedded intelligence in areas such as perception, multi-media content analysis, autonomy, etc
- Low power - the advent of Giga-scale SoC will require system level techniques for handling the power dissipation of silicon, such as power gating and integrated resource management.
- Interfacing to the environment - new ways of interfacing with the natural and the man-made environment, and in particular more intuitive ways for humans to interact with both technical systems and each other.
- Interfacing to the internet - the internet with its limited reliability and timing predictability challenges Embedded Systems dependability and end-to-end timing requirements. New communication protocols and control mechanisms are needed to reach a suitable level of communication predictability and to adapt Embedded Systems functions to communication uncertainties

3.1.2 Seamless connectivity and interoperability

Middleware, operating systems and other functions required to link the physical world, as seen by the networked nodes, and also the higher layer applications, as well as hardware features needed to support an efficient and effective interoperability implementation. It includes topics such as:

- Certifiable operating systems (micro-kernels and hypervisors) that can be distributed and composed, and are able to support dynamic reconfiguration.
- Opportunistic flexibility - taking advantage of the currently accessible opportunities e.g. network connection to a cloud, to dynamically improve the quality of service.
- Ubiquitous connectivity schemes that support the syntactic and semantic integration of heterogeneous sub-systems, under the constraints of minimum energy usage and limited bandwidth.
- Self-configuration, self-organisation, self-healing and self-protection of the computational components in order to establish connectivity and services in a particular application context, using knowledge autonomously acquired from the environment and enabling dynamic reconfiguration.
- Perception techniques for object and event recognition in order to increase intelligence in Embedded Systems and make distributed monitoring and control tasks in large-scale systems possible.

3.1.3 Design methods and tools

To manage architectural complexity during design while ensuring maturity at introduction under strong time-to-market constraints, methods and tools for Embedded Systems should bring innovations targeting:

- Multi-viewpoint engineering, and design exploration
- Incremental development, incremental validation, incremental certification, in particular for mixed criticality systems
- Early verification and early validation of non-functional properties
- Early detection of design errors and integration risks, in particular for mixed criticality systems
- Capitalisation of experience, and the embodiment of that experience in design rules.
- Design tools that can be integrated into the core design process workflow that address heterogeneous structures, particularly power efficient mapping on heterogeneous multiprocessing devices and complex memory hierarchies.
- Certification of mixed criticality systems and the development of well structured safety cases such that the safety of a proposed design can be convincingly demonstrated
- Advanced control algorithms to find optimal operating points in Embedded Systems that are characterised by nonlinear behaviour.
- Embedded fault handling, relying on model-based fault detection at run-time, and associated algorithms for fault tolerance.
- Design process management that addresses complexity, product hierarchy, supply chain and information flow management.
- Open interface standards, with agreement on the intellectual property rights of the specific tools developed to support it.
- Traceability of component properties and their attributes, including safety and dependability, during development and integration.
- Product lines of embedded systems.

3.1.4 Foundational research topics

While ARTEMIS is an industry oriented programme, it does not preclude supporting aspects of foundational research topics, advancing the industrial maturity in these foundational research topics. However, addressing the foundational research is not core for this call. It is noted that also the EU FP7 programme has organized consultations on several of these topics and included some of them in the work programme 2013.

The relevant topics are:

- Bridging physics and computing: so that Embedded Systems will be context-aware and able to make optimum use of available resources – not just computational resources, but also time, space and energy, and sensing the context and dealing with material properties.
- Hard real-time control: the automatic synthesis of control systems from abstract algorithms, taking into account distribution, heterogeneity, deferred implementation commitment and autonomous management of all types of resource. On multi-core and networked systems, hard real-time systems requiring worst case guarantees increasingly coexist with less demanding and less predictable soft real-time systems. Soft real-time systems often work with probabilistic guarantees and less accurately specified behaviour. New integration methods and validation approaches are needed to correctly and efficiently integrate such mixed real-time systems.
- Mixed criticality systems: integration of applications with different safety requirements merged on the same embedded system components and communication channels require new approaches to integration, qualification and incremental certification.
- Novel computing architectures that do not (necessarily) respect the conventions of data and instruction similarity, linear memory access, control flow priority and separation of data from semantics.
- Self-organising and dynamically adaptive systems: to achieve predictable system properties from the complex composition of a heterogeneous set of (possibly unreliable) components with evolving functionality.
- Modular, heterogeneous, composable systems and self-organising, adaptive systems: to achieve predictable system properties from the complex composition of a heterogeneous set of (possibly unreliable) components.
- Dependability and security: radical design and verification methodologies that will enable correct-by-construction design with automatic co-verification so as to achieve an order of magnitude advance in productivity and allow privacy and content protection in dynamic and distributed environments.

3.2 ARTEMIS Sub-programmes

The specific sub-programme priorities for 2013 are indicated in the following sub-sections. These are set in the context of the sub-programme definitions contained in the ARTEMIS Multi-Annual Strategic Plan and the ARTEMIS-JU Research Agenda.

A research project should specifically address the Main Goals and Approach, the Applications Relevance, and the Cross-domains aspects of the sub-programmes, as described below.

In addition, all projects are required to satisfy general requirements, not specific to any of the sub-programmes. These general requirements are set out in Section 4.

3.2.1 ASP1: Methods and processes for safety-relevant embedded systems

Objectives and Approach

The overall aim of this sub-programme is to enhance the quality of services and products in strategic European industrial sectors and to decrease fatalities and injuries by building cost-efficient processes and methods supporting the development and operation of safety enabling embedded systems.

The aim is to achieve technological breakthroughs in four research areas:

- Requirement Management
- Architecture Modelling and Exploration
- Analysis Methods
- Component Based Design, particularly building reliable systems out of unreliable components

Such breakthroughs are required not just for conventional discrete stand-alone devices, but also to multi-processor systems-on-a-chip.

Projects should contribute to one or more of the following specific objectives:

- A model-driven process for the compositional development of safety and security for critical global multi-systems/system/distributed system/ system of systems including multi-physics systems. This should enable model-based compositional development and qualification, supporting reasoning about non-functional properties (including but not limited to safety) and it should provide a basis for rapid qualification or certification of compositionally designed systems and especially rapid re-qualification or re-certification after change. This development process should consider the requirements of the existing and emerging safety standards, such a DO 178 B, DO 254, IEC 61508, and ISO 26262 such that standards conforming designs can be produced with reasonable effort.
- Manage variability and ensure support to product lines development.
- Develop system engineering ontology capabilities in order to support a business data centric system engineering approach and conduct multi-views concurrent engineering activities along the system development life cycle in extended enterprise.
- Analysis and management methods for the impact of security on safety. Analysis methods to verify the claimed assurance level of trusted environments. Autonomic security management of embedded systems fostering the connection of such systems to the internet in order to offer autonomous services.
- Processes, Methods, techniques and tools that support systems of systems design and allow for making design trade-offs between aspects of autonomy, evolvability, resilience vs. strict predictability and dependability. Processes, Methods, techniques and tools that support systems of systems certification.

