High-level vision ITEA-ARTEMIS 2030

VERSION 2012

ITEA2
INFORMATION TECHNOLOGY FOR EUROPEAN ADVANCEMENT

ARTEMIS

a document by the ARTEMIS ITEA Cooperation Committee

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19 September 2012

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ARTEMIS

Preamble

There is a wide consensus that the time from now to 2030 will be of permanent change and disruption. In 2030 the world population will reach the magic number of 8 billion people. Only 23% of this 8 billion will live in Europe and the Americas. The way of living and doing business will be fundamentally different from what it is today. To see this development positively, this should be seen as "8 billion opportunities".

ICT has a major role to play in mastering the changes. For Europe, an industry strong in ICT-based innovations is a prerequisite for maintaining global competitiveness. Moreover, such an industry creates high-value jobs in ICT and in other, more traditional industries that are dependent on ICT.

Transformation to the information society requires support for innovation policies and funding measures that strikes a balance between bottom-up and top-down. Given the current central role of both the ITEA and the ARTEMIS communities, and the balance between top-down and bottom-up that both programmes provide in the research and innovation in ICT in Europe, it is essential that their continuity is guaranteed for the coming period.

This Vision 2030 is a result of the ITEA-ARTEMIS Sherpa group, which will be continued as the ARTEMIS ITEA Cooperation Committee (AICC). In the Vision 2030, ITEA and ARTEMIS describe the areas of major changes and disruptions as well as the role of ICT in the global economy and society in 2030 as the context of their common mission: to maintain European leadership in embedded systems and software-intensive systems and services.

Chapter 1 describes the seven areas of major change and chapter 2 the role of ICT. Then in Chapter 3, ARTEMIS and ITEA are described as the complementary instruments to accomplish the mission. From this we deduce the need for the two programmes ITEA and ARTEMIS.

CHAPTER 1

Seven areas of major change

1 GLOBALISATION AND DEMOGRAPHIC CHANGE

Globalisation means ever increasing interaction and interdependence between societies, economies, governments, companies, institutions for research and education, civil society organisations and individuals all over the world. According to the Future Management Group, important drivers for globalisation have been liberalisation of trade and services, international tourism, intercultural trends and technological developments in the fields of information and communication.

In the years ahead two demographic developments will accelerate globalisation:

- The world population will grow from 7 billion people today to 8.3 billion in 2030. 95% of this growth will happen in developing and emerging countries
- The distribution of the world population will then be: Asia 58%, Africa 19%, the Americas 13% and Europe 9%
- Globally, the growth of the middle-class in these countries is even more impressive, from 1.8 billion people in 2009 to 4.9 billion people in 2030. Middle class means that they have an annual income of between US$ 6,000 and 30,000 measured in purchasing power parity. 80% of this middle-class will live outside Europe and North-America.

As a consequence, from 2010 to 2030 GDP growth in emerging and developing countries will be 70% as opposed to 30% in developed countries and, in less than two decades, the emerging markets will account for more than half of all global GDP.

Roland Berger Strategy Consultants have coined the slogan of "eight billion business opportunities" to describe their advice to European economic leaders.

ICT will be a key technology to exploit these opportunities. As we announced at our Co-summit 2011, "mobile and cloud power are enabling massive scalability and opportunities for growth".

- The number of mobile-only broadband users is expected to grow from 14 million in 2010 to 5 billion in 2030, most being in Asia and Africa (RB)

- The applications for all these mobile users will be in the cloud, for example financial transactions, trade, healthcare, education, entertainment.

Another important aspect of demographic change is the rising proportion of the elderly population in many parts of the world over the next few decades. The population pyramid turns upside down and becomes a spindle. Working life will become longer and the pension entitlement age will be higher according to FMG.

- The number of people in the world aged 60 and above will grow from 740 million today to 2 billion in 2050
- Age-appropriate products and services in ICT, especially in the sectors of health, security and assistance, will become increasingly important
- Worldwide revenue in the market segment covering those aged 60 and above ("Group 60+") will almost double from 6 billion euro in 2010 to 11 billion euro in 2020
- China's demographic profile is an outlier among most emerging markets. Due to its one-child policy, China is ageing at an extraordinary rate and, by 2030, is projected to be older than Europe (RB). In 2010, 118 million of the 1.3 billion Chinese were over 65 years old. By 2040, this number will have grown to 329 million.

2 MANAGEMENT OF SCARCE RESOURCES

The consequence of the growing world population and growing wealth in emerging countries is that, irrespective of vision 2030, the way we live and we are doing business in 2030 will be radically different from today. If we continue with a business-as-usual approach, we will need 2.3 planets instead of the single planet Earth we do have is the conclusion drawn by the World Business Council for Sustainable Development in its Vision 2050.

WBCSD developed a vision of a planet Earth well on the way to sustainability by 2050. This will be a world in which the global population is not just living on the planet, but living well and within the limits of the planet. By "living well", the report describes a standard of living where people have access to and the ability to afford education, healthcare, mobility, the basics of food, water, energy and shelter, and consumer goods. By "living within the limits of the planet", the report means living in such a way that this standard of living can be sustained with the available natural resources and without further harm to biodiversity, climate and other ecosystems.

To achieve this goal, sustainable solutions are needed for the management of scarce resources, such as food, water, energy and materials, especially rare earth metals.

To develop sustainable solutions, the whole chain from source to user needs to be understood, covered and tackled, e.g.:

- Water – from source to tap
- Energy – energy production, smart grid, connecting many different sources and consumers
- Food – from farm to fork
- Materials – for example, rare earth metals.

WATER

Today, drinking water is already very scarce in some regions of the world. Demand for drinking water continues to increase massively because of population growth and urbanisation. The Future Management Group sees this problem being intensified by careless use, pollution, intense agricultural demand, damaged supply infrastructures and over-exploitation of natural reserves like groundwater.

Today's total demand is 4500 billion m^3. Demand in 2030 is projected to be 6900 billion m^3, whereas the existing sustainable supply is 4200 billion m^3.

ENERGY

Neither does the Future Management Group see increasing global demand for energy in the course of the next few decades being curbed to any significant extent by higher energy efficiency and economisation.

- Global energy consumption will rise by 39% between 2010 and 2030
- Despite improved energy efficiency, energy consumption through electronic devices will triple until 2030 because of a massive rise in overall demand
- 19% of all electric energy is used for lighting, which is 2.5% of the global energy use, but intelligent lighting and controls can enable 70% of this energy to be saved. (Ph21)

FOOD

By 2050, agricultural production must increase by 70% in order to meet the nutritional needs of the growing world population.

- Innovative solutions are necessary, for example in the field of biological and genetic engineering or process automation in agriculture (FMG)
- Precision Farming, i.e. the large-scale use of IT in agriculture, will help save resources, reduce environmental impact and increase yields.

MATERIALS

By 2030, a shortage of high-tech metals will threaten the further development of future technologies such as photovoltaic cells, hybrid propulsion and energy-efficient flat screens.

In summary, consumption models need to be challenged in the coming decade, since the Earth's resources will fall short of meeting the needs of a growing world population and higher living standards in emerging countries. Business models and the management of scarce resources will need to adapt to this new situation. All these models and systems deal with the manipulation of physical entities and related information that spans many layers from networked sensors and actuators to high-level distributed and networked control, monitoring and information systems.

A combination of information systems and embedded systems will be needed to implement the "neural network of society" as coined in the ARTEMIS SRA.

3 CLIMATE CHANGE

Whether caused by human activity or by natural factors, the Future Management Group regards global climate change as one of the major challenges of the 21st century. The main factor is the warming of the planet's atmosphere, or global warming. The years between 2001 and 2009 constitute the warmest unbroken period since measurements began in 1850.

