ARTEMIS JU
Annual Work Programme 2011

.

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Change history from AWP 2010 to AWP2011

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

Changes:

- Section 2.1: removed the reference to consumer sector and plasma TV screens, as entertainment is not part of the programme.
- Section 2.1: added the MASP strategy on innovation eco-systems, this is the central strategy of ARTEMIS
- Section 2.2: moved the remark on self-assessments of projects and metrics from section 2.2 to section 4.2
- Added section 2.3
- Section 3.2: a remark on internet is added.
- Section 3.2.1: added a remark on qualification and certification processes.
- Section 3.2.2: removed a detailed remark on very specific interconnect technologies: Bluetooth etc.
- Section 3.2.3: added a bullet on Smart mobility and vehicle2vehicle infrastructures
- Section 3.2.3: removed a remark on multiple roles of citizens
- Section 3.2.3: remark on Internet is added.
- Section 3.2.4: Feedback of Process.IT and FIMA has been merged
- Section 3.2.5: replaced computing environments by compute platforms. Removed a remark on transition from vertical to horizontal markets. Added a remark on integration.
- Section 3.2.5: remove a remark on very specific applications. Removed a remark on clusters.
- Section 3.2.5: removed a detailed remark on configuration and tuning of embedded systems.
- Section 3.2.6: Text of ASP6 deviated quite a lot from the RA text on ASP6. Removed first paragraph, since it refers also to fault tolerance, a topic not mentioned in the RA..
- Section 3.2.6: added application examples from RA text.
- Section 3.2.6: removed a remark on conceptual framework to prevent repetition.
- Section 3.2.6: deleted two remarks (one on fault tolerance) and added a remark from RA text of ASP6 on cross domain applicability.

- Section 3.2.8: replaced first paragraph with a clearer text taken from the RA text on ASP8.
- Section 4: Added section 4.9 on tool platforms.

1 Introduction

Embedded Systems are everywhere, built into vehicles, roads, bridges and tunnels, into medical instruments and surgical robots, into homes, offices and factories, into aeroplanes and airports, into mobile phones and communication and virtual reality glasses, and even into our clothes. They are interconnected in networks of many devices - the vehicle to the fixed road infrastructure, the smart card to the banking system. Embedded Systems technologies are deployed in all relevant market sectors for Europe. Consequently Embedded Systems have a major impact on the way these sectors work and collaborate, how they will develop, how they are perceived by both professionals and the public, and how successful their products will be on the world market.

This present document - the ARTEMIS[1] Annual Work Programme for 2011 - sets out the research priorities for projects to be supported through the Call2011 (the fourth call) for Proposals of the ARTEMIS Joint Undertaking (JU).

[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

Embedded Systems will enable us to respond to the two wake-up calls that society has had in recent times - climate change and the economic crisis. Both these developments indicate a need for better use of natural, industrial and human resources.

This is recognised in the recovery package of the European Commission[2] which includes, for instance, a proposal to establish 3 major partnerships 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.

As the 2009 ISTAG Report[3] indicates, Embedded Systems enable better use of resources, with reduced waste and pollution, by providing more and better information and more sensitive and finely tuned monitoring and control in all domains - aviation, automobiles, manufacturing, traffic management, logistics, energy management ... even personal healthcare.

And, given sector-independent inter-communication, Embedded Systems enable us to move from localised, sector-specific improvements - in homes, offices, vehicles, factories, traffic management, healthcare, and so on .. to 'joined-up' optimisation - to smart cities, smart regions and even smart societies. We expect a blurring of the boundaries between previously distinct sectors: the role of transport, for instance, is now to be considered alongside ePresence within the wider context of the appropriate means to achieve work and personal objectives, and also a work-life balance.