- Developing methods and tools supporting the move from system architectures consisting of a set of loosely coupled or hierarchical control systems, towards more distributed control and peer-to-peer architectures, with a particular focus on guarantees of safety relevant properties, e.g., timing.
- Consider the use of models instead of documents as qualification/certification evidences.
- Manage variability and ensure support to product lines development.
- Analysis and management methods for the impact of security on safety. Analysis methods to verify the claimed assurance level of trusted environments. Autonomic security management of embedded systems fostering the connection of such systems to the internet in order to offer autonomous services.
- Formal methods and tools supporting the transition from system engineering to software engineering, in particular for the representation and analysis of quantified non-functional properties, and for the transition between quantitative requirements and quantitative contracts, that can be exploited at implementation level.
- A European Collaboration (i;e standard) Reference Technology Platform, embodying meta-models, methods, and tools for safety-critical hard-real-time and/or mixed criticality system development.
- Defining and implementing instances of the European Tool Platform dedicated to reference system architectures (as developed in ASP5, targeting one or more application domains). Such instances would typically adopt generic tools (e.g. system design tools), develop tailorisation (e.g.,

libraries of design patterns or analysis plug-ins) and integrate platform specific tools (e.g., operating system related software design tools
- Strengthening the European ecosystem of tool vendors, by assessing and promoting innovative tools or innovative evolutions of existing tools, that contribute to implementing the European Collaboration Reference Technology Platform, in all areas directly or indirectly related with dependability: including, but not limited to requirements management, design support at different levels of abstraction, formal analysis, design space exploration and virtual prototyping, early validation, product line support, incremental certification.

Expected Impact

Embedded systems with high safety requirements contribute more and more in the total costs and value creation in a large variety of equipment in application areas such as:
- Transportation (automotive, aerospace, rail): for instance, maximally utilizing the capacity of roads to accommodate increase in traffic demand while *improving* safety[9];
- Industry (process control, manufacturing, ...)
- Public infrastructures and utilities (electricity, gas, water, ...)
- Medicine (surgical equipment, diagnostic equipment, imaging equipment, health monitoring devices, systems and equipment, …)
- Energy generation.

Projects are therefore expected to:
- reduce time to market despite the increasing contribution of embedded systems and software and their growing size and complexity;
- increase the quality and reliability of products and services while providing novel functionalities to the user;
- improve cross-domain fertilisation.
- contribute to architectures that reduce cost and effort of qualification and certification processes.

Projects in this sub-programme are also expected make breakthroughs as described above in order to contribute to progress in one or more of several transverse processes such as Design for Safety, Design for Maintainability, Design for Reuse, and Design for Certification.

The ARTEMIS-JU 2013 MASP declares an aim to form an agreed set of specifications dedicated to well-defined applications and aspects of the complete design tool chain, referred to as a Tool Platform. It is expected that each Tool Platform will attract specialised developers and users, thereby forming an eco-system of technical expertise. Projects intending to address this ASP are expected to propose specific, adequately resourced contributions to existing or to new Tool Platforms.

Cross-domain aspects

The development of safety-relevant systems will mainly rely on development of cross-domain reference design platforms, design processes and associated S/W tools with multiple objectives (cost, time, energy, memory, safety, design distribution, standards compliance).

Systems of systems specific requirements, if needed, (e.g. self-assembly in manufacture, and inter-modality, formation flying or driving in transport) should be addressed in conjunction with the relevant application-oriented sub-programmes.

ASP1 depends on suitable platform technologies for the construction of dependable embedded computer systems. Examples for points of interaction include certifiable computing environments, fault-tolerance and robustness technologies or diagnosis and maintenance mechanisms for safety-relevant embedded systems. As a result, ASP1 will have a strong interaction with ASP5.

Synergy will also be sought with ASP6 in view of the similar objectives.

Synergy will be sought with ASP8 since usability is a main concern for early and smooth adoption in projects, and since there are safety aspects to the design of Human Machine Interfaces.

[9] The EU has a goal of zero traffic fatalities by 2020.

3.2.2 ASP2: Embedded Systems for Healthcare and Wellbeing

Objectives and Approach

Healthcare is under intensive strain due to demographic and economic challenges - a globally increasing number of patients with chronic diseases – leading to skyrocketing healthcare costs and staffing shortages. This requires novel methods to handle more patients within acceptable healthcare costs while keeping a high quality of care as well as the support for the individual to take care of her or his own health. The healthcare cycle can be made more cost-effective by improving the quality of care and by shortening medical treatment and hospital residence, also through support for a healthy living, care at home, early diagnosis and prevention, image guided intervention and personalised treatment supported by validated decision support systems.

In the MASP/RA 2013 five innovation scenarios are described:
1. Care at home and everywhere,
2. Reduced hospitalization time with novel therapeutic solutions
3. Early diagnosis and prevention
4. Image guided Intervention and Therapy
5. Clinical Decision support systems

The aim of this subprogram is to achieve product innovation and technological breakthroughs in these research areas. Both interoperability and seamless integration of interoperable components are essential in these research areas.

This will support personalized prevention and treatment strategies by taking advantage of the opportunities offered by new technology, such as:
- gathering data by a large variety of sensors and controlling treatment by various actuators in relevant situations: at home, on the move, at work, in health centres, clinics and hospitals, and enabling easy, efficient and effective individual monitoring and wide-scale screening;
- novel algorithms to analyse gathered data, from historical as well as parallel care cycles, and present the relevant information in an adequate way to persons related to their task and situation;
- providing integrated healthcare solutions for hospitals, clinics and health centres which can include full immersive environments for advanced mental healthcare treatment or advanced imaging rooms (CT, ultrasound, MRI, X-Ray ,PET);
- ubiquitous access to a citizens health data, by all partners in an inter-disciplinary care team under the conditions of proper privacy enforcements;
- supporting both the individual and professionals and enabling adequate communication between all partners in inter-disciplinary care teams using collaboration technology, including secure messaging, instant messaging, audio and video communication and even remote sharing of applications at any place and time on the device of choice.

The approach is to develop and deploy advances in embedded systems technology: communicating sensors and actuators; improvements in genetic, molecular and imaging equipment for diagnostics, including algorithms, equipment and infra-structure for massive image processing and simulation to support combination of images from different modalities (CT, ultra sound, MRI, X-Ray) and comparison or fusion of images with physiological models (e.g. heart, brain …); telemedicine including tele-monitoring and tele-surgery; lighting and displays for immersive environments; facilities for diagnostic and epidemiological analysis, remote management of implanted drug delivery; multi-modal interaction technologies (speech, vision and gestures) for information and data access, supporting navigation and decision making for diagnostic and (minimal invasive) surgery, not hampering the normal workflow.

Projects should contribute to one or more of the following specific objectives:
- System qualities such as performance, reliability, interoperability, that are key for solutions in healthcare and wellbeing, in particular medical systems since they are of life importance
- a reference architecture and design to support these system qualities demanding decisions on multi-objective trade-offs, involving real time behaviour, power consumption, cost, accuracy and speed. With increasing complexity, however, architects need advanced modelling support and simulation techniques to achieve the necessary levels of accuracy, cost and time efficiencies.

- distribution and interoperable, dynamically configurable networks obeying latency, bandwidth security and privacy and allowing massive reliable medical (image) data processing, and distributed control systems;
- automatic optimisation of resource usage at system level heuristics, intelligence and trade-off functions supporting remote system life-cycle management;
- provision of sensors and actuators, both portable and stationary, that are compliant to interoperability standards;
- safe and secure ambient identification and authentication;
- multi system integrated workflows;
- a stable, robust and extendable standard format for medical data (the data should and has to be readable more or less indefinitely, or at least over a human life time).