- Between 2010 and 2030, the average sea level worldwide will increase by between six to eleven cm (RB)
- Until 2015, the number of people affected by disasters connected with global warming, such as droughts, storms or floods, will increase by more than 50% to 375 million
- The damage in dollars inflicted annually by climate change will rise from US$ 63 billion in 2010 to US$ 157 billion in 2030.

Many sectors are directly affected by the climate change:

- For agriculture, the expected climatic changes will affect crop yields, livestock and the location of production. The growing risk and severity of extreme weather events will increase the risk of crop failure. As has been seen in the recent past, flooding also impacts regional economy and production in all economic sectors
- But climate change will also pile pressure on the fisheries and aquaculture sectors as marine ecosystems are expected to be affected and coastal erosion rates increase. So, existing coastal defences may provide insufficient protection against the sea and will need huge investments to keep the risk at acceptable levels
- In the energy sector, climate change will have a direct effect on both the supply and demand of energy. The projected impact of climate change on precipitation and glacier melt indicates that hydropower production could increase by 5% or more in northern Europe and decrease by 25% or more in southern Europe
- Climate change will cause significant changes in the quality and availability of water resources, affecting many sectors including food production, where water plays a crucial role. More than 80% of agricultural land is rain-fed. Food production also depends on available water resources for irrigation Limited water availability already poses a problem in many parts of Europe and the situation is likely to deteriorate further due to climate change, with Europe's high-water stress areas expected to increase from 19% today to 35% by the 2070s. Natural ecosystem services, such as the provision of drinking water, food production and building materials, will also be affected. (EC study Climate Change)

On the other hand, environmental protection is increasingly taken into account in the development of products and processes, with natural resources being used efficiently and environmentally harmful effects minimised throughout the complete product life cycle. For

instance, technologies are being used to conserve water and energy, for sophisticated waste disposal, recycling and filter systems as well as techniques for the efficient use of renewable energies.

- As a global mega-trend, "Going Green" is becoming increasingly important in mechanical engineering, driven by regulation, the necessity to reduce costs and the growing importance of an environment-friendly reputation (RB)
- The green technology share in the European industry will rise from 40% in 2010 to 60% in 2020.

The World Business Council for Sustainable Development's Vision 2050 believes that information and communication technologies can make a major contribution to the global response to climate change by enabling energy and emissions savings in transportation, building, industrial, power and other systems.

4 URBANISATION

While in 1950 less than one third of the world's population lived in cities, the Future Management Group puts this share at slightly more than half today and still growing. In 2007, for the first time in history, more people lived in cities than in rural areas (3.3 billion)

- The number of people living in cities will grow from 3.5 billion in 2011 (50% of the world's population) to 4.9 billion in 2030 (59%) (RB)
- Population numbers in economically remote areas will decrease significantly
- The number of mega-cities, i.e. cities with more than ten million inhabitants, will increase from 21 in 2009 to 29 in 2025.

Urbanisation - the increase in the urban share of the total population - is inevitable, posing both great challenges to and opportunities for society.

- No country in the industrial age has ever achieved significant economic growth without urbanisation. Cities concentrate poverty, but they also represent the hope of people to escape it.
- Cities also embody the environmental and climate damage done by modern civilisation. However, experts and policymakers increasingly recognise the potential value of cities to long-term sustainability
- The potential benefits of urbanisation far outweigh the disadvantages. The challenge is in learning how to exploit the unique properties and possibilities of cities. Products and techniques for making efficient use of crowded living spaces will attract a ready market.

The administration of cities and mega-cities and the management of their infrastructures rely heavily on ICT: energy, mobility, waste disposal, water and wastewater treatment, city lighting, safety and security.

5 MOBILITY

Transport is fundamental to our current economy and society. Mobility is vital to economic growth. The transport industry in Europe employs around 10 million people directly and accounts for about 5% of gross domestic product (GDP). Effective transport systems are key to European companies' ability to compete in the world economy. Logistics, such as transport and storage, account for 10–15% of the cost of a finished product for European companies. The quality of transport services has a major impact on people's quality of life. On average 13.2% of every household's budget is spent on transport goods and services. But congestion and fuel scarcity are important threats to mobility.

- Oil will become scarcer in future decades. Oil prices are projected to more than double between 2005 and 2050 levels. Current events show the extreme volatility of oil prices
- Transport has become more energy-efficient but still depends on oil for 96% of its energy needs.
- Congestion costs Europe about 1% of gross domestic product (GDP) each year
- There is a need to drastically reduce world greenhouse gas emissions, with the goal of limiting climate change to a 2ºC rise. The EU needs to reduce emissions by 80–95% in 2050 (compared to 1990 levels) to achieve this
- Congestion, both on the road and in the air, is a major concern. Freight transport activity is projected to increase, with respect to 2005, by around 40% in 2030 and by a little over 80% by 2050. Passenger traffic will grow slightly less than freight transport: 34% by 2030 and 51% by 2050.

Nevertheless, individual mobility will stay a major concern for the future. The strongly increasing traffic volumes demand a sustainable approach to society's mobility. This means that our transportation infrastructure must be efficient, safe, environmentally friendly and trustworthy. The transportation infrastructure is a combination of all mobility means, not only the road and rail infrastructures but also the vehicles, the communication possibilities, the services and the traffic management. To handle this increased traffic many technical issues need to be solved.

The Deutschland 2030 BDI report expects smart and integrated mobility services to be offered in 2030 and the focus may even shift from owning a car to buying a transportation service or even avoiding the need to move.

Actors are entering the market: suppliers of post-fossil engines or batteries, energy and IT suppliers. Cities and regions take the lead and redefine the public transport as an integral part of international mobility.

Networked transportation services enable seamless, easy-to-use and price-efficient door-to-door mobility integrating all kinds of transport systems, cars, buses, railways, aeroplanes, bikes.

These transportation services are based on global, comprehensive information systems including services like travel planning, selecting and providing the means of transportation including ticketing, real-time planning, traffic control, transportation means and the transitions between them.

6 HEALTHCARE AND NUTRITION

The health sector is becoming one of the most important future markets driven by wider access to healthcare, wellbeing and the convergence of medicine, pharmacy and biotechnology.

Better access for more people to healthcare is achieved by, for example:

- Making healthcare affordable for more people and in emerging countries
- Reducing treatment cost by improved diagnostics and image-guided surgery
- Moving from hospital treatment to home treatment where appropriate.

The convergence of Medicine, Pharmacy and Biotech is based on scientific and technological progress, according to the Deutschland 2030 BDI report. Progress in molecular diagnostics and the cost-efficient analysis of biomarkers (within the individual gene analysis) opens new possibilities for personalised nutrition and therapy. The traditional classifications of patients according to age, gender and family history is extended by much more precise and efficient indicators now available on an individual genetic level. This is already being applied today in oncology and blood cancer treatment.

In Pharmacy, Blockbusters i.e. pills for a large group of patients, are being replaced by Minibusters, i.e. personalised pills for individual patients.

The platform for cooperation among the Medicine, Pharmacy and Biotech actors is provided by ICT. ICT provides the algorithm for gene analyses, for the exchange of genome data, the processing of these data by the algorithms in medicine and pharmacy, and the automated production of Minibusters.

It is expected that personalised Medicine will break through before 2030, starting with groups of patients for whose illnesses the genetic and other reasons are sufficiently explored.

Other important challenges for the health sector are:

- To enable the extended full participation of more people in society, allowing care for their physical and mental well-being to enable them to work longer
- More focus on prevention is needed to reduce the care burden
- Most services for elderly people depend heavily on ICT, for example teleworking, healthcare monitoring, robots at home, future communication and entertainment.