The 2009 ISTAG Report specifically states that:

> *"ISTAG believes that the Artemis JTI, amongst other ETPs, within the federating concept of the Future Internet, can make essential contributions to the development and support of research objectives and the improvement of innovation capabilities in the area of the Internet of Things. This approach will benefit the many industrial sectors that depend on ICT innovation for their progress (automotive, aerospace, health, smart buildings, telecommunications, energy efficiency, security …) and which participate in the Artemis JTI. The technologies will also make significant contributions to a plethora of semi-autonomous "cyber-physical" systems with different local intelligence. ISTAG believes that keeping a competitive edge in design methodology for such networked systems is vital to the success of European industry."*[4]

Apart from their contribution to energy management and especially reduced consumption in other domains, new techniques are emerging to reduce the energy consumption of Embedded Systems themselves. This is important given the explosion in their use in all sectors,

[2] COM(2008) 800, action 8: 'Increase investment in R&D, Innovation and Education'
[3] *"Revising Europe's ICT Strategy"*. February 2009. (http://cordis.europa.eu/ist/istag-reports.htm)
[4] ibid.

2.2 Strategic context

The ARTEMIS strategy as defined in the Strategic Research Agenda (SRA) 2006 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. An update of the SRA is under development and expected for the first half of 2011.

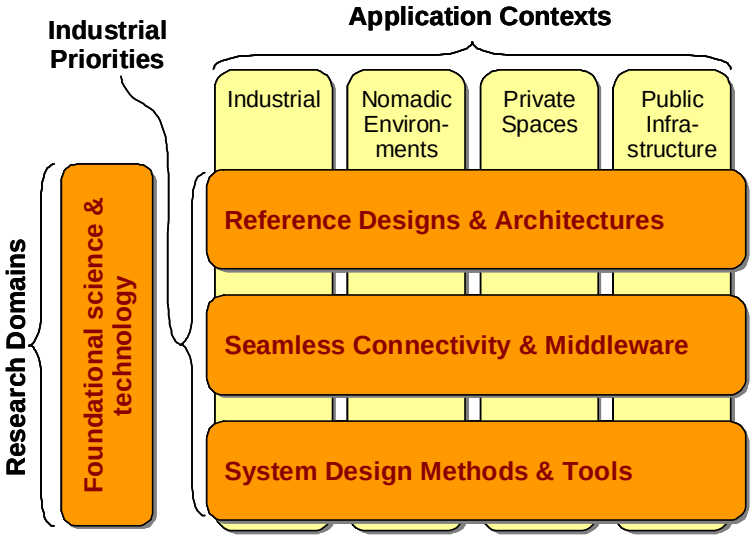
Specific barriers to progress have been identified that have common characteristics across the different application contexts. These fall into three main Research Domains that comprise the 'Industrial Priorities' (see section 3.1):

"Reference Designs and Architectures"
"Seamless Connectivity and Middleware"
"Design Methods and Tools"

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. These are:

"Industrial systems"
"Nomadic Environments"
"Private Spaces"
"Public Infrastructure"

There are therefore two dimensions to the ARTEMIS strategy: the four clusters of Application Contexts and the three Research Domains (which are themselves supported by research into foundational science and technology):



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 allow for real-time performance evaluation of novel designs and architectures.

In addition, the ARTEMIS-JU strategy as defined in the Multi-Annual Strategic Plan (MASP) 2011 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:

ASP1: Methods and processes for safety-relevant embedded systems
ASP2: Embedded Systems for Healthcare systems
ASP3: Embedded systems in Smart environments
ASP4: Manufacturing and production automation
ASP5: Computing platforms for embedded systems
ASP6: ES for Security and Critical Infrastructures Protection
ASP7: Embedded technology for sustainable urban life
ASP8: Human-centred design of embedded systems

One of the major characteristics of the new research approach promoted by the ARTEMIS JU is **the promotion of cross-fertilization and reuse of technology results in different application domains**. The implementation will therefore be managed by **tightly coordinating and synchronizing the research** performed in the sub-programmes, **with the longer-term goal** of stimulating long-lasting and self-sustaining "eco-systems" of actors, as described in the ARTEMIS-JU MASP.

This tight coordination will be assured by encouraging projects to be highly visible (within the constraints of the IPR contractual agreements).

In addition to making a contribution to the cross-domain aims of the strategy, 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 AWP2011.

2.3 Innovation environment context

The ARTEMIS-JU strategy described in the MASP states the Innovation environment that is necessary to support the R&D projects. It includes:

2.3.1 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.