Expected impact

By optimising the use of resources, fostering the ‘digital hospital’ where all devices, patients, and professionals are connected, projects are expected to lead to:
- reduction in visits to doctors,
- reduction in visits to hospitals (including out-patient clinics),
- shorter periods of hospitalisation (when hospitalisation is necessary),
- greater longevity with improved quality of life throughout,
- increased support to interdisciplinary care teams to achieve the outcomes above.

Cross-domain aspects

This subsection describes the cross domain aspects with the other ASP’s.

ASP 1 “Methods and tools for safety-relevant Embedded Systems” All the results of ASP 2 are used for caring for human beings. Since life depends on solutions for health and wellbeing the result has to be secure, fault-tolerant, and error-free. As is the case with other high-tech systems, solutions for healthcare and wellbeing have to be extended and adapted frequently to meet customer demands for more features and connectivity, leading to an enormous increase in the number of interfaces and system configurations. In addition, there is a continuous pressure to decrease time-to-market, i.e. the increasing complexity has to be addressed in shorter innovation cycles. Hence, healthcare systems cannot be developed from scratch, but have to reuse many components and incorporate third party components in a reliable way.

ASP 6 “Embedded Systems for Security and Critical Infrastructures Protection”, is also relevant to enable fine-grain situation-based access control based on an ambient identification system for care professionals as well as patients; and bi-directional authentication between sensor and actuator devices with other parts of an end-to-end system as well as identification of these devices e.g. to check their certification as medical device. Since solutions for Healthcare and Wellbeing will be more and more applied outside the hospital the solution should be integrated in a safely manner in the open environment. A person becomes a smart object itself with capabilities to sense vital signs and communication aids to medical professionals. The solutions should be independent from location and mobility

ASP 8 “ Human-centred design of embedded systems” : The capabilities that modern technology provides are huge. This has resulted in our current high-tech, but also complex, systems. The complexity factor of these systems results in the requirement of well-trained users. Systems such as MRI scanners, electron microscopes and operating robots cannot be used by novice users. Therapy delivery has to be supported by navigation, non-graphic and non-touch user-interfaces. Therapy specific cockpits have to deal with planning, decision support and (minimal invasive) therapy guidance. The recognition of this complexity has caused a shift from technology-driven innovation towards human-centric innovation. The systems should be self-explaining and act according to surgeons’ procedures. This human-centric innovation reinforces the importance of ‘ease-of-use’.

3.2.3 ASP3: Embedded systems in Smart environments

Objectives and Approach

The overall goal of ASP3 is to provide methods, tools, technology and models with which developers will be able to build “smart environments” of smart and heterogeneous devices interacting with each other and with the environment, and cooperating together to provide a foundation for rapid local applications and service innovations. Such smart environments are characterised by dynamicity, requiring a balance between design time choices and adaptability to runtime changes and frequent, possibly autonomous, runtime reconfiguration. And the systems of smart environments must be deployable on a wide range of devices, some of which may have restricted resources.

This will be achieved by building an embedded system reference architecture implementing a smart environment and supporting vertical service cases with relevant business models. The requirements of all stakeholders must be accommodated - SMEs, corporations, research institutes and public authorities willing to enter the innovative market of smart environment applications.
Alignment of the development of smart environment solutions with existing and emerging embedded systems in other domains will enrich the existing businesses.

Application scenarios for smart environments that have been identified already include:

- Smart indoor and outdoor spaces and locations (smart city, smart home, smart public space, smart office ...)
- Smart physical objects (objects equipped with identification mechanisms such as RFID tags, smart multi-media content storage, smart communications objects such as wireless grids and co-operative networks)
- Smart virtual spaces (Mixed mode Physical and 3D-Virtual spaces, community spaces)
- Smart mobility including critical infrastructures around vehicles, such as smart vehicle2vehicle and vehicle2infrastructure environments
- Private mobile social networks ('PMSNs')
- Profile-dependent intelligent guide ('PDIG')

The vertical and horizontal approaches are strictly related. Systems for vertical scenarios must be designed taking into account interoperability and extensibility: common service platforms must be able to cope with the needs of the most relevant applications. In order to narrow down the possible choices, a dual approach will be taken:

1. identify a common architecture and build a horizontal interoperable infrastructure for service innovation
2. identify a set of domain specific services, “vertical cases”, with relevant business models

Projects should contribute to one or more of the following specific objectives:

- a common, multi-domain architecture
- standards for interoperability in smart environments
- Interaction model between horizontal and vertical activities, to assure proper tackling of the interoperability and cross-domain issues
- infrastructure requirements to support new interaction and interface concepts (e.g. goal-based user-environment interaction, and automatic triggering of services with non-explicit requests)
- Environment representation language to support interoperability and reasoning
- Development tools for multi-device and shared resource applications
- Semantic platform specification

Expected impact

Projects in this ASP should provide key solutions for smart cities and enhance the ability of the citizen to participate in multiple communities and societies on a continuous basis, whatever their actual, present, physical environment.

Projects should also provide the citizen with more local, personal control, , less stress, less overhead and increased comfort and safety in everyday life.

Projects are expected to lead to:

- easier use of digital systems for citizens and professional users
- an infrastructural basis for new multi-domain services, integrating data and services from several application domains;
- some basic multi-domain services, defined and offered to the market;
- implementation and deployment of preliminary applications for smart homes, smart infrastructures around vehicles, private and public area monitoring;
- Internet based communication enabling the integration of applications from the information society with those of embedded systems or systems-of-systems.

As explained in 2.3. and more specifically in 2.3.5 above, the ARTEMIS-JU strategy for the innovation environment that is necessary to support the R&D projects aims to form an agreed set of specifications dedicated to well-defined applications and aspects of the complete design tool chain, referred to as a Tool Platform. It is expected that each Tool Platform will attract specialised developers and users, thereby forming an eco-system of technical expertise. Projects intending to address this ASP are expected to propose specific, adequately resourced contributions to the establishment of such a Tool Platform.

Cross-domain aspects

One of the central notions of the smart environment applications is their ability to benefit from information in different domains. The potential for reaching across application domains is expected to provide growth opportunities beyond what is possible with domain specific solutions, since the same smart environment can be used for multiple purposes by multiple classes of users. This should enable novel possibilities for service aggregation and service composition.

Projects must demonstrate that smart environments' connectivity and interaction technologies can provide strategic input to enhance the potential of all ARTEMIS application-oriented Sub-programmes, particularly ASP1 "Methods and Processes for Safety-relevant Embedded Systems" (focused on transportation systems), ASP2 "ES for Healthcare systems", ASP7 "Embedded Technology for Sustainable Urban Life" and ASP8 "Human Centric Design of Embedded Systems".

In return, the common architecture (embracing seamless connectivity and interoperability) supporting the expected horizontal and interoperable infrastructure will certainly have the potential to highly benefit from the incorporation and exploitation of input from all of the transversal sub-programmes, particularly ASP5 "Computing Platforms for embedded systems", and ASP6 "Embedded Systems for Security and Critical Infrastructures Protection", especially since smart environments will be based, to a large extent, on a secure, dependable, Internet of Things.