The convergence of sectors does not stop in the health domain (with personalised medicine and personalised pharmacy). There is also convergence with the nutrition domain.

In the future, food will not only be tasty and healthy, but it will also have beneficial effects on health and beauty. The borders between food and pharmaceuticals to cosmetics will disappear.
Pharmaceutical companies offer health-promoting foods. Food manufacturers are moving into health-related markets: health food stores, drug stores and pharmacies. Cosmetics manufacturers are venturing into the food and health market.

All three actors – pharmaceutical, food and cosmetic manufacturers – have their influence on agriculture to secure and steer their raw materials according to their needs.

All players in this converging domain of food, pharmaceuticals and cosmetics are confronted with increasing customer demand for information and reassurance on the origin and content of their products.

These increased demands come amid legislative and regulatory drives that increase the complexity and level of regulation imposed on supply worldwide.

Since all these products contain ingredients from around the world, and the finished product is then distributed globally, demand for authenticity can only be satisfied with global information platforms based on ICT.

7 DIGITAL SOCIETY

Digital society is a special aspect of "globalisation". We observe the emergence of two trends:

- A knowledge economy which is completely decoupled from geographies
- A virtualisation of communities and societies.

KNOWLEDGE ECONOMY

Globally, a structural change occurs from physical to intangible added value. In the 21st century, the production industry will experience the same fate as the agricultural industry in the 19th century: its contribution to the economic creation of value will decrease. The tertiary sector of services and the quaternary sector of knowledge work will become more important suggests the Future Management Group.

- More and more companies and complete industries will be based on production and exchange of knowledge and ideas instead of industrial goods.
- The management of available knowledge (=evaluated information) will become a strategic corporate factor
- In 2030, Internet penetration in the developed countries will be close to 100%. The Internet penetration rate has already grown from 51% in 2005 to 72% in 2010 (RB)
- The cross-linking of knowledge via the Internet will increase significantly up to 2030. Some experts predict that Internet users will consume an average of 3GB of data per day in 2030. (RB). The Internet will become the global repository of knowledge.

Timely, easy and reliable access to knowledge is a prerequisite for the knowledge economy. Since ICT is the main store of information and networks add the capability to relate information to any other information in the world, ICT has become essential for the evolution of existing knowledge and the creation of new knowledge.

VIRTUALISATION OF COMMUNITIES AND SOCIETIES

- In recent years the sheer amount of information and knowledge available has changed society. Individuals are no longer individuals only but they are part of social networks and entities. Web-based social and business networks serve as virtual communities in which individuals may even adopt a virtual identity
- Social media channels such as Facebook are also quite important for knowledge sharing. Facebook currently has more than 500 million active users, a number which is likely to increase. By 2030, social media could also replace many of the traditional types of media and will be firmly integrated into corporate IT (RB)
- There is a strong demand among the young generation to remain and stay connected to their communities in any circumstances. This will lead to a revision of all the legacy applications to integrate this collaborative way of living
- Of specific importance in Europe is the preservation of cultural heritage in a digitised society
- Security and safety, privacy and identity theft are important challenges for all future ICT systems.

CHAPTER 2

The need for research and ICT-based innovation

Nowadays, no business department could function properly without ICT, no bank, hospital or factory could operate effectively and no telephone would be operational any more. ICT is crucial in many parts of our daily life today.

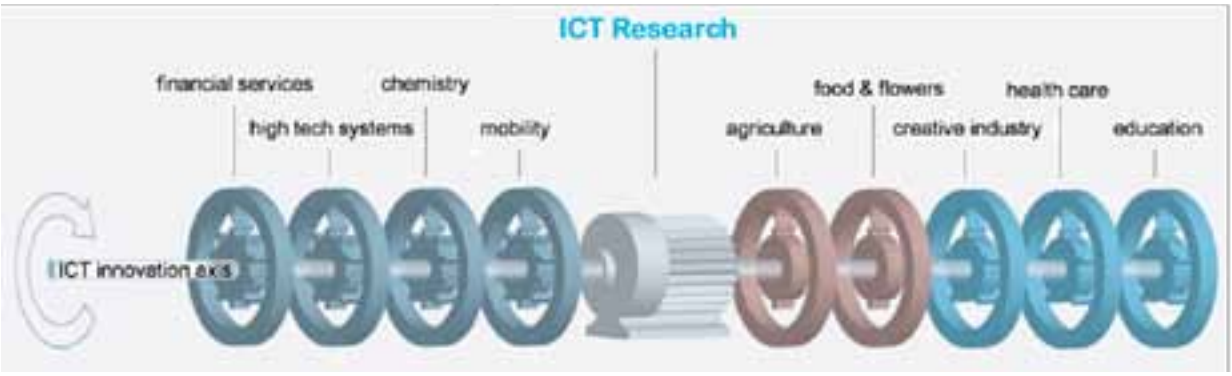
As more and more services make this shift, the transformative impact of ICT will become visible in every part of daily life.

As a result ICT will evolve in the basic infrastructure for all vital social, business and economic processes. Every commercial and public service will be provided through this e-Infrastructure. Therefore, ICT will continue to play a defining role by providing the critical infrastructure for the global economy.

These observations are supported by ISTAG in its report "Orientations for EU ICT R&D & Innovation beyond 2013". In this report ISTAG concludes that ICT will play an even more central role in business and societal processes for the coming decades. A selection of the ISTAG statements:

- "ICTs will grow out to be the basic and critical infrastructure for all vital social and economic processes"
- "ICTs will be indispensable to address the key challenges that society is facing in, for instance, urban planning, transport and logistics, in crime prevention and risk management, in health care and in coping with scarce resources. And, last but not least, ICTs will continue to play a defining role in our economy by providing the critical infrastructure for the global economy"
- "From a societal perspective, guarantees for universal access to robust, trustworthy and secure infrastructure services, and standards and open interfaces will become crucially important"
- "ICT is not only a solution to existing problems, but also a disruptive force in itself, having a pervasive and transformative impact on society."

Today, the dominant view of ICT is as an enabler technology that is used exclusively as an instrument to reach certain targets. However, recent history shows many examples in which ICT has proven to be a



Example: The Dutch ICT innovation axis driving Dutch application areas.

disruptive force in itself: services like social media, Google maps and Skype, combined with innovative platforms such as smart phones and tablets capable or executing "apps" have opened completely new roads to information access, information sharing, individual communication and business opportunities, also for SMEs.

Many examples support the observation that ICT has grown into a disruptive force in itself. The smart phone with all its apps makes its way not only into the consumer domain, but also more and more as mobile access to information and services in the business domain. Also access to many services is increasingly shifting to the internet, as for example banking, buying of goods by consumers and government services.

For business, cloud computing is at present creating radically new possibilities to roll-out global services at very low capital costs. New suppliers of cloud-based services have entered the ICT field and rapidly established themselves as dominant competitors in different industry segments where they change the rules of the game. This impact of ICT on daily life has most impact on the behaviour of younger generations that grow up with these developments.

Also the Delphi report observes that ICT has in many ways been a driver of social and economic change and will remain such a transformative force in the coming decades. Opportunities will emerge in an unpredictable way, as in the past, which requires the continuous evaluation of emerging innovation opportunities generated by new ICTs.

Experts believe that intelligent embedded systems will drive new applications that also affect sectors like manufacturing and energy. The results will be systems, technical processes and workflows that are continuously optimised from both an ecological and economic perspective. Developments in ICT will continue to increase their influence on the manufacturing, energy and medical technology sectors.

The continued maturing and rapid growth in the use of ICTs through to 2030 implies that ICTs will become the key infrastructure for the future European Knowledge Society.