2.3.2 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;

2.3.3 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 Standardisation SRA (available from the ARTEMIS-IA web-site, see section 7). Projects will be expected to communicate with relevant ARTEMIS standardisation initiatives[5] concerning their standardisation needs and opportunities, including those that may emerge during project execution.

2.3.4 Education

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

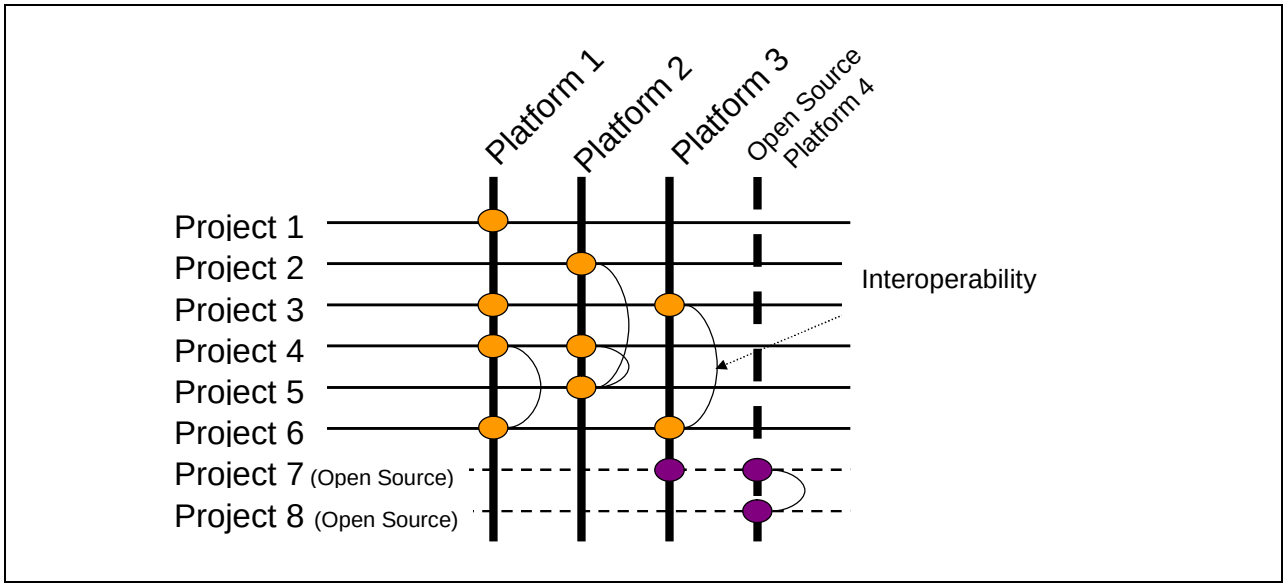
- creation of a highly skilled, multi-disciplinary work force, and maintenance and upgrading of existing skills of a professional workforce (life-long continuous learning);
- joining of forces and inclusion of interests of both industry and academia, in initiatives, support actions etc., designed to 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
  - 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.

2.3.5 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 new element is the concept of the “ARTEMIS Tool Platform”, 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.

[5] Such as the FP7 Supporting Action ‘PROSE’ (*“Promoting Standardisation for Embedded Systems”*)



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.

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).

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. There is one Call for Proposals to address those requirements during each year.

This present document is the Annual Work Programme for 2011. It defines the content and scope of the Call for Proposals to be launched in 2011.

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 2011 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"*. 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, such as the validation of embryonic techniques and technologies in an industrial setting, for example through prototypes, demonstrators or test-beds. And, as also indicated in section 2.4, it extends in the downstream direction to the prototyping of innovative embedded systems.

3.1 Industrial 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 that offer common architectural approaches for given ranges of applications. It includes topics such as:

- composability: the ability to derive instantiations of architecture from a generic platform that support the constructive composition of large systems out of components and sub-systems without uncontrolled emergent behaviour or side effects.
- architectural dependability, to ensure secure, reliable and timely system services despite accidental failure of system components and/or the activity of malicious intruders.
- design for safety by means of architectures instantiated from a generic platform that enable the implementation of safety critical systems and the concurrent construction of dependability models. In addition to the required dependability and functionality of the provided services, emphasis is put on architectural support for certification, and the establishment of a safety case.