3.2.4 ASP4: Embedded Systems for manufacturing and process automation

Objectives and Approach

The ambition is to reduce the environmental impact of manufacturing industries while maximising manufacturing efficiency. This will not only augment manufacturing employment in Europe but also assure jobs in the design, manufacturing, integration and servicing of the manufacturing equipment itself.

Embedded Systems will precisely control process parameters, including the active reduction of pollutants, to reduce the total cost and environmental impact of manufacture. Further competitive advantages will be achieved by controllability, flexibility and condition monitoring made possible through Embedded Systems solutions that will also reduce the need for maintenance, lowering cost still further.

Automation will support flexibility, from real-time product grade changes and process tuning to raw material quality changes. Improvement in end-product quality will be achieved through active control of the manufacturing process, moving from ‘off-line’ to ‘in-process’ quality control through advanced automation. Improved man-machine interaction through advanced Embedded Systems and “human-in-the-loop” control systems will improve quality, flexibility and productivity by assuring zero operator errors, as well as reduce accidents.

Manufacturing flexibility will assure agile adaptation to market demands, particularly for individual customisation. This will be achieved through reduced commissioning and production ramp-up times, allowing fast changes in product type or grade to be made. Concrete targets are to reduce commissioning time from 3 - 6 months to less than 1 month, and assuring quick turnaround times, where model changeover time is reduced from 8-12 weeks to1-2 weeks.

Targeting advanced production automation, this ASP is the essential enabler of the global objective of the “100% available plant” measured through OEE. This will achieved through substantial improvements related to one or several of the following areas:

- Instant access to virtual dynamic factory,
- Increased information transparency between filed devices and ERP,real time sensing and networking in challenging environments automation function development process,
- management of critical knowledge to support maintenance decision making
- automated orchestration of flexible production and distributed manufacturing
- automation system security and safety
- tool and methodologies supporting automation system design, engineering, deployment, operation and maintenance.

All of these improvements will require radical improvements to systems handling, automation and optimization, operation, maintenance, engineering and business. The overall approach is to establish an open embedded systems technology together with supporting methodologies, models and tools that enables a holistic life cycle approach to the main objective. The embedded system technology should enable the interoperation and reconfiguration of embedded devices, systems, systems of systems, and models in both products and processing equipment so as to build reliable, predictive and robust and safe plant solutions and/or intelligent production machines for robust and safe indoor/outdoor operation that enable efficient energy and material usage while improving transparency of operation and quality while supporting personnel health, environment, safety and quality (HESQ).

The required improvements to a very large extent are related to improvement in embedded system technologies comprising all the necessary devices, systems, system of systems, models and tools to support development, implementation and operation of production systems and the operation organization. Such improvements targets are related to functionalities or tools that are achieved through the support of embedded system technology such as:

- automation model life cycle management IP everywhere, middleware nowhere on-line real time quality assurance of measurement data
- robustness of sensor and actuator technology, e.g calibration, energy harvesting, disposability
- automation system human user interface context awareness and information timing
- automated device configuration

Projects should contribute to one or more of the following specific objectives:

- methodologies and tools for open automated device, system and system of system analysis and configuration targeting fast commissioning of new or updated systems, fast product and lot size changes, process understanding, equipment status and quality tuning through
  - machine learning methodologies
  - event based control
  - hard real time and device and systems predictability
  - methodologies and tools for automated run time and real time system control model generation
- real time and run-time configurability and maintainability: Architectures for exchanging large data streams between a limited number of nodes in a networked environment. In order to be cost effective new architectures need to be defined, to cope more effectively with the characteristics of their environment.
- Next to the distribution of the intelligence, new interfaces need to be defined, allowing the manufactures of the network components to design products that can be integrated seamlessly with the components of other suppliers
- methodologies targeting open integration of required production systems and external demands e.g. environment effects through
  - tools and methodologies for robust and predictive system of systems
- reduced life cycle cost (investment, installation, commissioning and operation) of robust automation equipment through re-use of consumer technology proving e.g.
  - predictable wireless latency
  - wireless power

Expected impact

Impact is expected to improved productions efficiency, improved product quality and improved OEE at process facility owner level while using less energy. Encouraging and motivating increased investments in the necessary automation technology. This will impact the whole value chain of the automation industry from component and device supplier over system suppliers to system integrators. Projects are expected to address and impact most of this value chain.

Further increased usage of automation - verging on autonomy - will enable *'High resolution management'*. Projects are expected to reduce energy consumption and improve raw material utilization while supporting improved safety and working conditions.

New industrial service-based architectures, sensors and communications also open the prospect for remote maintenance, monitoring, diagnosis, and control in which SMEs may participate more easily, and projects are expected to facilitate the 'opening up' of the market for such services.

Novel service propositions should be a component of the project, to ensure adoption, exploitation and impact of the results.

Cross-domain aspects

Improvement related to wireless communication and wireless power is expected to be relevant for ASP 2,3,7,8. The robustness aspect is expected to be relevant for ASP6. The aspects of automated configuration and control model identification and run time commissioning will generate methodologies and tools that have to conform to ideas in ASP1.

A new factory oriented framework, with innovative networking, communication and controlling technologies to enable open, modular and reconfigurable control and automation platforms, implies that projects in this ASP will have to share research and results with projects in ASP5 "Computing platforms for embedded systems".

3.2.5 ASP5: Computing platforms for embedded systems

Objectives and Approach

The main goal of this sub-programme is to foster integration (avoid fragmentation) of research in embedded system computing platforms by enabling an increase of cross-domain re-use and interoperation, thus leading to lower costs of ownership and wider applicability. Projects should concentrate on providing solutions for embedded system technology challenges that are common to multiple application domains.

A secondary goal is to enable massive real-time data-processing in multiple domains (image processing, signal processing, computational fluid flow ...).

A further goal is to enable composition of functions over highly concurrent, complex multi-core systems with a variety of communication schemes, types of core, etc. Run-time adaptability is required so as to optimise performance and resource usage - particularly extremely low power consumption, since modern electronics is an increasingly significant contributor to global power consumption and carbon emissions.

Projects should identify clusters of applications in different domains with a common “business pull” for innovation, and clusters of technical areas where the “techno push” fits to the innovation challenges of these application domains. Each project is expected to identify **the key standards** to be considered in its scope of application/technology focus and the sets of innovations needed, such as core technologies and associated APIs and Intellectual Properties for multi-core computing architectures, interfaces to the physical world, run-time software and communication mechanisms.