Many innovative companies have grasped the opportunities emerging from the convergence between ICT and other sectors, building new businesses on adaptive consumer behaviour. Predicting the social and economic impact of certain ICT technologies is extremely difficult and recent history has often proven such predictions to be wrong. Examples can be found, especially in the mobile phone industry, where Apple and Android revolutionised the smartphone market with significant consequences, even for telecom network providers. The only way to keep up with this revolution is to continuously invest in research and development.

Another example of such ICT driven transformations is observed from the "Internet of Things" which implies that interaction will be strengthened between the physical world and the virtual worlds of ICT. Physical entities will have digital intelligence and are also represented in the virtual world of internet. "Things" become context aware and will be able to sense, communicate, interact and exchange data, information and knowledge.

Through the use of intelligent software applications, appropriate rapid responses can be given to physical phenomena, based on the very latest information collected about physical entities and consideration of patterns in historical data, either for the same entity or for similar entities. These create new opportunities to meet business requirements, create new services based on real-time physical world data, gain insights into complex processes and relationships, handle incidents, address environmental degradation (pollution, disaster, global warming, etc), monitor human activities (health, movements, etc.), improve infrastructure integrity (energy, transport, etc.) and address energy efficiency issues (smart energy metering in buildings, efficient consumption by vehicles, etc.).

The future Knowledge Society will be a society in which massive amounts of information and data are processed and given meaning. The generation of information and data by sensors, machines and information-enhanced products requires progress in the basic technology needed to realise the computing power that has to process all the data into useful information. Multicore processing technologies are essential components in accelerating the day-to-day processing power needs according to the state-of-the-art technology of high-performance computing.

And ISTAG is not alone in its observations. ICTRegie in the Netherlands launched an agenda for the future of ICT in 2030 in the Netherlands. This agenda stresses the importance of research in ICT to propel innovation in many sectors of the economy as is depicted in the figure below.

ICT 2030.nl describes how the axis of innovation is driven by ICT research. ICT creates new markets for established operators and opens up existing markets to new players. So ICT can be visualised as an axis of innovation running through all sectors of the economy. However, this axis of innovation is of little value without an engine to drive that axis. Another crucial element is the transfer between the axis and those parts (sectors) that must be set in motion.

Hence, to gain maximum benefit from all opportunities generated by ICT, both smarter applications of available ICT as well as good research are needed while the development of new opportunities must not be forgotten.

This is the only way to keep the axis turning. The connection between ICT and the application fields is essential, and leads to new challenges and ideas. This requires intensive interaction among all of those involved in the

Seven areas of major change

DIGITAL SOCIETY

GLOBALISATION AND DEMOGRAPHIC CHANGE

management of scarce resources

climate change

urbanisation

mobility

healthcare and nutrition

innovation process: researchers, end users, ICT companies, businesses and the users of ICT solutions. This innovation ecosystem forms the basis for successful ICT-fuelled innovations in products, services and processes.

Also the Delphi report, built on extensive research and questions to a wide and heterogeneous audience, reveals similar messages for the German economy. The main messages in the Delphi report are:

1. Digitisation and the ongoing penetration of ICT into all areas of professional and private life will be even more all-embracing in moulding the information society in the future
2. Acceptance and trust in using ICT is the foundation for developing a modern and open information society
3. A high-performance communications infrastructure is a vital precondition and a strategic success factor for an open and competitive information society
4. The mobile use of the internet and its services will have a lasting impact on the information society and create independent new areas of application
5. Dynamism in ICT based technologies will drive innovation processes and have a serious impact on all key industries in the economy.

Since the dynamism in ICT uptake and progress is huge, research and innovation in ICTs remain essential in the coming decades to enable companies to identify and grasp business opportunities that realise economic growth in this sector for the coming decades.

In its report ISTAG recommends that the transformation of the industrial society to the information society be supported by several policies:

- "Stronger and better integration between the research and innovation dimensions but education should not be neglected; joint policy-making will be needed to achieve effective linkages between research and innovation, thereby shaping productivity, competitiveness and employment"
- "The mix of funding measures should strike a balance between bottom-up and top-down approaches to research"
- "A well-articulated innovation strategy needs to ensure that instruments and priorities encourage participation from a broad spectrum of small and large enterprises, universities and research and technology organisations; in fostering innovation, the role of industry as the bridge between research and 'commercialisation' has to be stressed and the fact that SMEs are consumers as well as performers of research better recognised"
- "Effective instruments are needed to achieve effective research coordination between the Member State and EU levels objectives, integrating the research base by overcoming fragmentation in research is vital, while simultaneously achieving a sharper division of labour between what is done at EU level and what is undertaken in national programmes; European research and innovation efforts must concentrate on themes where critical mass is vital for success and where breakthroughs require cross-border solutions, while also allocating sufficient resources to R&D topics which promise radical innovations."

Today's ICT systems are so complex that no single organisation or company can oversee all aspects or connections. With tomorrow's even more complex interacting systems-of-systems, the visibility of a single company will be reduced even further, stressing the relevance of cross-border innovation eco-systems that foster open innovation. Both ARTEMIS and ITEA have built such innovation eco-systems of companies and research organisations interacting closely. These eco-systems are essential to enable European organisations, including SMEs, to keep up with the fast changing reality in ICT, its increasing complexity and to remain at the top in innovation.

EUROPEAN ICT INDUSTRY STRENGTHS, WEAKNESSES, OPPORTUNITIES AND THREATS

A short SWOT analysis shows the position of the European industry, including its SMEs, on a global scale.

STRENGTHS

- Competent and highly competitive industry with a strong SME base in some areas.
- Strong industrial history backed by leading academic training and research
- High degree of technological ingenuity
- Respected position as a "high-quality" supplier of goods and services
- World-class education systems
- Access to a large knowledge-based, skilled and semi-skilled workforce
- Well established social security systems leading to high political stability and a well-structured society
- Strong work ethic among the population
- Initiate new tool developments for new topics

WEAKNESSES

- Slow to react to fast-changing needs and technological developments
- A fading credibility to influence worldwide standards
- Competent and high-productivity labour force is also perceived as an expensive labour force
- Less ability to access venture capital
- Culturally risk-averse
- Fragmented investments and different national industrial policies
- Tool companies are often taken over by non-European companies

OPPORTUNITIES

- Establish a preferred-supplier position for (high-reliability, high quality) electronics systems
- Become recognised as the "better supplier" of mid to high-value products for the rapidly expanding global middle to upper-class citizen
- Stimulate the innovation eco-system through better business and education connection.
- Stimulate SME involvement in innovation eco-systems

THREATS

- Brain drain of excellent scientists and engineers
- Continued "off-shoring" of high-value added product design
- Continuing/escalating decrease in the number of young people entering "hard" technical studies
- Strategic dependence on off-shore sources of essential technologies and know-how
- Vulnerability of ICT assets

From this SWOT it can be concluded that the European industry has a strong position. However, this position is under constant pressure and threat of deteriorating, something that should not be underestimated. Given the importance of the role of ICT in European industry and its products, a structural focus on the weaknesses and threats remains essential for the next decades.

CONCLUSION

In summary, the main messages of this chapter are:

- ICT as a vital e-infrastructure and driver of innovation
- ICT is not only a solution to existing problems, but also a disruptive// intrusive force in itself
- Transformation to the information society requires supporting innovation policies and funding measures, striking a balance between bottom-up and top-down
- A SWOT analysis indicates weaknesses and threats that warrant attention.

Given the current central role of both the ITEA and the ARTEMIS community, and the balance between top-down and bottom-up that both programmes provide in the research and innovation in ICT in Europe, it is essential that their continuation is guaranteed for the coming period.