3.1.2 Seamless connectivity and middleware

Middleware that allows seamless connectivity and interoperability. Especially interoperability needs particular attention due to the increasing connectivity of embedded systems. It includes topics such as:

- cross domain connectivity and communication capabilities, necessary to realise the seamless interoperability between the 'Ambient Intelligent Environments' envisaged for the European citizen (at home, travelling, at work, in public spaces,…)
- resource management to insure seamless connectivity and interoperability between ES in a physical and logical environment more and more subject to changes, and to dynamically adapt to such changes. Resource management should ensure high utilization of the system resources such as CPU, memory, network, and energy, and guarantee operation within resource reserves or budgets.

3.1.3 Design methods and tools

Integrated system design methods and tools for rapid development and prototyping. It includes topics such as:

- establishment of integrated chains of European-sourced tools platforms, based on ARTEMIS JU results, to support a complete process flow of development of Embedded Systems from user requirements, through system design, to system-on-chip production.

- system-level model-based tools and design processes that contribute, in an integrated fashion, to elevating the abstraction level for architecture exploration and product design.
- test, validation and verification tools to support compositional design that can be integrated into the complete process flow to support concurrent verification and validation at the product level as an integral part of the design process.

3.2 ARTEMIS Sub-programmes

The specific sub-programme priorities for 2011 are indicated below. 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 European Standard Reference Technology Platform, embodying meta-models, methods, and tools for safety-critical hard-real-time system development supported by European tool vendors.
- A model-driven process for the compositional development of safety and security critical 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.
- An analysis methodology to establish an industrially applicable methodology for exploration of design spaces and multi-criteria constraint satisfaction and design and development decision-making, with particular regard to safety properties, and for emergent properties of non-functional characteristics.
- Analysis methods for emergent properties of component based design, including dynamically networked systems.
- The design and prototype implementation of a cross-domain embedded systems architecture that addresses the requirements and constraints of the ARTEMIS SRA for composability, Networking and Security, Robustness, Diagnosis and Maintenance, Integrated Resource Management, Evolvability and Self-Organization and Sustainability.
- Methods, techniques and tools that allow for making design trade-offs between aspects of evolvability and system properties, such as cost and robustness.

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[6];
- 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.

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

Projects are therefore expected to:

- reduce time to market despite the increasing contribution of embedded systems and software and their increasing 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 2011 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 the establishment of such a Tool Platform.

Cross-domain aspects

The development of safety-relevant systems will mainly rely on development of cross-domain S/W tools and design processes 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 intermodality, 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.

3.2.2 ASP2: Embedded Systems for Healthcare systems

Objectives and Approach

Europe has an ageing population, growth in chronic diseases, more demanding citizens, and increasing expenditure on healthcare - presently rising from a recent figure of about 8% of GDP - or about 600 billion Euro p.a.

The main goal of this sub-programme is to facilitate the transformation from 'health care' to 'health management'. That is to say from "how to treat patients" to "how to keep people healthy".

This sub-programme aims to establish an overall system approach for healthcare based on an integrated system concept of seamless integration of interoperable components (both devices and services). 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 wide-scale screening;
- analysis of the gathered data, from historical as well as parallel care cycles, and present the relevant information in adequate way to persons related to their task and situation;
- ubiquitous access to a citizens health data, by all partners in an inter-disciplinary care team under the conditions of proper privacy enforcements;
- supporting professionals and enabling adequate communication between 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. from heart, brain …); telemedicine including tele-monitoring and tele-surgery; facilities for diagnostic and epidemiological analysis, remote management of implanted drug delivery; multi-modal interaction technologies (speech, vision and gestures) 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:

- a reference architecture to support integrated care cycles;
- interoperability guidelines and selected standards ;
- 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 system use optimisation using 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;
- Standards to build applications that cover the full path from sensor and actuators up to the backend infrastructure to make the information available to other health services;
- a licensing model for medical data;
- safe and secure ambient identification and authentication;
- multi system integrated workflows;
- multimodal interaction technologies (speech, vision and gestures) for diagnostic and surgical equipment;

- a stable, robust and extendable standard format for medical data (the data should and have 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

As we move from treatment to prevention, so healthcare must move out of its own separate compartments of hospitals and doctors' surgeries to pervade all the citizens' environments - workplaces, home, transport, leisure, .. . There must also be interfaces to public infrastructures since in many countries regional or national Health Information Exchange infrastructures are or will be implemented and even European ideas in the context of eHealth are on the agenda (eHealth card and Patient Summary Records). Healthcare must make use of the information and communication resources in these many environments. Healthcare systems must therefore be compatible and, as far as the citizen is concerned, appear to be integrated.