Projects should contribute to one or more of the following specific objectives:

- sharing and scalability of computing resources and data in **complex distributed and heterogeneous approaches** supporting real time awareness, **safety**, **privacy protection**, cyber-physical (sensor data) and Systems of Systems. Special attention for **Real-Time focus**, including cloud and High Performance Computing in the loop (e.g. for real-time imaging during chirurgical operation, traffic management, …)
- establishment of a common multi-domain methodology (in relation with ASP1) architecture, APIs, and design tool platform for advanced homogeneous or heterogeneous multi-core and many-core – distributed or not – compute elements (ECU) ensuring security and safety.
    - Safety: enforcing people protection and respect of safety standards/norms (e.g. ISO 26262, DO178)
    - Security: protecting against external hacking and private data protection; a key challenge is anonymizing data to be shared.
- establishment of heterogeneous multi-domain architectures and integrated and interoperable tool suites to support massive real-time data-processing;
- definition of performance & resource management models, meta-data and system layers in order to achieve global performance (including energy efficiency), resource optimization and management, quality of service (or graceful degradation), redistribution of functions in case of overload or failure, statically or dynamically during operation.
- development of design tools and associated runtime, including hypervisors to enable composability;
- Design methods, techniques and tools that reduce the energy consumption of systems and systems of systems
- extending design environments to support multi-core and many core architectures (including compilation, virtualization, run-time infrastructure, simulation, analysis, configurability w.r.t number of cores) and supporting certification/ safety assessment of the multi-core architectures;
- predictability, parallelisation, aggregation and management of systems according to a service-driven or data-centric approach, performance and energy modelling and analysis, verification, scalability, while preserving system-level predictability and appropriate levels of safety.
- design of new approaches to host applications at multiple levels of criticality on the same hardware; new architectural features and services to support sharing of hardware resources by applications at multiple levels of criticality;

- enhancing virtualization techniques (supporting tools, software, OS, hardware) to support multiple OSes on the same hardware, allowing multiple criticality (including real-time criticality) on the same hardware and providing multiple safety levels.
- new architectural features to support incremental validation and/or certification;
- run-time support of contract-based software implementation, i.e., hardware and operating system mechanisms able to detect the violation of insertion contracts by software components, and guaranteeing system integrity in spite of these violations;
- architectural features enabling better predictability and control of, the system, preventing it to fail or to leave its optimum point of efficiency or keeping its real-time properties. Feeding high-level design tools typically developed by ASP1 with appropriate behavioural models, at different levels of abstraction. Mechanisms extract in real time relevant data to develop and calibrate models using those data;
- new approaches to deal with the new challenges in reliability due to technology size reduction (40nm to 28nm) : higher soft error rates / reduced availability / lower voltage structures,
- innovative hardware features and associated platform services, raising the level of abstraction at which the execution platform can be considered by application designers, hence supporting a platform based design approach, with efficient design space exploration, typically feeding methods and tools developed by ASP1,
- verification and validation of systems with human in the loop,
- design and validation of mixed of open source and proprietary software on embedded systems.

Project results must be demonstrated with application use cases derived from one or several application domains, such as the applications domains covered by the other ASP's.

Expected impact

Projects are expected to facilitate easier IP and Reference Technology Platform (re)-use across applications and domains, and thereby creating new market opportunities and stimulating the emergence of new innovation ecosystems, in particular supporting SMEs.

Projects in this sub-programme are also expected to enable the development of low cost solutions for high volume market development through enhanced modularity, reuse, scalability, dependability and portability.

As explained in 2.3. and more specifically in 2.3.5 above, the ARTEMIS-JU strategy for the innovation environment that is necessary to support the R&D projects aims to form an agreed set of specifications dedicated to well-defined applications and aspects of the complete design tool chain, referred to as a Tool Platform.. Projects intending to address this ASP are expected to propose specific, adequately resourced contributions to the establishment of such a Tool Platform.

Cross-domain aspects

This sub-programme sits at the heart of the ARTEMIS ambition to *"remove barriers between application sectors ... yielding multi-domain reusable results"* (Reference - ARTEMIS SRA). The need for multi-domain and cross-domain application is therefore central to this sub-programme.

Nevertheless, there is most probably no "one-fits-all" global solution for all types of systems and applications. The computing environment for embedded systems has to address a wide design space in a variety of application domains. However, as a result of cross-domain synergies, computing infrastructures suitable for multiple application domains should emerge.
Even then, effective solutions to the often conflicting demands on applications - and on the computing platform - will continue to require domain-specific trade-off analysis for issues such as reliability, safety, hard real-time responsiveness, support for security, dependability, predictability and resource management, and energy consumption.

At the same time, cross-domain studies and exchanges should be undertaken so as to achieve conceptual and technological sharing between domain specific solutions.

3.2.6 ASP6: Embedded Systems for Security and Critical Infrastructures Protection

Objectives and Approach

In the context of an embedded system, security is related to its ability to store, process and/or transmit protected or sensitive information as well as to monitor the integrity of systems, which is of utmost importance for safety critical applications. Such ability is mandatory in enabling applications and services where trust in their Security, Privacy and Dependability (SPD) are crucial to both service provider and user. In some areas the availability of critical infrastructures and the provision of services for human activities become a common task and security has to coexist with safety requirements, e.g. in the smart grid combined with electro-mobility.

An important element will be to address the upcoming impact of the Internet of Things to security, privacy, and dependability, from the early stages of design up to final deployment. The Internet of Things imposes a new scale of security challenges as more and more intelligent physical objects around us communicate in a ubiquitous way posing new challenges in terms of overall system complexity and real-time response. A major challenge will be to fulfill safety and security requirements simultaneously in such an openly communicating environment.

Since embedded systems are utilized almost everywhere, the possible fields of applicability in the global market that can benefit from improving security and making devices more resistant to attacks are numerous, including but not limited to:

- Protection and control of utilities (energy, water, oil, gas, etc.) production/storage/transmission facilities as well as information/communication networks (fixed-lines, wireless) and transportation systems for people & goods (automotive, rail, avionics, space, naval);
- Protection and control of sensitive manufacturing plants, industrial processes, goods storage and logistic facilities, healthcare infrastructures;
- Protection of banking & finance infrastructures and services;
- Management of homeland security and crisis management together with protection and control of buildings and areas in the occasion of major public events (Olympic games, concerts, G8 meetings etc.), as well as protection of wide public areas in order to monitor security/safety aspects of everyday life;
- Security and privacy for private appliances & home networking, as well as in nomadic environments.

One target of the programme will be to enhance security of embedded systems both as stand-alone as well as networked systems, i.e. at both the node and the network level. Another target of the programme will be to develop appropriate embedded system technologies enabling protection of critical public infrastructure, such as transportation/communication/utilities networks, public building/areas, and our commercial and economic infrastructure.

In this respect, special focus will be given on developing embedded systems technologies to:

- ensure that safety is not compromised through openly communicating systems
- enable new more efficient intelligent utility infrastructures
- improve information exchange on people and goods while preserving privacy;
- provide support for critical applications, such as protection of infrastructures.

Projects should contribute to one or more of the following specific objectives:

- definition and implementation of a common conceptual framework and design flow from requirement to physical hardware or executable software to address the requirements for security, privacy and dependability in combination with other non functional requirements like safety.
- trusted service platforms supporting the governance of the Internet of Things and enabling seamless and secure interactions and cooperation of ESs over heterogeneous communication infrastructures;

- trusted platforms for secure embedded systems connecting hardware security and software security measures properly and enable separation of different applications in order to reduce system complexity and enable coexistence of security critical and standard applications;
- flexible communication protocols that enable trade-off between performance (latency, jitter, throughput, etc.) and security parameters (determinism, reliability, security, etc.);
- principles and methodology for specifying and implementing a dynamic security policy for federations of large networked embedded systems, dynamically composed by unmanaged devices, and incorporating spontaneously co-operating objects and ad hoc networks.