CHAPTER 3

One Mission, different instruments

As mentioned already in the preamble, the common mission of the communities of ITEA and ARTEMIS is to maintain European leadership in embedded systems and software-intensive systems and services.

Two significant programmes in Europe have proven to be successful in helping to fulfil this mission: the ARTEMIS-JU and ITEA 1 and ITEA 2. For all the evident reasons mentioned in Chapter 1 and 2, both programmes should be continued in successor programmes, starting with their first calls in 2014.

CHAPTER 3.1

ARTEMIS: THE CASE FOR A SUCCESSOR PROGRAMME

ARTEMIS: **A**dvanced **R**esearch & **T**echnology for **EM**bedded **I**ntelligence and **S**ystems

VISION

The vision driving ARTEMIS is of mankind benefiting from a major evolution in intelligent systems, a world in which all systems, machines and objects are smart, have a presence in cyber space, exploit the information and services around them, communicate which each other, with the environment and with people, and manage their resources autonomously. Digital convergence by emancipation of data, building embedded intelligence into every aspect of life and the internet revolution, are the opportunities of our time. These have changed the way we live as citizens and the way we do business in the new digital economy, and this trend is accelerating and will impact our society even more deeply.

In this context, the ARTEMIS vision nurtures the ambition to strengthen the European position in Embedded Intelligence and Systems and to ensure its achievement of world-class leadership in this area by establishing an environment that supports innovation, stimulating the emergence of a new supply industry and avoiding fragmentation of investments in R&D.

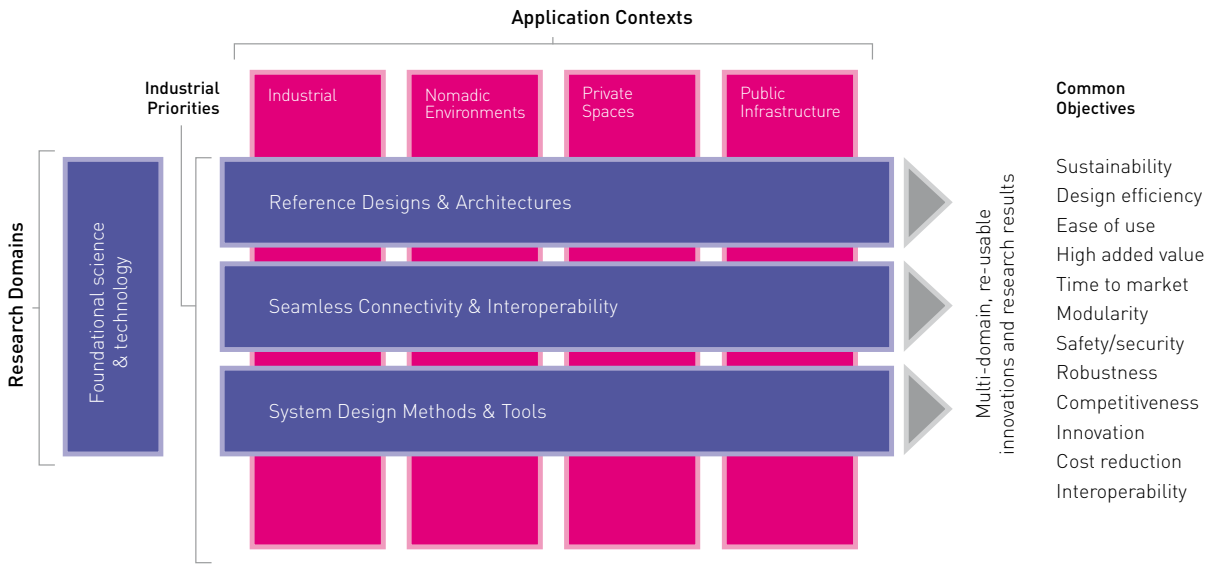


Figure: Relationship between the application and research dimensions of the ARTEMIS Strategy

STRATEGY

ARTEMIS developed an innovative strategy to follow this vision and achieve its objectives. This strategy mainly aimed to overcome the plea of the Embedded Systems arena to counteract 'fragmentation' in all areas of the innovation chain: in research, in the supply chain and in the market. Cutting barriers between application sectors to facilitate the cross-domain sharing of technologies and research needed a top-down strategic road mapping and an ambitious set of high level objectives. This strategy proved to be successful as it allowed the emergence of an outstanding record of successful projects in the period since ARTEMIS has been running (2007-2012).

Reviewed in 2010, the ARTEMIS Strategy has integrated a third dimension to address the societal challenges and foster innovation to support the development of high-value added Embedded Systems solutions that are reusable across a wide range of application sectors and that can be integrated to respond to a number of societal challenges. Today Europe faces further societal challenges arising from inverted demographic curves, constantly increasing demands for non-renewable natural resources, expectations for improved quality of life, and climate change.

"As the neural system of society, networked embedded systems should no longer be considered only in isolated application contexts but in relation to what they can offer in addressing today's and tomorrow's societal challenges".

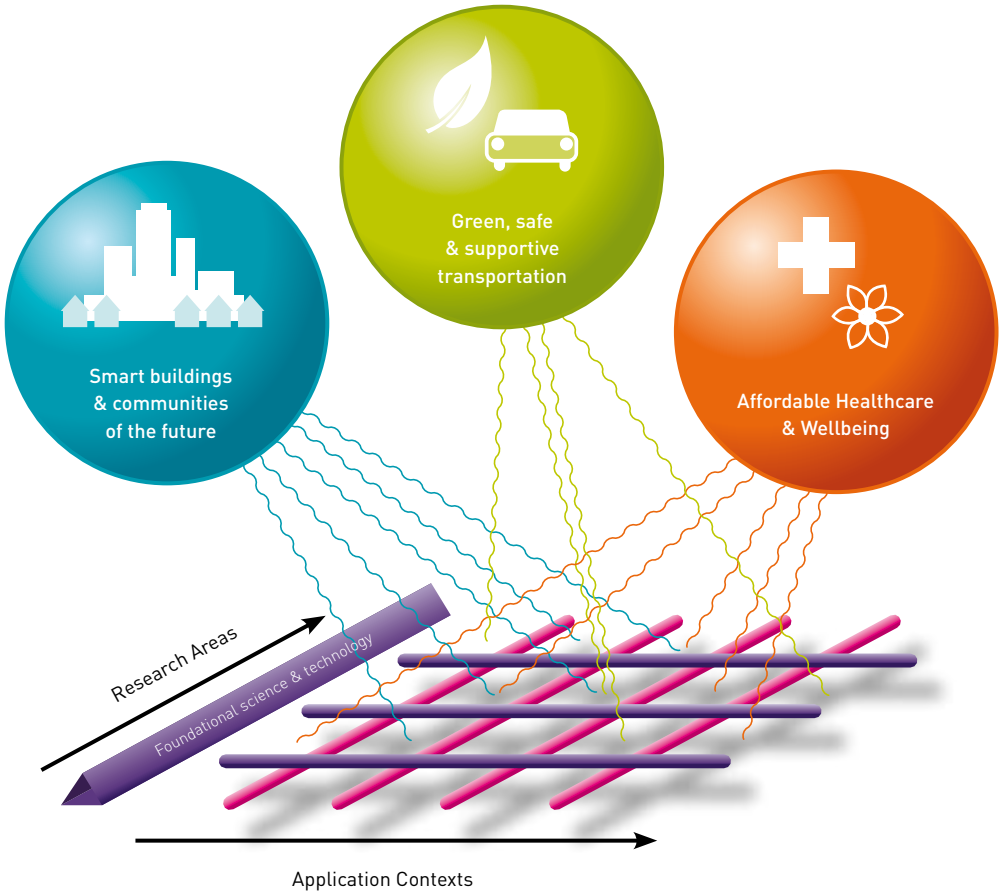


Figure: SRA applications contexts, research priorities and societal challenges into perspective

This strategy is also based upon exploiting European strengths and opportunities by:

- Building on the leading positions in specific technologies and in various application domains
- Creating opportunities for Europe to be positioned at the forefront of new or emerging markets with high potential growth rates to become among the world leaders in these domains.