Projects in this sub-programme must therefore share research and results with projects in other sub-programmes operating in private spaces, nomadic environments and transportation to enable this connectivity. The base technologies developed by the other sub-programmes will be used to implement the specific needs of this sub-programme.

With respect to the development of devices and systems collaboration with ASP1 "Methods and Processes for Safety-relevant Embedded Systems" will be expected.

An important issue is the interaction with people, the citizen/patient as well as professionals, using the system in the context and situation of their task. This relates to ASP8 "Human Centred design of embedded systems" particularly concerning cognitive modelling.

The dynamics of several services involved from device level up to data management, processing and interacting with persons could benefit from the work of ASP3 "ES in Smart Environments".

ASP6 "ES for Security and Critical Infrastructures Protection", is also relevant to, for instance, 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.

In addition, since senior citizens are an important target group and likely also need more support in managing their health, and to ensure transparency, and facilitate co-ordination and the achievement of synergy, proposals in this sub-programme should state how their proposed work would relate to work in the Ambient Assisted Living initiative.

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.

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

- Smart locations (smart city, smart home, smart public space, ...)
- 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
- Semantic platform specification

Expected impact

Projects in this ASP should 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 middleware) 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 "ES 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: Manufacturing and production automation

Objectives and Approach

By targeting production automation this ASP is an essential enabler of both the 'Factory of the Future' and the optimized continuous process plant. Production is a big consumer of energy (nearly one third of global primary energy and emit nearly one third of the CO2). Thus, production needs to react and adapt quickly to business challenges imposed by evolving environmental demands and fluctuating energy prices. The main objective of ASP4 is automation for the improvement of productivity, availability, flexibility, logistics, maintainability and Overall Equipment Effectiveness (OEE), while contributing to significantly reduced energy consumption.

The effective and efficient consumption of energy can only be achieved if energy use and related environment issues are made transparent in relation to productivity, availability, flexibility, logistics and maintainability. This can be addressed by making the energy consumption of equipment and processes transparent at fine granularity.

The overall approach is to establish an embedded systems' technology together with supporting methodologies, models and tools that enables an holistic and life cycle approach to the main objective.

The embedded system technology should enable the interoperation and reconfiguration of embedded devices, systems and models in both products and processing equipment so as to build reliable, predictive and robust plant solutions and/or intelligent production machines for indoor/outdoor operation that enable efficient energy and material usage while improving transparency of operation and quality while supporting reduced safety risks and enhanced security.

The embedded system technology comprises all the necessary systems, models and tools to support development and implementation of production systems and the operation organization.

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

- a new factory oriented framework for goods manufacturing, using smart automation to achieve sustainable production, with innovative networking, communication and controlling technologies to enable open, modular and reconfigurable control and automation platforms;
- new technologies for mobile outdoor production machines in areas of navigation, perception, environment modeling, tele-operation and wireless communication;
- a real-time asset monitoring and control for large-scale distributed production processes, linked to predictive and condition based maintenance activities and automatic reaction to malfunctions before they occur;
- real time and run-time methodology for continuous tracking of material flow from raw material to final deployed products based on models, sensors, sensor networks and RFID technologies;
- new multi-disciplinary coordination and control principles for large-scale, wireless sensor and actuator networks, including combined Control, Computing and Communication (C3) strategies. (distributed de-centralized, weakly connected systems);
- new tools for managing uncertainty and risk in distributed and networked systems;
- new tools for visualization of plant operations and energy usage;
- real time and run-time configurability and maintainability of production systems with respect to changing incoming material, energy and production equipment status;
- sensor, actuator and configuration technology for extreme environments;
- autonomous control and maintenance paradigms addressing productivity, availability, flexibility and Overall Equipment Effectiveness (OEE);
- life cycle management of automation system.