Expected Impact

Projects are expected to create new market opportunities by enhancing security, privacy and dependability so as to increase people's confidence in applications, systems, devices and infrastructures that were considered vulnerable or untrustworthy in the past, or by coping with the increasing risk of cybercrime resulting from the sharp increase of sensors and devices accessing the Internet, by:

- provide fully guaranteed secured services and access, that increases the trust of people in using inter-networked devices;;
- enabling industrial actors and service providers to offer new features and services to the customer;
- enforcement of privacy and sensitive data protection against external threats, with high availability of operations and systems thus creating a business differentiator through the development of new security solutions.

Results in this sub-program will address fundamental trust issues in the seamless connectivity, middleware research domain, while innovations in this research domain will be evaluated on security, privacy and dependability concerns.

Cross-domain aspects

The results of research on embedded system security and privacy in this sub-program will be applicable beyond the traditional fields of pervasive computing applications and services and public infrastructure protections. Contributions to other sub-programs will be realized through the following results:

- trusted and safe architectures (mono and multi–core) (linked to ASP5)
- modules and subsystems for security & privacy support
- trusted platform design at SW level (protocols and embedded OS) as well as seamless integration of event-based and SOA middleware platforms
- trusted platform design at HW level (tamper proof, tamper resistance, HW accelerators for cryptography, etc.) as well as smart-sensors and sensor-networks development tools and methods
- ad-hoc networking and robust communication (secure protocols, routing, etc.) technologies
- autonomic, auto-recovery, fault tolerance graceful degradation, self-management, self-configuration, self-healing methodologies and tools, consistent management of a dynamic contest formed by large networks of autonomous systems

The advantages of Security, Privacy and Dependability in embedded systems can be used in several application contexts. For example, results can be used in smart environments can take advantage of secure and dependable communications and guaranteed privacy in the information flow.
Furthermore, the results of research on Embedded Systems security and privacy resulting from this Sub-program, in addition to the traditional field of applications (pervasive computing applications/services and public infrastructures protections), can find additional application in the following fields:

- Wide deployment of m-commerce transactions and other financial services as well as trusted multimedia distribution on mobile – internet based networks;
- Remote (i.e. Internet-based) control of home, office and industrial processes;
- Decentralized and interconnected utilities productions, storage and transmission systems.

3.2.7 ASP7: Embedded Systems supporting sustainable urban life

Not open in this call

3.2.8 ASP8: Human-centred design of embedded systems

Objectives and Approach

Human-Machine Interfaces (HMI) are a crucial element of many Embedded Systems in all application contexts. Embedded Systems are used in fully autonomous systems but also more and more in "intelligent" assistance systems that support users in executing complex tasks like controlling a vehicle or advanced machinery. For "intelligent" automatic assistance and control systems, the need for intuitive HMI is obvious but, also for fully autonomous systems, user interfaces play a major role guaranteeing transparency of the systems states and processes, as a key factor for users' trust in functionality and services.

The main goal of this sub-programme is to develop and validate technical and methodological means to provide embedded HMI solutions which integrate naturally into operational environments, are easy to use and understand, and support an adequate level of situation awareness.

The approach is to establish a methodology for design and development of human-in-the-loop adaptive control systems suitable for application in multiple domains and sectors - particularly safety critical domains - taking into account not just explicit interactions between human and machine, but also the cognitive state of the human. This will require:

- cross-domain reusable system design principles and methods that foster the transition from conventional unimodal, menu-based dialogue structures to multimodal, conversational dialogue structures. New HMIs must assist the user in defining his or her own goals rather than to require using predefined function calls;
- cross-domain technologies for analysing the effectiveness of assistance systems (e.g. in preventing errors, in reducing workload, enhancing situation awareness and user experience) and for analysing the intuitiveness or complexity of the interaction between user and machine along different usability dimensions with associated metrics (analysis of HMI).

These developments must be supported by research into human performance; agile HMI prototyping; cognitive user models; and intelligent multi-modal interactive systems.

Industry needs must be acquired from different domains, and their commonalities identified. Empirical studies must be performed to identify the needs of the end-users (e.g. pilots, drivers, train operators, plant operators, patients, carers) and to study the characteristics of human interactions with (partially) autonomous systems fulfilling these needs.

Projects should contribute to one or more of the following specific objectives:

- a generic HMI Design Methodology that fulfils industry needs and can be easily instantiated in different domains;
- Object recognition, scene analysis and classification, image stabilisation, ego motion compensation (as in compensation for movement of camera),
- image processing using high performance processors which could combine many core processors and FPGAS for high definition/high frame rate image processing
- cognitive assistant (e.g detecting movement and identifying objects behind/out of field of view and alerting human) that could be combined with wearable cameras, while insuring image privacy aspects especially for high def images
- Developing and assessing through real-life experiments new methods and tools for the design of innovative interfaces between complex embedded control systems and human operators responsible for their operation.
- extension of model-based design approaches to the design and analysis of human machine interaction, including human models to enable user centred functionalities and closed loop adaptivity;
- cross-domain reusable technology to synthesize "intelligent" multi-modal HMI; e.g by using architectural design patterns for efficient HMI development;
- cross-domain technologies to analyse the effectiveness and economy of interaction with "intelligent" multi modal HMI designs by predicting human behaviour;

- agile model-based HMI prototyping taking into account multi-modal interfaces and the need for allocation of capabilities between “presentation layer” and “data management layer”;
- methodologies for building cognitive user models taking into account perceptual, cognitive and psychomotor capabilities as well as emotional state and attitude;
- modelling impaired cognitive states and associated behaviours in order to develop or evaluate means for mitigation,
- modelling cognitive processes and anthropometrical characteristics of human operators in an integrated framework;
- technologies for intelligent multi-modal interactive systems especially addressing the user’s inter-working with adaptive context-aware systems, towards naturalistic and empathic (the machine feels what the operator needs) interaction with complex machines taking into account operators’ emotional states;
- technologies for un-intrusive measurement of operators’ cognitive and emotional states (e.g. distraction, workload, fatigue, drowsiness, mood) for real-time adaptation of the human-machine interaction including the level of automation;
- technologies that enable systems to give advice how to recover from critical states or how to avoid critical states;
- methods and tools to create seamless integration between user interface development and functional software development tool chains and processes;
- HMI concepts to support users of complex embedded system testing environments in order to improve interaction between system developers and complex testing environments/development tools
- How to design systems to reduce training requirements

Expected impact

Human centred design (HCD) is a key enabler for embedded systems advancement and deployment in *all* ARTEMIS application contexts, and especially in safety critical domains:

- In *Industrial Systems* applications, projects should enhance the safety and confidence of users and the public by, for instance enable Advanced Driver Assistance Systems for road and rail vehicles and Advanced Multidimensional Cockpit Displays and Flight Management Systems in aircraft;
- In *Nomadic Environments* applications, projects should enhance the integration of information management in personal information spaces and reduce the digital divide;
- In *Private Spaces* applications, through the design of products with innovative user interfaces, projects should enhance the user experience and, for instance, ease access for aging or disabled persons;
- In *Public Infrastructure* applications, projects should enhance the safety and efficiency of, for instance, power plants, communication systems, emergency infrastructures, and health monitoring, care and treatment systems.

Projects are expected to lead to:
- the automation of tasks which are today fully under human control (e.g., driver assistance in the automotive domain);
- the extension of automation in tasks which are today highly assisted (e.g., pilot assistance systems in the avionics domain);
- the fulfilment of the user centred and technical objectives by providing open innovation environment (e.g., open experimental test-bed).