For the successor programme, ARTEMIS forecasts the adoption of this strategic approach as:

- It is inclusive of technology, market and society
- It is flexible, open and dynamic to adapt to the continuously evolving challenges in the areas of major change related in chapter 1:

Globalisation

- Management of scarce resources
- Climate change
- Urbanisation
- Mobility
- Healthcare and nutrition
- Digital society.

To build a sustainable innovation eco-system for Embedded Systems, implementation of the ARTEMIS strategy will continue to be based on a strong, research-led innovation programme at its heart, combining the top-down strategic programming with Europe-wide integration of the bottom-up priorities identified through its Centres of Innovation Excellence.

Product and service innovations are driven largely by developments in ICT and Embedded Systems, where especially Embedded Systems are increasingly crucial. Therefore ARTEMIS will continue, in addition to its R&D roadmap, to nurture activities supporting innovation such as education, standards and SME development...to boost the competitiveness of Europe's industry.

EMBEDDED SYSTEMS TECHNOLOGY

Already today, embedded software systems assist and control various aspects of our lives. They enable businesses to perform better and make citizen's lives more fulfilling and convenient. Some systems, especially for automotive and aircraft control, medical systems and nuclear power supply, are already critical to human life. This will evolve drastically: future generations will experience "embedded intelligence" pervasiveness that can hardly be imagined today. Embedded intelligent systems will literally be found everywhere and control pretty well everything while citizens' lives and well-being will depend on these systems to an inconceivable extent.

Embedded Systems will be part of all future products and services, providing intelligence on the spot and capabilities to cleverly connect to the abundance of systems in their environment, either physical or at cyber-space level, in real time. Internet has become the dominant connection medium for all communication and will remain so, especially for communication between the myriad of connected Embedded Systems. As a consequence, Embedded Systems form the edges of the 'Internet of Things', linking cyber space and the physical world of real 'things'. They will be crucial in enabling the 'Internet of Things' to deliver on its promises. Yet with major benefits also come severe risks, including the impact of system failures or loss of privacy and security, putting ever more strain on the correct and timely development and deployment of increasingly complex systems.

Real-time connections between sensors, embedded systems and large information systems will open up new functionalities that help to address the challenges imposed by the seven areas of major change.

Internet connected intelligent embedded systems will provide the core of solutions for the major societal challenges described in chapter 1 such as the management of scarce resources, climate change, urbanisation, mobility, healthcare and nutrition, and the digital society. Embedded systems will raise expectations as well as concerns about potential failures and safety, privacy and security making the quality and dependability of embedded systems key issues.

The impact of networking goes far beyond that of today. Many emerging embedded applications now share networks and components in configurations whose conceptual structure no longer readily matches the physical structure. In parallel, open networks of Embedded Systems applications from multiple domains are coupled: everything can, in principle, be connected to everything else. This 'bigger picture' for Embedded Systems implies change from local networks to open networks of embedded systems. This leads, in turn, to a shift from single-system ownership to multiple-design processes and responsibilities involving many parties, multi-views and conflicting objectives.

Networked Embedded Systems will, in effect, become the neural system of society, as is explained in detail in the ARTEMIS SRA.

Closer investigation of the applications has highlighted the importance of **interoperability**, system autonomy, networking - including use of the Internet - and consideration of mixed criticality for more **dependable systems**. 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 will be part of all future products and services providing intelligence on the spot and capabilities to cleverly connect to the abundance of systems in the environment; either physical or at the cyber space level, in real time or in distributed and heterogeneous systems, in open networks of embedded systems applications from multiple domains or in the Internet: everything can, in principle, be connected to everything else.
Networked embedded systems are, in effect, becoming the Neural System of Society.

The ubiquity and pervasiveness of embedded intelligence systems brings expectation of constant availability and absolute zero risk of failure. In the past, design complexity was limited to that of single, dedicated systems in isolation. Networking such systems forces the design to embrace the behaviour of many interconnected systems, with a consequent manifold multiplication of the complexity issues.

The ARTEMIS SRA 2011 points to a series of technical issues that should be resolved before 2030. First, those issues related to foundational science and technology; second, those related to the application contexts; and third, those encompassing societal challenges (see ARTEMIS SRA 2011: www.artemis-ia.eu/publications).

Such solutions to our pressing societal challenges will spur on European competitiveness.

Europe can address these challenges by using its sophisticated Embedded Systems Research and Development resources in industry and research institutes if well coordinated and if adequately funded. 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 key enabling role of Embedded Systems is becoming increasingly firmly established in European society as also indicated by the 2011 ISTAG Report. The role envisioned for ICT by ISTAG underlines the importance of Embedded Systems as key enabling technology in the shift 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.

ARTEMIS highlights two parallel sets of industrially-driven research objectives to help resolve the above:

- **Research into technology** that will offer completely new solutions to the technical barriers that hinder progress towards the application context's goals
- **Technical solutions** that form the basis of developing the pre-competitive industrial goals, by combating the complexity of new systems through improved designs and implementation processes and tools, a major Innovation Accelerator.

In more detail, the ARTEMIS SRA distinguishes three main areas of research:

- Reference designs and architectures
- Seamless connectivity and interoperability
- Design methods and tools.

The ARTEMIS SRA formulates the main topics of research for each of these areas, together with the major challenges for technological research, such as, but not limited to, architectures, interoperability, system-of-systems, safety, dependability, smart environments, energy consumption and management, and mixed criticality.

All these topics are elements that will be extended in the ARTEMIS successor to embrace the technology challenges for 2030, with more complex embedded systems that are:

- Derived from architectural models and principles allowing reusability, composability
- Safe and secure by design, based on interoperability standards for systems and design tools
- Situation aware for distributed real-time and highly certified operations
- Interconnected to enable the development of new and smart applications and to create solutions to the areas of major change
- Dynamic, autonomous, adaptive and self-organised
- Seamlessly interacting with their environment
- Designed using optimised and consistent processes and tools.

MAJOR AREAS OF CHANGE AND OPPORTUNITIES FOR EUROPEAN INDUSTRY COMPETITIVENESS

ARTEMIS aims to establish a new, holistic approach to research, technology and development, innovation and skill creation in Embedded Systems by means of innovation ecosystems. This will increase the efficiency of technological development by seeding projects focusing on EU excellence and, at the same time, enhance the competitiveness of the market in the supply of Embedded Systems technology.

BUILDING ON REALISED ARTEMIS ASSETS

In addition to the funded projects that are carried out under the umbrella of the ARTEMIS Joint Undertaking and that are R&D oriented, the ARTEMIS Industry Association has built a unique innovation eco-system by being active in Centres of Innovation Excellence, Design Environments and Tool Platforms, Standardisation and Education, 'Metrics and Projects' and a Results Repository through a number of very active working groups formed by voluntary members from industry and research institutions.

The ARTEMIS innovation eco-systems span the whole value chain, including SMEs, research institutes and large companies. Innovation eco-systems are essential to master the immense complexity of future embedded systems, since no single company can master all challenges involved.