Expected impact

The production industry employs around 35 million people in Europe making it by far the largest sector. Productivity improvements in this sector will have major impact for European economy and competitiveness. Projects are expected to increase manufacturing and production efficiency so as to improve raw material utilization, product quality, production flexibility, availability and maintainability - ultimately aiming at *'the segment of one'* - while cutting social, economic and environmental costs.

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

Cross-domain aspects

Low-power solutions and future wireless sensor networks, as required by instruments, for example, have much in common with smart environments (ASP3).

The reduction of risk of industrial accidents to achieve improved safety of manufacturing facilities and personnel, and improved protection of the environment and other citizens, will entail co-operation with ASP1 'Methods and processes for safety-relevant embedded systems'.

Projects in this ASP must share research and results with projects in ASP6 'ES for Security and Critical Infrastructures Protection. Manufacturing has less advanced solutions for cyber security than available for other IT dependent industries, such as web commerce and financial applications, and it would be highly advantageous to utilize the cyber security technology from such sectors, though with adjustment of focus to availability of the production system (e.g. uninterrupted energy supply)

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 compute 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:

- establishment of a common multi-domain architecture, APIs, and design tool platform for advanced multi-core compute platforms;
- establishment of heterogeneous multi-domain architectures and integrated and interoperable tool suites to support massive real-time data-processing;
- definition of a new programming model & new types of API to support platform-independent composition;
- definition of performance & resource management models, meta-data and system layers in order to achieve global performance and resource optimization and management;
- development of design tools and associated runtime support to enable composability;
- Extending design environments to support multi-core architectures (including compilation, 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.

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 the transition from a vertically structured to a horizontally structured market by enabling easier IP reuse 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, 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. 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

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, 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: ES for Security and Critical Infrastructures Protection

Objectives and Approach

In the context of an embedded system (ES), security is related to its ability to store, process and/or transmit protected or sensitive information. 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. Moreover, ESs are widely used for providing services that maintain SPD in a wide range of human activities including, in particular, contexts where security and privacy of people are not well guaranteed. Here, ES security is related to the ability of ESs to provide services assuring SPD for human life.

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 items around us communicate in a ubiquitous way, posing new challenges in terms of overall system complexity and real-time response.

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 as stand-alone or networked systems, i.e. at both the node and the network level.
Another target of the programme will be to develop appropriate ES 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 ES technologies to:

- improve mobility of 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 of a common conceptual framework to address the requirements for security, privacy and dependability in one or more of the three classes of systems identified above, with a particular focus on compositional design and development;
- instantiation of this framework with architectures, components, methods, interfaces and communications, tools and tool chains, to enable the design, development, analysis, validation, and deployment, as well as certification (or qualification);
- a cost and time effective, widely adoptable certification scheme for ESs in the domain of security;
- 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;
- 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:

- reducing the users' fear or reluctance in using inter-networked devices by providing fully guaranteed secured services and access, thus increasing the willingness of people to socialize, and decreasing the risks;
- enabling industrial actors and service providers to offer new security features with minimal additional cost and more freedom 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.

Cross-domain aspects

The results of research on ES 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 architectures (mono and multi–core)
- 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

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.

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 technology for sustainable urban life

Objectives and Approach

Since 2008 over 50% of the population lives in cities, and the aim of this sub-programme is to enable sustainable urban life, improving comfort and security while optimising resource usage. Additionally, it is expected that the results will also bring urban benefits to non-urban areas, thereby countering the tendency towards over-urbanisation.

- There are three main goals: Eco efficiency - optimising usage and management of all resources, such as water and energy;
- Eco sufficiency - through helping people to make better use of resources and enabling more effective renovation, maintenance and waste management;
- Improved comfort and security - via intelligent urban infrastructures to manage environmental quality, to support work, leisure and domestic life including surveillance and intelligent response.

The approach is to develop embedded intelligence and integration technology to achieve greater efficiency in use of resources, more flexibility in the provision of resources and better situation awareness for the citizen and for service and infrastructure owners. This should be achieved through the deployment and inter-operation of embedded systems throughout the environment.