Cross-domain aspects

In all domains addressed by ARTEMIS, interfaces of automated systems are used to interact with the environment, but also to interact with the user (e.g. to give the user advice or to intervene so as to prevent hazardous manoeuvres) and furthermore to allow the user to influence the automated system itself (e.g. to configure its rules and behaviour). In all ARTEMIS domains, systems are becoming more and more autonomous. In spite of differences in time-to-market, time-on-market, and certification requirements of automation and assistive technology in the different domains, cross-domain reuse of design methodologies, devices, processing hardware, and software components is achievable.

The sub-programme envisions cross-domain sharing of concepts, methods and tools in synthesis as well as analysis of HMI. Cross-domain clusters can be defined based on the interaction patterns between human and machine:

1. one human, one complex system (avionics, complex infrastructure monitoring, nomadic with "all in one" device, automotive, ..);
2. one human, many "not so complex systems" (home, automotive, ..);
3. several humans, one complex system (surgical team around a patient, satellite launch infrastructure, ...);
4. several humans, several complex systems (e.g. air traffic management, catastrophic situations management, systems of systems with human at different levels of responsibility, ...);

4 Requirements

The proposal should satisfy the following requirements:

4.1 General

Each proposal should address at least one ARTEMIS Sub-Programme (see Section 3.2) and identify which of the Industrial Priorities (see Section 3.1) are addressed

Each proposal should include demonstration of core technological developments in order to achieve the empirical validation expected (see Section 4.3).

Large, strategic initiatives are encouraged, complemented with smaller more focussed research proposals, to ensure maximum effective use of the available budgets.

4.2 Contribution to the ARTEMIS Strategic targets

ARTEMIS has an over-arching objective to close the design productivity gap between potential and capability. The results arising from Projects responding to this call will be expected to:

- reduce the cost of the system design from 2012 levels by 15% (8 year timescale);
- achieve 15% reduction in development cycles - especially in sectors requiring qualification or certification – from 2012 levels (8 year timescale);
- manage a complexity increase of 25% with 10% effort reduction, compared with 2012 (8 year timescale);
- reduce the effort and time required for re-validation and recertification of systems after making changes by 15%, compared with 2012 levels (8 year timescale);
- achieve cross-sectoral reusability of Embedded Systems devices and architecture platforms (for example, interoperable components (hardware and software) for automotive, railways, aerospace and manufacturing) that will be developed using the ARTEMIS JU results.

All projects are requested to formulate, their intended contribution to achievement of these targets in their project proposal. Proposals should describe how projects would measure their contribution and how they would establish a baseline and thereafter monitor their progress from the baseline. In addition, the contribution of projects to the attainment of the ARTEMIS high-level objectives will be monitored, initially by requesting projects to propose self-assessment criteria and baselines, and later via specific actions which will focus on Success Criteria and Metrics at the JU level, whose lead- and lag-indicators will offer a powerful tool for steering the content of future calls.

4.3 Expected impact

All projects to be supported will be expected to identify, at proposal stage, the impact that they aim to achieve with regard to the expected impact of the sub-programmes that they address. Proposals should describe how projects would measure their impact and how they would establish a baseline and thereafter monitor their progress from the baseline.

Projects are also expected, when possible, to promote and facilitate knowledge sharing and *patenting* activities (e.g for computer implemented inventions also referred to as software-enabled inventions) and indicate the way this knowledge sharing during and after project lifetime would be made/explored (e.g. financing of patenting activities).

4.4 Technology vis-à-vis Application

All projects are expected to have a strong application focus in order to present a realistic context for industrially relevant, short to medium term research and technology development, and to enable its validation. Nevertheless, all projects in all sub-programmes must make explicit contributions to the technological ambitions of ARTEMIS for Embedded Systems development. **Clear expression of the technical approach to the research objectives will be essential**.

4.5 Co-operation

All projects to be supported are expected to build on relevant assets from existing ARTEMIS JU projects as possible on FP7 and ITEA projects, and to take initiatives to share requirements and emerging results with other relevant JU projects during project execution, so as to achieve the coherent, synergistic progress sought by the ARTEMIS JU. The ARTEMIS Repository is one instrument to facilitate the sharing of emerging results.

4.6 Evolution of markets and market environment

All projects to be supported will be expected to maintain a 'market watch' to ensure the continuing relevance of their work to the evolving market, and to contribute to programme-level monitoring of the market for the purpose of evolving the Research Agenda and the Multi-Annual Strategic Plan.

In addition, the emerging use of the internet for Embedded System provides new market opportunities, therefore projects proposed should take account of this, if applicable, and of the ability of the Embedded Systems to exploit the capacity to interconnect not only for communication but also to gain access to the knowledge of Internet based information systems.

4.7 Standards & Regulations

ARTEMIS has a Strategic Agenda for Standardisation[10]. Its principle mission is to support the ARTEMIS ambitions for cross-domain synergies, composability, reusability, reliability, interoperability, verification and certification. This entails overcoming the present domain-orientation of many standards and standardisation groups. Projects will be expected to contribute to this aim, engaging where appropriate with the relevant standardisation, regulation and certification bodies.

Specifically, proposals must make explicit their intended contribution to:

- standard development and harmonisation, as the basis of any integration and inter-operation;
- open source reference implementations of standards, in order to facilitate their take-up in the market.

4.8 Innovation environment

The ARTEMIS Strategic Research Agenda sets out the ambition to *"establish a new holistic approach to research, technology development, innovation and skill creation"* by improving the linkages between the three parts of the 'knowledge triangle' - education, research and innovation.

With regard to Education and Training, the ARTEMIS Strategic Research Agenda sets out the aim to *"overcome the gap between the theory of academic education and the practice in industrial application"*. Proposals should describe their specific intended contribution to this aim.

ARTEMIS has a specific target for having *50% more European SMEs within the aegis of ARTEMIS JU engaged in the Embedded Systems supply chain, from concept through design and manufacture, delivery and support, than there were in 2005.* Project proposals should clearly indicate concrete and quantifiable measures to assist participating SMEs in their dissemination of project results and subsequent valorisation of the results in near-future business plans. Moreover, project consortia must be balanced, considering explicitly the involvement of SMEs and favouring clustering of SMEs in innovation eco-systems.

ARTEMIS also supports the consistent grouping, on a voluntary basis and at European scale, of industry and research in Centres of Innovation Excellence to foster the Innovation Environment. It is recommended that projects show awareness of existing eco-systems and CoIEs, with a view to more concrete collaboration in the future.

Proposal should, if applicable, also describe the possible interaction with existing national or European level experimentation platforms or living labs, or proposes setting such real-life experimentation environment, in order to foster co-creation, exploration, experimentation, approach as well as integrating research and innovation processes.

[10] The strategic agenda for standardisation has been prepared by the PROSE FP7 project and is available at http://www.artemis-ia.eu/publication/download/publication/744

4.9 Contribution to tool platforms

It is also recommended for each Project proposal to clearly state their policy towards the use of- and creation of- tool platforms. Projects should indicate their intensions for building an initial tool platform, and if they intend to apply as candidate for the label of an “ARTEMIS Reference Technology Platform”. They are also invited, if applicable, to indicate ARTEMIS labelled RTP” will be used (if any) or give indications about building an additional platform.