Some specific key activities are:

- A continuous open dialogue with ITEA resulting in the co-organised Co-Summit events over the five years, a high level umbrella group with ITEA and this shared vision 2030
- Open dialogue with AENEAS and EPoSS resulting in the SRIA published in April 2012
- Bringing together its 200+ members and 800+ project partners in annual events, such as:
  - Summer Camp event for the ARTEMIS community to develop the European research strategy
  - Technology conferences organised by combinations of projects, focusing on important topics, such as interoperability. Three technology conferences have been organised so far
- Furthermore, the ARTEMIS Industry Association has built a strong relationship and issued a label for recognised Centres of Innovation Excellence (CoIE) established for Embedded Systems such as EICOSE to boost the chances of good ideas and sound concepts becoming successful products and services in the market, thus implementing a bottom-up collection of the fast changing needs. There is a formal nomination procedure with labelling requirements. To date three Centres of Innovation Excellences have been established:
  - EICOSE
  - ProcessIT.EU

    - ES4IB (Embedded Systems 4 Intelligent Buildings)
- Supporting national mirror organisations such as ARTEMIS Austria and Prometeo in Spain, which are very active in organising national events.

Another differentiator is the drive to influence global standards, platforms and other structural conditions relevant for innovation. A large EU footprint is essential to have impact. ARTEMIS is active in:

- Driving the evolution of projects into clusters and, even larger, the Artemis Innovation Pilot Projects (AIPP's) whose aim is to:
    - Create new business innovating eco-systems
    - Efficiently use Public, Private Partnership in the Embedded Systems arena to overcome the resource deficit for R&D and to foster innovation & collaboration in Europe
    - Align implementation of R&D&I (Research and Development and Innovation) priorities for Embedded Systems in Europe to turn European "diversity" into a strength
    - Achieve a "European Dimension" by combining the R&D efforts across Europe for future proven application domains and technologies, while pulling resources in key areas, and involve relevant players with the ability to ensure successful valorisation and uptake of the results
    - Establish and sustain a holistic approach to R&D&I by undertaking projects of critical mass, reconciling the market silos/business efficient approach with the cross-domain synergies
    - Share risk by allowing projects that otherwise would not be undertaken
    - Build upon results from existing and previous projects for providing market-driven solutions based on prototypes and demonstrations
    - Pool industrial resources and "share" (e.g. standards and methods) to foster interoperability and synergies between various environments, in order to keep leadership position in traditional markets, and gain worldwide positions and more market in new areas
    - Set and share R&D&I infrastructures
- Introduce the concept of reference technology platforms and tool platforms, supported by a set of labelling requirements and a nomination procedure for these Reference Tool Platforms (RTP)
- Establish one ARTEMIS Tool Platform: CESAR, with more to come
- Establish a Working Group on Standardisation and a strategic agenda for standardisation that prompted the FP7 PROSE project.

The industrial focus in ARTEMIS has clearly been realised over the project-calls since 70% of the overall project participation is from industry (unique partners) in comparison to FP7 where industry participation is 25%. ARTEMIS is clearly an industry-driven research programme.

The member state involvement stimulates SME participation. Some facts:

- ARTEMIS attracts over 28% SMEs, good for 19% of the total eligible cost
- Three projects have only SMEs and research institutes as project partner participants, where SMEs are the project coordinator
- Nine SMEs participate in three or more ARTEMIS projects
- Twelve SMEs participate with EU funding only, so without national funding.

Both a high critical mass and cross-domain approach are essential to achieve breakthroughs for the design of increasingly complex networked embedded systems. ARTEMIS has accomplished substantial cross-domain projects with a large EU footprint supported by smaller special focus projects. Also this asset is supported by figures:

- 23 participating countries
- Average of 6.7 countries per project
- In total 585 unique partners (each organisation counted once only)
- Total project budget ranging from €2.5 m to €59 m
- Number of partners per project ranges from 8 to 56
- Number of countries per project ranges from 4 to 11.

Other important activities are the active monitoring of project impact and results by the Working Group Metrics and Success Factors. A first report on impact has been published with a second in preparation due for publication at the end of 2012. ARTEMIS actively nurtures project clusters by means of special events (ARTEMIS Technology Conferences).

ARTEMIS has also established a repository of project results. A prototype database tool has been implemented to capture public information of project results.

ARTEMIS contributes through all of its activities to strengthen the European innovation eco-system and thus improve the level of competitiveness of the European industry.

MAINTAINING THE ARTEMIS DIFFERENTIATORS

ARTEMIS should maintain its differentiators such as:

- An 'Industry driven' initiative
- A unique tri-partite cooperation between the EU member states, the European Commission and the industry
- Sustained focus on both business competitiveness and technical excellence
- A descriptive 'top-down' approach based on a Strategic Agenda, supported by a bottom-up expression of needs through Centres of Innovation Excellence
- Keeping the focus on large impact and market-oriented projects
- Having large footprint projects with support from smaller special-

focus projects, while ensuring the balance between different actors (large, mid and small industry as well as RTOs and universities) in the research to drive innovation
- Actively supporting the creation of innovation eco-systems
- Openness and complementarities with EU framework programmes and ITEA.

These differentiators are Innovation Accelerators essential to allow technology developments to become strong market influencers through business-driven engineering such as:
- Standards to ensure interoperability in its many forms, through active participation in their definition and promotion
- Tools, developed from a rigorous scientific basis, to allow timely and "right first time" product/system definition, analysis and development
- Rugged, science-based engineering processes to:
  - embrace fast-changing requirements as a fact,
  - integrate multiple and diverse technologies and non-functional aspects,
  - provably guarantee correct functionality,
  - provably guarantee immediate conformity to safety/security/privacy certification needs.

They facilitate Innovation by:
- Reducing development costs and time
- Allowing the pace of product-family roll-out to be governed by business needs (rather than engineering limitations)
- Lowering the threshold of product introduction in face of rapidly changing market needs
- Increasing customer confidence, trust and acceptance.

Education and training on Embedded Systems is also an integral feature of the ARTEMIS approach, for the better integration of academic educational curricula and industry needs, and to attract young talent. After all, at the end of the day it is people who have to take an interest in improving the effectiveness and reliability of the highly complex Embedded Systems.

Europe, with its world class automotive, aerospace, communication and medical equipment industries, still has an excellent position in Embedded Systems, which play a key role in enhancing the capabilities, availability and usefulness of these products. **Only through adequate coordination and collaboration and with the help of public funding can this position be maintained to help solve the enormous challenges emerging from the areas of major change and, at the same time, spur European competitiveness in many areas.**

Pan-European action is and remains essential to keep Europe at the forefront of product innovation by research in embedding intelligence. ARTEMIS is a key player in achieving a pan-European approach to product innovation and maintaining the competitiveness of the European industry towards 2030.

For more information see:
www.artemis.eu (ARTEMIS general)
www.artemis-ia.eu (ARTEMIS Industry Association)
www.artemis-ju.eu (ARTEMIS Joint Undertaking)
www.artemis-ia.eu/publications (for ARTEMIS SRA and other publications)

CHAPTER 3.2

THE CASE FOR ITEA 3

ITEA 3: SEIZING THE HIGH GROUND

ITEA stimulates and supports innovative, industry-driven, pre-competitive R&D projects which will contribute research excellence to Europe's competitive software-intensive systems and services sector. ITEA has a proven track record with major achievements in Europe's most competitive industries, such as automotive, communications, healthcare, aerospace and consumer electronics. In the future, with the transition to a service economy, ITEA will continue to play a key role in innovation and mastering economic and societal challenges in the period to 2030.

ITEA offers a unique approach to software-intensive systems and services development. This uniqueness comes from a programme led by an industrial community, closely connected to Public Authorities. ITEA is open to partners from large industrial companies and small and medium-sized enterprises (SMEs), as well as research institutes and universities. ITEA has proven its success with large companies as well as with SMEs for which it provides excellent opportunities to broaden their scope internationally.