Appliances are no longer independent entities, but part of a larger system connected through a residential gateway, with intelligent smart capabilities. Energy efficiency is a driver for purchase and renovation of domestic brown and white goods.

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

- definition and initial instantiation of architectures and communication platforms to enable the flexible and evolvable interoperation of systems, including sensors, actuators, information systems, and control systems across multiple domains - e.g. transport and energy management - and multiple vendors and service providers;
- reference designs for energy efficient HW/SW architectures (e.g. reference mobile handset, reference tiny communicating device);
- definition of a standard HW and SW modelling framework and of development tools based on common industry driven meta-models, for high-level analysis and validation of resource usage, emphasizing composability and reuse;
- design and realization of design-time energy exploration and optimization tools and methods;
- models to enable energy efficient topology management in distributed systems, with emphasis on dynamic reconfiguration capabilities of resource management devices as key non-functional capability to cope with the legacy challenge;
- Visualization of Sustainable Urban Life, and integration of such visualization with the underlying models and applications.

Three market sectors are especially relevant: public infrastructures and utilities; residential and non-residential buildings; and domestic electronics and appliances.

Expected impact

Public infrastructures and utilities span all kinds of urban buildings and infrastructures from power generation and distribution, to water supply and waste management, public health, education and leisure, security services, transport systems in urban areas, etc. Projects are expected to lead to offers of high-level internet-based services based on open reference implementations that enable the connection of diverse devices with each other, with home networks, and with smart grids. Public authorities should be involved where necessary to harmonize innovation and regulation.

Projects are expected to stimulate the creation of new business models - from conceptualisation to maintenance and operation of urban systems.

Projects are also expected to improve:

- eco-efficiency, such as improving energy efficiency and energy management (e.g. for energy efficient buildings), or improving sustainable use of resources in urban systems;
- eco-sufficiency, through improving human behaviour in the use of resources or improving the management and maintenance of resource distribution and management systems;
- comfort and security, through improvements in environmental quality, increased automation, and advances in Ambient Intelligence.

Cross-domain aspects

Safety aspects of transport systems, addressed in ASP1, will complement work in this sub-programme on the use of embedded systems for transport system optimisation in urban areas.

Comfort and security services aimed at eco-efficiency and eco-sufficiency addressed in this sub-programme constitute one specific aspect of ASP3 “ES in Smart Environments”.

In addition, there are cross-domain problems that are addressed in technology-oriented domains and applicable in developments and systems for sustainable urban life. This is the case particularly for computing environments and energy management in embedded systems (ASP5), security, privacy and dependability (ASP6), and user interfaces (ASP8).

This sub-programme will also draw on developments from these other areas, focusing on development and/or adaptation of specific aspects of the technology, such as surveillance systems, access control, and accessibility.

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;
- 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;
- 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;
- technologies for intelligent multi-modal interactive systems especially addressing the user's inter-working with adaptive context-aware systems.

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 2005 levels by 15% by 2013;
- achieve 15% reduction in development cycles - especially in sectors requiring qualification or certification - by 2013;
- manage a complexity increase of 25% with 10% effort reduction by 2013, compared with 2005,
- reduce the effort and time required for re-validation and recertification of systems after making changes by 15% by 2013, compared with 2005;
- achieve cross-sectoral reusability of Embedded Systems devices and architecture platforms (for example, interoperable components (hardware and software) for automotive, 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.

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 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.

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 (see section 7.). 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, with a view to more concrete collaboration in the future.

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 Project duration

In view of the downstream research focus of the ARTEMIS Joint Undertaking and the targets described in this document, projects with duration longer than 3 years must provide adequate justification for their length, relative to the application demonstrators and expected impact that they describe.

5 Implementation of Call in 2011 *(To be completed by the PAB)*

5.1 Call 4 3: JU-ARTEMIS-2011

- Date of publication: xxxx
- Closure date: xxxx, at 17.00 h Brussels local time.