4.10 Contribution to the repository

It is recommended that project proposals will clearly indicate what potential results they foresee to contribute to the ARTEMIS Repository as described in section 2.3.8 above.

4.11 Project duration

In view of the downstream research focus of the ARTEMIS Joint Undertaking and the targets described in this document, projects duration should be no longer than 3 years (end by end of 2017), in all cases , projects must provide adequate justification for their length, and expected impact that they describe.

5 Implementation of the Call 2013

5.1 Call 6: JU-ARTEMIS-2013

- <u>Date of publication</u>: **26th February 2013**
- <u>Closure date</u>: **6th June 2013**, at 17.00 h Brussels local time.
- <u>Indicative budget</u>: 73 M€[11]
- <u>Evaluation procedure:</u> Single stage (Full Project Proposal only)
- <u>Indicative evaluation and contractual timetable</u>: It is expected that the contract negotiations for the selected proposals will start as of September 2013.
- <u>Project Cooperation agreements</u>: Participants in all actions resulting from this call are required to conclude a project cooperation agreement.
- The grant which will be offered by the JU will be specified in the Grant Agreement applicable to ARTEMIS.

5.2 Call implementation in 2013

	Budget of Call 2013 (estimated) (€)
Total JU Contribution	25.652.000 *
Total contributions from ARTEMIS Member States [12]	46.640.000
Total budget of Call	**72.292.000**

* The JU contribution may be increased to 37.000.000 € in case of confirmation of possible upsides in some Member States.

[11] Including the JU funding estimated as 55% of the amount committed by ARTEMIS member States to the budget of this 2012 Call.

[12] At least 1,8 times the Community's financial contribution

6 Eligibility and Evaluation Criteria for Proposals

Eligibility checks

The following eligibility criteria will be checked by the ARTEMIS Joint Undertaking:

1. Eligibility Criteria for proposals
2. Eligibility Criteria for funding of individual participants (ARTEMIS JU funding and national funding from ARTEMIS Member States)

6.1 Eligibility Criteria for Proposals

A FPP will only be considered eligible if it meets all of the following conditions:

- It is submitted using the EPSS (Electronic Proposal Submission System)
- It is received by the ARTEMIS JU before the deadline given in the call text for FPPs.
- It involves at least 3 non-affiliated legal entities established in at least 3 ARTEMIS Member States.
- It is complete (i.e. both Part A with the requested administrative forms and part B with the description of the proposed research are present).
- It is submitted in English[13].
- The content of the FPP relates to the topic(s) described in this work programme.

6.2 Eligibility criteria for funding

The ARTEMIS JU will carry out the verification of participants from ARTEMIS member States and their contribution to the project proposals, on the basis of verifications carried out by the respective national authorities, against the pre-defined national eligibility criteria for funding as published in the Call. The verifications by national authorities will be done as much as possible before proposers submit a Full Project Proposal.

The full details on the eligibility criteria for funding will be published in the Call.

6.3 Evaluation criteria

The evaluation criteria against which proposals will be judged are set out in the document ARTEMIS-PAB-2012-D.18: "ARTEMIS Joint Undertaking selection and evaluation procedures related to Calls for proposals".

6.3.1 Evaluation criteria for ASP proposals

The 5 evaluation criteria are:

1. Relevance and contributions to the objectives of the Call.
2. R&D innovation and technical excellence.
3. Science and Technology (S&T) approach and work plan.
4. Market innovation and market impact.
5. Quality of consortium and management.

Evaluation scores will be awarded for each of the five criteria, and not for the sub-criteria. Each criterion will be scored from 1 to 10. Criteria 1, 2, 3, and 5 will have a weight of 1 and criterion 4 will have a weight of 2. The threshold for the individual criteria (1), (2), (3), (4) will be 6. There is no threshold for the

[13] Except for the additional information and forms that may be requested by ARTEMIS Member States for the verification of eligibility of national funding that can be in their respective national languages

individual criterion (5). The overall threshold, applying to the weighted sum of the five individual scores, will be 40.

6.3.2 Some further explanation on the evaluation criteria:

1. Relevance and contributions to the objectives of the Call.
    - Relevance will be considered in relation to the topic(s) of the work programme open in a given call and to the objectives of the sub-programmes for those topics as set out in Sections 3.2.1 to 3.2.8.
    - Relevance and contributions to the ARTEMIS general requirements set out in paragraph 4.1
    - Relevance and contribution to the ARTEMIS strategic targets listed in paragraph 4.2.

2. R&D innovation and technical excellence.
    - Soundness of the concept
    - Clarity and quality of the objectives and expected results
    - Progress beyond the state-of-the-art.

3. S&T approach and work plan
    - Quality and effectiveness of the S&T methodology
    - Quality of the work plan.

4. Market innovation and market impact
    - Contribution, at the European and/or international level, to the expected impacts of the work programme, and specifically to the expected impacts of the sub-programme(s) that the proposed project intends to address as set out in Sections 3.2.1 to 3.2.8.
    - Degree of application innovation in the context of the sub-programmes addressed
    - Market impact and quality of the exploitation plans of the industrial partners; quality of the market analysis section including competitor descriptions and market opportunities.
    - Introduction and enablement of new, more competitive practices and methodologies
    - Appropriateness of measures for the dissemination of project results.
    - Contribution to the Innovation Environment
    - Contribution to ARTEMIS Repository
    - Contribution to standards.
    - Contribution to ARTEMIS tool- platform policy
    - Management of intellectual property.

5. Quality of consortium and management[14].
    - Appropriateness of the management structure and procedures
    - Quality and relevant experience of the individual participants
    - Quality of the consortium as a whole including complementarities, balance and involvement of SMEs

7 How to submit a proposal

Proposals (Full Project Proposals) should be submitted in accordance with the terms set out in the call for proposals. In order to submit a proposal, applicants should consult the following documents:

- The text of the call for proposals, as announced in the Official Journal of the European Union and published on the webpage of the ARTEMIS Joint Undertaking
- This work programme
- The guide for Applicants

[14] This evaluation criterion corresponds to the **selection criteria** in the meaning of the general financial regulation (article 115) [OJ L248, 16.09.2002, p. 1] and its implementing rules (article 176 and 177) [OJ L 357, 31.12.2002, p.1] and of the financial rules of the Joint Undertaking (article 101). It will also be the basis for assessing the 'operational capacity' of participants. The other four evaluation criteria (1-4) correspond to the **award criteria.**

- Eligibility criteria and funding rates

There are also a number of other useful texts which applicants could refer to:

Document	Document / Web site
ARTEMIS SRA 2011	http://www.artemis-ia.eu/sra
Reference Design & Architecture SRA	http://www.artemis-ia.eu/publication/download/publication/633
Seamless Connectivity and Middleware SRA	http://www.artemis-ia.eu/publication/download/publication/634
System Design Methods and Tools SRA	http://www.artemis-ia.eu/publication/download/publication/632
ARTEMIS-JU MASP and Research Agenda (RA)	http://www.artemis-ju.eu/publication/download/publication/270 http://www.artemis-ju.eu/publication/download/publication/271
STANDARDISATION SA	http://www.artemis-ia.eu/publication/download/publication/744