As a EUREKA Cluster programme, the ITEA approach is:

- Industry driven
- Bottom-up to favour innovation
- Flexible to favour business impact
- Market oriented
- Inter-governmental
- Based on a multi-dimensional concept of excellence for project selection
- Community-oriented, easily accessible by industry and SMEs.

In a nutshell, ITEA stands for innovation, business impact and fast exploitation. Its projects are of concrete relevance for every participating company and country. In addition, in ITEA 3 our ambition will be to seize the high ground to ensure that European industry continues to be at the leading edge worldwide.

'Seizing the high ground' means being a winner and this is the case for ITEA 3.

ITEA 3: ADDRESSING ALL THE CATEGORIES OF ICT NEEDED TO MASTER THE CHANGES

There is a wide consensus that the period from now to 2030 will be one of permanent change and disruption. Chapter 1 described in some detail the major areas of these changes and disruptions.

In each of these areas, ICT plays a major role in mastering the changes. For the leaders in economy and society, ICT appears in seven categories:

1 Industrialised non-differentiating services
2 Customised services
3 Smart products
4 Smart services
5 Innovative engineering
6 Smart infrastructure
7 Security of systems and services.

For Europe, an industry which is strong in ICT-based innovations in all these categories is a prerequisite for maintaining a competitive global position. Moreover, it creates high-value jobs in the ICT industry and also in other more traditional, ICT-dependent industries. For example, nowadays 40% of the added value of a car is in its software. In other industries, ICT delivers increased productivity and thereby also contributes to employment and prosperity.

The last six categories are clearly being addressed in ICT research and innovation. But the first category – industrialised non-differentiating services – also deserves the attention of the research and innovation community. Bringing low-cost high-volume commodity services back to Europe is a positive challenge. The key to this is clearly automation.

ITEA 3 is therefore addressing all seven categories of ICT that are necessary to mastering the changes ahead of us.

1 INDUSTRIALISED NON-DIFFERENTIATING SERVICES

Non-differentiating services can often be outsourced, performed in low-cost countries or moved into the cloud.

Examples are:
- Outsourced application management: e.g. maintenance of existing applications, migration to new platforms
- Outsourced business processes: e.g. accounting, call centres, salary administration, ERP, CRM
- IT outsourcing: e.g. desktop software support.

The challenge for Europe is to get this back through smart automation. The development of such kind of services is in the scope of ITEA 3, e.g. in cloud projects or with companies in Business Information Systems as a key partner.

2 CUSTOMISED SERVICES

Differentiating services often remain in-house and are provided in a customised way.

Examples are:
- Ticketing
- Dealer systems
- Customer-facing services
- Maintenance services in the hospital.

Other customised services are:
- Security services like access control and video surveillance
- Services like hardware desktop support.

Also these services tend to remain in-house.

There are many projects in ITEA that address customised services, like:
- Security policies in multi-domain environments
- Multimedia content analysis
- Service infrastructure for technical hospital facilities.

3 SMART PRODUCTS

Product intelligence comes from embedded software.
From the very beginning, ITEA had projects addressing smart products and embedded software.

Examples are:
- Automotive open system architecture
- Horizontal standard for machine-to-machine communication
- Web of Objects
- Wireless sensor networks
- Digital cinema
- High-performance medical imaging.

The intelligence of a smart product is generally shown through its interactions with the environment.
- A smart car is connected to its maintenance service operator that provides information on its status, the need for maintenance and communicates with roadside units sending alerts in the case of an emergency
- Smartphones are connected to information databases via internet. They can download from among a huge selection of apps, allowing household devices to be controlled and payments to be effected, for example.

4 SMART SERVICES

When do we call a service smart?
In general, the notion of smart service is based on the distinction between passive versus active behaviour; in the latter case actions are taken and additional information is gathered to deduce correct solutions. In many cases sensors are involved in getting this information.

Some examples:
- Video surveillance is not smart in itself. If it provides face recognition and automatic alerts concerning dangerous persons, then we would call it smart
- Smart systems avoid false alarms and false manoeuvring in medical contexts
- Autonomous aeroplane flying and automated landing are smart services as is autonomous car driving.

There are many ITEA projects in this area addressing, for example:
- Smart urban spaces
- Do it Yourself smart experiences
- Maritime surveillance
- Smart rehabilitation of patients after heart surgery
- Smart navigation for heart surgery.

In ITEA 3, we expect to have projects on:

- Global service platforms for smart energy, water, food management, mobility services, smart city lighting
- Clinical decision support systems
- Smart building services, monitoring and controlling elevators, heating, security systems, blinds, window cleaning (robotised), energy supply.

5 INNOVATIVE ENGINEERING

Innovative Engineering is an on-going challenge for the R&I community to deal with software intensive systems and services and embedded systems.

The drivers for these challenges are:

- New technologies, like multicore architectures
- New standards, like ISO 26262
- New development paradigms, like agile methods
- Time-to-market & development costs.

Permanent challenges are:

- The extremely different lifetimes of software and the products in which software constitutes a vital embedded element
- The ever increasing demand for safety, security and reliability of software intensive systems and services
- The permanently growing number of "multi-X" dimensions of software and systems engineering: multi-disciplinary, multi-site, multi-company, multi-cultural.

Innovative engineering has been an important R&I domain since the beginning of ITEA. One of the first success stories was the launch of AUTOSAR, the automotive open system architecture. Like a string of pearls the engineering success stories continued throughout ITEA and ITEA 2.

Examples are:

- Multicore architectures in the automotive domain
- Sustainable engineering ecosystem in the aerospace domain
- Open engineering standards for train control systems
- Integrating safety standards into AUTOSAR processes.

We are convinced that innovative engineering will also constitute a lively part of ITEA 3.

6 SMART INFRASTRUCTURE

A smart infrastructure is, in many cases, just a different view of smart services.

For companies, the following examples are smart services; for political leaders they are smart infrastructures:

- Global service platforms for smart energy, water, food management, mobility services, smart city lighting
- Smart building services, monitoring and controlling elevators, heating, security systems, blinds, window cleaning (robotised), energy supply
- Internet infrastructure and cloud computing.

In ITEA, we have already had some projects addressing these topics and we expect many more to come.

7 SECURITY OF SYSTEMS AND SERVICES

Security of systems and services appears in two different sub-categories. Security and reliability of systems should be carefully distinguished from security and safety of people and infrastructures:

- Security and reliability:
  - Security of systems against outside attacks
  - Reliability of systems i.e. the system delivers what has been promised, under all circumstances.

  System security and reliability are key subjects for ITEA because they concern the protection of the digital society from outside attacks and bad design.

  Examples of ITEA projects are:
  - Access control security
  - Advanced test automation, Model-based testing and test-driven development,
  - Multi-domain security testing technologies.

- Security and safety
  - Protecting people from criminal acts, and products or services that make people's lives safer, including Babywatch and airbags
  - Safety is specific to people and may be a systems behaviour requirement.

Also the security of the flow of physical goods and information, the security of infrastructures such as Internet, smart grids, railways and airports is of major importance. A safe, stable and reliable infrastructure is a key enabler for economic prosperity.

ITEA projects in this area are addressing, for example:
- Safety systems in the home environment
- Surveillance and rescue framework for mobile environments
- Maritime surveillance framework
- Disaster control Management

ITEA 3: CONCLUSION

The ambition for ITEA 3 is to push for projects that enable our industries to seize the high ground in all these categories.

The ambition for ITEA 3 is to push for projects that enable our industries to seize the high ground in all these categories.

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High-level vision ITEA-ARTEMIS 2030

ITEA 2
INFORMATION TECHNOLOGY FOR EUROPEAN ADVANCEMENT

ARTEMIS