  (NB. A two-step process is foreseen, where project proposer may submit a Project Outline by xxxx, and receive feeback by May xxxx).
- Indicative budget: …. M€[7]
- Evaluation procedure: ….. one stage or two stages (to be defined later)
- Indicative evaluation and contractual timetable: It is expected that the contract negotiations for the selected proposals will start as of ……
- Project Cooperation agreements: 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 2011

Budget per year as per (draft) AIP 2011	**Budget of Call 2011 (M€)**	**Budget of Call 2011 (estimated) (M€)**
Total EC Contribution [8]	xxx	xxx
Total contributions from ARTEMIS Member States [9]	xxx	xxx
Total budget of Calls	**xxxx**	**xxxx**

[7] estimated as 55% of the amount committed by ARTEMIS member States to the budget of this 2011 Call.

[8] The amount of xxx M€ refers to the …… appropriations in the general budget of the European Union for operational costs based on the preliminary draft budget (PDB) xxxx that includes a reference budget for ARTEMIS JU. If the final amount approved by the budgetary authority is different, the Annual Implementation Plan would consider the approved figure. The amount of xxxx refers to the Legislative Financial Statement submitted by the Commission to Parliament and Council on 15 May 2007 (COM(2007)243).

[9] At least 1,8 times the Community's financial contribution, that is EUR xxx million / (55%) or xxxx million for xxxx.

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 (Project Outlines and Full Project 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 (to be reviewed after dialogue with PAB)

6.1.1 Project Outlines (PO)

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

- It is submitted using the ARTEMIS Proposal Service (APS)
- It is received by the ARTEMIS JU before the deadline given in the call text for POs.
- It involves at least 3 non-affiliated legal entities established in at least 3 ARTEMIS Member
- States
- It is complete (i.e. both the requested administrative forms and the proposal description are
- present).
- It is submitted in English[10].
- The content of the PO relates to the topic(s) described in this work programme.

6.1.2 Full Project Proposals (FPP)

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

- The corresponding PO has been considered eligible by the ARTEMIS JU
- It is submitted using the ARTEMIS Proposal Service (APS)
- 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 the requested administrative forms and the proposal description are
- present).
- It is submitted in English[11].
- 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.

[10] 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

[11] 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

6.3 Evaluation criteria

6.3.1 Project Outline

The Project Outline will be assessed by the ARTEMIS JU, on the basis of the following criteria:

- Relevance will be considered in relation to the topic(s) of the work programme open in a given call and to the objectives of a call.
- Relevance and contribution to the overall ARTEMIS targets listed in section 4.
- Soundness of the concept
- Clarity and quality of the objectives and expected results
- Contribution, at the European and/or international level, to the expected impacts listed in the work-programme under the relevant sub-programme
- Degree of application innovation in the context of the sub-programmes addressed
- Expected market impact of the results for the industrial partners
- Quality of the consortium as a whole including complementarities, balance and involvement of SMEs

6.3.2 Full Project Proposal

The evaluation criteria against which proposals will be judged are set out in the document ARTEMISPAB-4-08: "ARTEMIS Joint Undertaking selection and evaluation procedures related to Calls for 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 individual criterion (5). The overall threshold, applying to the weighted sum of the five individual scores, will be 40.

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 contribution to the overall ARTEMIS targets listed in section 4.

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 standards.
- Contribution to ARTEMIS tool- platform policy
- Management of intellectual property.

5. Quality of consortium and management[12].
- 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
- Appropriateness of the level, allocation and justification of the resources to be committed (budget, staff, equipment).

[12] 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.**

7 How to submit a proposal

Proposals (Project Outlines and 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

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

Document	Document / Web site
ARTEMIS SRA Introduction	http://www.artemisia-association.org/downloads//SRA_MARS_2006.pdf
Reference Design & Architecture SRA	http://www.artemisia-association.org/downloads/RAPPORT_RDA.pdf
Seamless Connectivity and Middleware SRA	http://www.artemisia-association.org/downloads/RAPPORT_SCM.pdf
System Design Methods and Tools SRA	http://www.artemisia-association.org/downloads/RAPPORT_DMT.pdf
ARTEMIS-JU MASP (including the ARTEMIS-JU Research Agenda)	http://www.artemisia-association.org/downloads/RAPPORT_DMT.pdf
STANDARDISATION SA	http://www.artemisia-association.org/downloads/standardisation.pdf